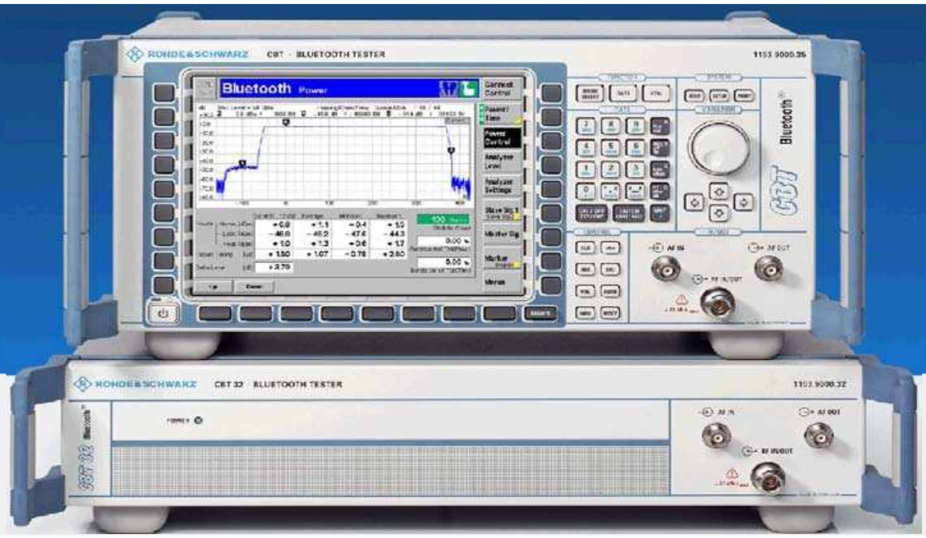
Operating Manual



Bluetooth® Tester

R&S® CBT
1153.9000.35

R&S® CBT 32
1153.9000.32

Printed in Germany

ROHDE&SCHWARZ
Test and Measurement

The following abbreviations are used throughout this manual:
R&S®CBT is abbreviated as R&S CBT or CBT.
Options R&S®CBT-xxx are abbreviated as R&S CBT-xxx or CBT-xxx (e.g. CBT-B41).

Supplement to the Operating Manual for Bluetooth® Tester R&S® CBT / CBT 32

New Features in FW V5.15: Enhanced Power Control

Dear CBT Customer,
The free firmware V5.15 upgrade to the R&S CBT Bluetooth® tester offers a new *Enhanced Power Control* feature which is not documented in the current revision of the operating manual, 1153.4395.12-04. This supplement describes the new feature.

Please use the R&S Remote Service Tool to upgrade your CBT via GPIB. Please ensure that you use the firmware directory called CBT_V5.15.

Enhanced Power Control

See: Bluetooth Signalling Measurements – Connection Control – Connection
Bluetooth Signalling Measurements – Connection Control – Slave Sig.
Bluetooth Signalling Measurements – Power (and other measurement dialogs).

In *Bluetooth Signalling* mode, the R&S CBT supports TX Enhanced Power Control tests. This comprises the features listed below.

R&S CBT Feature	**Manual control**
Check of the Enhanced Power Control support of the connected DUT.	Open *Connection Control – Connection* tab and establish connection to the DUT. *Enhanced Power Control* support is displayed In the *Supported Features* section of the setup table.
Activation/deactivation of the Enhanced Power Control functionality of the DUT in test mode.	Open *Connection Control – Slave Sig.* tab and select *Enhanced Power Control Mode: Auto*
Transmission of LMP_power_control_req PDUs with the power power adjustment_req set to *got to max,* commanding the DUT to transmit at maximum output power.	Open a measurement dialog (e.g. *Power)* and press the *Power Max.* hotkey. The hotkey is associated to the measurement control softkeys (see Fig. 1 below); it is available in all measurement dialogs except ACP. An notice box appears if *Power Max* is pressed but the DUT does ot support Enhanced Power Control.
Increase/decrease of the DUT output power by a single power step using power change request LMP commands (like normal power control, already available in previous firmware versions).	Open a measurement dialog (e.g. *Power)* and press the *Power UP* or *Power Down* hotkeys. The hotkeys are associated to the measurement control softkeys (see Fig. 1 below).
Evaluation of the power check responses from the DUT and verification that minimum or maximum output power has been reached for all supported modulations.	Use remote control command `[SENSe:]ENHanced:PCONtrol:STATe?`

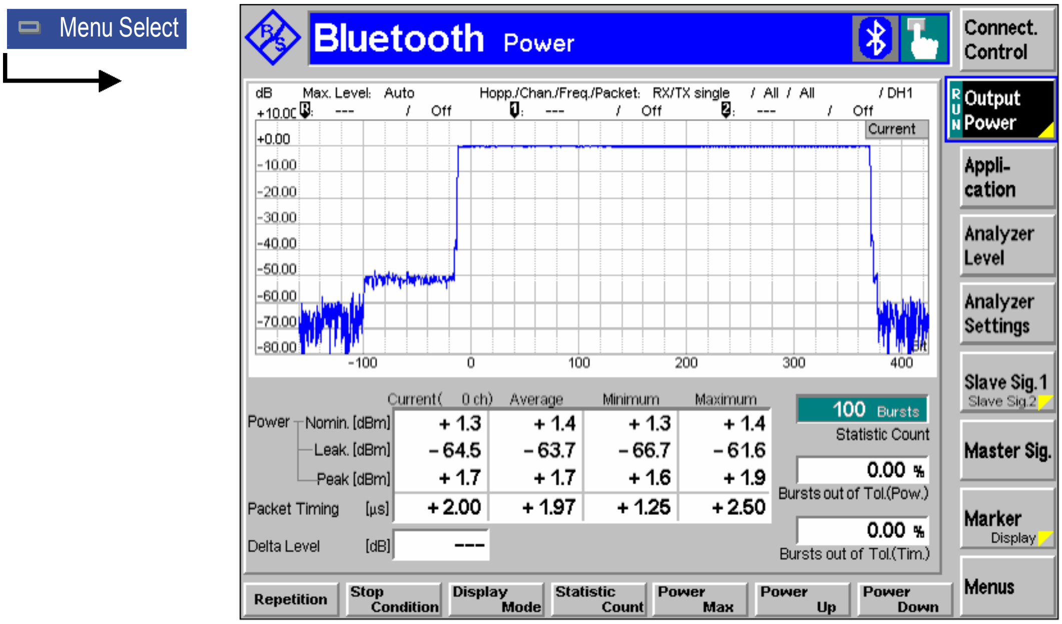


Fig. 1 Power Max / Power Up / Power Down softkeys

The following remote control commands are related to Enhanced Power Control.

[SENSe:]SINFo:FEATure:PCONtrol:ENHanced?		Enhanced Power Control		
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported The feature is not supported	–	–	5.15
Description of command				Sig. State
This command is always a query. It returns whether or not the feature "Enhanced Power Control" is supported by the DUT.				~CONN

CONFigure:SSIGnal:PCTR:ENHanced *<Mode>* **PROCedure:SSIGnal:PCTR:ENHanced *<Mode>***		Enhanced Power Control Mode		
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
AUT | **OFF**	Enhanced Power Control enabled (if supported by the DUT) Enhanced Power Control disabled, use normal power control	ADAP	–	5.15
Description of command				Sig. State
This command enables/disables Enhanced Power Control of the DUT in test mode. In the *Connected* state, the DUT always accepts power control commands. The `CONFigure…` command selects the Enhanced Power Control mode before the DUT is connected (signaling states < CONN). `PROCedure…` changes the mode for a connected DUT (signaling states ~CONN).				all

PROCedure:PCONtrol:STEP				Power Control Up/Down
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
UP | **DOWN** | **MAX**	Send increase power request to the DUT Send decrease power request to the DUT Command DUT to transmit at maximum power (for DUTs which support Enhanced Power Control)	–	–	V3.50 V5.15
Description of command				Sig. State
This command sends power control commands to the DUT to test its power control capabilities.				CONN, TEST

[SENSe:]ENHanced:PCONtrol:STATe?				Query Enhanced Power Control State
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
 RMAX | **RMIN** | **C1ST** | **NNM** | **NSUP,**	GFSK modulated burst areas DUT has reached its maximum power DUT has reached its minimum power DUT has changed its power by one step No new message (none of the previous events) Enhanced Power Control not supported	–	–	V5.15
RMAX | **RMIN** | **C1ST** | **NNM** | **NSUP,**	Values for π/4 DQPSK modulated burst areas			
RMAX | **RMIN** | **C1ST** | **NNM** | **NSUP**	Values for 8DPSK modulated burst areas			
Description of command				Sig. State
This query returns the Enhanced Power Control state of the DUT. The response contains three values, one per modulation type (GFSK, π/4 DQPSK, and 8DPSK modulation).				~CONN

Tabbed Divider Overview

* Model R&S® CBT; see comparison of CBT models on the next page.

R&S® CBT and R&S® CBT 32

This manual describes two different models of the Bluetooth Communication tester R&S® CBT.

- Model R&S® CBT is equipped with an LC display and provides front panel keys, softkeys and hardkeys for manual control. Besides, the R&S® CBT can be controlled via GPIB or RS-232 interface.
- Model R&S® CBT 32 can be mounted into a 19'' rack and is intended for remote control via GPIB or RS-232 interface.

Both instruments have the same measurement functionality and remote control command set.

Manual and remote control of the R&S® CBT is described in separate chapters. Background information about the measurements and settings and about the Bluetooth standard is reported in the reference chapter for manual control (Chapter 4), together with the menus of the graphical user interface.

To avoid redundancy, the reference chapter for remote control (Chapter 6) focusses on program syntax and parameter ranges but contains only a short description of the command functions. For programmers who use a R&S® CBT 32, each section in Chapter 6 contains a cross reference to the section in Chapter 4 that provides more detailed information.

Throughout the manual, *R&S® CBT* is used as an abbreviation for both instrument models.

R&S® CBT Options

This manual describes the basic functionality of the R&S® CBT and all R&S® CBT options:

- Option R&S® CBT-B41, Audio Measurements
- Option R&S® CBT-B42, Digital Audio Interfaces
- Option R&S® CBT-K52, A2DP Stereo Profile
- Option R&S® CBT-K54, Audio Profiles
- Option R&S® CBT-B55/K55, Enhanced Data Rate

CE

Certificate No.: 2008-06

This is to certify that:

Equipment type	Stock No.	Designation
CBT32	1153.9000.32	Bluetooth Tester 2HU
CBT	1153.9000.35	Bluetooth Tester 4HU
CBT-B41	1170.3406.02/.05	Audio Generator and Analyzer
CBT-B42	1170.3706.03	Digital Audio Interface
CBT-B55	1170.3006.02	EDR Extension

complies with the provisions of the Directive of the Council of the European Union on the approximation of the laws of the Member States

- relating to electrical equipment for use within defined voltage limits (2006/95/EC)
- relating to electromagnetic compatibility (2004/108/EC)

Conformity is proven by compliance with the following standards:

EN 61010-1 : 2001
EN 55011 : 1998 + A1 : 1999 + A2 : 2002, Class A
EN 61326 : 1997 + A1 : 1998 + A2 : 2001 + A3 : 2003

For the assessment of electromagnetic compatibility, the limits of radio interference for Class A equipment as well as the immunity to interference for operation in industry have been used as a basis.

Affixing the EC conformity mark as from 2004

ROHDE & SCHWARZ GmbH & Co. KG
Mühldorfstr. 15, D-81671 München

Munich, 2008-02-07

Central Quality Management MF-QZ / Radde

Basic Safety Instructions

Always read through and comply with the following safety instructions!

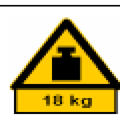
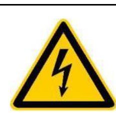
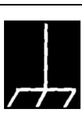
All plants and locations of the Rohde & Schwarz group of companies make every effort to keep the safety standards of our products up to date and to offer our customers the highest possible degree of safety. Our products and the auxiliary equipment they require are designed, built and tested in accordance with the safety standards that apply in each case. Compliance with these standards is continuously monitored by our quality assurance system. The product described here has been designed, built and tested in accordance with the attached EC Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards. To maintain this condition and to ensure safe operation, you must observe all instructions and warnings provided in this manual. If you have any questions regarding these safety instructions, the Rohde & Schwarz group of companies will be happy to answer them.

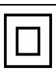
Furthermore, it is your responsibility to use the product in an appropriate manner. This product is designed for use solely in industrial and laboratory environments or, if expressly permitted, also in the field and must not be used in any way that may cause personal injury or property damage. You are responsible if the product is used for any intention other than its designated purpose or in disregard of the manufacturer's instructions. The manufacturer shall assume no responsibility for such use of the product.

The product is used for its designated purpose if it is used in accordance with its product documentation and within its performance limits (see data sheet, documentation, the following safety instructions). Using the product requires technical skills and a basic knowledge of English. It is therefore essential that only skilled and specialized staff or thoroughly trained personnel with the required skills be allowed to use the product. If personal safety gear is required for using Rohde & Schwarz products, this will be indicated at the appropriate place in the product documentation. Keep the basic safety instructions and the product documentation in a safe place and pass them on to the subsequent users.

Observing the safety instructions will help prevent personal injury or damage of any kind caused by dangerous situations. Therefore, carefully read through and adhere to the following safety instructions before and when using the product. It is also absolutely essential to observe the additional safety instructions on personal safety, for example, that appear in relevant parts of the product documentation. In these safety instructions, the word "product" refers to all merchandise sold and distributed by the Rohde & Schwarz group of companies, including instruments, systems and all accessories.

Symbols and safety labels

							
Notice, general danger location Observe product documentation	Caution when handling heavy equipment	Danger of electric shock	Warning! Hot surface	PE terminal	Ground	Ground terminal	Be careful when handling electrostatic sensitive devices

					
ON/OFF supply voltage	Standby indication	Direct current (DC)	Alternating current (AC)	Direct/alternating current (DC/AC)	Device fully protected by double (reinforced) insulation

Tags and their meaning

The following signal words are used in the product documentation in order to warn the reader about risks and dangers.

⚠ DANGER	indicates a hazardous situation which, if not avoided, will result in death or serious injury.
⚠ WARNING	indicates a hazardous situation which, if not avoided, could result in death or serious injury.
⚠ CAUTION	indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	indicates the possibility of incorrect operation which can result in damage to the product. In the product documentation, the word ATTENTION is used synonymously.

These tags are in accordance with the standard definition for civil applications in the European Economic Area. Definitions that deviate from the standard definition may also exist in other economic areas or military applications. It is therefore essential to make sure that the tags described here are always used only in connection with the related product documentation and the related product. The use of tags in connection with unrelated products or documentation can result in misinterpretation and in personal injury or material damage.

Operating states and operating positions

The product may be operated only under the operating conditions and in the positions specified by the manufacturer, without the product's ventilation being obstructed. If the manufacturer's specifications are not observed, this can result in electric shock, fire and/or serious personal injury or death. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed.

1. Unless otherwise specified, the following requirements apply to Rohde & Schwarz products: predefined operating position is always with the housing floor facing down, IP protection 2X, pollution severity 2, overvoltage category 2, use only indoors, max. operating altitude 2000 m above sea level, max. transport altitude 4500 m above sea level. A tolerance of ±10 % shall apply to the nominal voltage and ±5 % to the nominal frequency.
2. Do not place the product on surfaces, vehicles, cabinets or tables that for reasons of weight or stability are unsuitable for this purpose. Always follow the manufacturer's installation instructions when installing the product and fastening it to objects or structures (e.g. walls and shelves). An installation that is not carried out as described in the product documentation could result in personal injury or death.
3. Do not place the product on heat-generating devices such as radiators or fan heaters. The ambient temperature must not exceed the maximum temperature specified in the product documentation or in the data sheet. Product overheating can cause electric shock, fire and/or serious personal injury or death.

Electrical safety

If the information on electrical safety is not observed either at all to the extent necessary, electric shock, fire and/or serious personal injury or death may occur.

1. Prior to switching on the product, always ensure that the nominal voltage setting on the product matches the nominal voltage of the AC supply network. If a different voltage is to be set, the power fuse of the product may have to be changed accordingly.
2. In the case of products of safety class I with movable power cord and connector, operation is permitted only on sockets with an earthing contact and protective earth connection.
3. Intentionally breaking the protective earth connection either in the feed line or in the product itself is not permitted. Doing so can result in the danger of an electric shock from the product. If extension cords or connector strips are implemented, they must be checked on a regular basis to ensure that they are safe to use.
4. If the product does not have a power switch for disconnection from the AC supply network, the plug of the connecting cable is regarded as the disconnecting device. In such cases, always ensure that the power plug is easily reachable and accessible at all times (corresponding to the length of connecting cable, approx. 2 m). Functional or electronic switches are not suitable for providing disconnection from the AC supply network. If products without power switches are integrated into racks or systems, a disconnecting device must be provided at the system level.
5. Never use the product if the power cable is damaged. Check the power cable on a regular basis to ensure that it is in proper operating condition. By taking appropriate safety measures and carefully laying the power cable, you can ensure that the cable will not be damaged and that no one can be hurt by, for example, tripping over the cable or suffering an electric shock.
6. The product may be operated only from TN/TT supply networks fused with max. 16 A (higher fuse only after consulting with the Rohde & Schwarz group of companies).
7. Do not insert the plug into sockets that are dusty or dirty. Insert the plug firmly and all the way into the socket. Otherwise, sparks that result in fire and/or injuries may occur.
8. Do not overload any sockets, extension cords or connector strips; doing so can cause fire or electric shocks.
9. For measurements in circuits with voltages V_{rms} > 30 V, suitable measures (e.g. appropriate measuring equipment, fusing, current limiting, electrical separation, insulation) should be taken to avoid any hazards.
10. Ensure that the connections with information technology equipment, e.g. PCs or other industrial computers, comply with the IEC60950-1/EN60950-1 or IEC61010-1/EN 61010-1 standards that apply in each case.
11. Unless expressly permitted, never remove the cover or any part of the housing while the product is in operation. Doing so will expose circuits and components and can lead to injuries, fire or damage to the product.
12. If a product is to be permanently installed, the connection between the PE terminal on site and the product's PE conductor must be made first before any other connection is made. The product may be installed and connected only by a licensed electrician.
13. For permanently installed equipment without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fused in such a way that anyone who has access to the product, as well as the product itself, is adequately protected from injury or damage.

14. Use suitable overvoltage protection to ensure that no overvoltage (such as that caused by a bolt of lightning) can reach the product. Otherwise, the person operating the product will be exposed to the danger of an electric shock.
15. Any object that is not designed to be placed in the openings of the housing must not be used for this purpose. Doing so can cause short circuits inside the product and/or electric shocks, fire or injuries.
16. Unless specified otherwise, products are not liquid-proof (see also section "Operating states and operating positions", item 1. Therefore, the equipment must be protected against penetration by liquids. If the necessary precautions are not taken, the user may suffer electric shock or the product itself may be damaged, which can also lead to personal injury.
17. Never use the product under conditions in which condensation has formed or can form in or on the product, e.g. if the product has been moved from a cold to a warm environment. Penetration by water increases the risk of electric shock.
18. Prior to cleaning the product, disconnect it completely from the power supply (e.g. AC supply network or battery). Use a soft, non-linting cloth to clean the product. Never use chemical cleaning agents such as alcohol, acetone or diluents for cellulose lacquers.

Operation

1. Operating the products requires special training and intense concentration. Make sure that persons who use the products are physically, mentally and emotionally fit enough to do so; otherwise, injuries or material damage may occur. It is the responsibility of the employer/operator to select suitable personnel for operating the products.
2. Before you move or transport the product, read and observe the section titled "Transport".
3. As with all industrially manufactured goods, the use of substances that induce an allergic reaction (allergens) such as nickel cannot be generally excluded. If you develop an allergic reaction (such as a skin rash, frequent sneezing, red eyes or respiratory difficulties) when using a Rohde & Schwarz product, consult a physician immediately to determine the cause and to prevent health problems or stress.
4. Before you start processing the product mechanically and/or thermally, or before you take it apart, be sure to read and pay special attention to the section titled "Waste disposal", item 1.
5. Depending on the function, certain products such as RF radio equipment can produce an elevated level of electromagnetic radiation. Considering that unborn babies require increased protection, pregnant women must be protected by appropriate measures. Persons with pacemakers may also be exposed to risks from electromagnetic radiation. The employer/operator must evaluate workplaces where there is a special risk of exposure to radiation and, if necessary, take measures to avert the potential danger.
6. Should a fire occur, the product may release hazardous substances (gases, fluids, etc.) that can cause health problems. Therefore, suitable measures must be taken, e.g. protective masks and protective clothing must be worn.
7. If a laser product (e.g. a CD/DVD drive) is integrated into a Rohde & Schwarz product, absolutely no other settings or functions may be used as described in the product documentation. The objective is to prevent personal injury (e.g. due to laser beams).

Repair and service

1. The product may be opened only by authorized, specially trained personnel. Before any work is performed on the product or before the product is opened, it must be disconnected from the AC supply network. Otherwise, personnel will be exposed to the risk of an electric shock.
2. Adjustments, replacement of parts, maintenance and repair may be performed only by electrical experts authorized by Rohde & Schwarz. Only original parts may be used for replacing parts relevant to safety (e.g. power switches, power transformers, fuses). A safety test must always be performed after parts relevant to safety have been replaced (visual inspection, PE conductor test, insulation resistance measurement, leakage current measurement, functional test). This helps ensure the continued safety of the product.

Batteries and rechargeable batteries/cells

If the information regarding batteries and rechargeable batteries/cells is not observed either at all or to the extent necessary, product users may be exposed to the risk of explosions, fire and/or serious personal injury, and, in some cases, death. Batteries and rechargeable batteries with alkaline electrolytes (e.g. lithium cells) must be handled in accordance with the EN 62133 standard.

1. Cells must not be taken apart or crushed.
2. Cells or batteries must not be exposed to heat or fire. Storage in direct sunlight must be avoided. Keep cells and batteries clean and dry. Clean soiled connectors using a dry, clean cloth.
3. Cells or batteries must not be short-circuited. Cells or batteries must not be stored in a box or in a drawer where they can short-circuit each other, or where they can be short-circuited by other conductive materials. Cells and batteries must not be removed from their original packaging until they are ready to be used.
4. Keep cells and batteries out of the hands of children. If a cell or a battery has been swallowed, seek medical aid immediately.
5. Cells and batteries must not be exposed to any mechanical shocks that are stronger than permitted.
6. If a cell develops a leak, the fluid must not be allowed to come into contact with the skin or eyes. If contact occurs, wash the affected area with plenty of water and seek medical aid.
7. Improperly replacing or charging cells or batteries that contain alkaline electrolytes (e.g. lithium cells) can cause explosions. Replace cells or batteries only with the matching Rohde & Schwarz type (see parts list) in order to ensure the safety of the product.
8. Cells and batteries must be recycled and kept separate from residual waste. Rechargeable batteries and normal batteries that contain lead, mercury or cadmium are hazardous waste. Observe the national regulations regarding waste disposal and recycling.

Transport

1. The product may be very heavy. Therefore, the product must be handled with care. In some cases, the user may require a suitable means of lifting or moving the product (e.g. with a lift-truck) to avoid back or other physical injuries.

2. Handles on the products are designed exclusively to enable personnel to transport the product. It is therefore not permissible to use handles to fasten the product to or on transport equipment such as cranes, fork lifts, wagons, etc. The user is responsible for securely fastening the products to or on the means of transport or lifting. Observe the safety regulations of the manufacturer of the means of transport or lifting. Noncompliance can result in personal injury or material damage.
3. If you use the product in a vehicle, it is the sole responsibility of the driver to drive the vehicle safely and properly. The manufacturer assumes no responsibility for accidents or collisions. Never use the product in a moving vehicle if doing so could distract the driver of the vehicle. Adequately secure the product in the vehicle to prevent injuries or other damage in the event of an accident.

Waste disposal

1. If products or their components are mechanically and/or thermally processed in a manner that goes beyond their intended use, hazardous substances (heavy-metal dust such as lead, beryllium, nickel) may be released. For this reason, the product may only be disassembled by specially trained personnel. Improper disassembly may be hazardous to your health. National waste disposal regulations must be observed.
2. If handling the product releases hazardous substances or fuels that must be disposed of in a special way, e.g. coolants or engine oils that must be replenished regularly, the safety instructions of the manufacturer of the hazardous substances or fuels and the applicable regional waste disposal regulations must be observed. Also observe the relevant safety instructions in the product documentation. The improper disposal of hazardous substances or fuels can cause health problems and lead to environmental damage.

Informaciones elementales de seguridad

Es imprescindible leer y observar las siguientes instrucciones e informaciones de seguridad!

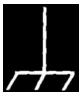
El principio del grupo de empresas Rohde & Schwarz consiste en tener nuestros productos siempre al día con los estándares de seguridad y de ofrecer a nuestros clientes el máximo grado de seguridad. Nuestros productos y todos los equipos adicionales son siempre fabricados y examinados según las normas de seguridad vigentes. Nuestro sistema de garantía de calidad controla constantemente que sean cumplidas estas normas. El presente producto ha sido fabricado y examinado según el certificado de conformidad adjunto de la UE y ha salido de nuestra planta en estado impecable según los estándares técnicos de seguridad. Para poder preservar este estado y garantizar un funcionamiento libre de peligros, el usuario deberá atenerse a todas las indicaciones, informaciones de seguridad y notas de alerta. El grupo de empresas Rohde & Schwarz está siempre a su disposición en caso de que tengan preguntas referentes a estas informaciones de seguridad.

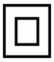
Además queda en la responsabilidad del usuario utilizar el producto en la forma debida. Este producto está destinado exclusivamente al uso en la industria y el laboratorio o, si ha sido expresamente autorizado, para aplicaciones de campo y de ninguna manera deberá ser utilizado de modo que alguna persona/cosa pueda sufrir daño. El uso del producto fuera de sus fines definidos o sin tener en cuenta las instrucciones del fabricante queda en la responsabilidad del usuario. El fabricante no se hace en ninguna forma responsable de consecuencias a causa del mal uso del producto.

Se parte del uso correcto del producto para los fines definidos si el producto es utilizado conforme a las indicaciones de la correspondiente documentación del producto y dentro del margen de rendimiento definido (ver hoja de datos, documentación, informaciones de seguridad que siguen). El uso del producto hace necesarios conocimientos técnicos y ciertos conocimientos del idioma inglés. Por eso se debe tener en cuenta que el producto solo pueda ser operado por personal especializado o personas instruidas en profundidad con las capacidades correspondientes. Si fuera necesaria indumentaria de seguridad para el uso de productos de Rohde & Schwarz, encontraría la información debida en la documentación del producto en el capítulo correspondiente. Guarde bien las informaciones de seguridad elementales, así como la documentación del producto, y entréguelas a usuarios posteriores.

Tener en cuenta las informaciones de seguridad sirve para evitar en lo posible lesiones o daños por peligros de toda clase. Por eso es imprescindible leer detalladamente y comprender por completo las siguientes informaciones de seguridad antes de usar el producto, y respetarlas durante el uso del producto. Deberán tenerse en cuenta todas las demás informaciones de seguridad, como p. ej. las referentes a la protección de personas, que encontrarán en el capítulo correspondiente de la documentación del producto y que también son de obligado cumplimiento. En las presentes informaciones de seguridad se recogen todos los objetos que distribuye el grupo de empresas Rohde & Schwarz bajo la denominación de "producto", entre ellos también aparatos, instalaciones así como toda clase de accesorios.

Símbolos y definiciones de seguridad

							
Aviso: punto de peligro general Observar la documentación del producto	Atención en el manejo de dispositivos de peso elevado	Peligro de choque eléctrico	Adver-tencia: superficie caliente	Conexión a conductor de protección	Conexión a tierra	Conexión a masa	Aviso: Cuidado en el manejo de dispositivos sensibles a la electrostática (ESD)

					
Tensión de alimentación de PUESTA EN MARCHA / PARADA	Indicación de estado de espera (Standby)	Corriente continua (DC)	Corriente alterna (AC)	Corriente continua / Corriente alterna (DC/AC)	El aparato está protegido en su totalidad por un aislamiento doble (reforzado)

Palabras de señal y su significado

En la documentación del producto se utilizan las siguientes palabras de señal con el fin de advertir contra riesgos y peligros.

⚠ PELIGRO	PELIGRO identifica un peligro inminente con riesgo elevado que provocará muerte o lesiones graves si no se evita.
⚠ ADVERTENCIA	ADVERTENCIA identifica un posible peligro con riesgo medio de provocar muerte o lesiones (graves) si no se evita.
⚠ ATENCIÓN	ATENCIÓN identifica un peligro con riesgo reducido de provocar lesiones leves o moderadas si no se evita.
AVISO	AVISO indica la posibilidad de utilizar mal el producto y, como consecuencia, dañarlo. En la documentación del producto se emplea de forma sinónima el término CUIDADO.

Las palabras de señal corresponden a la definición habitual para aplicaciones civiles en el área económica europea. Pueden existir definiciones diferentes a esta definición en otras áreas económicas o en aplicaciones militares. Por eso se deberá tener en cuenta que las palabras de señal aquí descritas sean utilizadas siempre solamente en combinación con la correspondiente documentación del producto y solamente en combinación con el producto correspondiente. La utilización de las palabras de señal en combinación con productos o documentaciones que no les correspondan puede llevar a interpretaciones equivocadas y tener por consecuencia daños en personas u objetos.

Estados operativos y posiciones de funcionamiento

El producto solamente debe ser utilizado según lo indicado por el fabricante respecto a los estados operativos y posiciones de funcionamiento sin que se obstruya la ventilación. Si no se siguen las indicaciones del fabricante, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte. En todos los trabajos deberán ser tenidas en cuenta las normas nacionales y locales de seguridad del trabajo y de prevención de accidentes.

1. Si no se convino de otra manera, es para los productos Rohde & Schwarz válido lo que sigue: como posición de funcionamiento se define por principio la posición con el suelo de la caja para abajo, modo de protección IP 2X, grado de suciedad 2, categoría de sobrecarga eléctrica 2, uso solamente en estancias interiores, utilización hasta 2000 m sobre el nivel del mar, transporte hasta 4500 m sobre el nivel del mar. Se aplicará una tolerancia de ±10 % sobre el voltaje nominal y de ±5 % sobre la frecuencia nominal.
2. No sitúe el producto encima de superficies, vehículos, estantes o mesas, que por sus características de peso o de estabilidad no sean aptos para él. Siga siempre las instrucciones de instalación del fabricante cuando instale y asegure el producto en objetos o estructuras (p. ej. paredes y estantes). Si se realiza la instalación de modo distinto al indicado en la documentación del producto, pueden causarse lesiones o incluso la muerte.
3. No ponga el producto sobre aparatos que generen calor (p. ej. radiadores o calefactores). La temperatura ambiente no debe superar la temperatura máxima especificada en la documentación del producto o en la hoja de datos. En caso de sobrecalentamiento del producto, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte.

Seguridad eléctrica

Si no se siguen (o se siguen de modo insuficiente) las indicaciones del fabricante en cuanto a seguridad eléctrica, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte.

1. Antes de la puesta en marcha del producto se deberá comprobar siempre que la tensión preseleccionada en el producto coincida con la de la red de alimentación eléctrica. Si es necesario modificar el ajuste de tensión, también se deberán cambiar en caso dado los fusibles correspondientes del producto.
2. Los productos de la clase de protección I con alimentación móvil y enchufe individual solamente podrán enchufarse a tomas de corriente con contacto de seguridad y con conductor de protección conectado.
3. Queda prohibida la interrupción intencionada del conductor de protección, tanto en la toma de corriente como en el mismo producto. La interrupción puede tener como consecuencia el riesgo de que el producto sea fuente de choques eléctricos. Si se utilizan cables alargadores o regletas de enchufe, deberá garantizarse la realización de un examen regular de los mismos en cuanto a su estado técnico de seguridad.
4. Si el producto no está equipado con un interruptor para desconectarlo de la red, se deberá considerar el enchufe del cable de conexión como interruptor. En estos casos se deberá asegurar que el enchufe siempre sea de fácil acceso (de acuerdo con la longitud del cable de conexión, aproximadamente 2 m). Los interruptores de función o electrónicos no son aptos para el corte de la red eléctrica. Si los productos sin interruptor están integrados en bastidores o instalaciones, se deberá colocar el interruptor en el nivel de la instalación.
5. No utilice nunca el producto si está dañado el cable de conexión a red. Compruebe regularmente el correcto estado de los cables de conexión a red. Asegúrese, mediante las medidas de protección y de instalación adecuadas, de que el cable de conexión a red no pueda ser dañado o de que nadie pueda ser dañado por él, p. ej. al tropezar o por un choque eléctrico.
6. Solamente está permitido el funcionamiento en redes de alimentación TN/TT aseguradas con fusibles de 16 A como máximo (utilización de fusibles de mayor amperaje solo previa consulta con el grupo de empresas Rohde & Schwarz).
7. Nunca conecte el enchufe en tomas de corriente sucias o llenas de polvo. Introduzca el enchufe por completo y fuertemente en la toma de corriente. La no observación de estas medidas puede provocar chispas, fuego y/o lesiones.
8. No sobrecargue las tomas de corriente, los cables alargadores o las regletas de enchufe ya que esto podría causar fuego o choques eléctricos.
9. En las mediciones en circuitos de corriente con una tensión U_{eff} > 30 V se deberán tomar las medidas apropiadas para impedir cualquier peligro (p. ej. medios de medición adecuados, seguros, limitación de tensión, corte protector, aislamiento etc.).
10. Para la conexión con dispositivos informáticos como un PC o un ordenador industrial, debe comprobarse que éstos cumplan los estándares IEC60950-1/EN60950-1 o IEC61010-1/EN 61010-1 válidos en cada caso.
11. A menos que esté permitido expresamente, no retire nunca la tapa ni componentes de la carcasa mientras el producto esté en servicio. Esto pone a descubierto los cables y componentes eléctricos y puede causar lesiones, fuego o daños en el producto.

12. Si un producto se instala en un lugar fijo, se deberá primero conectar el conductor de protección fijo con el conductor de protección del producto antes de hacer cualquier otra conexión. La instalación y la conexión deberán ser efectuadas por un electricista especializado.
13. En el caso de dispositivos fijos que no estén provistos de fusibles, interruptor automático ni otros mecanismos de seguridad similares, el circuito de alimentación debe estar protegido de modo que todas las personas que puedan acceder al producto, así como el producto mismo, estén a salvo de posibles daños.
14. Todo producto debe estar protegido contra sobretensión (debida p. ej. a una caída del rayo) mediante los correspondientes sistemas de protección. Si no, el personal que lo utilice quedará expuesto al peligro de choque eléctrico.
15. No debe introducirse en los orificios de la caja del aparato ningún objeto que no esté destinado a ello. Esto puede producir cortocircuitos en el producto y/o puede causar choques eléctricos, fuego o lesiones.
16. Salvo indicación contraria, los productos no están impermeabilizados (ver también el capítulo "Estados operativos y posiciones de funcionamiento", punto 1). Por eso es necesario tomar las medidas necesarias para evitar la entrada de líquidos. En caso contrario, existe peligro de choque eléctrico para el usuario o de daños en el producto, que también pueden redundar en peligro para las personas.
17. No utilice el producto en condiciones en las que pueda producirse o ya se hayan producido condensaciones sobre el producto o en el interior de éste, como p. ej. al desplazarlo de un lugar frío a otro caliente. La entrada de agua aumenta el riesgo de choque eléctrico.
18. Antes de la limpieza, desconecte por completo el producto de la alimentación de tensión (p. ej. red de alimentación o batería). Realice la limpieza de los aparatos con un paño suave, que no se deshilache. No utilice bajo ningún concepto productos de limpieza químicos como alcohol, acetona o diluyentes para lacas nitrocelulósicas.

Funcionamiento

1. El uso del producto requiere instrucciones especiales y una alta concentración durante el manejo. Debe asegurarse que las personas que manejen el producto estén a la altura de los requerimientos necesarios en cuanto a aptitudes físicas, psíquicas y emocionales, ya que de otra manera no se pueden excluir lesiones o daños de objetos. El empresario u operador es responsable de seleccionar el personal usuario apto para el manejo del producto.
2. Antes de desplazar o transportar el producto, lea y tenga en cuenta el capítulo "Transporte".
3. Como con todo producto de fabricación industrial no puede quedar excluida en general la posibilidad de que se produzcan alergias provocadas por algunos materiales empleados, los llamados alérgenos (p. ej. el níquel). Si durante el manejo de productos Rohde & Schwarz se producen reacciones alérgicas, como p. ej. irritaciones cutáneas, estornudos continuos, enrojecimiento de la conjuntiva o dificultades respiratorias, debe avisarse inmediatamente a un médico para investigar las causas y evitar cualquier molestia o daño a la salud.
4. Antes de la manipulación mecánica y/o térmica o el desmontaje del producto, debe tenerse en cuenta imprescindiblemente el capítulo "Eliminación", punto 1.

5. Ciertos productos, como p. ej. las instalaciones de radiocomunicación RF, pueden a causa de su función natural, emitir una radiación electromagnética aumentada. Deben tomarse todas las medidas necesarias para la protección de las mujeres embarazadas. También las personas con marcapasos pueden correr peligro a causa de la radiación electromagnética. El empresario/operador tiene la obligación de evaluar y señalizar las áreas de trabajo en las que exista un riesgo elevado de exposición a radiaciones.
6. Tenga en cuenta que en caso de incendio pueden desprenderse del producto sustancias tóxicas (gases, líquidos etc.) que pueden generar daños a la salud. Por eso, en caso de incendio deben usarse medidas adecuadas, como p. ej. máscaras antigás e indumentaria de protección.
7. En caso de que un producto Rohde & Schwarz contenga un producto láser (p. ej. un lector de CD/DVD), no debe usarse ninguna otra configuración o función aparte de las descritas en la documentación del producto, a fin de evitar lesiones (p. ej. debidas a irradiación láser).

Reparación y mantenimiento

1. El producto solamente debe ser abierto por personal especializado con autorización para ello. Antes de manipular el producto o abrirlo, es obligatorio desconectarlo de la tensión de alimentación, para evitar toda posibilidad de choque eléctrico.
2. El ajuste, el cambio de partes, el mantenimiento y la reparación deberán ser efectuadas solamente por electricistas autorizados por Rohde & Schwarz. Si se reponen partes con importancia para los aspectos de seguridad (p. ej. el enchufe, los transformadores o los fusibles), solamente podrán ser sustituidos por partes originales. Después de cada cambio de partes relevantes para la seguridad deberá realizarse un control de seguridad (control a primera vista, control del conductor de protección, medición de resistencia de aislamiento, medición de la corriente de fuga, control de funcionamiento). Con esto queda garantizada la seguridad del producto.

Baterías y acumuladores o celdas

Si no se siguen (o se siguen de modo insuficiente) las indicaciones en cuanto a las baterías y acumuladores o celdas, pueden producirse explosiones, incendios y/o lesiones graves con posible consecuencia de muerte. El manejo de baterías y acumuladores con electrolitos alcalinos (p. ej. celdas de litio) debe seguir el estándar EN 62133.

1. No deben desmontarse, abrirse ni triturarse las celdas.
2. Las celdas o baterías no deben someterse a calor ni fuego. Debe evitarse el almacenamiento a la luz directa del sol. Las celdas y baterías deben mantenerse limpias y secas. Limpiar las conexiones sucias con un paño seco y limpio.
3. Las celdas o baterías no deben cortocircuitarse. Es peligroso almacenar las celdas o baterías en estuches o cajones en cuyo interior puedan cortocircuitarse por contacto recíproco o por contacto con otros materiales conductores. No deben extraerse las celdas o baterías de sus embalajes originales hasta el momento en que vayan a utilizarse.
4. Mantener baterías y celdas fuera del alcance de los niños. En caso de ingestión de una celda o batería, avisar inmediatamente a un médico.
5. Las celdas o baterías no deben someterse a impactos mecánicos fuertes indebidos.

6. En caso de falta de estanqueidad de una celda, el líquido vertido no debe entrar en contacto con la piel ni los ojos. Si se produce contacto, lavar con agua abundante la zona afectada y avisar a un médico.
7. En caso de cambio o recarga inadecuados, las celdas o baterías que contienen electrolitos alcalinos (p. ej. las celdas de litio) pueden explotar. Para garantizar la seguridad del producto, las celdas o baterías solo deben ser sustituidas por el tipo Rohde & Schwarz correspondiente (ver lista de recambios).
8. Las baterías y celdas deben reciclarse y no deben tirarse a la basura doméstica. Las baterías o acumuladores que contienen plomo, mercurio o cadmio deben tratarse como residuos especiales. Respete en esta relación las normas nacionales de eliminación y reciclaje.

Transporte

1. El producto puede tener un peso elevado. Por eso es necesario desplazarlo o transportarlo con precaución y, si es necesario, usando un sistema de elevación adecuado (p. ej. una carretilla elevadora), a fin de evitar lesiones en la espalda u otros daños personales.
2. Las asas instaladas en los productos sirven solamente de ayuda para el transporte del producto por personas. Por eso no está permitido utilizar las asas para la sujeción en o sobre medios de transporte como p. ej. grúas, carretillas elevadoras de horquilla, carros etc. Es responsabilidad suya fijar los productos de manera segura a los medios de transporte o elevación. Para evitar daños personales o daños en el producto, siga las instrucciones de seguridad del fabricante del medio de transporte o elevación utilizado.
3. Si se utiliza el producto dentro de un vehículo, recae de manera exclusiva en el conductor la responsabilidad de conducir el vehículo de manera segura y adecuada. El fabricante no asumirá ninguna responsabilidad por accidentes o colisiones. No utilice nunca el producto dentro de un vehículo en movimiento si esto pudiera distraer al conductor. Asegure el producto dentro del vehículo debidamente para evitar, en caso de un accidente, lesiones u otra clase de daños.

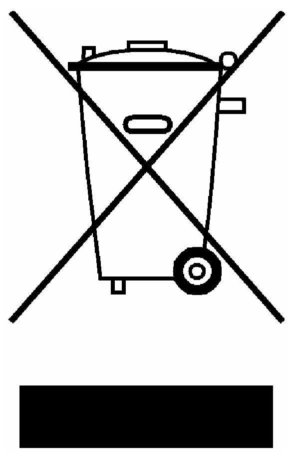
Eliminación

1. Si se trabaja de manera mecánica y/o térmica cualquier producto o componente más allá del funcionamiento previsto, pueden liberarse sustancias peligrosas (polvos con contenido de metales pesados como p. ej. plomo, berilio o níquel). Por eso el producto solo debe ser desmontado por personal especializado con formación adecuada. Un desmontaje inadecuado puede ocasionar daños para la salud. Se deben tener en cuenta las directivas nacionales referentes a la eliminación de residuos.
2. En caso de que durante el trato del producto se formen sustancias peligrosas o combustibles que deban tratarse como residuos especiales (p. ej. refrigerantes o aceites de motor con intervalos de cambio definidos), deben tenerse en cuenta las indicaciones de seguridad del fabricante de dichas sustancias y las normas regionales de eliminación de residuos. Tenga en cuenta también en caso necesario las indicaciones de seguridad especiales contenidas en la documentación del producto. La eliminación incorrecta de sustancias peligrosas o combustibles puede causar daños a la salud o daños al medio ambiente.

Customer Information Regarding Product Disposal

The German Electrical and Electronic Equipment (ElektroG) Act is an implementation of the following EC directives:

- 2002/96/EC on waste electrical and electronic equipment (WEEE) and
- 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS).



Product labeling in accordance with EN 50419

Once the lifetime of a product has ended, this product must not be disposed of in the standard domestic refuse. Even disposal via the municipal collection points for waste electrical and electronic equipment is not permitted.

Rohde & Schwarz GmbH & Co. KG has developed a disposal concept for the environmental-friendly disposal or recycling of waste material and fully assumes its obligation as a producer to take back and dispose of electrical and electronic waste in accordance with the ElektroG Act.

Please contact your local service representative to dispose of the product.

ROHDE&SCHWARZ

Certified Quality System

DIN EN ISO 9001 : 2000
DIN EN 9100 : 2003
DIN EN ISO 14001 : 2004

DQS REG. NO 001954 QM UM

QUALITÄTSZERTIFIKAT

Sehr geehrter Kunde,
Sie haben sich für den Kauf eines Rohde & Schwarz-Produktes entschieden. Hiermit erhalten Sie ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unseres Managementsystems entwickelt, gefertigt und geprüft.
Das Rohde & Schwarz Managementsystem ist zertifiziert nach:

DIN EN ISO 9001:2000
DIN EN 9100:2003
DIN EN ISO 14001:2004

CERTIFICATE OF QUALITY

Dear Customer,
you have decided to buy a Rohde & Schwarz product. You are thus assured of receiving a product that is manufactured using the most modern methods available. This product was developed, manufactured and tested in compliance with our quality management system standards.
The Rohde & Schwarz quality management system is certified according to:

DIN EN ISO 9001:2000
DIN EN 9100:2003
DIN EN ISO 14001:2004

CERTIFICAT DE QUALITÉ

Cher Client,
vous avez choisi d'acheter un produit Rohde & Schwarz. Vous disposez donc d'un produit fabriqué d'après les méthodes les plus avancées. Le développement, la fabrication et les tests respectent nos normes de gestion qualité.
Le système de gestion qualité de Rohde & Schwarz a été homologué conformément aux normes:

DIN EN ISO 9001:2000
DIN EN 9100:2003
DIN EN ISO 14001:2004

ROHDE&SCHWARZ

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1171.0200.11-03.00

Customer Support

Technical support – where and when you need it

For quick, expert help with any Rohde & Schwarz equipment, contact one of our Customer Support Centers. A team of highly qualified engineers provides telephone support and will work with you to find a solution to your query on any aspect of the operation, programming or applications of Rohde & Schwarz equipment.

Up-to-date information and upgrades

To keep your instrument up-to-date and to be informed about new application notes related to your instrument, please send an e-mail to the Customer Support Center stating your instrument and your wish. We will take care that you will get the right information.

USA & Canada

Monday to Friday	(except US public holidays)
8:00 AM – 8:00 PM	Eastern Standard Time (EST)
Tel. from USA	888-test-rsa (888-837-8772) (opt 2)
From outside USA	+1 410 910 7800 (opt 2)
Fax	+1 410 910 7801
E-mail	CustomerSupport@rohde-schwarz.com

East Asia

Monday to Friday	(except Singaporean public holidays)
8:30 AM – 6:00 PM	Singapore Time (SGT)
Tel.	+65 6 513 0488
Fax	+65 6 846 1090
E-mail	CustomerSupport@rohde-schwarz.com

Rest of the World

Monday to Friday	(except German public holidays)
08:00 – 17:00	Central European Time (CET)
Tel. from Europe	+49 (0) 180 512 42 42*
From outside Europe	+49 89 4129 13776
Fax	+49 (0) 89 41 29 637 78
E-mail	CustomerSupport@rohde-schwarz.com

* 0.14 €/Min within the German fixed-line telephone network, varying prices for the mobile telephone network and in different countries.

ROHDE&SCHWARZ

1171.0200.22-03.00

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- Sales Locations
- Service Locations
- National Websites

What's New in this Revision…

This operating manual describes version V5.00 and higher of the R&S® CBT software. Compared to the previous version V4.61, this new firmware provides the extensions and improvements listed below.

New Features	Description	Refer to...
Profile info (FW V5.00)	While in *A2DP (Sink) Profile* submode, the R&S CBT displays the "Codec Specific Information Elements" that the connected Bluetooth® DUT supports.	Chapter 4, → Bluetooth Signalling Mode → A2DP (Sink) Profile
Audio link test (FW V5.00)	New connector configuration: the audio signal from the internal digital audio generator is modulated onto the Bluetooth RF carrier, transmitted to the DUT and looped back by the DUT.	Chapter 4, → Options and Extensions → Audio Test Scenarios
Enable ACL data transfer (FW V5.00)	New command `SOURce:ACLData:ENABle` enables the transfer of SCL data via `SOURce:ACLData` or `[SENSe:]ACLData`.	Chapter 6, → Bluetooth Signalling Mode → ACL Data
Subarray commands (FW V5.00)	Subarray commands can also return arithmetic mean values (`PAVG`) and x-axis values for minima and maxima (`XMINimum, XMAXimum`).	Chapter 5, → Retrieving Measurement Results
Version Manager (FW V5.00)	Redesign and improvements in the Version Manager.	Chapter 1, → R&S CBT Version Manager
Utility commands (FW V5.00)	SYSTem:REBoot reboots the instrument SYSTEM:REBoot:ERRor reboots the instrument when a non-recoverable system error is encountered	Chapter 6, Base System Commands → System Commands

Frequently Used Abbreviations

ACL	*Asynchronous connection-less link*
AF	*Audio frequency*
Att.	*Attenuation*
BD_ADDR	*Bluetooth device address*
BER	*Bit error rate*
Chan.	*Channel*
Cnt	*Center*
CRC	*Cyclic redundancy check*
Dev	*Device*
DEVM	*Differential Error Vector Magnitude*
DHn	*Data high rate (packets)*
Disp.	*Display Mode*
DUT	*Device under test*
EDR	*Enhanced Data Rate*
Ext.	*External*
Freq.	*Frequency*
GPIB	*General Purpose Interface Bus = IEEE Bus according to standard IEC 625.1/IEEE 488.1*
HEC	*Header error check*
IF	*Intermediate frequency*
LAP	*Lower address part*
LMP	*Link manager protocol*
Max.	*Maximum (Level)*
NAP	*Non-specific address part*
NS	*Non Signalling*
PER	*Packet error rate*
Pk	*Peak*
PRBS	*Pseudo random bit sequence*
RBW	*Resolution Bandwidth*
Ref.	*Reference (marker)*
Rel.	*Relative*
RF	*Radio Frequency*
RX	*Receiver*
SCO	*Synchronous connection-oriented link*
Sig	*Signalling*
SSB	*Single Side Band*
SW	*Software*
TX	*Transmitter*
UAP	*Upper address part*
THD	*Total Harmonic Distortion*
THD + N	*Total Harmonic Distortion and Noise*

Contents

1 Preparation for Use

This chapter describes the controls and connectors of the R&S® CBT and gives all information that is necessary to put the instrument into operation and connect external devices. Notes on the update of the R&S® CBT software and a description of the *VersionManager* appear at the end of this chapter.

Caution!

Please make sure to observe the instructions of the following sections so that you cannot cause damage to the instrument or endanger people. This is of particular importance when you use the instrument for the first time. Also observe the general safety instructions at the beginning of this manual.

Chapter 2 provides an introduction to the operation of the R&S® CBT by means of typical configuration and measurement examples. For a description of the operating concept and general features of the graphical user interface refer to Chapter 3.

For remote control of the R&S® CBT or R&S® CBT 32 refer to the general description of the SCPI commands, the instrument model, the status reporting system and measurement control in Chapter 5 of the complete operating manual. A more detailed description of the hardware connectors and interfaces can be found in Chapter 8.

Note: R&S® CBT and R&S® CBT 32

This chapter describes instrument models R&S® CBT and R&S® CBT 32. The following topics are discussed in separate sections:

- *The front panel of the R&S® CBT with its display and controls is described on p. 1.2 ff.; the rear panel on p. 1.7 f.*
- *The front panel of the R&S® CBT 32 is described on p. 1.9 ff.; the rear panel on p. 1.10 f. An additional section describes rack mounting of the R&S® CBT 32.*

The remaining sections are valid for both instruments; R&S® CBT is used as an abbreviation for both models.

Front View (R&S CBT)

The front panel of the R&S® CBT consists of the VGA display with the softkey area (left side) and the hardkey area (right side, see Fig. 1-1). Brief explanations on the controls and connectors of the hardkey area and the rear panel can be found on the next pages. Operation by means of softkeys is described in Chapter 3, *Manual Operation*.

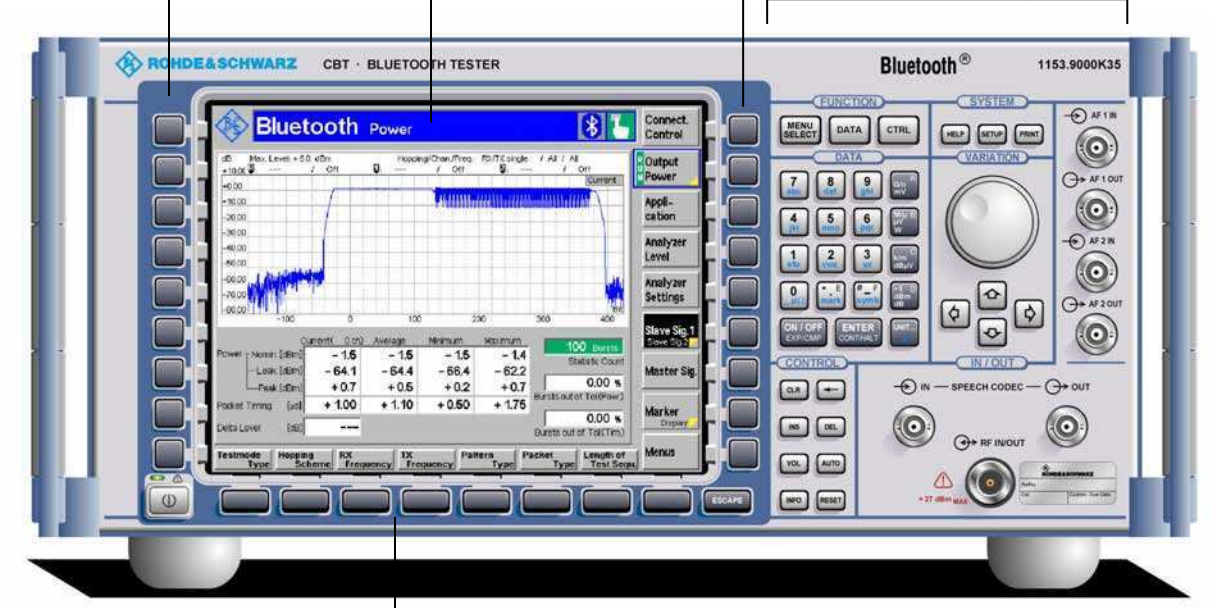
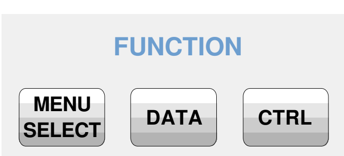


Fig. 1-1 R&S® CBT front view

Fig. 1-2 R&S® CBT front view – hardkeys

FUNCTION

Operating Manual



Fast access to the most important menus:

MENU SELECT	Menu overview and selection	☞ Chap. 4
DATA	File manager	
CTRL	For future extensions	

DATA

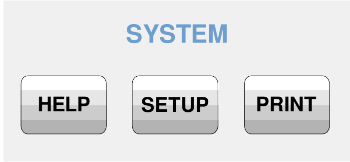
Operating Manual

Data input:

0 ... 9	Numerical input (letters for string editors)	☞ Chap. 3
** . E*	Special characters, dec. point, hex value "E"	
# - F	Spec. characters, sign change, hex value "F"	
G/n mV A	Factor $10^9/10^{-9}$, unit, hex value "A"	
M/µ µV W B	Factor $10^6/10^{-6}$, unit, hex value "B"	
k/m dB µV C	Factor $10^3/10^{-3}$, unit, hex value "C"	
**1 dBm dB D*	Factor 10^0, unit, hex value "D"	
ON / OFF EXP/COMP	Switching on/off editors/measurements	
ENTER	Confirmation of entry in editors	
CONT/HALT	Calling/quitting editors, measurement control	
UNIT ⇩	For future extensions	

Fig. 1-3 R&S® CBT front view – hardkeys

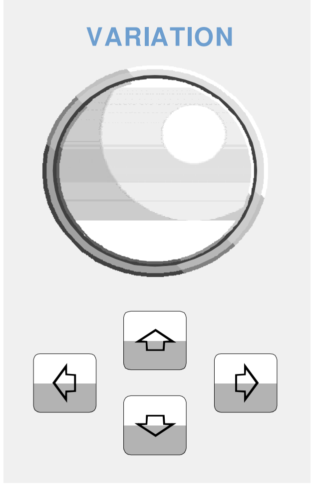
SYSTEM *Operating Manual*



System control:

HELP	Displays online help	☞ Chap. 4
SETUP	Instrument settings	
PRINT	Print screen contents to output device or file	

VARIATION *Operating Manual*



Value variation and group selection:

Rotary knob	Value variation in input fields and parameters, line selection in tables, field selection in popup menus. Press to expand/compress tables and pull-down lists and to confirm entries and selections.	☞ Chap. 3
Cursor key vertical	Group selection in popup menus (vertical)	
Cursor key horizontal	Group selection in popup menus (horizontal), Cursor positioning in editors and tables	

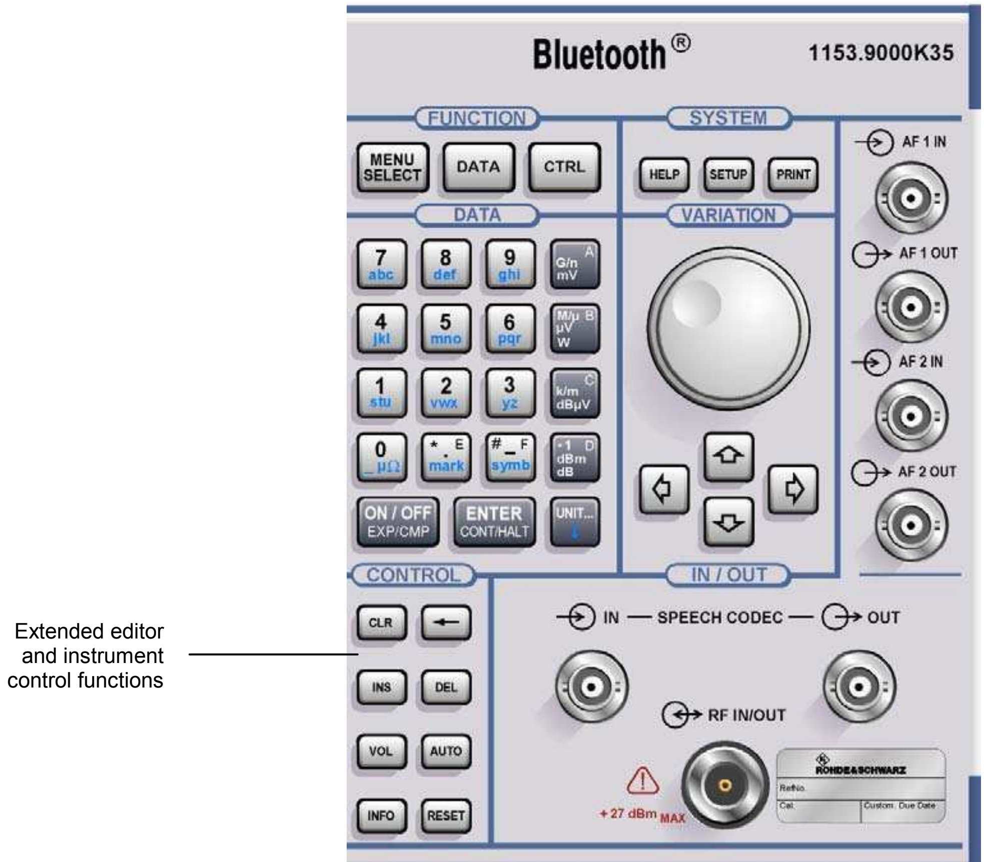


Fig. 1-4 R&S® CBT front view – hardkeys

CONTROL *Operating Manual*

Extended control functions:

CLR	Clears the complete editor string	☞ Chap. 3
⇦	Deletes the character to the left of the cursor (back space)	
INS	Changes between insertion and overwriting in the editor	
DEL	Deletes the character marked by the cursor	
VOL	For future extensions	
AUTO	For future extensions	
INFO	System info and hardware diagnosis	
RESET	Resets to default values	

Further Keys *Operating Manual*

ESCAPE	Quits popup menus, closes an editor discarding the entries made	☞ Chap. 3
Store Settings	Green LED indicates that the R&S® CBT is power-supplied. Pressing the key during operation stores the current settings and then start the shut-down process.	☞ Ch. 1, "Switching on the Instrument / Startup Test"

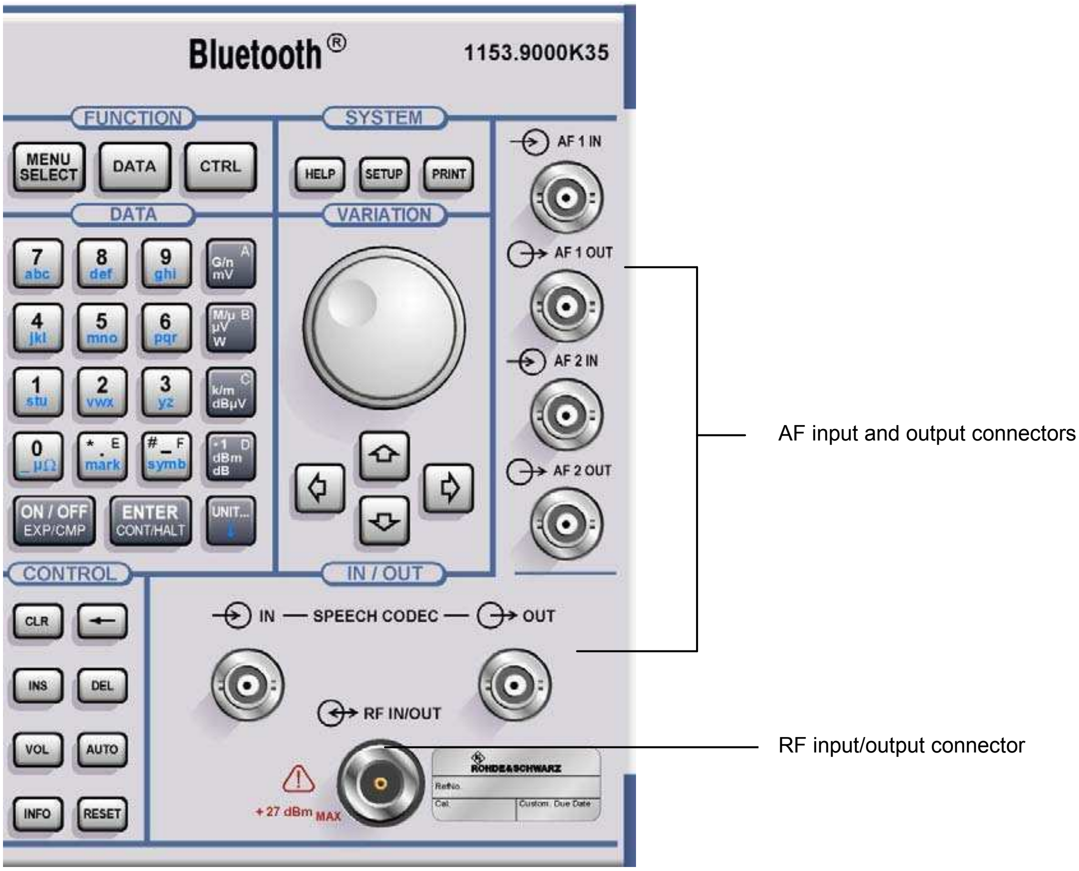
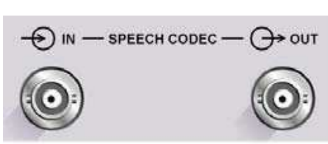


Fig. 1-5 R&S® CBT front view connectors

AF connectors

Operating Manual

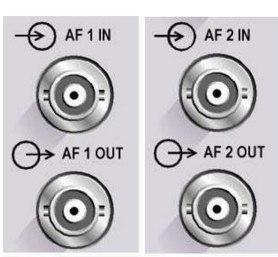


Connectors for audio signals:

SPEECH CODEC IN	Speech encoder input
SPEECH CODEC OUT	Speech decoder output

If no audio option R&S® CBT-B41 is installed, these connectors are labeled *AF IN* and *AF OUT*, respectively.

Chapter 8, "Hardware connectors"

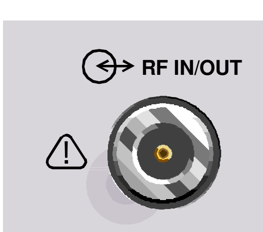


The following audio connectors are available with the audio option R&S® CBT-B41:

AF 1 IN	Input for audio analyzer path 1
AF 1 OUT	Output for audio generator path 1
AF 2 IN	Input for audio analyzer path 2
AF 2 OUT	Output for audio generator path 2

RF connector

Operating Manual



Bidirectional RF connector

Caution:

Note the maximum permissible input levels for all RF connectors according to the label on the front panel or the data sheet in order to prevent damage to the instrument.

Chapter 8, "Hardware connectors "

Rear View (R&S CBT)

The rear panel of the R&S® CBT contains the mains power switch and connectors for the power supply, interfaces and input/output signals.

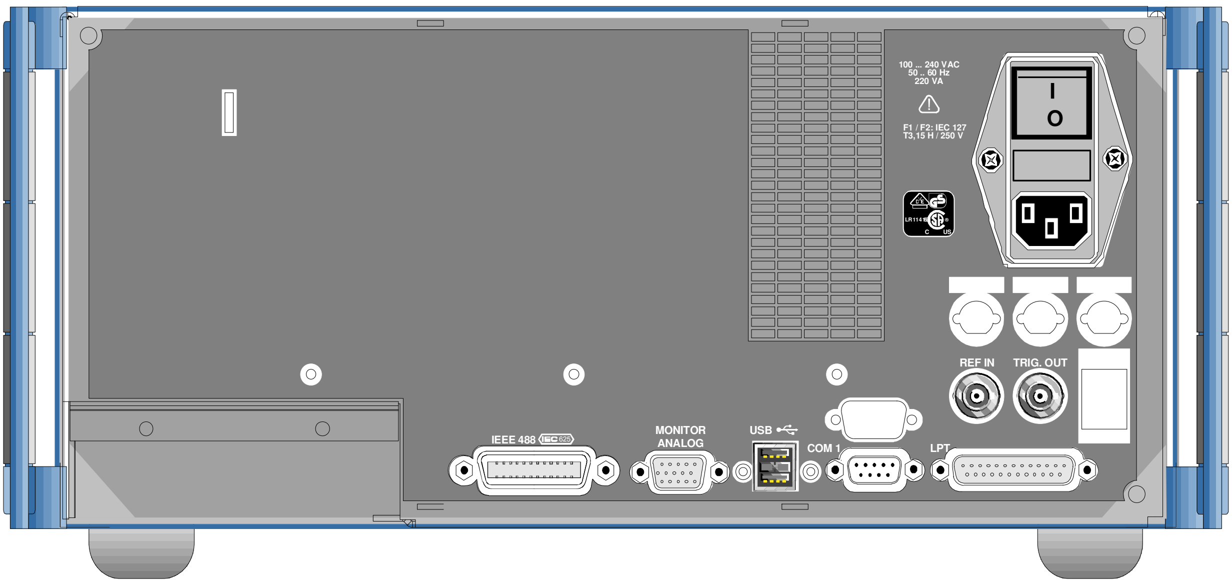
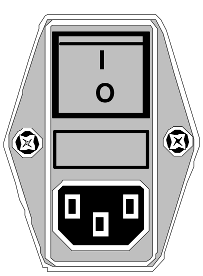


Fig. 1-6 R&S® CBT rear view

Mains switch

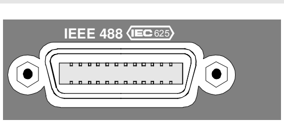
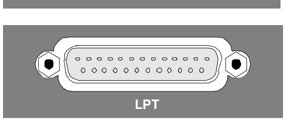
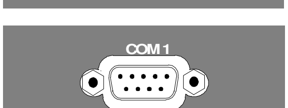
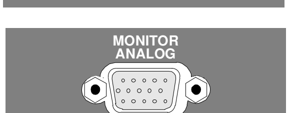
Operating Manual

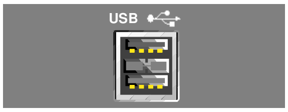


Mains power switch	☞	Chapter 1, "Switching on the Instrument, Startup test
Fuse holder	☞	Chapter 1, "Replacing Fuses"
Mains connector	☞	Chapter 1, "Connecting the Instrument to the AC Supply”

Interfaces

Operating Manual

 IEEE 488	GPIB-bus connector (IEEE 488 / IEC 625),	☞	Ch. 8, "Hardware Interfaces "
 LPT	Parallel interface: 25-contact printer connector, Centronics-compatible	☞	Chapter 1, "Connecting an Output Device" C. 8, "Hardware Interfaces”
 COM 1	Connector for serial interface 1: 9-contact Sub-D connector	☞	Chapter 8, "Hardware Inter-faces”
 MONITOR ANALOG	Connector for an external VGA monitor: 15-contact Sub-D connector	☞	Ch. 1, "Connecting a Monitor" Ch. 8, "Hardware Interfaces”



Connector for external keyboard:
USB connector

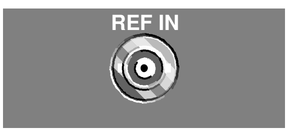
☞ Ch. 1, "Connecting an External Keyboard"
Ch. 8, "Hardware Interfaces”

Caution!

Never connect an external mass storage device, e.g. a USB memory stick, to the USB connector, because this may cause a system crash and even damage the instrument software.

Reference frequency

Operating Manual



Input for external 10 MHz reference frequency

☞ Chapter 8, "Hardware Connectors

Trigger output signal

☞ Chapter 8, "Hardware Connectors

Caution!

Do not use open or unshielded cables in order to comply with EMC directives.

Front View (R&S CBT 32)

The front panel of the R&S® CBT 32 contains a green LED indicating whether the instrument is power-supplied and the AF and RF connectors.

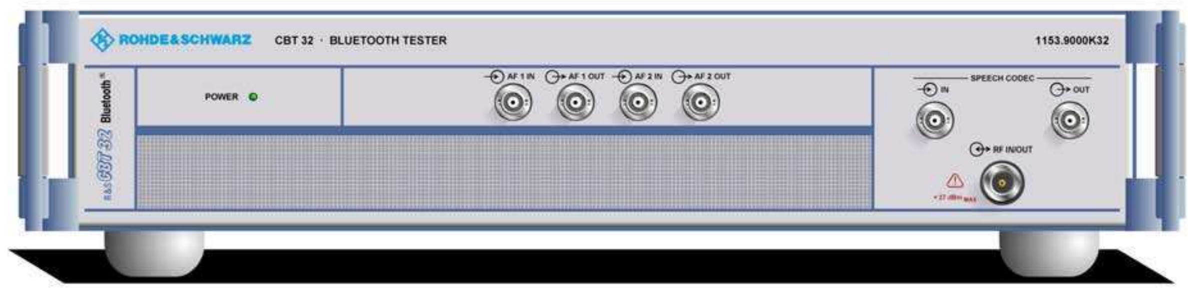


Fig. 1-7 R&S® CBT 32 front view

Power LED

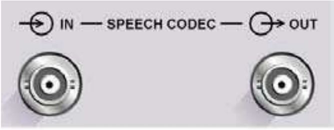
Operating Manual

Green LED indicates that the R&S® CBT 32 is power-supplied.

☞ Ch. 1, “Switching on the Instrument / Startup Test”

AF connectors

Operating Manual

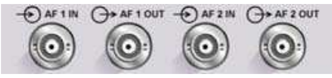


Connectors for audio signals:

SPEECH CODEC IN	Speech encoder input
SPEECH CODEC OUT	Speech decoder output

If no audio option R&S® CBT-B41 is installed, these connectors are labeled *AF IN* and *AF OUT*, respectively.

☞ Chapter 8, "Hardware connectors"

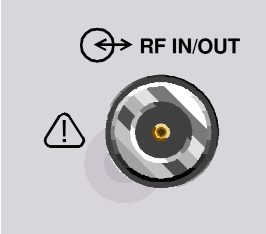


The following audio connectors are available with the audio option R&S® CBT-B41:

AF 1 IN	Input for audio analyzer path 1
AF 1 OUT	Output for audio generator path 1
AF 2 IN	Input for audio analyzer path 2
AF 2 OUT	Output for audio generator path 2

RF connector

Operating Manual



Bidirectional RF connector

Caution:

Note the maximum permissible input levels for all RF connectors according to the label on the front panel or the data sheet in order to prevent damage to the instrument.

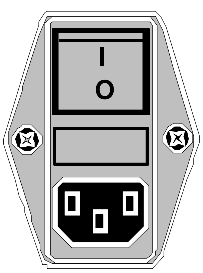
☞ Chapter 8, "Hardware connectors "

Rear View (R&S CBT 32)

The rear panel of the R&S® CBT 32 contains the mains power switch and connectors for the power supply, interfaces and input/output signals.

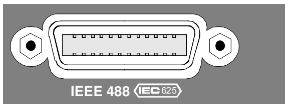
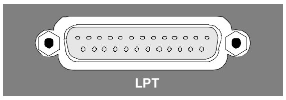
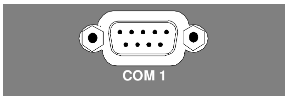
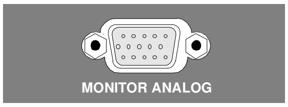
Fig. 1-8 R&S® CBT 32 rear view

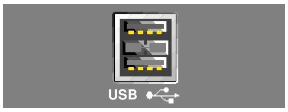
Mains switch — *Operating Manual*



Mains power switch	☞	Chapter 1, "Switching on the Instrument, Startup test
Fuse holder	☞	Chapter 1, "Replacing Fuses"
Mains connector	☞	Chapter 1, "Connecting the Instrument to the AC Supply”

Interfaces — *Operating Manual*

	GPIB-bus connector (IEEE 488 / IEC 625),	☞	Ch. 8, "Hardware Interfaces "
	Parallel interface: 25-contact printer connector (for service purposes), Centronics-compatible	☞	Chapter 1, "Connecting an Output Device" C. 8, "Hardware Interfaces”
	Connector for serial interface 1: 9-contact Sub-D connector	☞	Chapter 8, "Hardware Interfaces”
	Connector for an external VGA monitor (for debugging and service purposes): 15-contact Sub-D connector	☞	Ch. 1, "Connecting a Monitor" Ch. 8, "Hardware Interfaces”



Connector for external keyboard
(for service purposes):
USB connector

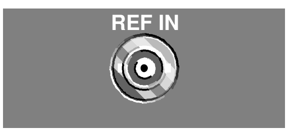
☞ Ch. 1, "Connecting an External Keyboard"
Ch. 8, "Hardware Interfaces”

Caution!

Never connect an external mass storage device, e.g. a USB memory stick, to the USB connector, because this may cause a system crash and even damage the instrument software.

Reference frequency

Operating Manual



Input for external 10 MHz
reference frequency

☞ Chapter 8, "Hardware Connectors

Trigger output signal

☞ Chapter 8, "Hardware Connectors

Caution!

Do not use open or unshielded cables in order to comply with EMC directives.

Putting the Instrument into Operation

This section describes the basic steps to be taken when setting up the R&S® CBT for the first time.

Caution:

Please make sure to observe the instructions of the following sections so that you cannot cause damage to the instrument or endanger people. This is of particular importance when you use the instrument for the first time.

Please also observe the general safety instructions at the beginning of this manual.

Unpacking the Instrument

When receiving your instrument, first perform the following steps.

1. Remove the instrument from its packaging and check the equipment for completeness using the delivery note and the accessory lists for the various items.
2. First, pull off the polyethylene protection pads from the instrument's rear feet and then carefully remove the pads from the instrument handles at the front.
3. Pull off the corrugated cardboard cover that protects the rear of the instrument.
4. Carefully unthread the corrugated cardboard cover at the front that protects the instrument handles and remove it.
5. Check the instrument for any damage. If there is damage, immediately contact the carrier who delivered the instrument. In this case, make sure not to discard the box and packing material.

It is advisable to keep the original packing material in order to prevent control elements and connectors from being damaged in case the instrument is to be transported or shipped at a later date.

Setting up the Instrument

The R&S® CBT is designed for use under laboratory conditions, either on a bench top or in a rack (model R&S® CBT 32). The general ambient conditions required at the operating site are as follows:

- The ambient temperature must be in the ranges specified for operation and for compliance with specifications (see data sheet).
- All fan openings including the rear panel perforations must be unobstructed. The distance to the wall should be at least 10 cm.

Notes: *For safe and convenient operation of the instrument note the following:*

- Avoid moisture condensation. If it occurs, the instrument must be wiped dry before switching on.
- Note the warm-up time of the temperature-controlled TCXO reference oscillator, see data sheet.

Bench Top Operation

Permissible operating positions of the R&S® CBT:

- Horizontal position, standing on the feet.
- Model R&S® CBT 32: Mounted in a 19" rack (see next section).
- Model R&S® CBT: For applications in the laboratory or on a work bench, it is recommended that the support feet on the bottom of the instrument be extended. For the LCD display, this provides the optimum viewing angle which typically ranges from perpendicular to the display front to approximately 30° below.

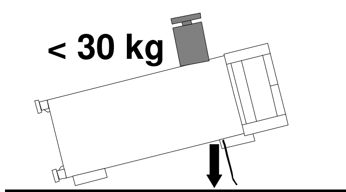
Warning! Danger of injury

The feet may fold in if they are not folded out completely or if the instrument is shifted. The feet may break if they are overloaded. Fold the feet completely in or completely out to ensure stability of the instrument and personal safety. To avoid injuries, never shift the instrument when its feet are folded out.

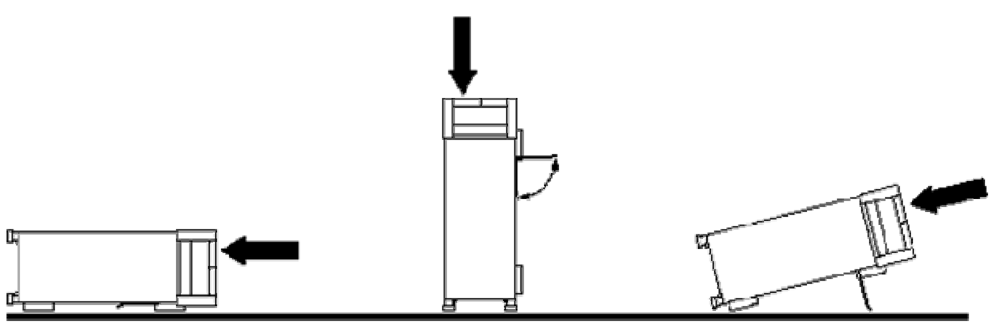
The overall load (the instrument's own weight plus that of the instruments stacked on top of it) on the folded-out feet must not exceed 30 kg.

Place the instrument on a stable surface. Secure the instruments stacked on top of it against slipping (e.g. by locking their feet on the top front frame).

When the instrument is standing on its folded-out feet, do not work under the instrument and do not put anything under it, otherwise injuries or material damage could occur.



The instrument can be used in each of the positions shown here.



Mounting the Instrument in a Rack (R&S® CBT 32)

Using the adapter R&S® ZZA-211 (order number 1096.3260.00) an R&S® CBT32 can be mounted in 19" racks according to the mounting instructions supplied with the rack adapter.

Note: *For convenient operation of the instrument note the following:*

- Allow for sufficient air supply in the rack.
- Make sure that there is sufficient space between the ventilation holes and the rack casing.

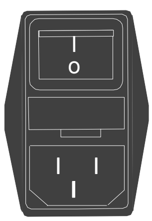
Connecting the Instrument to the AC Supply

The R&S® CBT may be connected to one-phase AC supplies with nominal voltages ranging from 100 V to 240 V and nominal frequencies ranging from 50 Hz to 60 Hz (see inscription on the rear panel and data sheet). The maximum power consumption is 240 VA, the typical power consumption is quoted in the data sheet.

Caution!

- *After moisture condensation, allow the instrument to dry before switching on.*
- *Note the permissible ambient temperature according to the data sheet.*
- *Do not cover the lateral and rear ventilation holes.*
- *Note the warm-up time of the temperature-controlled TCXO reference, see data sheet.*

Note: *The R&S® CBT is automatically adapted to the AC supply voltage applied. External switchover or adaptation of the fuses is not necessary.*



Mains connector

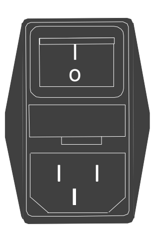
- Use the AC power cable supplied with the instrument and the mains connector on the rear panel for the connection.

As the instrument is designed according to the regulations for safety class EN61010, it must be connected to a power outlet with earthing contact.

Switching on the Instrument / Startup Test

- To switch on your R&S® CBT, set the mains switch at the rear panel to position **I**.

The instrument automatically performs a system check and boots the instrument software as described below.



Mains switch

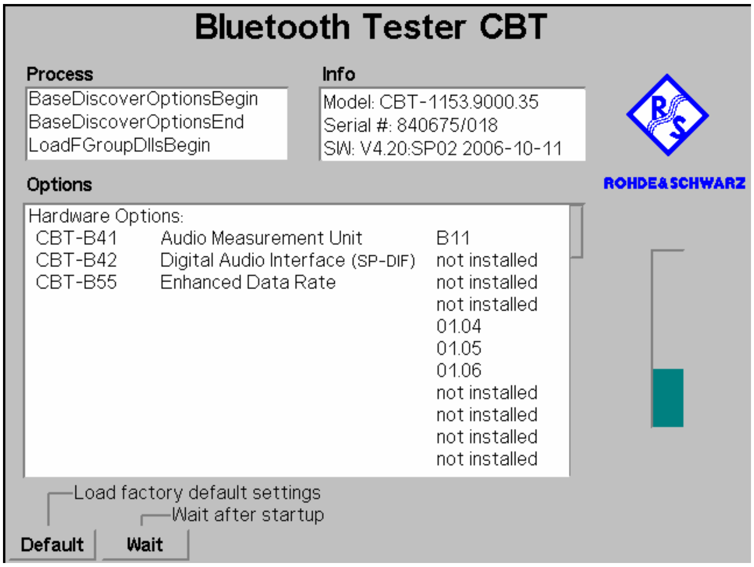
The *mains switch* can be set to two positions:

0 The instrument is disconnected from the mains

I The instrument is power-supplied and ready for operation; the startup procedure is initiated

Startup menu (model R&S® CBT)

While the instrument software is loaded, the instrument shows the *Startup* menu.



Displays in startup menu

The display windows of the startup menu provide information on

- The startup procedure (*Process)*
- Instrument model, serial number and version of the R&S® CBT base software *(Info).*
- Installed hardware and software options and equipment *(Options)*. Available software options are listed with their version numbers.
- Progress of the startup procedure (*Startup* bar graph).

After terminating the startup procedure, the instrument automatically activates the last main menu or graphical measurement menu of the previous session.

Switching off the Instrument

Model R&S® CBT 32:

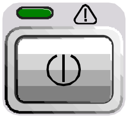
➢ Set the mains switch at the rear to the *0* position.

Model R&S® CBT:

To keep all the instrument settings that you have made during operation, always proceed in the following order to switch off your R&S® CBT:

➢ Press the *Store Settings* key on the front panel to initiate the shutdown process and save the current data to the internal hard disk.

➢ Wait until the shutdown process has been terminated before setting the mains switch at the rear to the *0* position.



Store Settings key

The *Store Settings* key initiates a shutdown of the instrument and stores all settings. The green LED is on if the R&S® CBT is power-supplied. While the LED is on the instrument can be in two alternative states:

Operation In this operating mode, all modules of the instrument are supplied with operating voltage and the instrument software is active.

Settings are stored

The instrument software has been shut down and all settings have been stored. The R&S® CBT is ready for being turned off at the mains switch. The *Store Settings* key is inactive and the message *You may now switch off the instrument at the rear panel* is displayed.

How to Ensure EMC

In order to avoid electromagnetic interference, the instrument may only be operated when it is closed and with all shielding covers fitted. Only appropriate shielded signal and control cables may be used.

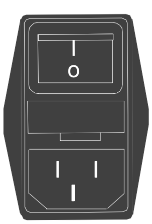
Input Level

Caution!

– *In order to prevent damage to the instrument note the maximum permissible input levels at the AF inputs AF IN and at the bidirectional RF connector RF IN/OUT at the front of the instrument.*

Replacing Fuses

The instrument is protected by two fuses IEC 127 – T 3,15 H /250 V (stock no. 0099.6729.00).



Fuse holder

The fuses are located in the fuse holder between the mains power switch and the mains connector. To replace the fuses:

➢ Take the fuse holder out of its slot. If necessary, use a coin to lift the cover.

➢ Exchange the fuses and put the holder back to the slot, slightly pressing on the cover.

Replacement fuses are provided with the instrument.

Connecting the R&S CBT to the Test Setup

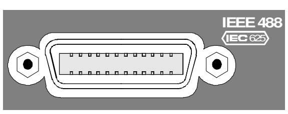
Warning:

Connect external devices and peripherals only when the instrument is switched off. Otherwise, future errors cannot be excluded.

Connecting a Controller

The R&S® CBT can be connected to an external controller via the GPIB bus (IEEE bus according to standard IEEE 488; throughout this documentation we will primarily use the term GPIB bus which is also used in the operating menus and in the SCPI command syntax) or via serial interface:

Connection via GPIB bus



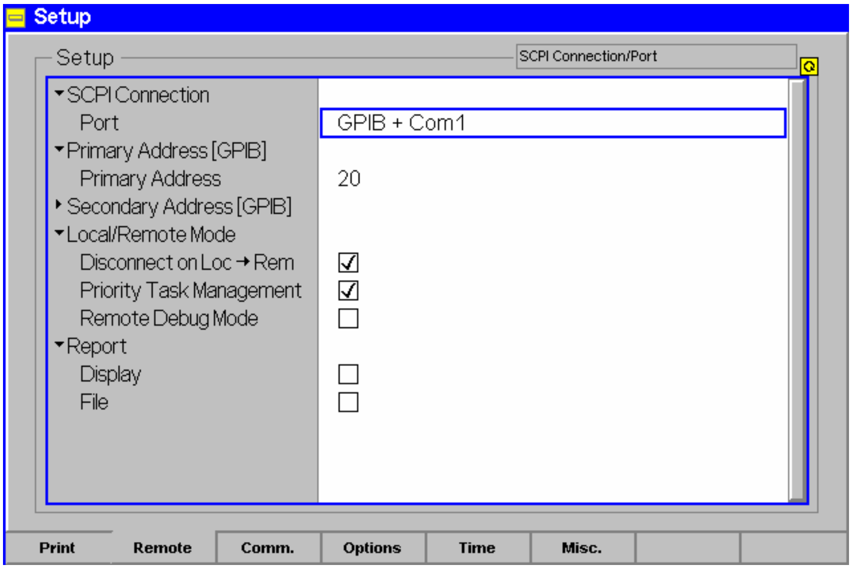
The R&S® CBT is connected to the GPIB interface of the controller via the GPIB bus connector (IEEE 488 / IEC 625) at the rear of the instrument and a shielded cable. The technical specifications of the GPIB interface are listed in section "Hardware Interfaces" in Chapter 8.

GPIB Bus Configuration (Model R&S® CBT)

In the default configuration the CBT accepts commands from either the GPIB or COM 1 interface. The parameters for GPIB bus control of the R&S® CBT are set in the *Remote* tab of the *Setup* popup menu (in the following abbreviated by *Setup – Remote,* see also Chapter 4, *Settings for Remote Control).*

- To open the *Setup - Remote* menu, press the *SETUP* key at the front of the instrument and activate the *Remote* hotkey at the lower edge of the screen.
- Use the rotary knob to move the focus onto the *SCPI Connection* section of the *Setup* table. If necessary, press the rotary knob or the *ON/OFF* key to expand the parameters in the table (see Chapter 3).
- In the *Port* table row select either *GPIB + Com 1* or *GPIB* bus interface for data transfer.

The bus address is factory-set to 20. It can be changed in the *Primary Address* input field.

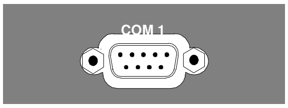


GPIB Bus Configuration (Model R&S® CBT 32)

The GPIB bus parameters are set via remote control. In the default configuration the CBT accepts commands from either the GPIB or COM 1 interface.

Primary address setting: `SYSTem:REMote:ADDRess:PRIMary <Address_no>`

Connection via serial interface



The R&S® CBT can be connected to the serial interface of a controller via the serial interface COM 1 and a null-modem cable. The pin assignment and wiring of a null-modem cable are described in the *Handshake* section of Chapter 8. The technical specifications of the serial (RS-232-C) interface are also listed in Chapter 8 (refer to the *Hardware Interfaces* section).

Either a 25-pin or a 9-pin connector can be used on the controller side. It may be necessary to use an appropriate adapter (see Chapter 8, *Hardware Interfaces*).

COM selection (Model R&S® CBT)

In the default configuration the CBT accepts commands from either the GPIB or COM 1 interface. To change the interface,

1. Proceed as described above to open the *Remote* tab of the *Setup* menu.
2. In the *Port* table row, select *GPIB + Com 1* or COM 1 to activate the RS-232 interface for data transfer.

COM selection (Model R&S® CBT 32)

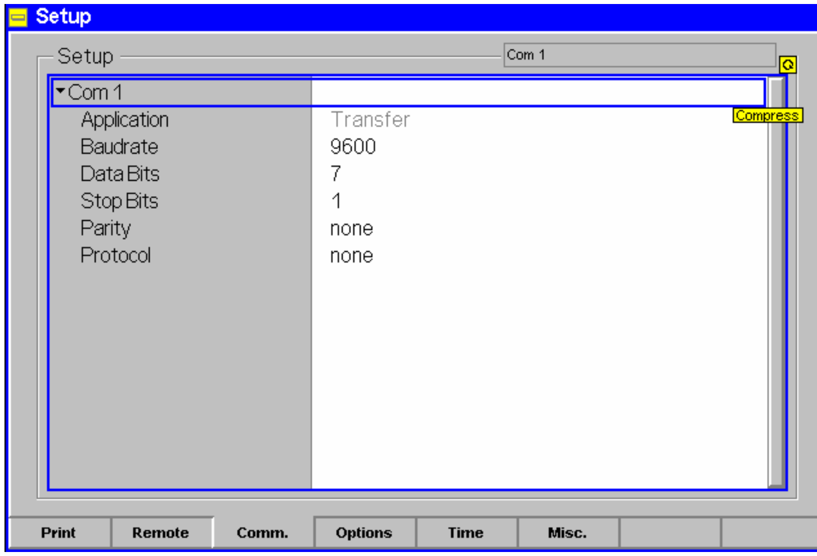
In the default configuration the CBT accepts commands from either the GPIB or COM 1 interface, so there is no need to change the interface. The automatic interface detection can be disabled, if so desired, using an external keyboard and a monitor. After startup of the R&S® CBT 32 proceed as follows:

1. Press *Ctrl + S* to open the *Setup* menu.
2. Press *Ctrl + F2* to access the *Remote* tab.
3. Use *Alt,* the cursor keys and *Enter* to access the *Port* parameter and change the interface.

For more information about keyboard function keys and shortcuts refer to the service manual.

COM configuration (Model R&S® CBT)

After selection of a serial interface, the transmission parameters must be set to comply with the parameters of the addressed device. This is done in the *Comm. (communications)* tab of the *Setup* menu:



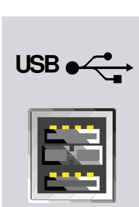
1. To open the *Setup – Comm.* tab press the *SETUP* key at the front of the instrument and activate the *Comm.* hotkey at the lower edge of the screen.
2. In the table section corresponding to the selected COM port check the settings for the *Baudrate, Data Bits, Parity,* and *Protocol.*

COM configuration (Model R&S® CBT 32)

The COM 1 parameters are set via remote control.

```
SYSTem:COMMunicate:SERial1[:RECeive]:BAUD <Rate>
SYSTem:COMMunicate:SERial1[:RECeive]:BITS 7 | 8
SYSTem:COMMunicate:SERial1[:RECeive]:STOP 1 | 2
SYSTem:COMMunicate:SERial1[:RECeive]:PARity[:TYPE]
                         NONE | ODD | EVEN
SYSTem:COMMunicate:SERial1:TRANsmit:PACE
                         XON | ACK | NONE
```

Connecting an External Keyboard



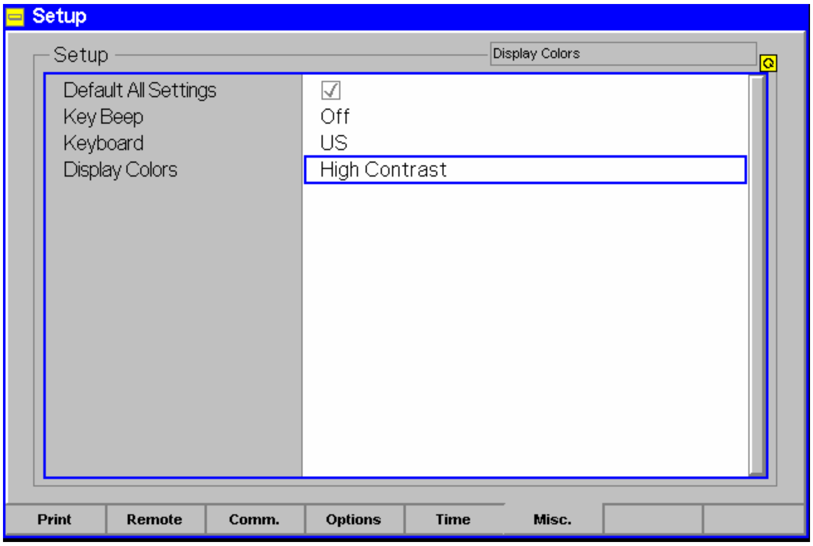
The USB connector at the rear of the instrument permits to connect an external PC keyboard (USB) to the R&S® CBT. An external keyboard facilitates the input of numbers and texts (model R&S® CBT) and can be used for debugging and service purposes (model R&S® CBT 32: The external monitor displays the remote screen described in Chapter 5).

Note: *On faceless instruments R&S® CBT 32 equipped with firmware V4.60 or higher, you have to press the "Scroll Lock" key in order to enable external keyboard control.*

For the interface description see section "Hardware Interfaces" in Chapter 8.

Language assignment (Model R&S® CBT)

The keyboard language can be changed in the *Misc.* tab of the *Setup* menu (model R&S® CBT):



- To open the *Setup – Misc.* tab press the *SETUP* key at the front of the instrument and activate the *Misc.* hotkey at the lower edge of the screen.
- Press the *Keyboard* softkey and set the desired key assignment *(US* or *German).*

Language assignment (Model R&S® CBT 32)

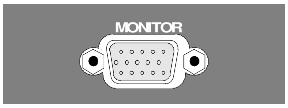
The keyboard language is set via remote control.

`SYSTem:MISC:KEYBoard US | GR`

Caution!

Never connect an external mass storage device, e.g. a USB memory stick, to the USB connector, because this may cause a system crash and even damage the instrument software.

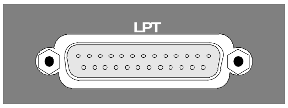
Connecting a Monitor



The 15-contact Sub-D connector at the rear of the instrument permits an external VGA monitor to be connected to the R&S® CBT.

For the interface description see section "Hardware Interfaces" in Chapter 8.

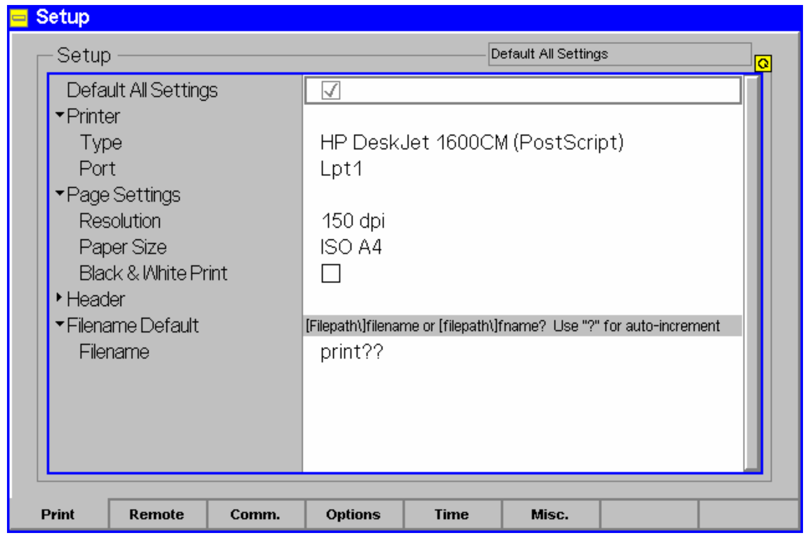
Connecting a Printer



A printer can be connected via the 25-contact parallel interface *LPT* at the rear of the instrument (recommended) or the serial interface COM 1. For the interface description see section "Hardware Interfaces" in Chapter 8.

Printer selection (Model R&S® CBT)

The printer type and port must be set in the *Print* tab of the *Setup* menu:



➢ To open the *Setup – Print* tab press the *SETUP* key at the front of the instrument and activate the *Print* hotkey at the lower edge of the screen.

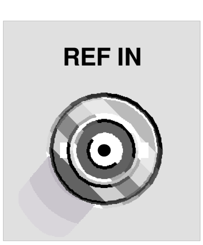
➢ In the *Printer* section set the printer type and port *(COM 1* for the serial (RS-232) port; *LPT 1* for the parallel printer port).

It is recommended to connect the output device to the parallel interface *LPT*, if possible: With this selection, configuration of the interface is not necessary; besides, the serial connectors may be used for other purposes, e.g. for remote control.

Printer selection (Model R&S® CBT 32)

A printer can be connected to the R&S® CBT 32 for service purposes. An external keyboard and a monitor is required to configure the printer and generate hardcopies. Proceed as described in paragraph *COM selection (Model R&S® CBT 32)* on p. 1.18.

Synchronization with External Devices; Connection of Further Components



The BNC female connector REF IN is provided for synchronization of the R&S® CBT with external devices.

Software Update and Version Management

The R&S® CBT is delivered with the latest firmware version available. New firmware can be easily installed via the GPIB interface/connector on the rear panel of the instrument.

Installation of new firmware versions and the use of different applications and versions on the same instrument is made easier by the following tools:

- The *R&S® Remote Service Tool* (see p. 1.22 ff.) transfers software versions to the instrument.
- The *VersionManager* (see p. 1.30 ff.) is designed to manage different software versions stored on the instrument.

R&S Remote Service Tool

The R&S® Remote Service Tool organizes the exchange of data between the R&S® CBT and an external PC or laptop, in particular to

- Copy software versions and install them on the R&S® CBT
- Copy or move data files (e.g. screenshots created with the *Print* menu of model R&S® CBT)
- Send remote control commands to the instrument

The tool is available for download on the CMU Customer Web (https://gloris.rohde-schwarz.com/gloris/1cmp/cmucustomer/index.html). It consists of a single *.exe file which can be copied to any directory.

When the executable file is started (double-clicked), the R&S® Remote Service Tool opens the following main application window.

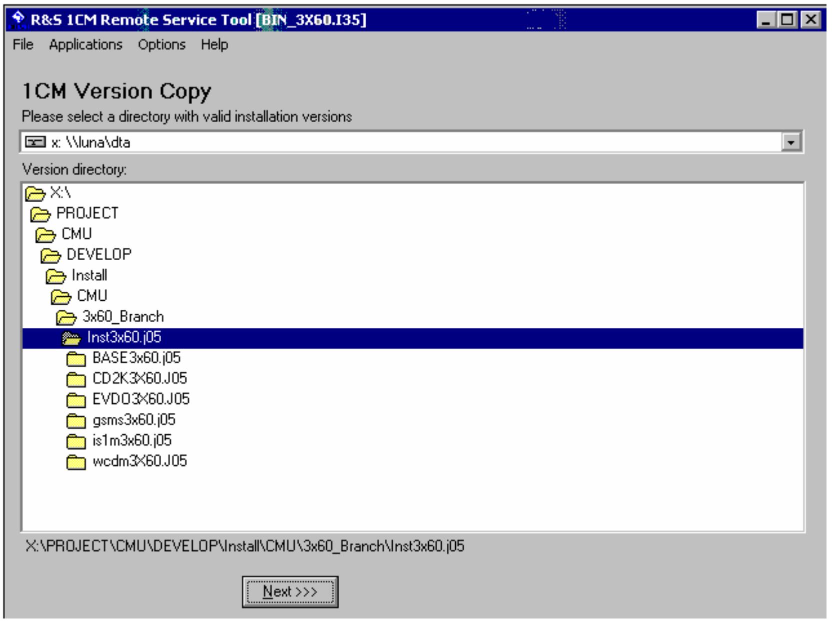


Fig. 1-9 Remote Service Tool main screen (example)

Connecting the R&S® CBT

The R&S® Remote Service Tool can communicate with the R&S® CBT via the GPIB (IEEE 488) or a RS-232 interface. It is recommended to use the GPIB interface, connecting the GPIB cable to the *IEEE 488 / IEC 625* connector on the rear panel of the instrument.

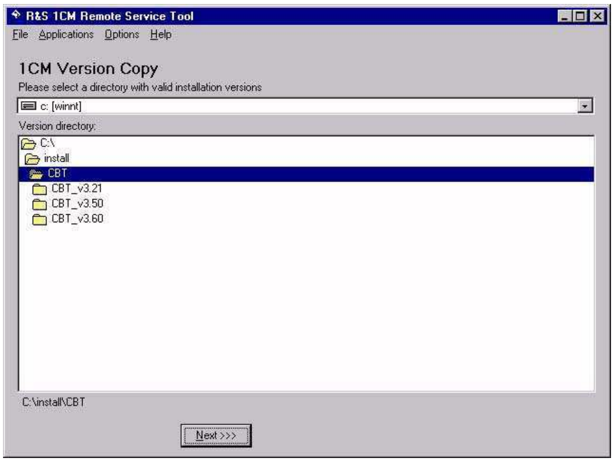
Note: *The GPIB settings of the Remote Service Tool and of the R&S® CBT must be the same. Refer to section Connecting a Controller on p. 1.17 to learn how to configure the R&S® CBT's GPIB settings.*

1. Connect the GPIB cable to the *IEEE 488 / IEC 625* connector on the rear panel of the instrument.
2. Start the Remote Service Tool.
3. Click the *Options* menu and make sure that *Use GPIB* is selected.
4. Click *Options – GPIB Options* and check that the *Board Index* and *Primary Address* settings are equal to the R&S® CBT configuration (CBT default settings: board index GPIB0, primary address 20).

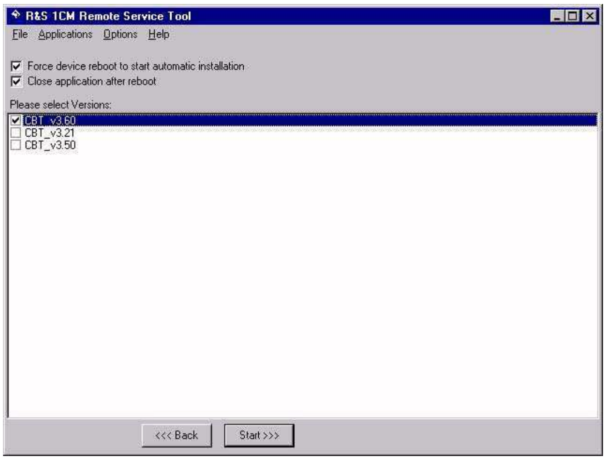
Installing software versions

To copy a new software version to the CBT…

1. Switch on and start up your R&S® CBT.
2. Select *Applications – Version Copy* from the menu bar of the Remote Service Tool.
3. In the *Version directory* of the main application window, select the folder from where you want to copy your software version and click *Next >>>*.



4. Select the software version you wish to install and click *Start >>>*.



The software version is copied to the internal drive c:\internal\install of your R&S® CBT. In addition, a text file named *Versions.new* (see section *File Versions.new* on p. 1.29 ff.) is generated and copied to the same directory. With default installation options (see figure above), the following happens after the file transfer is completed:

- The CBT is rebooted and the new software version is installed and activated (a key code must be entered once when a new software package is installed; see section *Hardware and Software Options* in chapter 4 of the operating manual).
- The Remote Service Tool is closed automatically.

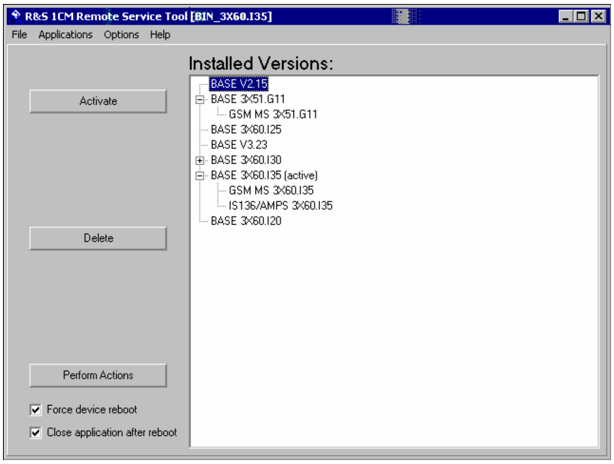
Old software versions are not affected. You can delete or activate an old software version using the *Version Manager* (see p. 1.30 ff.).

Listing and modifying software versions

The *Remote Service Tool* can not only install firmware versions but also display and modify the installed firmware configurations.

To list the firmware configurations installed on your CBT…

1. Click *Application – List Software*.



The list of installed versions has a tree structure. Each expandable node ⊞ contains a software configuration consisting of one base system version and one or more network options. The active configuration is marked as *(active)* and also displayed in the title bar of the *Remote Service Tool.* You can use the controls on the left side to do the following:

2. Select a configuration in the list and click *Activate* to label the configuration active.
3. Select a configuration in the list which is not the active configuration and click *Delete* to label the configuration deleted. Repeat this for all configurations you wish to delete.

Labeled configurations are not deleted immediately. You can simply *Restore* any configuration that you labeled inadvertently.

4. Click *Perform Actions* to activate and/or delete the labeled configurations.

The labeled configurations are written to the *Versions.new* text file (see section *File Versions.new* on p. 1.29 ff.) which is copied to the internal drive c:\internal\install of your R&S® CBT In the default configuration where *Force device reboot* is enabled, the R&S® CBT is rebooted immediately so that the *VersionManager* can activate and delete the labeled configurations.

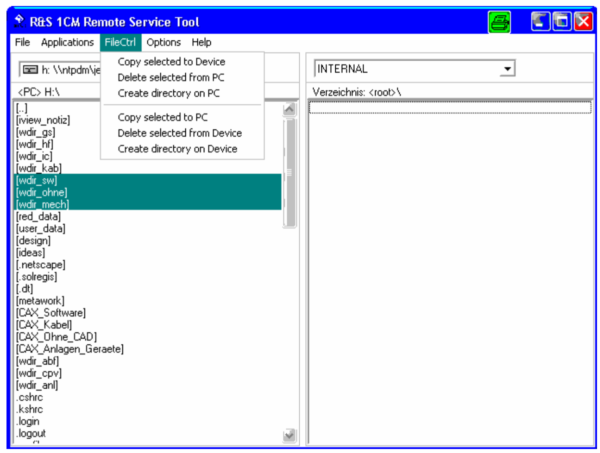
Tip: *Disable* Force device reboot *in case you wish to postpone the actions until next time you switch on your instrument.*

Copying files

To transfer a file from the CBT to the PC or vice versa…

1. Switch on and start up your R&S® CBT.
2. Select *Applications – File Transfer* from the menu bar of the Remote Service Tool.

The main application window shows the directories and files on your PC and on the INTERNAL directory of the CBT's internal hard disk.



3. Select a directory, a file or several files and use the commands in the *FileCtrl* menu to initiate the file transfer. You can also right-click the file list to open the equivalent context menu.

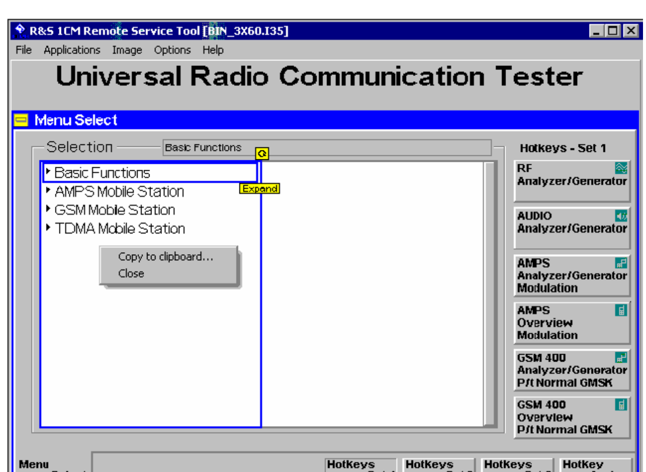
Extracting screenshots

A screenshot transferred by means of the *Remote Service Tool* can be viewed and copied to the clipboard so that you can use it in another application.

To generate, transfer and further process a screenshot…

1. Press the *PRINT* button on the front panel of the CBT to open the *Print* dialog, select *Internal WMF* as a destination and specify a file name <file>.wmf for the generated image file (without adding a path).
2. Press *OK* to write the file to the *INTERNAL\USERDATA\PRINT* directory of the CBT.
3. Proceed as described above to transfer the file <file>.wmf from the CBT to your PC.
4. Double-click the transferred file (alternative: select the file and press *Enter).*

The *Remote Service Tool* acts as a viewer for the file:



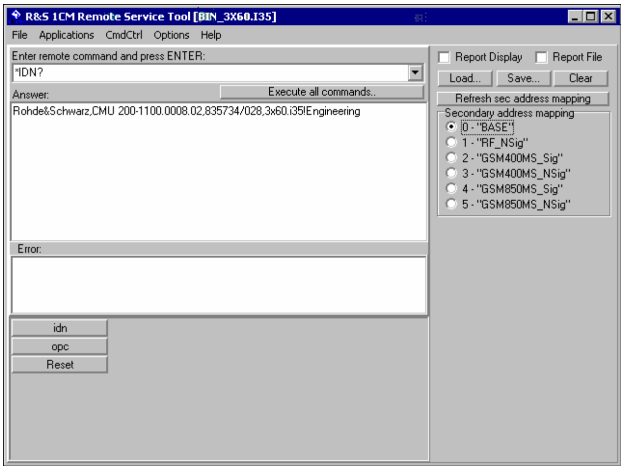
5. Right-click to open a context menu and either copy or close the file.

Remote control of the R&S CBT

You can use the *Remote Service Tool* to transfer remote control commands or command scripts to be executed on the R&S® CBT.

To transfer a single command or command sequence…

1. Click *Applications – Command* to activate the remote control screen.
2. Select the appropriate function group in the *Secondary address mapping* panel.
3. Enter a command in the *Enter remote command…* input field and press *Enter.*
4. Repeat steps 2 and 3 for all commands you wish to execute.



To execute a command script…

5. Generate an ASCII text file of remote control commands, either manually or by saving a previously transferred command sequence *(Save…* button in the remote control screen.
6. In the remote control screen, click *Load…* and open the file.

The script is transferred and executed automatically. The remote control screen provides further control elements to make the command transfer more convenient; see section *Remote Control of the R&S* on p. 1.28 ff.

Table 1 Overview of R&S® Remote Service Tool functions

Menu	Command	Function
File	Close	Close the Remote Service Tool
Application	Version Copy	Copy a software version to the R&S® CBT. See the application example *Installing software versions* above.
	List Software	Display of all software configurations installed on the R&S® CBT and activate and/or delete configurations. See the application example *Listing and modifying software versions* above.
	Command	Transfer of remote control commands or command scripts to be executed on the R&S® CBT. This command activates an additional *Cmd Ctrl* menu to generate log files and customize the screen. See application example *Transferring remote control commands* above and section *Remote Control of the R&S* on p. 1.28 ff.

Menu	Command	Function
	File Transfer	Transfer of data between a PC and the R&S® CBT. This command activates an additional *FileCtrl* menu to create directories, copy or delete files. See application examples *Copying files* and *Extracting screenshots* above.
	Error Reports	For future extensions
Options	Use GPIB	Use the GPIB bus for communication with the R&S® CBT **Note:** This communication mode is recommended
	USE RS232	Use the RS232 bus for communication with the R&S® CBT **Note:** Use the *RS 232 Options* quoted below if you choose this communication mode.
	GPIB Options	Change GPIB connection parameters. The default settings for the R&S® CBT are: Board Index: 0 Primary Address: 20 **Note:** The GPIB settings of the Remote Service Tool and of the R&S® CBT must be the same. Refer to section *Connecting a Controller* on p. 1.17 to learn how to configure the R&S® CBT's GPIB settings.
	RS232 Options	Change RS232 transmission parameters. The following settings ensure a reliable connection: Baud Rate: 115200 Data Bits: 8 Stop Bits: 1 Parity: None Protocol: CtsRts (do not change!) **Note:** The RS232 settings of the Remote Service Tool and of the R&S® CBT must be the same. Refer to section *Connecting a Controller* on p. 1.17 to learn how to configure the R&S® CBT's RS232 settings. Should you experience any problems with the data transfer, first check and possibly exchange the connecting cable.
	Device Clear	Clear the screen
	Go to Local	Exit remote control mode and return to manual operation
	Device Reboot	Reboot the R&S® CBT
Help	About	Shows an information box with the current version of the Remote Service Tool

Remote Control of the R&S CBT

The remote control screen transfers remote control commands or command scripts to be executed on the R&S® CBT; see application example *Remote control of the R&S CBT* on p. 1.26. It is opened by clicking *Application – Command.*

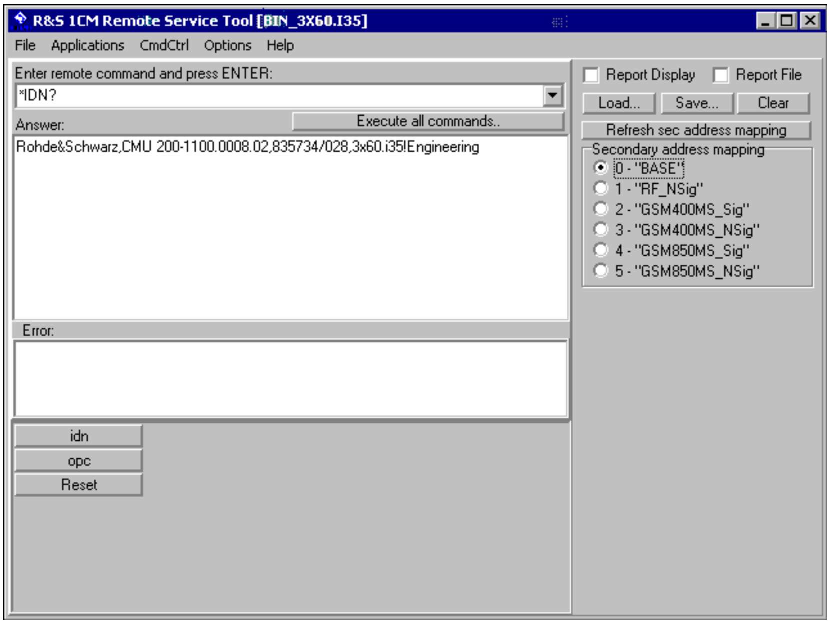


Fig. 1-10 Remote control screen

The commands to be executed are entered in the *Enter remote command…* input field; the responses of the R&S® CBT and possible error messages are displayed below. Besides the remote control screen provides the following control elements:

Execute all commands — Executes all commands entered since the *Remote Service Tool* was started or since the list was cleared. The complete command list appears in a pull-down list associated with the *Enter remote command…* input field.

Report Display / **Report File** — Display the remote report on the R&S® CBT's remote screen and create a report file. These functions are identical with the *Report Display* and *Report File* hotkeys in the CBT's remote screen.

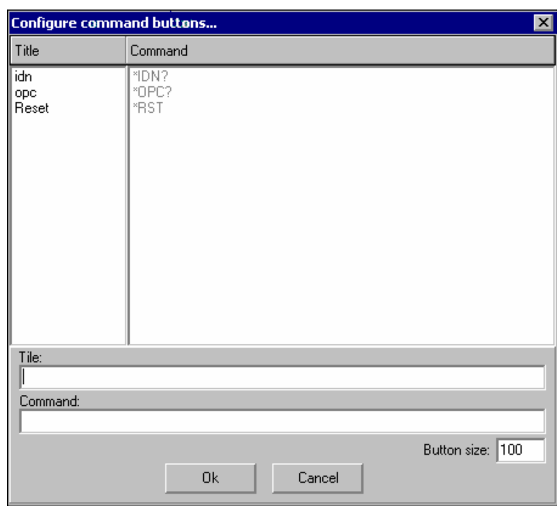
Load / **Save** — Load an ASCII text file (default extension: *.lst, can be changed at will), with a command script to be executed or save the current command list to a text file file.

Clear — Clears the current command list.

Refresh sec. address mapping — Refreshes the list of assigned secondary addresses and function groups, e.g. after the mapping was changed on the R&S® CBT. Commands are sent to the secondary address selected in the list.

While the remote control screen is active, an additional *Cmd Ctrl* menu is available:

Table 2 Overview of Cmd Ctrl menu in the Remote Service Tool

Menu	Command	Function
Cmd Ctrl	Filename…	Calls up an *Open File* dialog to define the name and location of a log file containing all executed commands and device responses. The responses can be up to 2 MByte in size, so the log file information is often more complete than the remote report displayed on the instrument's remote screen.
	Logging	Toggle function: Enables or disabled logging.
	Append File	Toggle function: If enabled, new information is appended at the end of the log file. Otherwise the log file is overwritten at the beginning of each *Remote Service Tool* session.
	Button Setup	Opens a dialog to create command buttons, to be used as shortcuts for manual entry of frequently used commands. The command buttons *idn, opc,* and *Reset* in Fig. 1-10 on p. 1.28 are created as follows: 

File Versions.new

The versions.new file stores the software configurations that the R&S® CBT *VersionManager* has to install, delete, or activate. The following versions.new file initiates the installation of a software configuration containing a base system and a Bluetooth package:

```
BASEV4.20
BLTHV4.20
Automatic Install
```

Creating a versions.new file

The file is most conveniently created using the *Remote Service Tool;* see application examples *Installing software versions* on p. 1.23 and *Listing and modifying software versions* on p. 1.24. The *Remote Service Tool* also copies the file to its location on the CBT's internal hard disk (c:\internal\install) so that it will be executed when the *VersionManager* is started.

Alternatively, the file can be created manually and copied to the c:\internal\install directory.

Restrictions

The information in the versions.new file must be unambiguous: Only one software configuration with 1 base system software can be installed at once. Alternatively, the file may list several network options to be combined with an already installed, compatible base system version.

Only one software configuration can be active, however, several configurations can be deleted at once. To avoid errors, it is recommended to use different files for installation and deletion/activation.

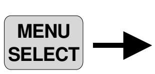
R&S CBT VersionManager

The *VersionManager* is a tool designed to activate, delete, install, combine, or list different software versions in a convenient way. Moreover, it provides information on the hardware and software configuration of the instrument *(Edit service tables, Scan disk)*, resets the startup and copies information to an external storage medium *(Write log files to disk, List all versions to disk).*

The *VersionManager* is part of each R&S® CBT firmware version. It is opened automatically after the boot-up process if a software version is copied to the internal drive c:\internal\install. Alternatively, the *VersionManager* can be called up by pressing the *Menu Select* key after the boot-up sequence is terminated (from the moment when the R&S® CBT display turns black until the end of the 3-beep acoustic signal).

Note: ***VersionManager for model R&S® CBT 32***

An external keyboard and a monitor is required to control the VersionManager. Refer to Chapter 4 of the service manual for information about the necessary keyboard shortcuts.



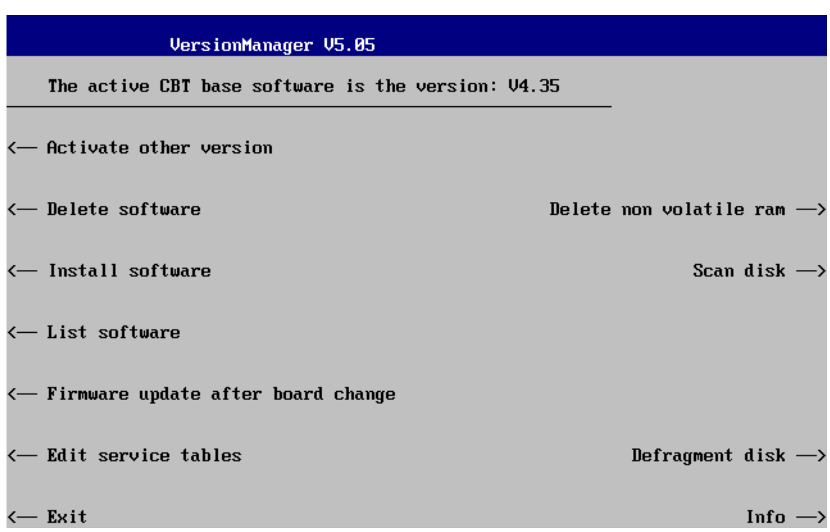
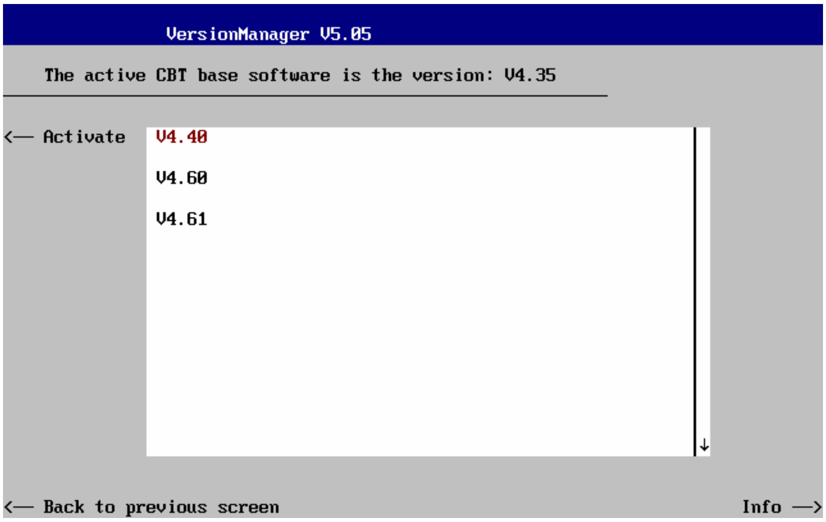


Fig. 1-11 VersionManager main screen (example)

The different functions of the *VersionManager* are activated by pressing the corresponding softkeys. Some of them (labeled optional below) are available in a particular configuration of the hard disk only. The upper two softkeys in both softkey bars are not assigned.

Activate other software
(optional)

Activate other software opens a list of all firmware configurations stored on the R&S® CBT hard disk except the current configuration. Therefore, this function is not available if the hard disk contains only a single configuration (to retrieve information, *List software* can be used instead).

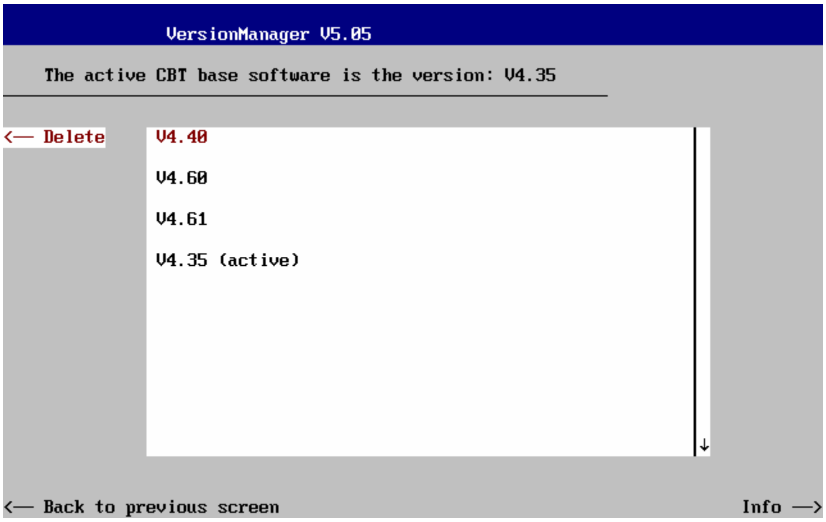


Each entry in the list corresponds to a firmware configuration consisting of exactly one R&S® CBT software version. The version to be activated is displayed in red color on top of the list. To select another version, the list can be scrolled using the rotary knob or the cursor keys.

Activate	Activate the current firmware configuration.
Back to previous screen	Close the current screen and go back to the main screen. This option is identical in all *VersionManager* submenus.
Info	Open the *Info* screen associated with the current screen; see *Info on* p. 1.34. This option is identical in all *VersionManager* submenus.

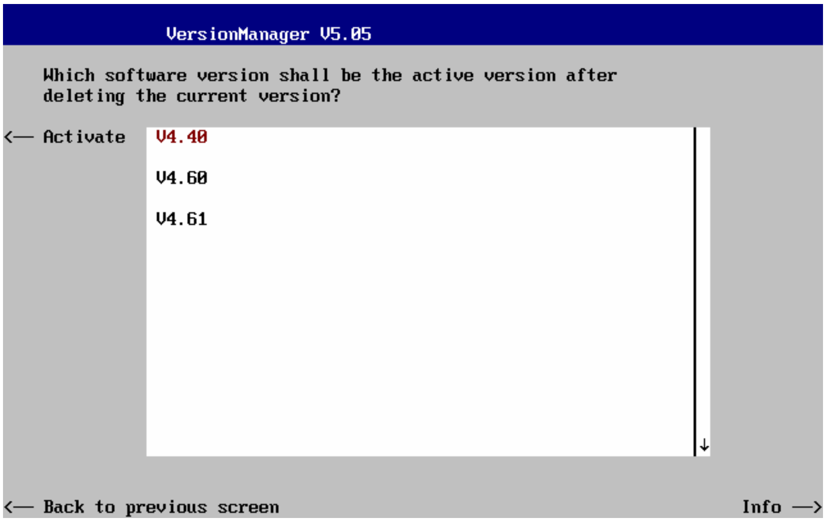
Delete software
(optional)

Delete software opens a list of all firmware configurations stored on the R&S® CBT hard disk. The dialog can be operated as explained above; see *Activate software*. The last firmware configuration can not be deleted, so this function is not available if the hard disk contains only a single configuration.



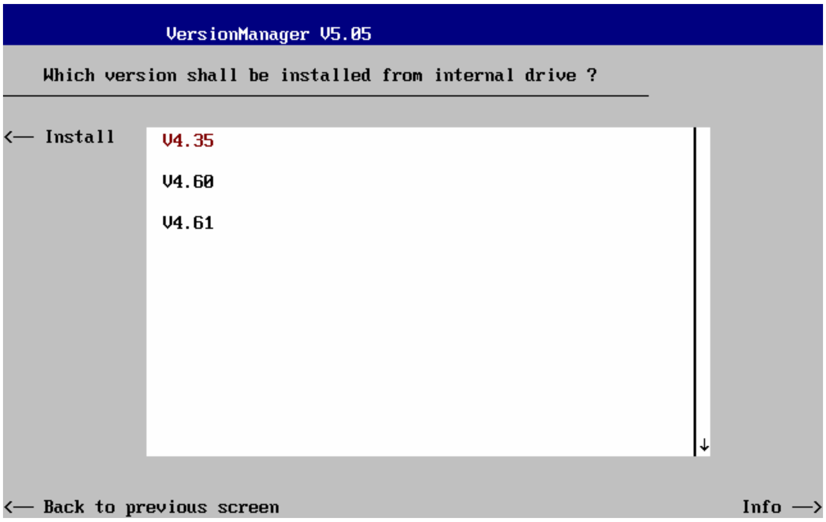
Delete Delete the current firmware configuration.

If the active firmware configuration is deleted, the R&S® CBT asks which of the remaining versions shall be activated:



Activate Activate the current firmware configuration.

Install software... *Install software...* opens a list of all installation versions available on internal storage c:\internal\install



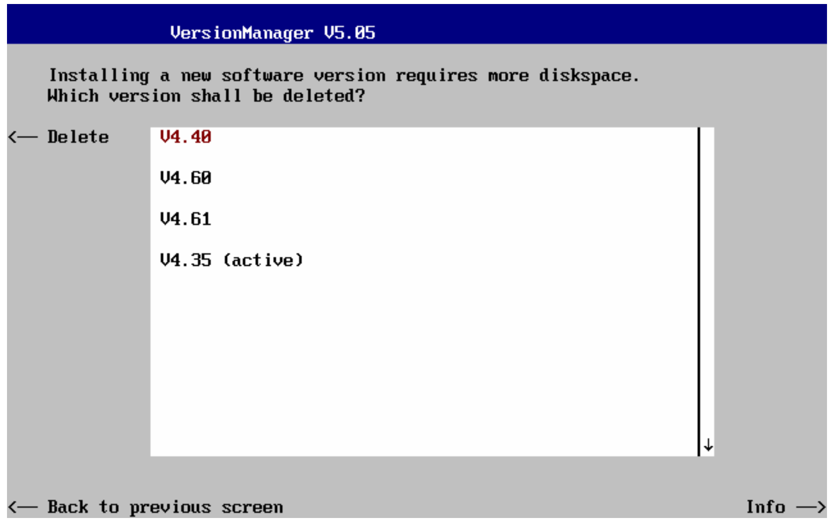
Install. Install the selected firmware version

Back to... Close the current screen and go back to the *software version* selection dialog to select a compatible software version.

Note: ***Notice messages after firmware updates***

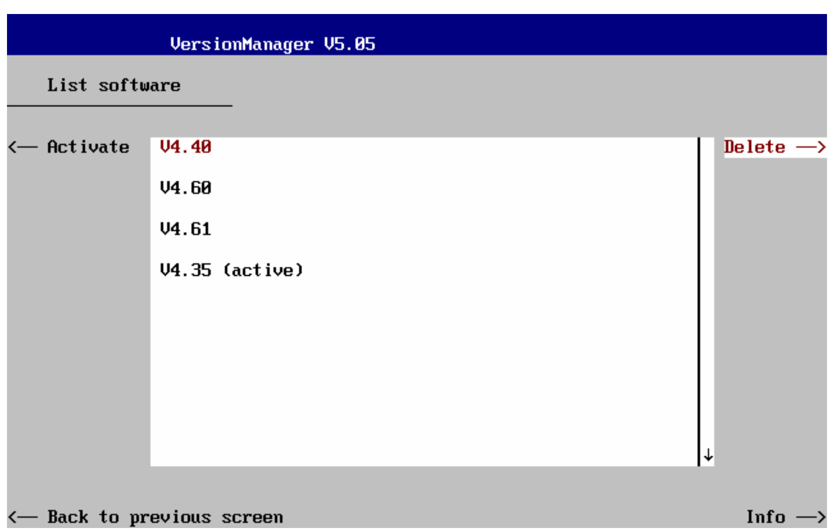
In most cases firmware updates don't affect the accuracy of the measurements. There are some exceptions where a correction procedure must be executed in the Maintenance menu after the firmware update. The R&S® CBT displays a notice message whenever this happens. The box contains the name of the required correction procedure and appears during startup until the correction has been performed.

Lack of disk space: Before installing the next software version, the R&S® CBT checks whether there is enough disk space on the hard disk. If not, the following dialog is displayed:



Delete Delete the current version and return back to the previous screen.

List software *List software* opens a list of all available firmware configurations. It is possible to activate and delete configurations from the list; see description of *Activate software* and *Delete software* functions above.



Firmware update after board change(…) *Firmware update after board change* performs an update of the current firmware including a complete R&S® CBT hardware detection. No installation is required. The update takes some time and should be attempted in case of problems or after a modification of the R&S® CBT hardware configuration only (also after a combined hardware/software exchange).

Edit service tables *Edit service tables* calls up the *Service Table Editor* menu showing all hardware modules that are possibly fitted in your instrument. For service purposes, further information can be obtained by typing a particular board name and board index in the two lines below the table.

Exit

Exit closes the *VersionManager* and resumes the R&S® CBT start-up procedure.

Delete non volatile ram

Delete non volatile ram deletes all entries stored in the non volatile ram of the R&S® CBT. This memory contains particular settings of the last R&S® CBT session that can be reused in the next session (e.g. the last active function group and measurement menu, special configuration etc.).

Deleting the non volatile ram can be useful after an abnormal termination of a R&S® CBT measurement session.

Note: *The settings stored in the non volatile ram can also be written to a configuration file and reused in later sessions; see Chapter 3, section* Saving Configurations.

Scan disk

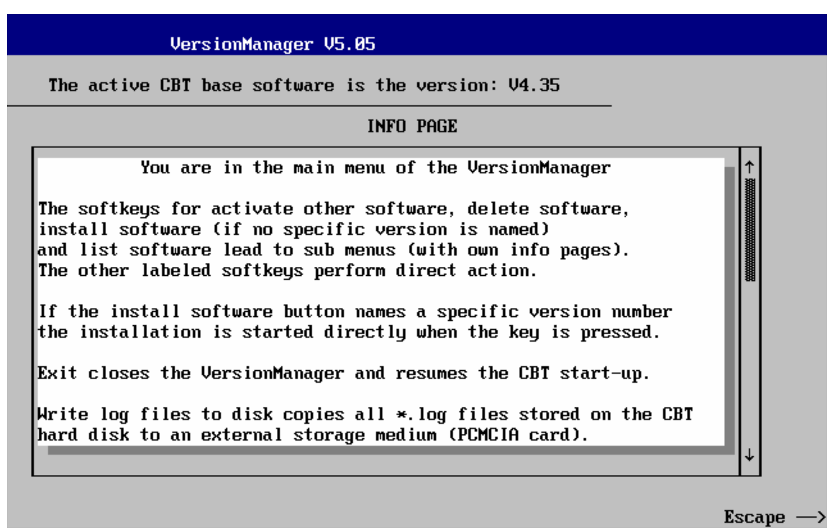
Scan disk closes the *VersionManager,* executes the MS *Scan Disk* program and finally returns you to the *VersionManager*. Refer to your *Scan Disk* documentation for further information.

Defragment disk

Defragment disk closes the *VersionManager,* executes the MS *Defrag.exe* program and finally returns you to the *VersionManager*. Defragmenting the hard disk is suitable to improve performance after installing and deleting many different software versions. Refer to your *Defrag.exe* documentation for further information.

Info

Info opens an output window displaying information on the current screen. Separate *Info* windows are provided for the different *VersionManager* dialogs.

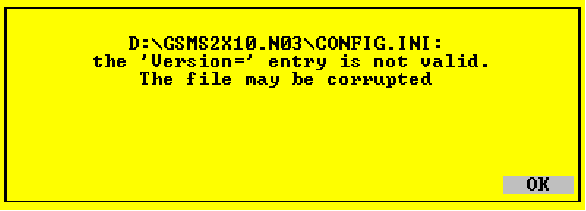


Escape Close the Info screen and return to the previous screen.

Error and notify message

During operation, the *VersionManager* can generate two different types of messages:

- Error messages indicating that an action could not be successfully performed are displayed in yellow boxes. All error messages with possible reasons and remedial actions are explained in Chapter 9.



- Notifications describing ongoing processes of the instrument are displayed in blue boxes. These messages are self-explanatory and do not require an action to be taken by the user.

Contents

2 Getting Started

The following chapter presents a sample session with the Bluetooth communication tester R&S® CBT. It is intended to provide a quick overview of the function groups *RF Non Signalling, Bluetooth Non Signalling* and *Bluetooth Signalling* and to lead through the most common tests which are performed on Bluetooth devices.

Before starting any measurement with the R&S® CBT, please note the instructions given in Chapter 1 for putting the instrument into operation. In Chapters 3 and 4 of the complete operating manual on your CD-ROM you will find detailed information on customizing the instrument and the display according to your personal needs and preferences.

The tests reported below include

- Startup of the R&S® CBT
- *RF Non Signalling* measurements and basic instrument settings
- Connection of the DUT and selection of the *Bluetooth* function group
- Basic settings in the *Non Signalling* mode
- Signalling parameters and call setup
- *Power, Modulation, Spectrum* and *Receiver Quality* measurements in *Signalling* mode

The steps to perform are explained on the left side of each double-page together with the results obtained on the R&S® CBT screen. The right side contains additional information and lists alternative settings and related measurements which could not be reported in detail.

For a systematic explanation of all menus, functions and parameters and background information refer to the reference part in Chapter 4.

NOTE

The measurement examples reported in this chapter require none of the hardware or software options of the R&S CBT. For a detailed description of the optional extensions, (e.g. the EDR options R&S CBT-B55/-K55, the Audio option R&S CBT-B41, and the Audio Profiles option R&S CBT-K54), refer to chapter 4 of the complete operating manual.

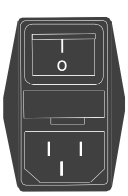
A Short Tutorial on R&S CBT Operation

The principles of manual operation – controls, operating menus, dialog elements and measurement control – are discussed in Chapter 3 of the complete operating manual. Below you will find some essentials for first time users.

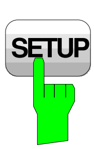
Condensed Operating Instructions

1. When using the R&S® CBT for the first time it is useful to set it to the default state (press the *RESET* key on the front panel).
2. There is no home menu but you can press the *MENU SELECT* key in any state of the unit. This displays a large popup menu where you can select a function group *(RF, Bluetooth)*, signalling test mode *(Non Signalling, Signalling)* and measurement. Press *ENTER* to activate a selection.
3. The *SETUP* hardkey allows you to make general, measurement-independent instrument configurations such as *Remote* or *Time*, and to obtain information about your instrument and the installed hardware and software.
4. The softkeys on the right-hand side of the display are used to change the hotkeys across the bottom and their functions. Pressing the *Menus* softkey (bottom right) allows a fast switchover between related menus using the hotkeys.
5. In the *Bluetooth Signalling* function group, measurements can be performed with a radio connection between the R&S® CBT and the Device Under Test (DUT). A series of popup menus guides you through the different signalling states until the connection is established. To access and configure a measurement menu you don't have to set up a connection and exchange signalling information.

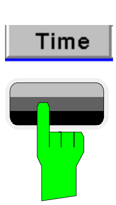
Accessing and Closing Menus



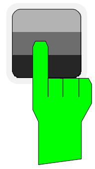
A startup menu is displayed automatically when the R&S® CBT is switched on. After terminating the startup procedure, the instrument automatically activates the last menu of the previous session.



Press the *MENU SELECT, DATA, HELP, SETUP, PRINT, RESET* or *INFO* keys on the front panel to open general configuration and selection menus.



Use the hotkeys displayed across the bottom of a measurement menu to switch over between different measurement menus or access tabs in popup menus.



The *Connect. Control* softkey is displayed in the top right position of each measurement menu. Press this softkey to open a popup menu and define the output signals, configure the measurement trigger and the analyzer and select many network-specific settings.

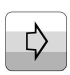
In *Bluetooth Signalling* test mode, the *Connection Control* menu is also used to set up and terminate a connection between the R&S® CBT and the DUT.

Press the *ESCAPE* key to close any of the popup menus.

Measurement menus are closed on switching over to another measurement menu.

Using Dialog Elements in the Menus

Press a softkey to activate the dialog elements assigned to it.



Use the 4 cursor keys to switch over between different input fields. A blue frame shows the active input field.

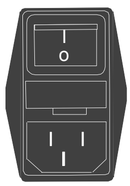
Use the rotary knob to select one of several elements in a list.

Use the rotary knob to increment/decrement numeric values. Use the numeric keypad or an external keyboard to enter new values.

For a comprehensive introduction to manual operation of the R&S® CBT refer to Chapter 3 of the complete operating manual on your CD-ROM.

Startup of the R&S CBT

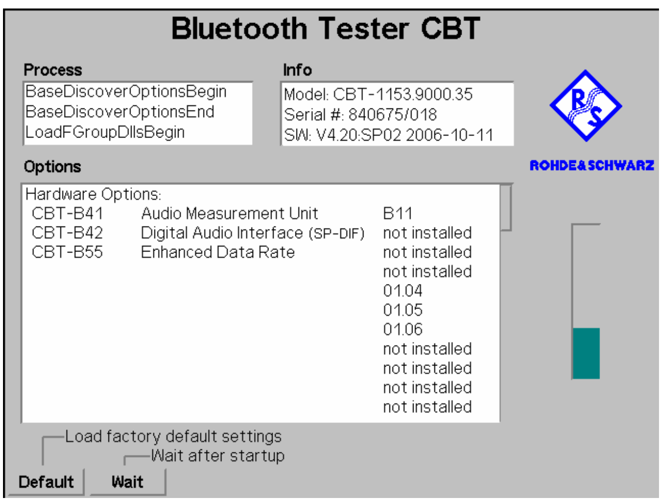
This section describes how you can customize the R&S® CBT and perform simple RF measurements. As a prerequisite for starting the session, the instrument must be correctly set up and connected to the AC power supply as described in Chapter 1.



⇓

Step 1

➢ Switch on the R&S® CBT using the mains switch at the rear. ①



Step 2

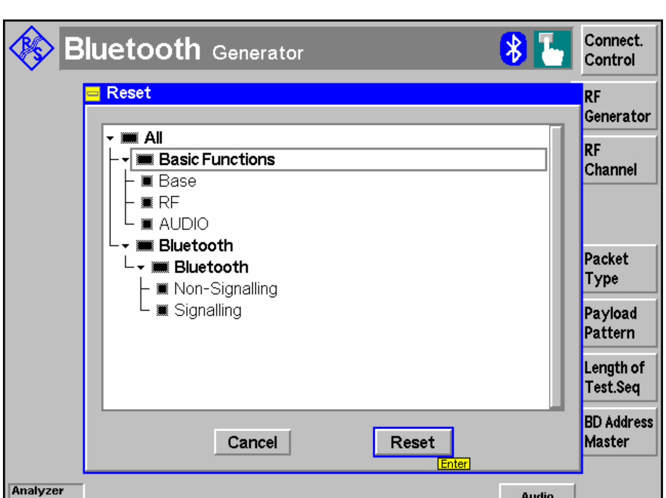
The software is booted and after a short while the R&S® CBT displays the startup menu. This menu is usually closed as soon as the instrument software is loaded and the startup test is finished. ③

➢ Press the *Wait* hotkey to prevent the instrument from switching to the next menu.

The *Wait* hotkey changes to *Cont.* with the additional message *Change to last menu* displayed on top. ④

➢ Press the *Cont.* hotkey to resume the startup process.

⇓



Step 3

➢ Press the *RESET* key to open the *Reset* popup menu.

➢ Proceed as described in Chapter 4 of the complete operating manual, section *Reset of Instrument Settings,* to expand the tree of function groups.

➢ Select all function groups to be reset (all nodes must be black).

➢ Use the cursor keys to activate the *Reset* button and press *ENTER.*

➢ In the popup window opened *(Are you sure?)*, select *Yes* to confirm the instrument reset.

The R&S CBT indicates that it performs a reset of the selected function groups and is then ready to carry out the following steps. The *Reset* popup menu is closed automatically.

Additional Information...

Alternative Settings and Measurements

... on Step 1

① **Mains switch on the rear panel**

When the mains switch at the rear is set to the *O* position, the complete instrument is disconnected from the power supply and the green LED above the *Store Settings* key in the lower left position of the front panel is off. When the mains power switch is set to the *I* position, the green LED is on and the instrument automatically initiates its start-up procedure.

The *Store Settings* key is not needed during the start-up procedure but should be used to terminate the measurement session. It ensures that the instrument settings are stored to the internal hard disk before the R&S® CBT is shut down.

☞ Chapter 1

The R&S® CBT is automatically set to the AC supply voltage and frequency applied. Note the permissible ranges of AC voltages and frequencies indicated at the rear of the instrument and in the data sheet.

... on Step 2

③ **Startup menu**

The startup menu displays the following information:

- The startup procedure *(Process)*
- Instrument model, serial number and version of the R&S® CBT base software *(Info)*
- Installed hardware and software options and equipment *(Options)*
- Progress of the startup procedure (Startup bar graph)

☞ Chapter 4 of the complete operating manual

The *Default* hotkey can be used to load the factory default settings for all function groups. Settings made and stored in the previous session are overwritten.

④ **Wait hotkey**

By default the R&S® CBT switches to the last main menu of the previous session after the end of the startup process. This is convenient if an interrupted session is to be resumed or if the instrument is often used in a particular operating mode.

On the other hand, you can use the *Wait* function to access all configuration and selection menus that can be opened by means of the front panel keys before starting the actual measurement.

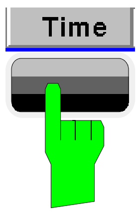
While the *Wait* hotkey is active, a reset of the instrument is not possible.

The user interface of the R&S® CBT has been optimized with the aim of facilitating fast and easy switchover between the menus and measurement modes. This includes the general configurations, which can be accessed from any measurement menu.

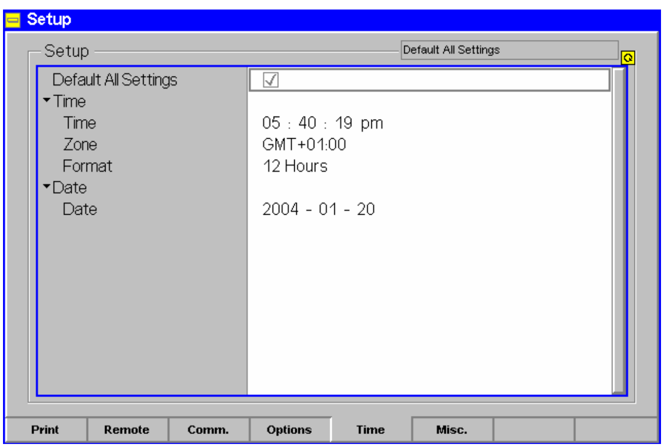
The most important selection and configuration menus such as *Reset, Setup, Menu Select* etc. are directly accessible via front panel keys.

Step 4

- Press the *SETUP* key to access general device settings.



- Press the *Time* hotkey to switch over to the *Time* tab of the *Setup* menu. ①



Step 5

The *Time* tab of the *Setup* menu displays the current time zone, time and date. ②

- Use the rotary knob to move the focus onto the *Time* section of the *Setup* table. If necessary, press the rotary knob or the *ON/OFF* key to expand the parameters in the table (see Chapter 3 of the complete operating manual).
- Move to one of the input fields associated to the *Time* parameter, select with *ENTER* and use the rotary knob or the numeric keypad to correct the settings for the current time. You can edit hours, minutes and seconds separately.
- Press *ENTER* to confirm the entries and quit the input fields.
- Move to *Zone*, activate with *ENTER,* and use the rotary knob to choose your own time zone. R&S® CBT
- In the same way, activate the *Format* select field and use the rotary knob to switch over between European and North American time conventions.

Additional Information...

Alternative Settings and Measurements

... on Step 4

① **Softkeys and hotkeys**

Softkeys and hotkeys are activated by pressing the associated keys on both sides and across the bottom of the display.

The general purpose of softkeys is to provide settings, control the generator and the measurements. Hotkeys are used to switch over between different menus and different tabs belonging to a popup menu.

☞ Chapter 3 of the complete operating manual

... on Step 5

② **Setup menu**

The *Setup* menu comprises several tabs providing general instrument settings. It is advisable to check and adjust the factory settings when you operate the R&S® CBT for the first time.

To switch over between the tabs of the setup menu use the hotkeys displayed at the bottom of the display.

☞ Chapter 4 of the complete operating manual

The different types of menus and control elements of the graphical user interface are explained in Chapter 3 of the complete operating manual. In the same chapter you can find a short tutorial on the entry of numbers and characters.

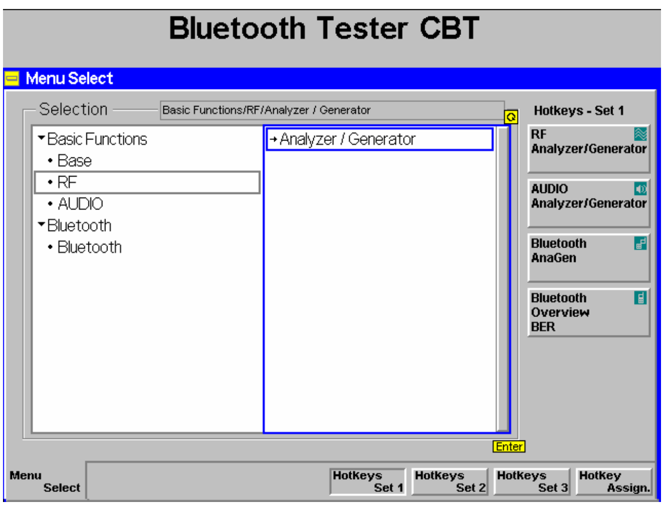
RF Non Signalling Measurements

In the *RF Non Signalling* mode, you can generate a modulated RF signal and measure the power of an RF signal with definite frequency characteristics. No specific device under test is needed for the measurement example reported in this section.

Step 1

- Press the *MENU SELECT* key to open the *Menu Select* menu.①

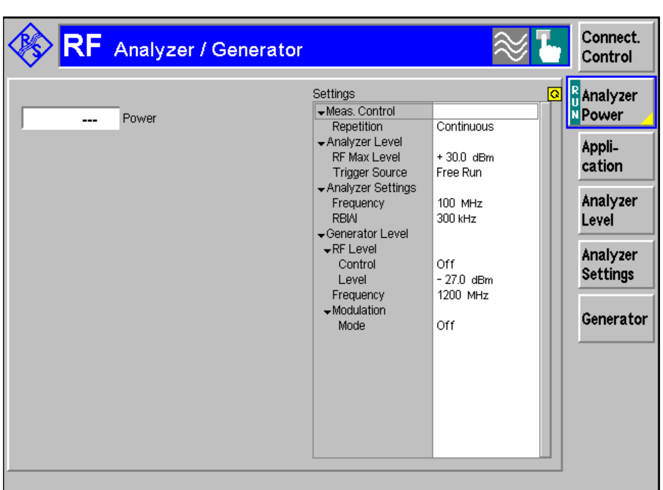
⇓



- Use the cursor keys and the rotary knob to select the *RF* function group in the left half of the *Selection* table.
- In the right half of the table, select the *Analyzer/Generator* menu.
- Press *ENTER* to activate the measurement selected and open the *RF Analyzer/Generator* menu.

⇓

Step 2



In the *Settings* table, the *Analyzer / Generator* menu indicates the parameters of the generated RF signal and the RF input path settings. ②

At present, all parameters have been reset to factory default values. Different softkey/hotkey combinations and popup menus are provided to change the settings. User-defined parameters will be saved for later sessions when the R&S® CBT is switched off.

If the *Power* output field in the *Analyzer/Generator* menu shows an invalid result ("---"), this is because no RF input signal is applied to the R&S® CBT. The RF generator is switched off. ③

⇓

Additional Information...

... on Step 1

① **Menu Select menu**

The *Menu Select* menu shows all function groups installed on your R&S® CBT. If a function group is selected the available test modes and measurement menus are indicated.

- The *Base* function group contains the *Maintenance* menu providing service information, selftests and correction procedures.
- The *RF* function group contains the *Analyzer/Generator* measurement menu.
- The Bluetooth function group is subdivided into the two test modes *Non Signalling* and *Signalling.* Each of them contains specific measurement menus.

... on Step 2

② **Analyzer/Generator menu**

The *Analyzer/Generator* menu contains several softkeys to

- Adjust the input path settings to the received and analyzed RF signal *(Analyzer Level, Analyzer Settings*)
- Control the RF signals generated *(Generator*)

Defining a level and frequency via the *Generator* softkey and the associated hotkeys implies that a continuous signal (CW) with this level and frequency is generated.

The *RF Max. Level* defined via *Analyzer Level* represents the maximum input power that the instrument can measure. The possible range of *Max. Level* depends on the external attenuation used (see section *Analyzer Settings* in Chapter 4).

Defining a (center) *Analyzer Settings – Frequency* implies that only signals around this frequency are analyzed.

The *Analyzer Settings – RBW* hotkey defines the resolution bandwidth of the analyzer.

③ The status of the *Analyzer Power* measurement is shown in the corresponding softkey. For ongoing measurements, the result in the *Power* output field is constantly updated.

Once the softkey is selected, the *Analyzer Power* measurement can be switched off and on by means of the *ON/OFF* key. In contrast, the *CONT/HALT* toggle key halts the measurement after the next valid result has been obtained.

Alternative Settings and Measurements

☞ Chapter 4 of the complete operating manual

The *RF, Bluetooth Non Signalling* and *Bluetooth Signalling* measurement menus are complemented by specific *Connection Control* popup menus.

☞ Chapter 4 of the complete operating manual

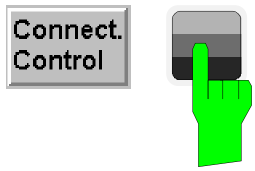
The *Generator* softkey provides the most important settings of the *Generator* tab of the *Connection Control* menu.

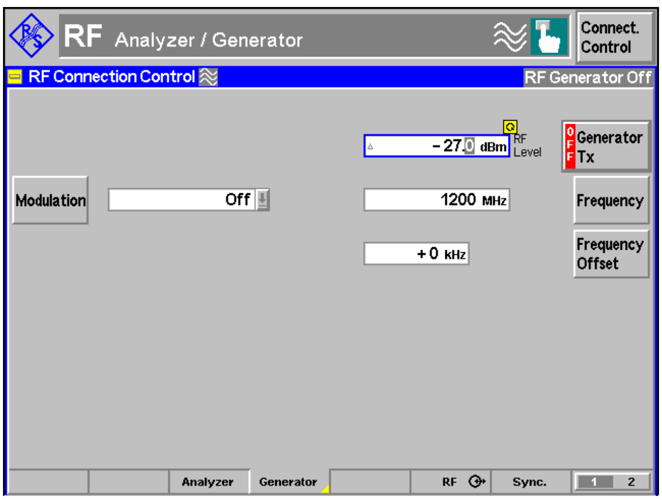
The *Analyzer Level* and *Analyzer Settings* softkeys correspond to the *Analyzer* tab of the *Connection Control* menu.

Many softkeys and hotkeys are provided in different measurement menus and have an analogous function.

☞ Ch. 4 and Ch. 5 of the complete operating manual

The options for the measurement status are *ON, OFF, or HLT*. The *HLT* state is reached after the end of a single shot measurement (see the section about measurement control in Chapter 5).





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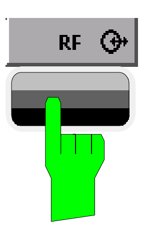

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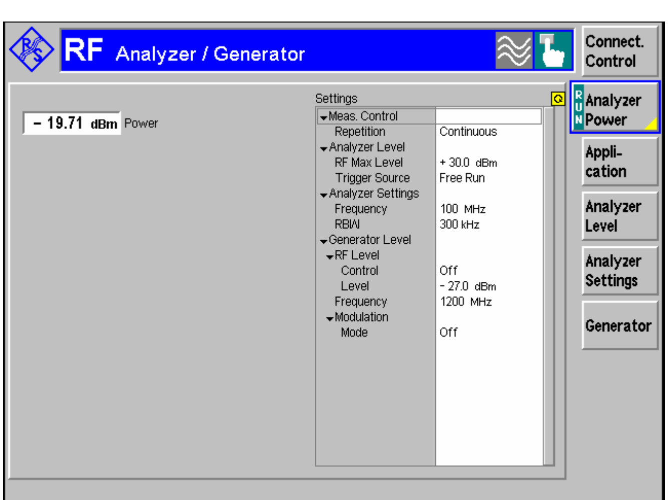


Step 3

➢ Press the *Connect. Control* softkey and use the *Generator* hotkey to open the *Generator* tab.

The *Generator* tab controls the RF generator and defines the *Frequency* and *Modulation* of the generated RF signal.

➢ Press once to select the *Generator* softkey.

➢ Press the *ON/OFF* key to switch the RF generator on. ①

In the default configuration (after a *Reset* of the RF function group), the generator frequency is equal to the center frequency of the analyzer.

Otherwise you can use the *Frequency* softkey to adjust the generator frequency to the analyzer frequency indicated in the *Settings* table of the *Analyzer/Generator* menu.

Step 4

➢ Press the *RF* ⊙→ hotkey to open the tab defining the signal connectors and external attenuation.

In this menu it is possible to define external output and input attenuation factors. ②

➢ Make sure that all factors are 0.0 dB.

➢ Press the *1 / 2* hotkey to access the measurement trigger settings. ③

➢ Press the *ESCAPE* key to close the popup menu and return to the *RF Analyzer/Generator* main menu.

Step 5

The R&S® CBT now measures its own generator signal applied to the bidirectional RF connector *RF IN/OUT.* The result is indicated in the *Power* output field. The result is larger than the RF generator level because the attenuation in the signal path is smaller than the attenuation for external signals. ②

Additional Information...

... on Step 3

① **Generator control and generator settings**

The state of the RF generator is shown in the *Generator TX* softkey. Possible states are *ON* (an RF signal at the specified level and frequency is generated) or *OFF* (no RF output signal).

The frequency range of the RF generator covers the Bluetooth band plus a margin of several MHz. The frequency must be in multiples of 1 MHz but can be modified by an additional *Frequency Offset.*

By default the RF generator signal is an unmodulated RF carrier signal. You can use the *Modulation* softkey and generate a modulated Bluetooth *Test* signal.

... on Step 4

② **External attenuation**

An external attenuation can be reported to the R&S® CBT in order to compensate for a known loss or gain in the external test setup.

In our example, you can report the (negative) difference between the generator power of –27 dBm and the measured analyzer power as a (negative) external output gain at the RF connector. The RF generator decreases its level to provide the commanded power of –27 dBm at the analyzer. .

③ **Trigger source**

The trigger source is selected in the *Trigger* tab of the *Connection Control* menu. With the default setting *Free Run* the measurement is not time-synchronized to the input signal. The measurement is repeated as fast as possible.

To analyze a signal with a periodic power ramp (burst signal) you can use the *Power* trigger.

Alternative Settings and Measurements

☞ Ch. 4 and Ch. 5

To access the essential generator settings you can also use the *Generator* softkey in the *Analyzer/Generator* menu.

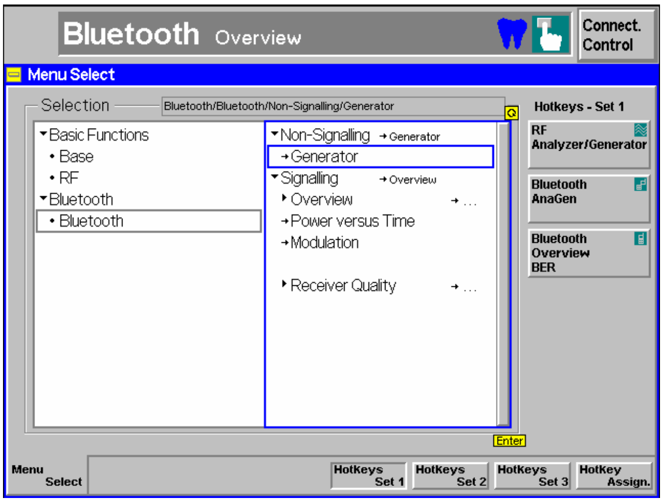
☞ Chapter 4 of the complete operating manual

Note that an external attenuation reported to the R&S® CBT shifts the possible ranges of input and output levels.

☞ Chapter 4 of the complete operating manual

Preparing a Bluetooth Device Test

This section describes the steps that are necessary to prepare a Bluetooth device and connect it to the R&S® CBT. We assume that you have already switched on the instrument, booted the software and performed a reset as described in section *Startup of the R&S CBT* on p. 2.4 ff.



Step 1

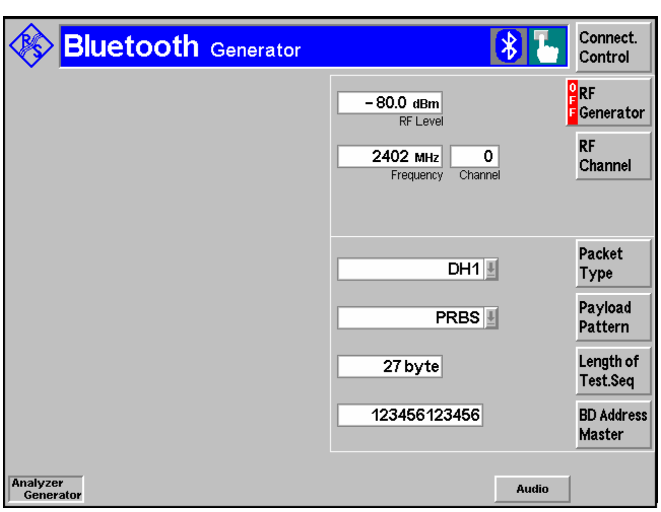
- Press the *Menu Select* key on the front panel to open the *Menu Select* menu. Select the *Bluetooth* function group.
- Select the *Non Signalling* test mode.
- Select the *Generator* menu.
- Press *ENTER* to activate the selected test mode and open the *Generator* menu.

⇓

Step 2

- Connect the bi-directional RF connector *RF IN/OUT* of the R&S® CBT to the connector of your Bluetooth device. ①
- Make sure that the device is supplied with the correct operating voltage (battery or power supply) ② and that the internal test mode is locally enabled. ③

⇓



Step 3

The *Generator* menu of the *Bluetooth Non Signalling* mode ④ configures the RF output signal of the R&S® CBT.

At present, all parameters are set to default values. You can change them after pressing one of the softkeys. User-defined settings will be saved for later sessions when the R&S® CBT is switched off.

The *RF Generator* softkey indicates that the generator is switched *OFF*.

The two input fields associated to the *RF Channel* softkey contain the generator frequency and the corresponding Bluetooth channel number. ⑤

Additional Information...

... on Step 2

① **RF connection of the device**

A high-quality cable should be used for this connection, ideally with an attenuation of less than 0.5 dB.

② **Power supply of the device**

In case the device is operated from an external power supply, make sure that it is capable of supplying the maximum peak current required. As Bluetooth devices generate bursted RF signals with a pulse-shaped current consumption. Problems may arise if the power supply cannot provide such currents with a constant voltage.

③ **Test mode of a Bluetooth device**

The internal test mode is a special state of the Bluetooth model designed for testing the Bluetooth transmitter and receiver. Before a connection between the tester and the Bluetooth device is attempted, this mode must be locally enabled as described in the Bluetooth standard.

... on Step 3

④ **Bluetooth Non Signalling test mode**

In *Bluetooth Non Signalling* mode, the R&S® CBT generates an RF test signal with Bluetooth specifications, i.e. an RF signal with variable level, frequency and payload carrying Bluetooth packets. The CBT cannot perform any measurements in this mode, but tests may be “mobile assisted” or carried out by means of external equipment.

⑤ **Bluetooth channels and frequencies**

The assignment between carrier frequency and channel number is according to Bluetooth specifications. In *Non Signalling* mode, it is possible to select channels independent from the geographical hopping schemes: The channel structure is as follows:

$$f_k = 2402.0\,\text{MHz} + k \cdot 1\,\text{MHz}, \quad k = 0,...,93$$

The RF frequency can be set in 1 MHz steps.

Alternative Settings and Measurements

☞ Data sheet and chapter 4 of the complete operating manual, section *RF Connector*

☞ Chapter 4 section *Connection Setup,* section *Signalling Control in Test Mode (Connected)*

☞ Data sheet and chapter 4, section *RF Connectors*

☞ Chapter 4 of the complete operating manual

☞ Chapter 4

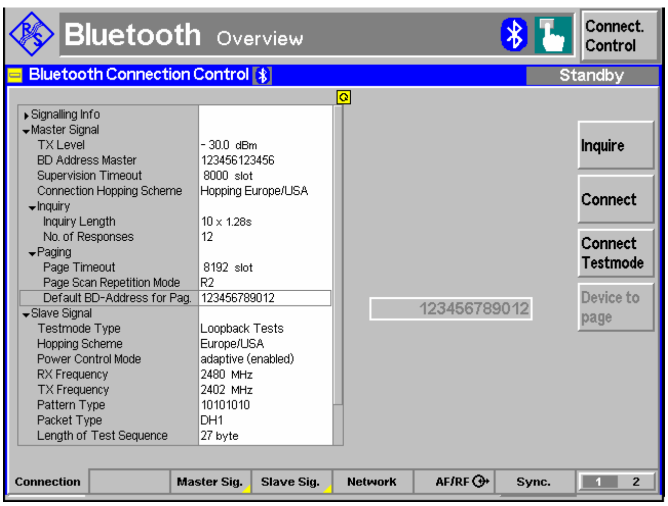
In *Signalling* mode, the geographical hopping scheme of the *Bluetooth DUT* must be reported to the tester. The measurement is then restricted to a subrange of the entire Bluetooth channel range available in *Non Signalling* mode.

Signalling Mode

In the *Signalling* mode the R&S® CBT first transmits an inquiry signal to detect connectable Bluetooth devices within its domain. From the list of devices compiled during this stage, you can select one target device. The R&S® CBT transmits a signal to synchronize to the target device and attempt a connection. After the connection is established, the DUT is commanded to enter its internal test mode where you can perform transmitter and receiver tests.

Call Setup and Signalling Parameters

The signalling process is controlled from the *Connection Control* popup menu. The first of four *Connection* tabs contained in the *Connection Control* popup menu is automatically displayed when you select the *Signalling* mode (see *Menu Select* on page 2.8; for the following examples, *Bluetooth Signalling* with the *Overview* menu was selected).

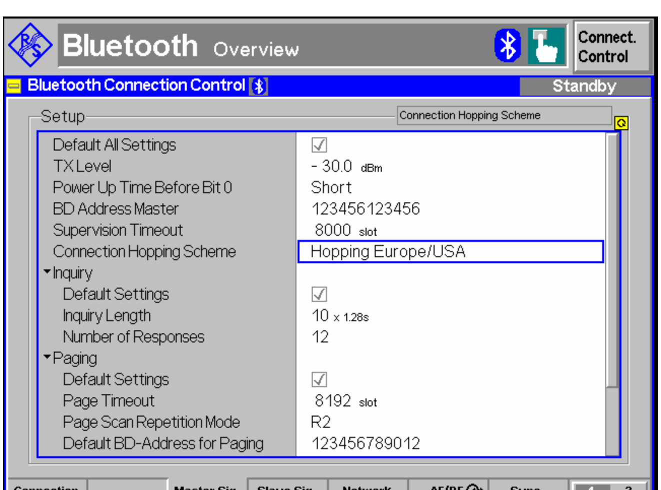


Step 1

The *Connection (Standby)* tab indicates how the R&S® CBT will inquire for Bluetooth devices in its range *(Master Signal)*.① In addition it shows the paging mode *(Paging)* and the characteristics of the DUT in its test mode *(Slave Sig.)*.

In the softkey bar on the right side, the *Device to Page* softkey allows you to select a target device for the connection. ②

⇓



Step 2

- Press the *Master Sig.* hotkey.

The *Master Sig.* tab is displayed. The R&S® CBT provides two versions of this tab. You can toggle between the versions by pressing *Master Sig.* repeatedly. ③

- Press the *ON/OFF* key to expand the menu tables.
- Select the *Default BD-Address for Paging* parameter and enter the Bluetooth device address of your device. ②
- Select *Connection Hopping Scheme* and enter the geographical hopping scheme of your device.
- Press the *Connection* hotkey to return back to the *Connection* tab.

Additional Information...

... on Step 1

① Master signal

Once a connection has been set up (see below), the R&S® CBT and the DUT represent a Bluetooth piconet where the R&S® CBT acts as a Bluetooth master, the DUT as a slave. The *Master Signal* section in the *Connection (Standby)* tab contains the parameters that the R&S® CBT uses to inquire for Bluetooth devices in its range and set up a connection.

② Bluetooth device address and inquiry

Every Bluetooth device is identified by its Bluetooth device address (BD_address), a unique hex value consisting of the 6-digit lower address part (LAP), the 2-digit upper address part (UAP), and the 4-digit non-specific address part (NAP). The R&S® CBT is able to transmit inquiry packets and compile a list of all Bluetooth devices within its range that responded. As an alternative, a known BD_address can be entered in the *Master Sig.* tab (see below) and used as a default address for attempting a connection. In this way it is possible to skip the *Inquiry* state and accelerate the measurement.

To better simulate what happens in a real Bluetooth network, the R&S® CBT is also assigned a BD_address.

... on Step 2

③ Master Sig. parameters

The *Master Sig.* tab defines a variety of parameters to configure how the connection is set up. In particular, the *Paging* parameters define how the R&S® CBT will attempt to page to a device under test, i.e. time-outs used, paging modes and a default BD_address of the DUT.

Alternative Settings and Measurements

☞ Chapter 4 of the complete operating manual

The master signalling parameters are configured in the *Master Sig.* tab of the *Connection Control* menu; see below on this page.

☞ Chapter 4 of the complete operating manual

See section *Signalling Control: Inquiry State*

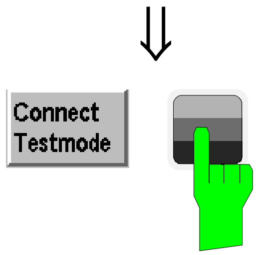
Tip: Quick Connection

After an inquiry, the R&S® CBT remembers the information on the DUT to reuse it for all later connection attempts. To further speed up the connection, the *Read Signalling Info* parameter is provided in the *Master Sig.* tab; see Chapter 4.

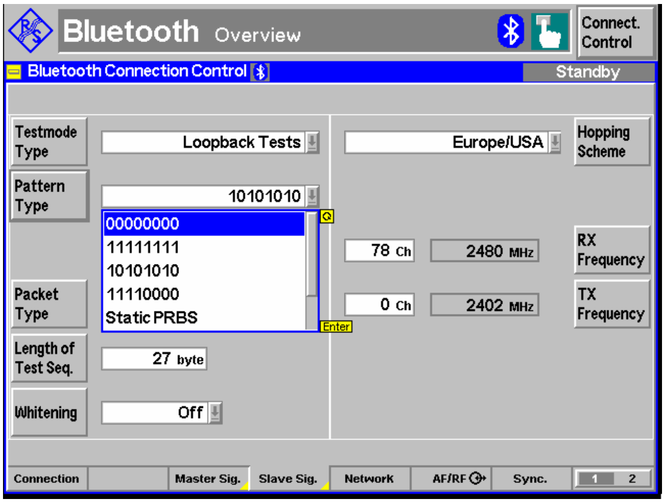
☞ Chapter 4 of the complete operating manual

See section *Master Sig. Parameters (Connection Control – Master Sig.)*

Step 3



➢ Press the *Connect Testmode* softkey.



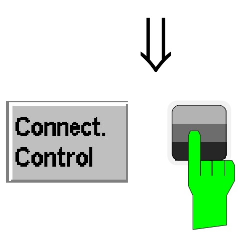
The *Connected (Paging)* tab is displayed. ④. As soon as the connection is established, the *Connection (Connected)* tab is displayed (by default, this tab is closed automatically after a short while, but you can reopen it by pressing the *Connect. Control* softkey).

➢ Press *Slave Sig.* to open the *Slave Sig.* tab and check the test mode settings of the DUT.

The *Slave Sig.* tab controls the behavior of the DUT in its test mode. In particular, it selects the *Testmode Type*, the *Pattern Type* and the *Hopping Scheme* ⑤.

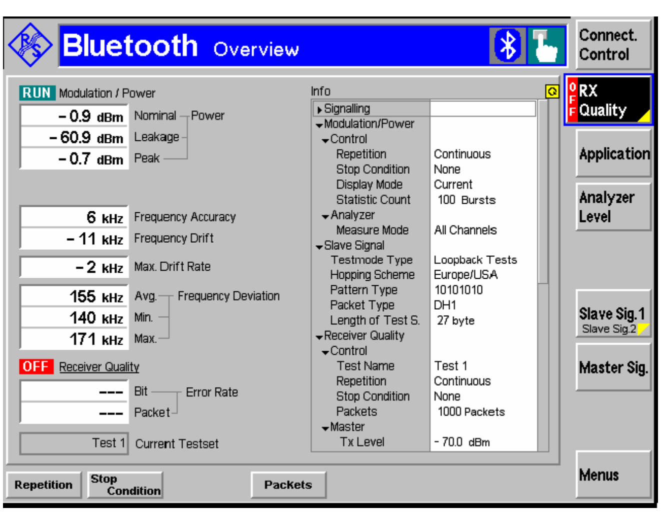
➢ To continue, make sure that the DUT transmits an alternating 1010101010 pattern. ⑥

Step 4



➢ Press the *Connect. Control* softkey or the *ESCAPE* key.

➢ The *Connect. Control* menu is closed; the R&S® CBT displays the *Overview* menu.



The *Overview* menu indicates the signalling information retrieved from the device *(Info* table) ⑦ and the main settings and results of the *Power, Modulation* and *Receiver Quality* measurements.

While the *Receiver Quality* measurement is running, the R&S® CBT uses a PRBS *Pattern Type* by default so that some *Modulation* parameters can not be measured.

➢ Press *Application*, select the *Receiver Quality* hotkey, select the *RX Quality* and the *ON/OFF* key to switch off the *Receiver Quality* measurement.

The R&S® CBT now uses the 1010101010 *Pattern Type* selected above and displays all *Modulation* results.

Additional Information...

... on Step 3

④ **Paging state**

In the *Paging* state, the R&S® CBT attempts to connect to a selected device. The header message *Connecting to Device* is displayed in the *Connection Control* menu. Once connected the R&S® CBT will provide the necessary signalling information to place the DUT into its internal test mode. The parameters specified in the *Slave Sig.* tab are used for the entire connection.

Unless the internal test mode of the device to page is locally enabled (see p. 2.13) the connection will fail, and the R&S® CBT will display the message *Device is not enabled for test mode – Cancel/Retry*. You can continue the connection after enabling the device and pressing *Retry*.

⑤ **Test mode and hopping scheme**

The test mode is a special state of the Bluetooth model designed for testing the Bluetooth transmitter and receiver. In this mode, the R&S® CBT and the DUT form a piconet where the R&S® CBT acts as a master and has full control over the test procedure. The DUT acts as a slave. While in test mode, the DUT does not support normal operation.

Bluetooth channels are defined in the frequency range between 2402 MHz and 2495 MHz. Different subranges of this frequency band are used in different countries. In a Bluetooth piconet, the hopping sequence defining the RF channels to be used and their order is determined by the BD_address of the master. Analogously, a *Hopping Scheme* supported by the DUT must be used by the R&S® CBT.

⑥ **Testmode Types and Pattern Types**

The testmode type defines the timing of the slave signal relative to the master signal and the data sequence that the slave will transmit. The Bluetooth standard defines transmitter tests and loopback tests. You can perform *Power* and *Modulation* measurements using both testmode types; *Receiver Quality* measurements require a loopback testmode type.

The R&S® CBT instructs the DUT to transmit a definite bit pattern. According to the Bluetooth test specification, the measurement of many modulation parameters requires a periodic 10101010 bit pattern. For other bit patterns, the output fields in the *Overview* menu show invalid results "–".

... on Step 4

⑦ **Signalling Info**

The *Signalling Info* table shows the basic properties of the connected device. Note that the values shown are not settings (like the *Paging* and *Master Signalling* parameters set in the *Master Sig.* tab) but represent the information provided by the device and transferred to the R&S® CBT. The parameters are therefore available in the *Connected* signalling state only.

Alternative Settings and Measurements

☞ Chapter 4 of the complete operating manual

See section *Signalling Control: Paging State*

☞ Chapter 4 of the complete operating manual

See section *Behavior of the DUT (Connection Control – Slave Sig.)*

Besides the geographical hopping schemes (Europe/USA, France), the *reduced hopping sequence* was defined to support quick testing over the whole frequency range, including the channels of the *Europe/USA* scheme and the schemes of the other countries.

☞ Chapter 4 of the complete operating manual

See sections *Behavior of the DUT (Connection Control – Slave Sig.)* and *Modulation Measurements.*

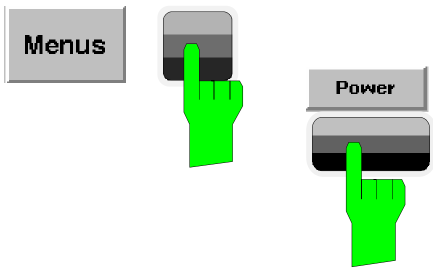
The testmode and pattern type can be changed directly from the measurement menus (without opening the *Connection Control* menu) by pressing *Slave Sig. 1 – Slave Sig. 2 – Testmode Type/Pattern Type.*

☞ Chapter 4 of the complete operating manual

For a comprehensive overview of signalling states and possible transitions refer to the diagram at the beginning of section *Bluetooth Signalling Mode.*

Power Measurements

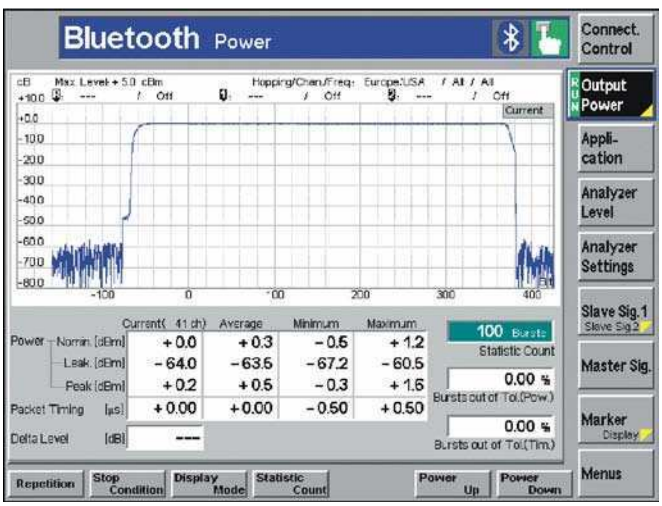
You can call up all measurement menus in *Bluetooth Signalling* mode from the *Menu Select* menu. Once a measurement menu is opened, you can use hotkeys to switch over to any of the other measurements. The following measurement examples don't require the EDR option R&S CMU-K55.



Step 1

➢ Press the *Menus* softkey to display the measurement groups available in the hotkey bar.

➢ Press the *Power* hotkey to switch over to the graphical measurement menu *Power*.

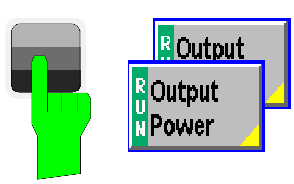


The *Power* menu shows the power of the current burst as a function of time. ①

The burst power is displayed in a graphical test diagram. Test settings (at present, the default settings) and values at particular points are displayed in two parameter lines above the diagram. Below the diagram, an output table plus three output fields provide a statistical evaluation of the measurement curve.

The measurement menu provides various tools allowing to take a closer look at the measurement results.

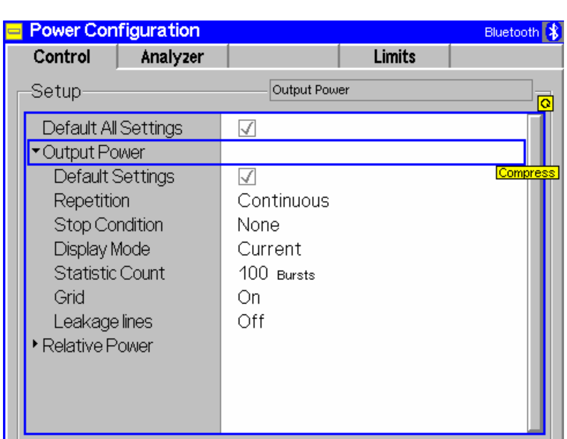
⇓



Step 2

➢ Select (press) the *Output Power* softkey.

➢ Press the selected *Output Power* softkey again to call up the *Power Configuration* menu.



The *Power Configuration* menu defines the scope of the *Power* measurement. To pick just one example of the settings, we limit the number of bursts measured.②

➢ Press the *ON/OFF* key to expand the menu table.

➢ Select *Single Shot* in the *Repetition* field.③

➢ Press the *ESCAPE* key to close the *Power Configuration* menu and return to the main menu.

The *Power* measurement is stopped after one statistics cycle. The status indication next to the *Power* softkey is set to *HLT*.④

Additional Information...

... on Step 1

① **Power menu**

By default the diagram in the *Power* menu shows the burst power within one timeslot with a length of 625 bits. You can adjust the level and time scales, e.g. to measure the rising edge of the burst and to account for bursts of different length (see below).

... on Step 2

② **Power Configuration menu**

The *Power Configuration* menu contains three tabs to define

- The parameters controlling the measurement statistics *(Control)*
- The analyzer settings for *Power* measurements *(Analyzer)*
- The limit lines *(Limit Lines)*

Many of the settings of the *Power Configuration* menu are directly accessible from the measurement menus (without opening the *Power Configuration* menu). E.g. most *Control* parameters can be accessed via hotkeys after pressing the *Output Power* measurement control softkey. See also *Softkeys and Hotkeys* on p. 2.21.

③ **Repetition mode and Stop Condition**

If no stop condition is imposed *(Stop Condition = None)*, the *Repetition* mode determines whether the measurement is

- Continued until explicitly stopped by the operator *(Continuous)*
- Stopped after one statistics cycle *(Single Shot)*

By default, a statistics cycle *(Statistic Count)* comprises 100 bursts. With *Stop Condition = On Limit Failure*, the measurement is stopped after the first burst which is out of tolerance.

④ **Measurement in the HLT state**

While the *Power* measurement is in the *HLT* state, the diagram and the output table show the measurement results of the last burst measured.

Alternative Settings and Measurements

(re ①)

☞ Chapter 4 of the complete operating manual

See section *Power Measurements.*

The *Power Up/Power Down* hotkeys send power control commands to the DUT.

(re ②)

☞ Chapter 3 of the complete operating manual

Settings made in the *Power Configuration* menu apply to power measurements only.

Settings made in *the Connect. Control* menus apply to the entire function group *Bluetooth Signalling*.

(re ③)

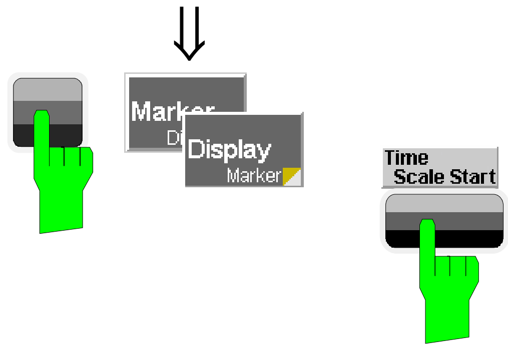
☞ Chapter 3 of the complete operating manual

The stop condition *On Limit Failure* should be selected if the limit check represents the main purpose of the measurement.

The limits can be modified in the *Limits* tab of the *Power Configuration* menu.

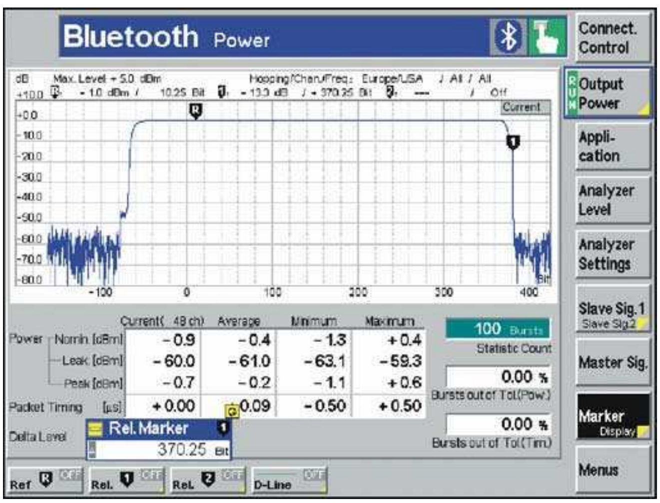
(re ④)

☞ Chapter 3 and 5 of the complete operating manual



Step 3

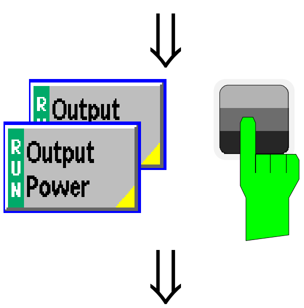
- Press the *Marker/Display* softkey twice to toggle to the *Display/Marker* hotkey bar. ⑤
- Press the *Time Scale Start* hotkey to modify the x-axis and view the rising edge of the burst.



The whole display range is shifted, however, the total span remains unchanged.

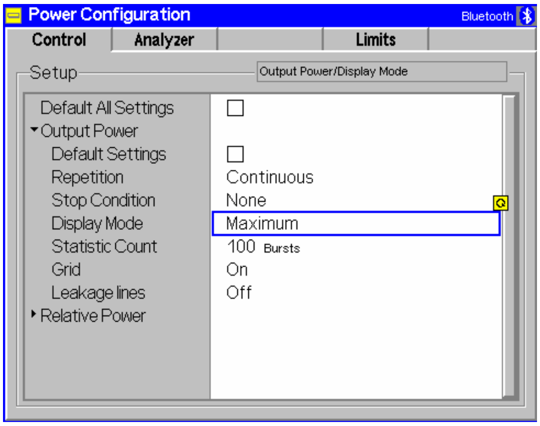
- Press the *Display/Marker* softkey again to toggle back to the *Marker/Display* hotkey bar.
- Press the *Ref R* hotkey. Enter an abscissa value (in bits) to position a reference marker onto the trace. In the same way, place a *Rel. Marker* to a different position. ⑥

The coordinates (time and burst power) of the reference marker are displayed in the second parameter line.



Step 4

- Press the *Output Power* softkey twice to reopen the *Power Configuration* menu.
- Select the *Control* tab.
- Select *Continuous* from the *Repetition* group of toggle switches to restart the measurement.
- From the *Display Mode* field, select *Maximum*. ⑦



Instead of the current burst power, the diagram now shows the maximum burst power ever measured at each point in time. As no stop condition is set, the measurement will be running until explicitly terminated.

Additional Information...

... on Step 3

⑤ **Softkeys and Hotkeys**

The functionality of each softkey on the right side is extended by hotkeys assigned to the softkeys. These hotkeys are displayed across the hotkey bar below the diagram when the softkey is selected.

Most of the softkey/hotkey combinations provide settings that can also be accessed via configuration menus. For example, the settings offered by the *Analyzer Level* softkey are equivalent to the *Analyzer* and *Trigger* tabs in the *Connection Control* menu. Identical settings overwrite each other; the last value entered is valid for the whole function group.

⑥ **Markers**

Markers are a graphical tool used to locate points on a trace and read out their coordinates. A reference marker and two delta markers may be defined in the *Power* menu.

The reference marker measures the absolute level of the trace, the delta markers and measure the distance between their position and the reference marker.

... on Step 4

⑦ **Display mode**

If the measurement extends over several bursts the R&S® CBT calculates four different traces one of which can be selected in the *Display Mode* panel. The purpose of the four traces is to give an overview of the range and arithmetic mean value of the levels detected at any point on the time axis. The following traces can be displayed:

Current	Current burst level
Maximum	Maximum of all burst levels measured
Minimum	Minimum of all burst levels measured
Average	Burst levels averaged according to the formulas in Chapter 3

The *Statistic Count* parameter defines how many evaluation periods form a statistics cycle. In our example the statistics cycle comprises 100 bursts (default value).

Alternative Settings and Measurements

☞ Chapter 4 of the complete operating manual

Analyzer Level controls the level in the RF input signal path and the trigger.

Analyzer Settings determines which RF channels are monitored during the measurement.

Slave Sig. controls the behavior of the DUT in its test mode.

Master Sig. defines how the R&S® CBT sets up a connection to the DUT.

Marker/Display sets markers and D-lines.

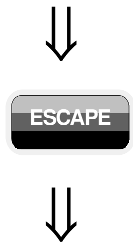
Display/Marker defines the start of the time axis and the display area.

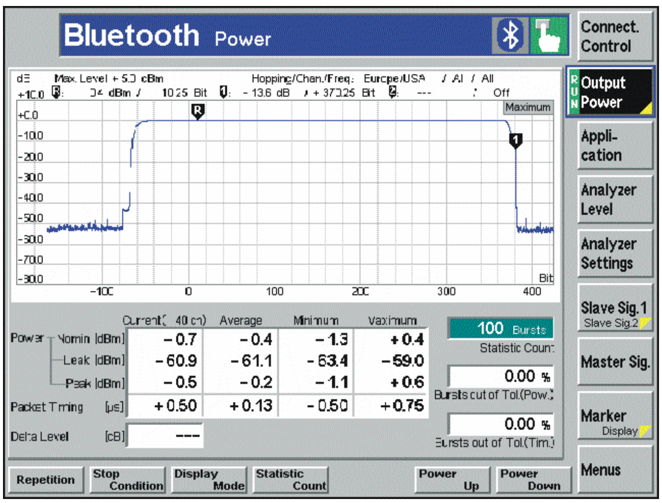
☞ Chapter 4 of the complete operating manual

In addition to markers, a D-line can be used to measure a particular level in the diagram.

☞ Chapter 3 of the complete operating manual

To refine the statistical evaluation, a suitable combination of the statistic count, repetition mode, stop condition and display mode should be selected.





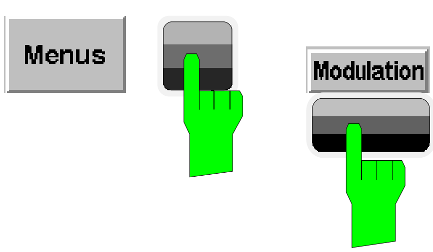
Step 6

Press *ESCAPE* to close the *Power Configuration* menu and return to the main menu.

The trace is now continuously measured and updated in the display. With the display mode *Maximum,* trace values will be replaced only if a current measured value at a particular test point exceeds all values measured previously.

Modulation Measurements

To switch over to the *Modulation* measurement, you can again use the hotkey bar.



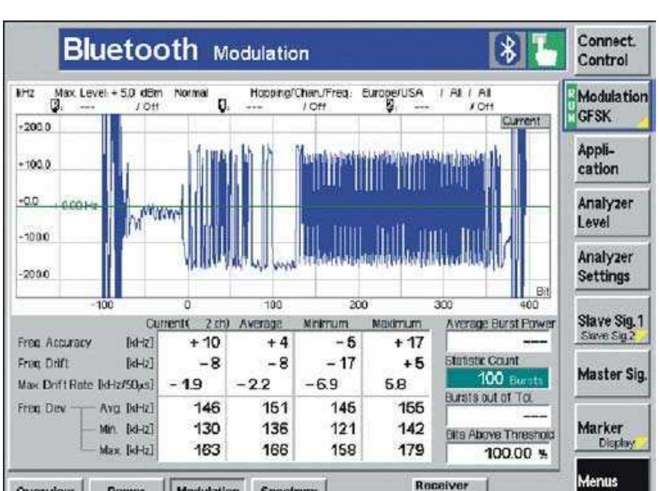
Step 1

- ➢ Press the *Menus* softkey to display the measurement groups available in the hotkey bar.
- ➢ Press the *Modulation* hotkey to open the *Modulation* menu.
- ➢ Press *Application – GFSK* to measure Bluetooth basic rate packets.
- ➢ Press the *Connect. Control* softkey and make sure that a transmitter or loopback test with a 01010101 pattern is active. ①

The *Modulation* menu shows the frequency deviation in the current burst as a function of time.

The frequency deviation is displayed in a graphical test diagram. Below the diagram, an output table plus three output fields display additional modulation parameters.

If a result in the table exceeds the tolerances, the corresponding output field turns red, and an arrow pointing upwards/downwards indicates that the result is above/below the limit. ②



Out-of-tolerance power measurements

If a power measurement is out of tolerance, please ensure that the attenuation of any cables and/or antenna couplers used is taken into account by the R&S® CBT. If tight limits to the nominal and peak burst power are set, even a small attenuation can result in an out-of-tolerance measurement.

External attenuation values for each input/output may be entered in the *RF* ⊙→ tab of the *Connect. Control* menu

The cables, RF connections and antenna couplers must also be in good condition for satisfactory measurements. Dirty or broken RF connections can cause problems at the high frequencies used by Bluetooth networks.

If a *Power* measurement doesn't yield any valid results, check whether the conditions listed at the beginning of section *Power Measurements* in Chapter 4 of the complete operating manual are fulfilled.

Additional Information...

.... on Step 1

① **Modulation measurement and statistical quantities**

If some of the results of the *Modulation* measurement are invalid, check whether the conditions listed at the beginning of section *Modulation Measurements* in Chapter 4 of the complete operating manual are fulfilled.

The table in the *Modulation* menu reports a statistical evaluation of quantities characterizing the errors of the modulation vector. The values in the three columns of the table are calculated as follows:

- The *Current* column contains the results for the current burst.
- The *Average* column contains the currents results averaged over the last statistics cycle.
- The *Minimum* and *Maximum* columns contain the extreme values of the current results for all bursts measured.

☞ Chapter 4 of the complete operating manual

The averaging rules for the different results in the table are explained in detail in Chapter 3 and in Chapter 4, section *Modulation Measurements – Measurement Results.*

The quantities *Frequency Accuracy, Frequency Drift, Max. Drift Rate,* and *Frequency Deviation* are explained in detail in section *Modulation Measurements.*

② **Measured values and limits**

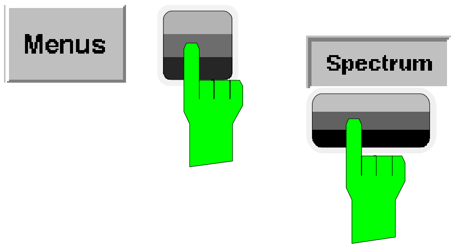
The limits may be modified in the *Limits* tab of the *Modulation Configuration* Menu which is opened by pressing the *Modulation* softkey twice. The *Modulation Configuration* menu is analogous to the *Power Configuration* menu explained on the previous pages.

☞ Chapter 4 of the complete operating manual

The principle of *Modulation* measurements and the measured quantities are explained at the beginning of section *Modulation Measurements.*

Spectrum Measurements

To switch over to the *Spectrum* measurement, you can again use the hotkey bar.

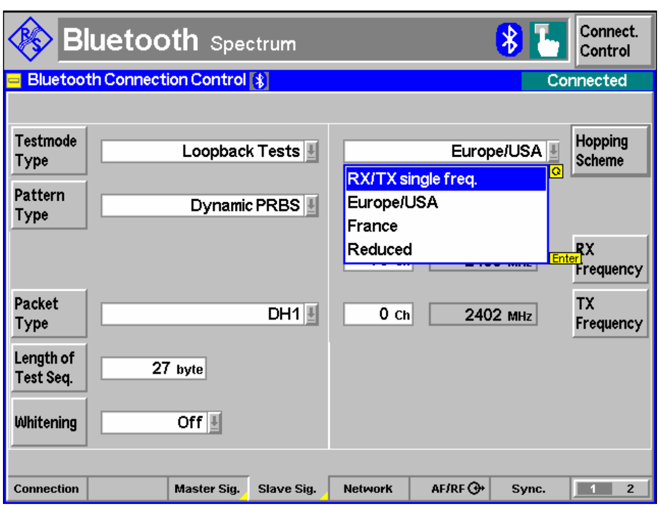


Step 1

➢ Press the *Menus* softkey to display the measurement groups available in the hotkey bar.

➢ Press the *Spectrum* hotkey to open the *Spectrum* menu.

➢ Press *Application – ACP* to measure the off-carrier channel power (adjacent channel power).

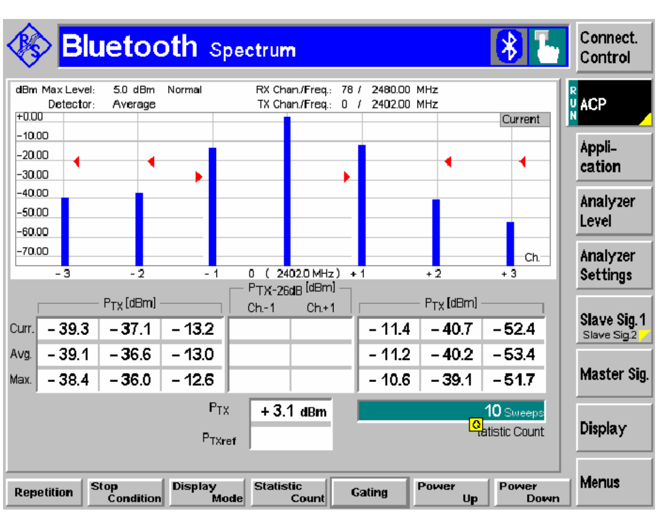


➢ Press the *Connect. Control* softkey, open the *Slave Sig.* Tab, and disable frequency hopping *(Hopping Scheme: RX/TX single freq.)*. ①

➢ Make sure that the *Packet Type* is DH1 and that the *Pattern Type* is a PRBS sequence as required by the conformance test specification.

➢ Close the *Connection Control* menu.

⇓



Step 2

The diagram in the *Spectrum – ACP* menu shows the absolute power (in dBm) that the Bluetooth device transmits in its nominal TX channel (here: 2402 MHz) and in the three channels to the right and left of the nominal channel (numbered –3 to +3). Red triangles denote the limits for the ACP.

The absolute powers appear in the output fields below the diagram, too. The R&S CBT displays current, average and maximum results (see *Modulation* measurements above). In the current configuration, the output fields for $P_{TX\,-\,26\,dB}$ and P_{TXref} show invalid results. ②

If a result in the table exceeds the tolerances, the corresponding output field turns red, and an arrow pointing upwards/downwards indicates that the result is above/below the limit.

Additional Information...

... on Step 1

① **Spectrum measurement settings**

The Bluetooth conformance specification stipulates different test settings for the different *Spectrum* measurement applications:

- The *ACP* measurement is performed at constant frequency (hopping disabled), with a DH1 packet type and a PRBS pattern.
- The *20 dB Bandwidth* measurement is performed with frequency hopping, the longest packet type supported by the DUT, the longest supported test sequence, and a PRBS pattern.
- The *Frequency Range* measurement is performed at constant frequency (hopping disabled) and in two different measurement windows around the lower and upper edge of the nominal Bluetooth band.

... on Step 2

② **Extended Spectrum measurement**

With options R&S CBT-B55/-K55, the R&S CBT can analyze the DPSK-modulated portion of EDR packets and provide additional measurement results. The prerequisites for the EDR measurement and the EDR-related channel powers $P_{TX-26\,dB}$ and P_{TXref} are explained in chapter 4.

Alternative Settings and Measurements

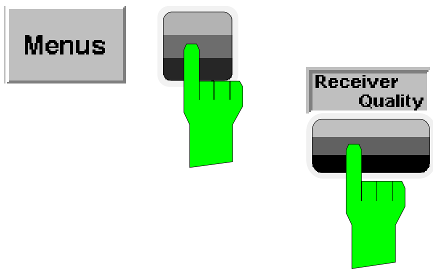
☞ Chapter 4 of the complete operating manual

The different *Spectrum* applications, the test requirements, and the measurement results are explained in detail in section *Spectrum Measurements.*

☞ Chapter 4 of the complete operating manual

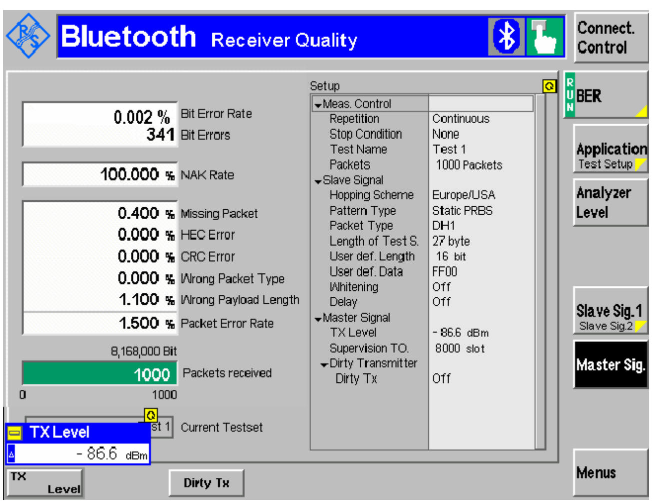
Receiver Quality Measurements

To test the *Receiver Quality* the R&S® CBT transmits a bit sequence that the DUT will demodulate and loop back to the tester. The R&S® CBT compares the bits received with those sent and can thus calculate the percentage of faulty bits. Therefore, the R&S® CBT automatically activates a loopback test when a *Receiver Quality* measurement is active. ①



Step 1

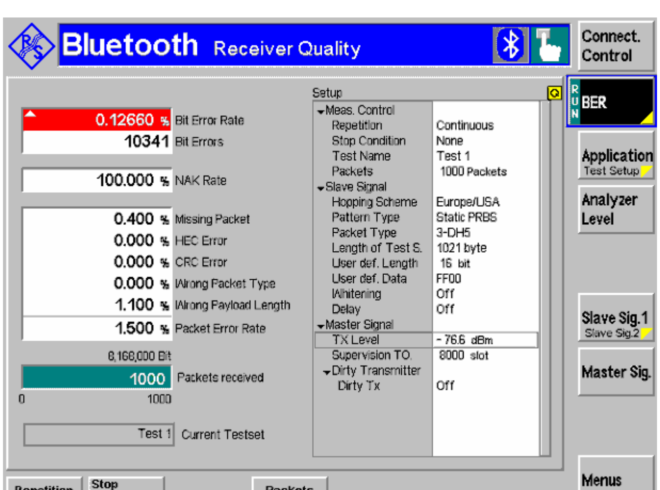
- Press the *Menus* softkey to change the measurement group.
- Press the *Receiver Quality* hotkey to open the *Receiver Quality* menu.
- Press the *BER* measurement control softkey and *ON/OFF* to switch on the measurement.



The *Receiver Quality* menu shows the results of the bit error rate test and the most important test settings. The R&S® CBT's default RF generator signal is at a relatively high level so the detected bit error rates are low.

- Press the *Master Sig.* softkey and the *TX Level* hotkey to reduce the level of the RF generator signal.

⇓



As the *TX Level* decreases, the R&S® CBT measures a higher bit error rate. The R&S® CBT is also able to search for the *TX Level* that corresponds to a particular bit error rate:

- Press the *Application* softkey to display all applications of the *Receiver Quality* measurement group. ②
- Select the *BER Search* application and search for the *TX Level* corresponding to a bit error rate of 2%.

Additional Information...

Alternative Settings and Measurements

... on Step 1

① **Loopback test mode**

In a loopback test, the R&S® CBT transmits normal baseband packets. The DUT (acting as a Bluetooth slave) decodes the received packets and sends back the payload using the same packet type. The return packet is sent back either in the slave TX timeslot directly following the transmission of the R&S® CBT or with a *Delay* of one slave and one master timeslot.

The R&S® CBT provides a selection of bit patterns *(Pattern Type)* to be used for loopback tests. The data may or may not be whitened (scrambled with a particular bit sequence). Moreover, the *Packet Type* for test packets and the *Length of the test sequence* can be set

☞ Chapter 4 of the complete operating manual

See section *Behavior of the DUT (Connection Control – Slave Sig.)*

... on Step 2

② **Applications**

Applications are different measurements belonging to the same measurement group. Each application is assigned its own set of configuration parameters. Therefore, the applications of a measurement group can be configured individually and serviced in parallel.

Within the *Receiver Quality* measurement group, the applications *BER* (bit error rate tests) and *BER Search* (search for an RF output level corresponding to a definite bit error rate) are available. For single shot BER measurements, up to five different test setups with independent parameters can be configured (see *Control* tab in the *Receiver Quality Configuration* menu).

☞ Chapter 4 of the complete operating manual

For a general discussion of measurement control and applications see Chapter 3 and Chapter 5 of the complete operating manual.

Failed Receiver Quality Test

If a BER test fails ensure that the attenuation of any antenna coupler and/or cables used is being taken into account by the R&S® CBT. During the test the mobile receiver is being tested with very low RF signal levels, and even a small attenuation can cause the test to be failed.

Contents

3 Manual Operation

This chapter provides a survey of the R&S® CBT's operating concept. It includes a description of the basic menu types, the selection and setting of parameters, and a general discussion of measurement control. The operating menus in the R&S® CBT basic system, the *RF* function group, and the *Bluetooth* function group are described in greater detail in Chapter 4.

Operating concept The R&S® CBT was designed for easy, intuitive operation. All menus rely upon a limited number of controls with analogous or identical function. Basic settings are discussed in section *Measurement Control* on page 3.15 and in Chapter 5.

Basic elements The R&S® CBT is operated via softkeys and tables. Softkeys provide fast access to the instrument functions. Tables facilitate the management of larger amounts of data.

Flexibility and uniformity The R&S® CBT can switch between various operating modes (multi-mode operation). For this purpose, it is possible to navigate between menus in almost any instrument state. The different function groups (*RF, Base, Bluetooth*) operate in the same way; with measurements of the same type belonging to different applications being standardized.

Controls

The R&S® CBT is operated under menu control via keys, softkeys and hotkeys:

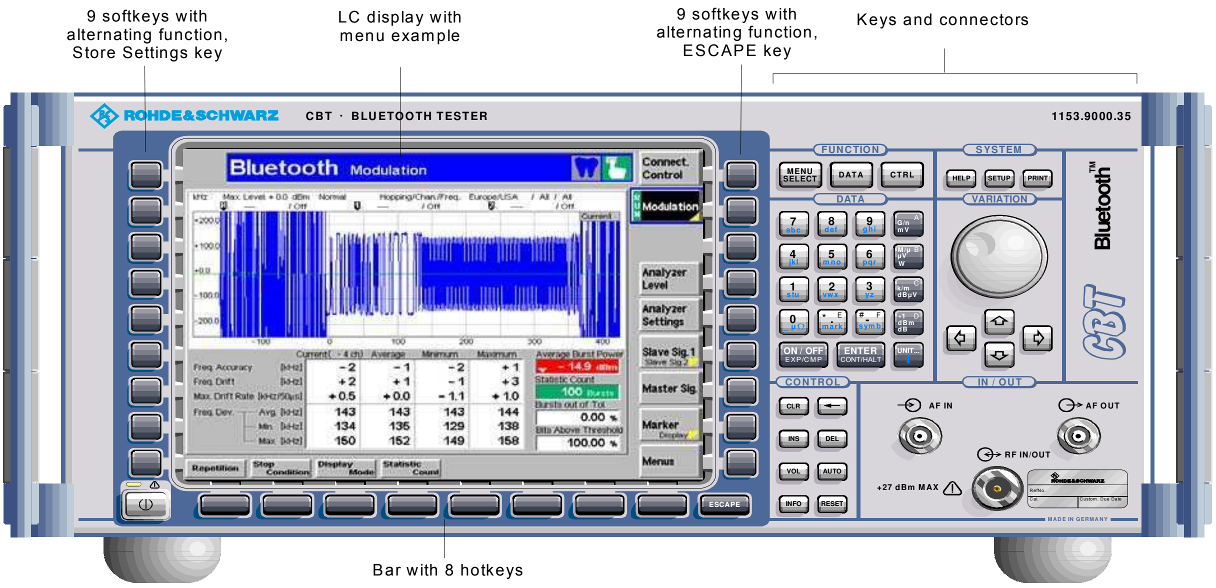


Fig. 3-1 Keys, softkeys and hotkeys

Rotary Knob

The rotary knob can be used in two different ways:

- It is **turned** to select entries in list fields and tables and to vary (increment/decrement) numerical and alphanumerical entries.
- It is **pressed** to expand or compress table sections (thus replacing the *ON/OFF* key), to expand pull-down lists, to open auxiliary input fields, and to confirm numerical entries or selections (thus replacing the *ENTER* key).

Front Panel Keys

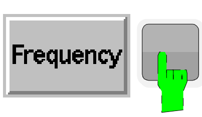
The keys located in the right-hand part of the front panel are combined to form groups according to their functions. They control

- Data input and variation
- Pre-selection of the menus
- Settings of the instrument, editor, help file and output

The keys are described with their function in Chapter 1, section *Front and Rear View*.

Softkeys

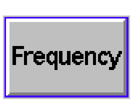
Softkeys are assigned to the nine keys located both at the left and at the right edge of the screen. To simplify the display, only the softkeys which are actually assigned in a menu are indicated (see menu example in *Fig. 3-1*).



Selection of softkeys:

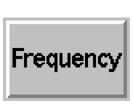
The R&S® CBT provides selectable and non-selectable softkeys. A softkey is selected by pressing the associated key.

⇓



A selected softkey is highlighted by a blue frame. Softkey selection establishes a connection to settings and functions related to the softkey. These related functions can be initiated via keys (e.g. *ON/OFF, CONT/HALT),* or via the selected softkey itself (e.g. calling up popup menus by pressing a selected softkey again).

⇓

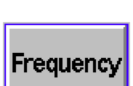


After the function has been terminated, or after another softkey is selected, the softkey returns to its initial state.

Softkey types and their function:

Softkeys perform definite tasks within the corresponding menus. Different types of softkeys are provided:

– Pressing the softkey (i.e. the associated key) causes an immediate response on the screen. An example is the non-selectable softkey *Connect. Control* which is used to call up a popup menu.



– Pressing the softkey activates a dialog box, e.g. an input field.

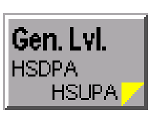
- The softkey is a measurement control softkey (main softkey) indicating the measurement state (*RUN, OFF, HLT)*. A yellow triangle indicates that a popup menu providing configurations can be opened with the softkey (press once for selection, a second time for opening the popup).

  A measurement can be started and aborted with the *ON/OFF* key (i.e. the ON/OFF key switches between the measurement states *RUN* and *OFF*). It can be stopped while preserving the valid results with the *CONT/HALT* key (i.e. the *CONT/HALT* key switches between the measurement states *RUN* and *HLT;* starting a measurement from the *OFF* state by means of the *CONT/HALT* key is not possible). In the *HLT* state, the instrument resources are not released; the application is still available. The formal aspects of measurement control are explained in Chapter 5.

- The softkey indicates the generator status *(ON, OFF)*. A yellow triangle indicates that a popup menu providing configurations can be opened with the softkey (press once for selection, a second time for opening the popup).

  A generator can be started and aborted with the *ON/OFF* key. The formal aspects of generator control are explained in Chapter 5, section *Measurement Control*.

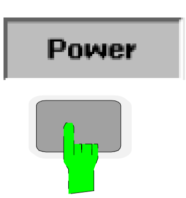
The softkey toggles between two hotkey bars (corresponding to two groups of settings). The current group is indicated in large typeface in the first line of the softkey; the alternative group appears in smaller typeface next to a double triangle.



The principle of toggle softkeys may be extended to three different groups of settings.

Hotkeys

Hotkeys are assigned to the eight keys at the lower edge of the screen. Only the hotkeys which are actually assigned in a menu are indicated (see *Fig. 3-1*).



Selection:

A hotkey is activated by pressing the associated key. After activation it changes its frame.

Function:

Hotkeys permit to

- Change from one measurement menu/graphical measurement menu to the other
- Select tabs in the popup menu
- A yellow triangle indicates that a second version of the current tab providing additional configurations can be opened with the hotkey. The hotkey toggles between the two versions of the tab.

In the graphical measurement menu (see page 3.6), hotkeys provide extended settings and can be used like ordinary function softkeys.

Operating Menus

The R&S® CBT offers a large variety of operating modes and applications. To ensure quick and easy operation, uniform menus have been implemented. They can be divided into three types:

Measurement menu	Offers the most important settings controlling a measurement and displays the main results.
Popup menu	Provides extended settings for a measurement menu or function group.
Graphical menu	Displays a measurement trace together with settings and further measurement results, contains softkeys and hotkeys used to access measurement control settings.

Measurement Menus

A measurement menu provides the basic settings controlling a measurement and at the same time displays the main results. Together with the graphical measurement menus, measurement menus constitute the basic level in the operating system of the R&S® CBT. They can only be replaced by other measurement menus or graphical measurement menus. To change the menu, the hotkeys at the lower edge of the measurement menu are used.

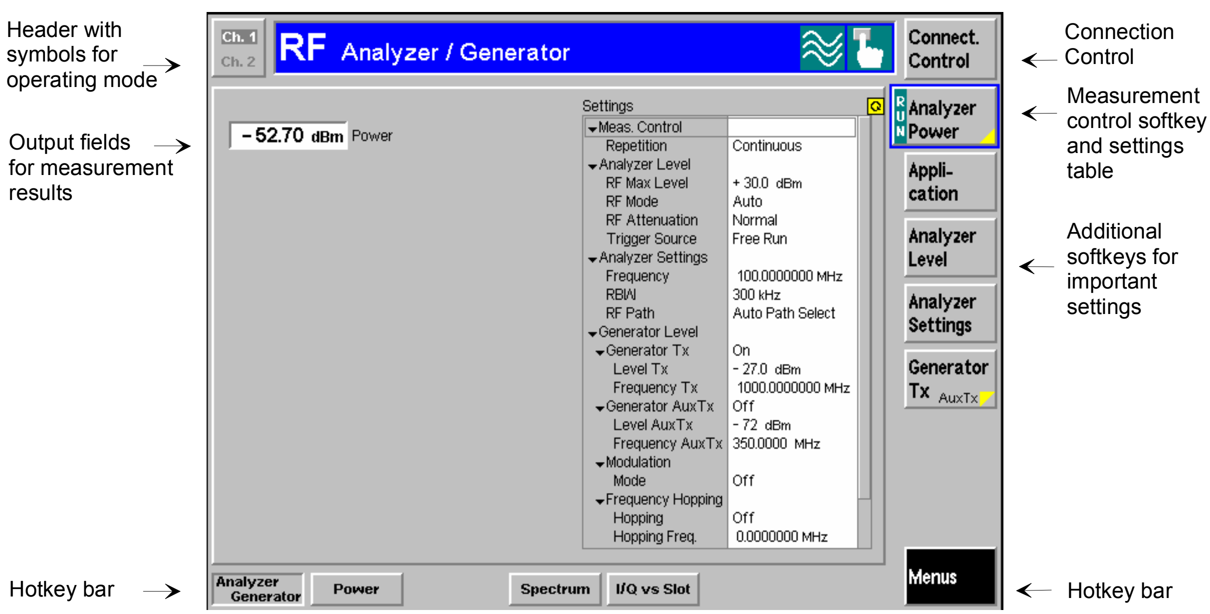
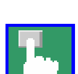


Fig. 3-2 Example of a measurement menu

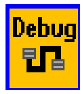
Header The header consists of the heading and the symbols for the operating mode and test mode (signalling state, if applicable in the function group).

- The *heading* briefly describes the purpose of the menu (e.g. type of settings, measurement group, function group, etc.).
- The *operating mode*, i.e. the type of operation/control of the R&S® CBT, is indicated by the symbols at the right edge of the header. The following operating modes are available:



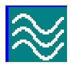
Manual control

Remote control via GPIB (IEEE)-bus

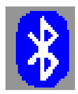


Remote debug mode (activated in the *Setup – Remote* tab)

- The *function group* is indicated to the left of the operating mode:

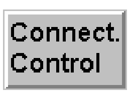


RF measurements



Bluetooth measurements

General settings



The *Connect. Control* softkey is located to the right of the header of each measurement or graphical measurement menu. This softkey opens a popup menu defining the input and output connectors, the external attenuation, the reference frequency as well as many network-specific settings.

In the *Signalling* test mode of Bluetooth, the *Connection Control* menu is also used to set up and terminate a connection between the R&S® CBT and the DUT.

The *Connection Control* menu also contains the input path and the trigger settings for the current function group and signalling state.

Measurement control softkey

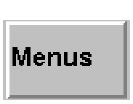
The measurement control softkey (main softkey) controls the measurement application and indicates its state *(RUN | HLT | OFF);* see section Softkeys on p. 3.1 ff. Its labeling corresponds to the menu heading. For large measurement groups that are subdivided into several applications, the labeling indicates the current application.

The hotkey bar associated with the measurement control softkey provides parameters to define the scope of the measurement (statistical settings).

Pressing the measurement control softkey twice opens a popup menu providing measurement-specific settings.

Softkeys for important settings

The softkeys below the measurement control softkey provide groups of important measurement settings. Each softkey activates an associated hotkey bar. An active softkey is displayed in inverse video.



The *Menus* softkey displays all measurements in the function group, so it is possible to change from one measurement to another.

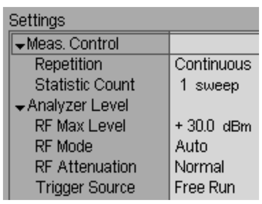
Hotkeys

If one of the softkeys is activated, the hotkeys below the test diagram provide sub-functions for this softkey.
If the Menus softkey is activated, the hotkeys change between the various measurement groups of the current function group.

Popup box

Popup boxes are associated with all hotkeys that require a selection or input of parameters. These popup boxes are operated like input fields in the measurement menus (input of numbers and characters) or list fields (selection from a range of alternative settings).
Popup boxes are closed when the calling hotkey is pressed again or when another popup box is opened. They remain open when another softkey is selected, so it is possible to easily test the effect of repeated changes of a parameter.

Settings table



The *Settings* table in the right half of the menu gives an overview of the current measurement settings. The entries vary with the measurement and measurement applications. The rotary knob scrolls and expands the *Settings* table.

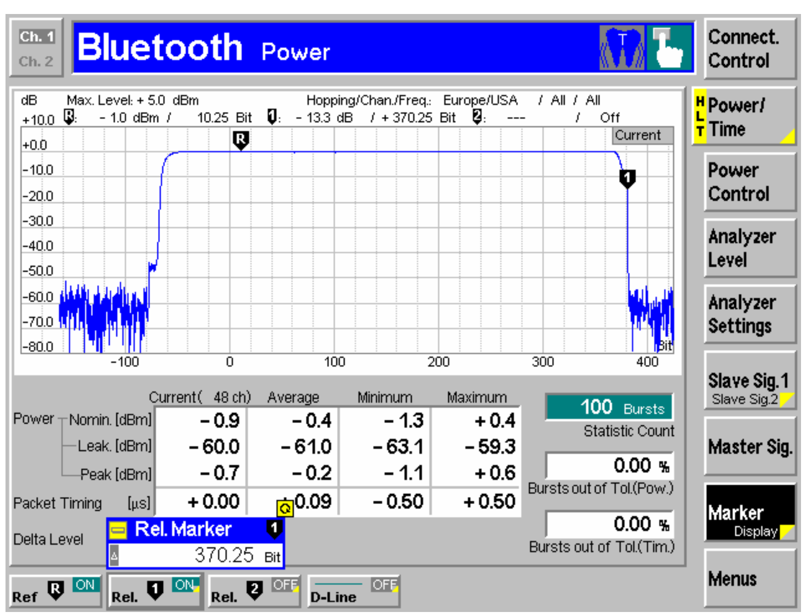
Graphical Measurement Menus

The R&S® CBT displays arrays of measurement results in the form of two-dimensional diagrams. In order to obtain additional space for the test diagram, no settings table is displayed. The header and the functionality of the softkeys and associated hotkeys is identical to the measurement menu; see section *Measurement Menus* on page 3.4.

Header with configuration softkeys

Test diagram

Hotkeys for marker configuration



Measurement control softkey

Active softkey

Fig. 3-3 Example of graphical measurement menu

Popup Menus

Popup menus extend the functionality of a measurement menu. They are assigned to the configuration softkey *Connect. Control* as well as to all measurement control softkeys in a measurement menu that are marked by a yellow triangle at the bottom right. They may be divided into several tabs that are selected via hotkeys in the measurement menu.

The popup menu *Connection Control* is activated by pressing the associated softkey. Popup menus which configure a measurement are activated by pressing the measurement control softkey twice (selection of softkey and subsequent opening of popup menu). A popup menu is closed by means of the *ESCAPE* key or by pressing the calling softkey again.

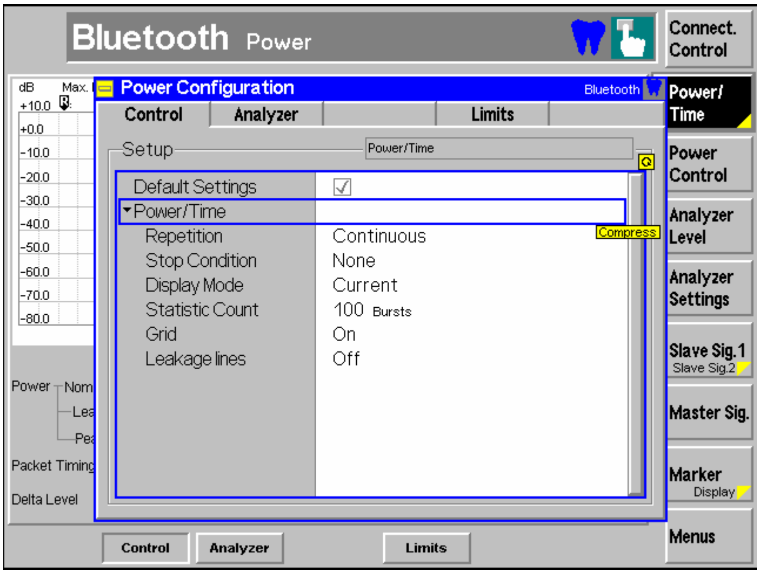


Fig. 3-4 Example of a popup menu

Header

The header consists of

- The heading (*<name of the measurement group> Configuration*; the function group is indicated on the right in small characters),
- The symbol for the signalling state on the right. See section *Measurement Menus* on page 3.4.

Tabs

Popup menus come without tabs (1 single window) or with several tabs.

The tabs may contain input fields, select fields, command and on/off switches (check boxes). Various fields can be combined to form groups (panels).

(Expanding) menu tables

Configuration settings in popup menus are often arranged in tables. If a table provides a large number of settings, these are usually grouped under several header lines marked by a black triangle. The items belonging to a group can be shown (expanded, triangle points down) and hidden (compressed, triangle points to the right) by selecting the corresponding header line and pressing the *ON/OFF* key or the rotary knob.

Operation of Popup Menus

The following table provides an overview of the operation of popup menus.

Table 3-1 Operation of popup menus

Action		Operation via keys
Open menu		Press the softkey twice (selection plus opening of menu), press only once in the case of *Connect. Control*
Select	tabs dialog elements	Press hotkey softkeys *(Connect. Control)*, cursor keys ⇦⇨⇧⇩
Edit fields		Keys *ON/OFF, ENTER,* number and unit keys, rotary knob, see section *Dialog Elements in the Menu* on page 3.9.
Edit table entries		Keys ON/OFF, ENTER, number and unit keys, rotary knob, see section *Dialog Elements in the Menu* on page 3.9.
Quit and close menu		Any assigned softkey / *ESCAPE* key

Dialog Elements in the Menu

This section describes the various types of dialog fields and the procedure for the input of values and parameters.

In many input or select field types, a selection made must be confirmed using the *ENTER* key. The cursor can be freely shifted over these fields; only after confirmation is the setting transferred to the instrument software.

In the case of select fields without confirmation, settings take effect immediately with the cursor selection.

Input Fields

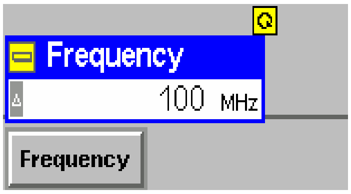
An input field (editor) is a white, rectangular area on the screen which permits numbers or characters to be entered. Input fields are available both in measurement and in popup menus. In graphical measurement menus, the input fields are popup windows which can be called up by means of hotkeys while the instrument is in the function mode.

Note: *The easiest and quickest way to enter numbers or characters is by means of an external keyboard that is connected to the* KEYBOARD *connector at the rear of the R&S® CBT (see Chapter 1). Alternatively, follow the directions given in the next two sections.*

Input of Numbers

Input fields for numerical values are activated by pressing the respective softkey. Numerical values can either be varied using the rotary knob (by incrementing/decrementing individual digits) or directly entered via the numerical keypad *(DATA)* on the front panel or an external keyboard. To this end, the insert and overwrite mode is available. It may be necessary to confirm the input for transfer to the instrument hardware.

In the following, the most important possible inputs using the rotary knob or the numerical keys will be described.

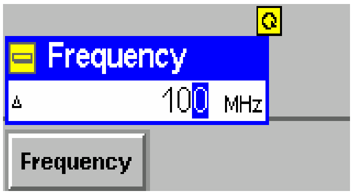


Activating an input field and a digit

- To activate the input field press the associated softkey.

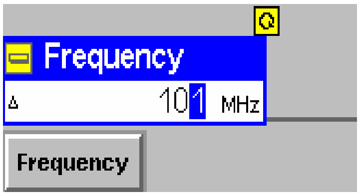
  The input field appears with a blue frame. The symbol for the rotary knob appears at the top right of the input field.

  The input field is in start mode, indicated by a small white triangle on a gray background. From the start mode, it can be switched to either insert or overwrite mode.



Input using the rotary knob – Overwrite mode

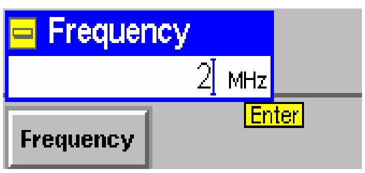
- In the start mode, turn the rotary knob to activate the overwrite mode and vary the last digit of the current number.
- Use the left or right *cursor key* to switch between the decimal places of the indicated number.
- Increment/decrement the active digit by turning the rotary knob.



The individual digits can be varied without restriction. Incrementing a “9“ produces 0 and causes the next higher digit to be incremented by 1. The editor behaves analogously when a “0“ is decremented.

An *Enter* symbol at the bottom right of the input field indicates that the current value has yet to be written to the R&S® CBT software.

- Confirm the entry and terminate the input using the *ENTER* key or by pressing the rotary knob or another softkey or ...
- Press *ESCAPE* to discard the entry.



Input using the numerical keypad – Insert Mode

- In the start mode, type one of the number keys of the numerical keypad.

  The previous numeric value of the editor is completely replaced. The R&S® CBT changes to the insert mode characterized by a cursor symbol. Further digits are inserted to the left of the cursor.
- Entries made in insert mode via the numerical keypad must always be confirmed using the *ENTER* key or by pressing the rotary knob.

Further control keys

The keys of the *CONTROL* group extend the functions of numerical input.

- Use the INS *(insert)* key to change between the modes *insert* and *overwrite*.

  In the insert mode, the cursor appears in the input field.
- Use the ← *(backspace)* key to delete the character to the left of the cursor (in insert mode).
- Use the DEL *(delete)* key to delete the highlighted character (in overwrite mode) and the digit right from the cursor key (in insert mode).
- Use the CLR *(clear)* key to delete all characters.

Confirming/discarding the input

The behavior of the editors depends on whether the values were entered in the insert or in the overwrite mode:

- If only the overwrite mode was used to define the input value no confirmation is necessary. The input value is valid as soon as another softkey or hotkey is pressed.
- If the insert mode is used, or if it was used before swapping over to the overwrite mode, the input must be confirmed with the *ENTER* key or by pressing the rotary knob. By pressing *ESCAPE* or another softkey, the input will be discarded and the previous value restored.

If the number entered conflicts with the resolution of the R&S® CBT, it will be rounded to the maximum number of digits allowed.

Error message during input

If the value defined in the input field is too high or too low, a window with the error message „*<numerical value> is out of range. <permissible maximum value> is limit.*“ will appear together with three buttons:

Accept	Permissible maximum value accepted for input field,
Re-edit	New entry
Cancel	Last valid input value is retained.

Input of alphanumerical characters

Input fields for alphanumerical characters are activated by pressing the respective softkey. Characters can be either varied using the rotary knob (by variation of individual characters in alphabetical order) or entered via the numerical keypad *(DATA)* on the front panel or an external keyboard. The input must be confirmed using the *ENTER* key in order to be transferred to the instrument hardware. The input is terminated upon confirmation.

The table below shows the assignment of the numerical keys.

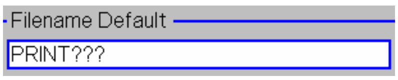
Table 3-2 Assignment of numerical keys and alphanumeric characters

Key	**Character (upper case)**	**Character (lower case)**
7 abc	A B C 7 Ä Æ Å Ç	a b c 7 ä æ å ç
8 def	D E F 8 É	d e f 8 é è
9 ghi	G H I 9	g h i 9 ì
4 jkl	J K L 4	j k l 4
5 mno	M N O 5 Ñ Ö	m n o 5 ñ ö ò
6 pqr	P Q R 6	p q r 6 ß
1 stu	S T U 1 Ü	s t u 1 ü ù
2 vwx	V W X 2	v w x 2
3 yz	Y Z 3	y z 3
0 _µΩ	space µ Ω 0 £ $ ¥ €	space µ Ω 0 £ $ ¥ €
. * mark	\ _ * , : ; ' " ? ( )	\ _ * , : ; ' " ? ( )
- # symb	- # / ( ) < = > % &	- # / ( ) < = > % &
UNIT.. ⇩	Upper / lower case	Upper / lower case

The full character set may be restricted if required for reasons of compatibility (e.g. for input fields defining file names).

The most important possible inputs using the rotary knob or the digital keys are described in the following.

Activating the input field and auxiliary editor



- To activate the input field press the associated softkey. If the softkey is assigned to a panel with several controls, use the cursor key to select the desired input field.

- Press or turn the rotary knob to open the auxiliary editor associated with the input field.

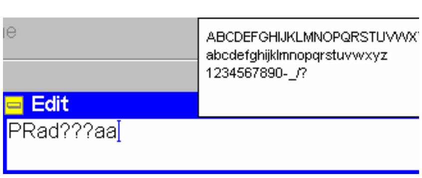
  The auxiliary editor is used to edit a name that may extend over several lines. The cursor is placed at the end of the current character string.

Input using the numerical keys

- Press one of the numerical keys to write a character to the current cursor position.
- To change a character, position the cursor to the desired character using the left or right *cursor key* and overwrite the character.
- Press a numerical key repeatedly to access the different characters assigned to it (see assignment of keys in *Table 3-2*).
- Press the *UNIT* key plus a numerical key to switch to the upper case character set.
- Confirm the input using the *ENTER* key.

  If the syntax specified is invalid (e.g. an invalid file name was defined), an error message of the type *Filename syntax <name> is invalid Cancel / Re-edit* is displayed. Otherwise the edited character string is written to the input field in the menu.
- Press another softkey or change the menu to close the auxiliary editor.

Input using the rotary knob



- After opening the auxiliary editor, turn the rotary knob in either direction. A list of all valid (upper and lower case) characters for the current input field is opened.
- Turn the rotary knob and select the character to be written to the cursor position in the auxiliary editor. Selected characters are shown in inverse video.
- Press the rotary knob to confirm your selection and enter the selected character into the auxiliary editor.
- Select a character and turn the rotary knob to increment/decrement the character in alphabetical order.

Insert/overwrite

The keys of the *CONTROL* group extend the functions of character input.

- Use the INS *(insert)* key to change between the modes *insert* and *delete*.

In insert mode, the cursor appears in the input field.

- Use the *(backspace)* key to delete the character to the left of the cursor.
- Use the *(delete)* key to delete the inversely displayed character (in overwrite mode).
- Use the *(clear)* key to delete all characters.

Confirming/discarding the input

- Use the *(ESCAPE)* key or another softkey to abort character input and deactivate the input field and the softkey.
- Use the *(ENTER)* key to confirm the character input.

If the syntax specified is invalid (e.g. an invalid file name was defined), an error message of the type *Filename syntax <name> is invalid Cancel / Re-edit* is displayed. Otherwise the edited character string is written to the input field in the menu.

- Press another softkey or change the menu to close the auxiliary editor.

Select Fields in Popup Menus

Various types of fields permit to select one or several settings out of a number of given options. The desired settings are to be marked; the selection is to be confirmed using the *ENTER* key, if required.

Popup menus may or may not contain softkeys; they contain input or select fields which can be combined to form panels or groups and tables. Select fields and tables in the popup menus can be controlled intuitively using the cursor keys. The following overview applies to all field types.

Table 3-3 Operation of select fields

Action	Key operation
Select field group / list	Cursor keys, softkey
Select single field, command button, or line in list field or table	Rotary knob
Switch on or off single field or line in list field	*On/Off* key, in the case of buttons also rotary knob, *ENTER* key
Confirmation (if required)	*ENTER* key

Pull-down list fields

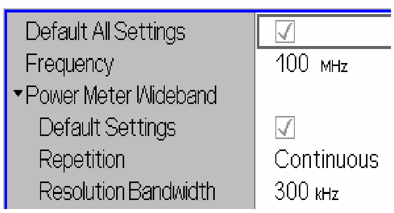
are compressed into one line in the popup menu.

➢ Press the associated softkey (if available) or use the cursor keys to select the list. Press *ENTER* or the rotary knob to expand the list (expand in upward or downward direction depending on the space available).

➢ To select a line use the rotary knob.

➢ Press *ENTER* to confirm your selection and close the list.

➢ Press *ESCAPE* or another key to discard your selection and close the list.



(Expanding) menu tables

usually cover the whole popup menu or tab so they are active as soon as the menu is opened. The right-hand fields of a menu table (white background) can be edited. Table lines without any input option but with a black triangle are headers with several sub-items that can be expanded or compressed:

➢ To move the control frame to a line use the rotary knob or the cursor up/down keys.

➢ Press *ENTER* to select a line and start editing. Numerical values can be entered as described in section *Input of Numbers* on page 3.9. Alternative settings can be selected using the rotary knob.

➢ Press *ENTER* to confirm an entry and quit the table line.

➢ Press *ESCAPE* or another key to discard your entry and release the table line.

➢ Select a header line and press the rotary knob to expand (show) or compress (hide) a table section. Press the *ON/OFF* key to expand all compressed tables in the menu.

Measurement Control

This section gives a brief survey of the R&S® CBT's measurement control using the function group *RF Non Signalling* as an example. This includes a discussion of the different measurement modes and measured quantities. Settings and measurement parameters frequently encountered are explained from a general point of view.

The formal aspects of measurement control are discussed in more detail in Chapter 5 *(Remote Control – Basics)*.

The menus of the graphical user interface can be arranged in different ways. According to their tasks, they form the following groups:

- The function groups *RF* and *Bluetooth.* Both function groups are supplied with the firmware for the R&S® CBT base system.
- The two signalling modes *Signalling* and *Non Signalling.* The signalling properties are specific to Bluetooth and the devices under test.
- General configurations *(Connection Control),* configurations specific to a measured quantity *(Power Configuration, Modulation Configuration* etc.), and menus to display the results of the measurement *(Power, Modulation* etc.).

In a more formal sense, the R&S® CBT uses measurement menus, popup menus, table menus, and graphical measurement menus and dialog windows of various sizes. This aspect is discussed in the preceding sections.

Test Modes

Bluetooth measurements are performed in one of the two modes *Signalling* or *Non Signalling*. The *Non Signalling* mode can be used to generate an RF signal with Bluetooth specifications and to configure the RF inputs and outputs of the R&S CBT. The *Signalling* mode serves to measure the performance of the Bluetooth device under test (DUT) under realistic operating conditions where the R&S CBT mimics a Bluetooth master.

Definition

The term signalling denotes all actions necessary to establish, control and terminate a communication between the Bluetooth master (R&S CBT) and the DUT. The signalling messages conveyed allow the Bluetooth device and the network to discuss the management of issues either related to the user or concerning technical aspects of the communication.

Non Signalling Mode

In the Bluetooth *Non Signalling* mode, the R&S CBT generates an RF test signal with Bluetooth specifications, i.e. a Bluetooth packet with variable level, frequency and payload. It is possible to configure the RF inputs and outputs of the R&S CBT but no measurements can be performed.

Signalling Mode

In the *Signalling* mode, when pressing the Inquiry button, the R&S CBT transmits an inquiry signal to detect connectable Bluetooth devices within its domain. From the list of devices compiled during this stage, one target device can be selected for paging. The R&S CBT transmits a signal to synchronize and attempt a connection to the target device. After the connection is established, the DUT can be placed either into its internal test mode or into one of the submodes *Audio, Sniff, Hold, Park.* In the submodes special measurements can be carried out.

The R&S CBT is able to configure a broad range of network and test mode parameters and to determine the parameters characterizing the Bluetooth device under test. Measurements of the burst power versus time, the modulation parameters, and the receiver quality.

Configurations

The R&S® CBT offers a wide range of settings for input and output signals and measurements. Configurations either refer to the whole function group *(Connection Control)* or to a particular measurement.

Connection Control

The *Connect. Control* softkey is located on the right side of the title bar of each measurement and graphical measurement menu. It opens a popup menu with several tabs to configure

- The analyzer settings and input path configuration *(Analyzer)*
- The RF generator *(Generator)*
- The RF connector and the external attenuation *(RF)*
- The reference signal and system clock *(Sync.)*
- The trigger settings *(Trigger)*

All settings made in the *Connect. Control* menu apply to the whole function group and signalling mode.

Configuration of measurements

A *Configuration* popup menu offering specific settings is assigned to most measurement groups (see e.g. the *Power, Modulation, Spectrum* and *Receiver Quality* measurements in the *Bluetooth Signalling* function group). The *Configuration* menu also provides general parameters that can be defined independently in many measurement groups:

- The repetition mode, the stop condition, the statistic count and the display mode for the measurement *(Control)*
- Tolerances for the measured quantities *(Limits, Limit Lines)*

These settings are explained in more detail below (see section *General Settings* on page 3.18 ff.).

Measurement Groups

Measurement results are indicated in two different ways:

- Discrete values and parameters are displayed in output fields, lists and tables. In remote control, these results are referred to as scalars.
- Measurement curves (traces) are displayed in a Cartesian coordinate system, the time, frequency or another continuous parameter forming the x-axis scale. Power results are usually plotted in semi-logarithmic diagrams. Relatively small sets of test points are generally viewed in a bar graph. In remote control, results of this type are referred to as arrays.

While the measurement is running in repetition mode *continuous* (see page 3.18), the indicated results are constantly updated. Each function group and measurement mode comprises a particular selection of measurement groups. The measurements belonging to function group *RF (Non Signalling)*, *Bluetooth,* and *Audio* are shown in the following table.

Table 3-4 Measurements in function group *RF (Non Signalling)*

Measurement	Function
Analyzer/Generator	Shows the settings for the signals generated and analyzed by the instrument, the generator status, and the state of the RF analysis. Moreover the current analyzer power can be measured with different filters.

Table 3-5 Measurements in *Bluetooth* function group

Measurement	Functionality
Overview	Indication of the scalar *Power, Modulation,* and *Receiver Quality* results and display of the most important signalling parameters.
Power – Output Power	Measurement of the transmitter output power of the Bluetooth DUT as a function of time with evaluation of the nominal power, peak power, leakage power and packet timing plus a power control check. A statistical evaluation and a limit check is done for the measured quantities (except the power control check).
Power – Relative Power	Measurement of the transmitter output power of the Bluetooth DUT as a function of time, evaluated separately for the *GFSK* and *DPSK* portions of EDR packets, and with a calculation of Relative Power ($P_{DPSK} – P_{GFSK}$) and the guard time. A statistical evaluation and a limit check is done for the measured quantities. This application is only available after installation of the EDR options (R&S CBT-B55/K55).
Modulation – GFSK	Measurement of the frequency deviation over the whole Bluetooth packet and calculation of the frequency accuracy, the frequency drift, the maximum drift rate and a conformance check for the bits satisfying a threshold condition for the frequency deviation. A statistical evaluation and a limit check is done for all modulation results. For EDR packets, this measurement is only made over the GFSK portion of the packet.
Modulation – DPSK	Measurement of the frequency stability and modulation accuracy (DEVM) over the DPSK portion of EDR packets, along with a conformance check for symbols satisfying a threshold condition for DEVM. A statistical evaluation and a limit check is done for all modulation results. This application is only available after installation of the EDR options (R&S CBT-B55/K55).
Modulation – Encoding	Measurement of the Bit Error Rate and the percentage of packets that the R&S CBT received with zero bit errors while the Bluetooth EUT operates in *TX Tests* mode. This application is only available after installation of the EDR options (R&S CBT-B55/K55).
Modulation – I/Q Analyzer	Display of the constellation points (or vector diagrams) for the DPSK modulated portion of the EDR bursts. This application is only available after installation of the EDR options (R&S CBT-B55/K55).
Modulation – Phase Difference	Calculation of the normalized phase difference of each symbol relative to the preceding symbol. This application is only available after installation of the EDR options (R&S CBT-B55/K55).
Spectrum – ACP	Measurement of the output RF spectrum emissions in the frequency domain. The measurement yield the Adjacent Channel Power (ACP) in 3 upper and 3 lower adjacent channels.
Spectrum – 20 dB Bandwidth	Measurement of the width of the frequency band around the peak of the emissionwhere the transmit power drops by less than 20 dB.
Spectrum – Frequency Range	Calculation of the lower and upper limit frequencies where the signal power crosses a specified power threshold.
Receiver Quality – BER **Receiver Quality – BER Search**	Measurement of the bit error rate and the packet error rate at variable receiver input level of the DUT (application *BER)* or search for the receiver input level corresponding to a particular bit error rate (application *BER Search)*. A broad range of parameters configure the *Receiver Quality* measurements; up to five different configurations can be stored in separate (and pre-configured) *Test Setups*. With the EDR options (R&S CBT-B55/K55) the R&S CBT also supports Receiver Quality tests on EDR packets.

Table 3-6 Measurements in function group *Audio* (with option R&S® CBT-B41)

Measurement	Function
Analyzer/Generator	Generates a single-tone sinusoidal audio signal and measures the DC and AC voltage and the Total Harmonic Distortion and Noise of a single-tone audio signal.
Multitone	Generates a composite audio signal consisting of up to 20 individual fixed-frequency tones with configurable frequency and level. An audio signal containing the same tones can be analyzed in a single measurement and displayed in a bar chart. A limit check is provided for all results.
THD	Provides a single-frequency audio test signal with adjustable power and very low harmonic distortion and measures the AF power at the generator frequency (1st harmonic labeled d1) and at the 2^{nd}, 3^{rd} …9^{th} harmonics. These results yield the Total Harmonic Distortion, defined as the ratio of the summed up power of the 2^{nd}, 3^{rd} … 9^{th} harmonics to the power of all harmonics including the fundamental signal.

General Settings

A number of settings can be made in several of the configuration menus assigned to the individual measurement groups. In combination, these settings define the scope of each measurement, i.e. the number of results acquired and the type of results displayed. The following brief overview is intended to avoid confusion of terms.

Application

Applications are different measurements belonging to the same measurement group. They effectively split up a measurement group into various related subgroups which can be configured separately.

They are selected via the *Application* softkey in the measurement menus.

Statistic Count / Statistics Cycle

The statistic count is equal to the integer number of evaluation periods which form one statistics cycle. In Bluetooth measurements, an evaluation period corresponds to the duration of a Bluetooth packet comprising up 1, 3, or 5 timeslots. Together with the *repetition mode* and the *stop condition,* the statistic count determines when exactly the measurement is stopped.

The *statistic count* is set in the *Control* tab of the configuration popup-menus assigned to the measurement groups *Power, Modulation* and *Receiver Quality.*

Repetition Mode

The *repetition mode* defines how many statistics cycles are measured if the measurement is not stopped by a limit failure (see stop condition *On Limit Failure* below). Two modes are available for all measurements:

Single Shot The measurement is stopped after one statistics cycle

Continuous The measurement is continued until explicitly terminated by the user; the results are periodically updated

A third repetition mode is available in remote control:

Counting Repeated single shot measurement with a fixed number of statistics cycles

The *repetition mode* is set in the *Control* tab of the measurement configuration popup-menus.

Note: *In contrast to other instrument settings, the repetition modes in manual and remote control are independent and do not overwrite each other. The default repetition mode in manual control is* Continuous *(observe results over an extended period of time), the* *default mode in remote control is* Single Shot *(perform one measurement and retrieve results).*

Stop Condition

For measurements providing a limit check, two stop conditions can be selected:

None The measurement is performed according to its repetition mode, regardless of the measurement results.

On Limit Failure The measurement is stopped as soon as one of the limits is exceeded, regardless of the repetition mode set. If no limit failure occurs, it is performed according to its repetition mode.

The *stop condition* is set in the *Control* tab of the measurement configuration popup-menus.

Display Mode

In graphical measurement diagrams, the *display mode* defines which of the measured and calculated curves (traces) is displayed if the measurement extends over several evaluation periods. In general, traces are evaluated at a set of fixed, equidistant test points (samples). After n evaluation periods, n measurement results per test point have been acquired. After a single shot measurement extending over c periods, c measurement results per test point have been acquired.

Current The current burst, i.e. the last result for all test points, is displayed.

Minimum At each test point, the minimum value of all bursts measured is displayed.

Maximum At each test point, the maximum value of all bursts measured is displayed.

Average At each test point, a suitably defined average over all bursts measured is displayed; see paragraph on *Calculation of average quantities* below.

Note the difference in the calculation of *Average* on one hand, *Minimum, Maximum* and *Max./Min.* on the other hand, if the measurement extends over more than one statistic count (repetition mode *Continuous,* measurement time longer than one statistic count).

After evaluation of the different traces, the burst power is logarithmized and plotted in a semi-logarithmic diagram.

The *display mode* is set in the *Control* tab of the measurement configuration popup-menus.

Calculation of average quantities

The *Average* traces in the *Power* and *Modulation* menus are obtained as follows:

Let c be the number of evaluation periods forming one statistics cycle (one *statistic count)* and assume that n periods have been measured since the start of the measurement. In calculating the *Average* trace, the following two situations are distinguished:

$n \le c$ Single shot measurement or continuous measurement during the first statistics cycle: At each test point, *Average* trace no. n is calculated from *Average* trace no. n – 1 and *Current* trace no. n according to the following recurrence:

$$Avg(n) = \frac{n-1}{n} Avg(n-1) + \frac{1}{n} Curr(n) \qquad (n = 1, \ldots, c)$$

Equation 3-1

The *Average* trace represents the arithmetic mean value over all n evaluation periods measured.

$n > c$ Continuous measurement after the first statistics cycle: At each test point, *Average* trace no. n is calculated from *Average* trace no. n – 1 and *Current* trace no. n according to:

$$Avg(n) = \frac{c-1}{c} Avg(n-1) + \frac{1}{c} Curr(n) \qquad (n > c)$$

Equation 3-2

The formulas hold for n = 1 where the average trace becomes equal to the current trace (statistics off). Scalar quantities are averaged in analogy to *Average* traces.

Calculation of statistical quantities

In *Power* and *Modulation* measurements the statistical functions *Average, Minimum,* and *Maximum* are applied to a set of test points depending on two independent parameters:

- The time, i.e. the abscissa values t_i, i ranging from 1 to the total number of test points comprising the trace.
- The packet number ranging from 1 to the number n of the current packet.

The result of the statistical operations depends on the parameter range considered and – in the case of statistics functions evaluated over several parameters – on the order of evaluations. This is why the definition of statistical quantities deserves some attention and is explained in the relevant sections in chapter 4.

In the *Power* menu, the quantities *Nominal Power* and *Leakage Power* represent the power averaged over different areas of the packet, i.e. each measurement result corresponds to the arithmetical mean value of all test points t_i within a given time range. For each packet, these quantities are entered in the *Current* column of the output table. The results in the *Minimum* and *Maximum* column correspond to the largest and smallest of all *Current* results ever measured. The results in the *Average* column correspond to the arithmetical mean value of the *Current* results averaged according to Equation 3-1 and Equation 3-2 above.

Contents

4 Functions and their Application

This chapter explains in detail all functions of the R&S® CBT and their application. The structure of the chapter is based on the different menu groups of the instrument. It is organized like a typical measurement session including the following stages:

1. Startup menu
2. Menu selection
3. General device configurations
4. System information and hardware diagnosis
5. General RF measurements (measurements and measurement results, configurations)
6. Bluetooth measurements (measurements and measurement results, configurations)
7. Optional extensions, e.g. *Audio Generator and Analyzer* (option CMU-B41)

In contrast to Chapter 6, *Remote Control – Commands*, the measurement and results are explained first, special measurement configurations are relegated to the end of the chapter. The description of the softkeys is followed by the remote-control commands. Similarly, the description of the commands in Chapter 6 also contains the corresponding menus of the user interface.

The description of the operating concept is to be found in Chapter 3; in addition, an overview of all menus is given at the end of Chapter 3. To find information on a particular topic please refer to the index at the end of the manual.

Startup Menu

The startup menu provides information on the instrument and the installed options. It appears for a few seconds in the display after switching on the R&S® CBT and activating the operating mode (see Chapter 1, *Switching on the Instrument/Startup Test)*. While this menu is displayed, the R&S® CBT performs a startup test.

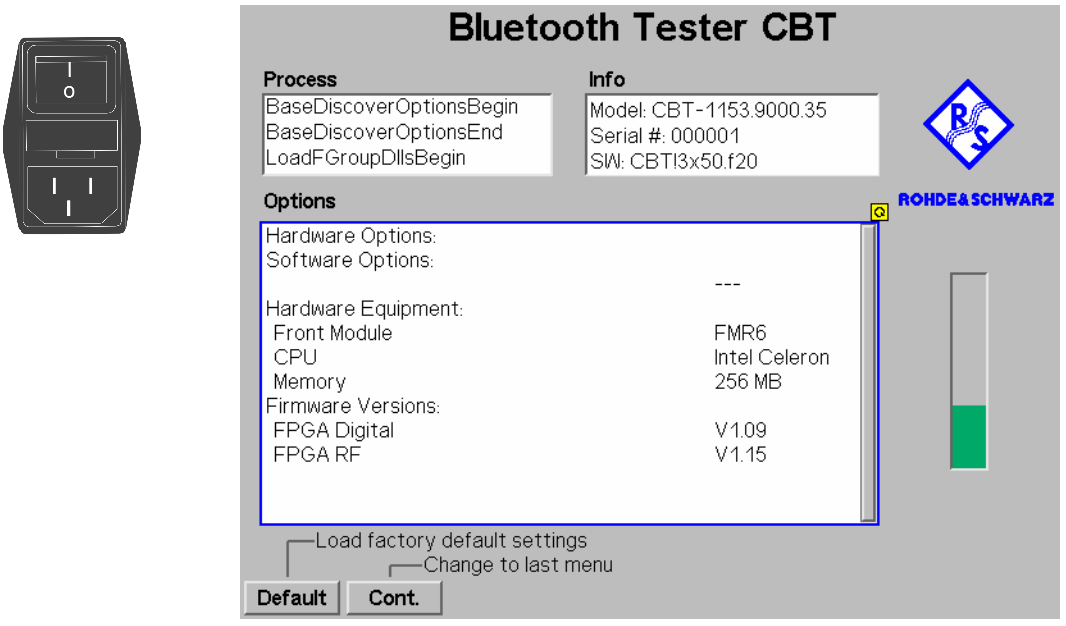


Fig. 4-1 Startup menu

Displays in the startup menu

The display windows of the startup menu provide information on

- The startup procedure (*Process).*
- Instrument model, serial number and version of the R&S® CBT base software *(Info).*
- Installed hardware and software options and equipment *(Options)*. Available software options are listed with their version numbers.
- Progress of the startup procedure (*Startup* bar graph).

After terminating the startup procedure, the instrument changes to the last main menu or graphical measurement menu of the previous session.

Hotkeys

During the startup procedure, the hotkeys of the startup menu are available.

Default

The *Default* hotkey activates the default settings of the instrument for all function groups and test modes. Alternatively, a reset can be performed any time using the *RESET* key; see section *Reset of Instrument Settings (RESET Key)* on p. 4.3.

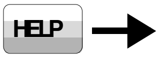
Wait

The *Wait* hotkey prevents the instrument from closing the *Startup* menu.

As a result of this, the *Wait* softkey changes to *Cont.* with the additional message *Change to last menu* displayed on top. Instead of changing to the last main menu or graphical measurement menu of the previous session the measurement can be continued by pressing a key *(Menu Select, Setup, ...*).

On-Screen Help (HELP Key)

The *Help* menu displays help on the basic menus, controls and keys. It is possible to expand and compress the topics using the *ON/OFF* key. The menu is opened via the *HELP* key *(SYSTEM keypad)*.



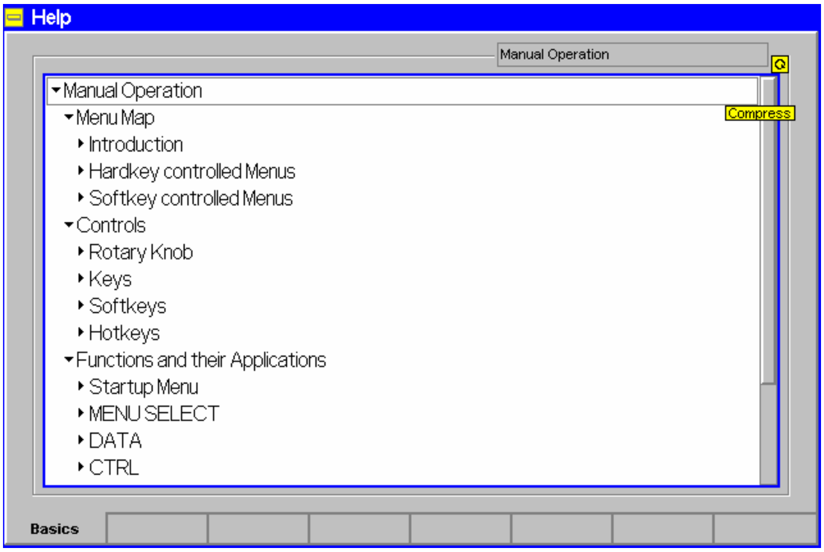


Fig. 4-2 Popup window Help

Reset of Instrument Settings (RESET Key)

The popup window *Reset* sets the instrument settings in all or some function groups and test modes to their default values. It is opened via the *RESET* key *(CONTROL keypad)*.

Note: *A reset of the instrument does not necessarily mean that the current instrument settings are lost. The R&S® CBT can store the settings in a configuration file and re-use them in a later session; see section Saving Configurations (Data – Save) on p. 4.21..*

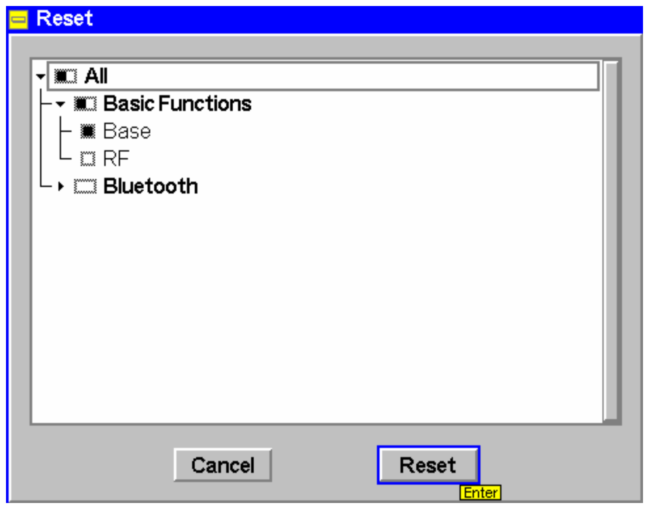


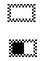
Fig. 4-3 Popup window Reset

Selection of the settings

All function groups and test modes available on the instrument are arranged in a tree view. When the popup is opened, this configuration tree is expanded and the active function group and test mode is selected.

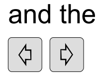
Nodes containing subnodes (e.g. function groups containing the test modes *Non Signalling* and *Signalling)* are marked with rectangular symbols, lowest-level nodes (e.g. the individual test modes within a function group) with smaller, quadratic symbols:

 The node is deselected

 The node is partially selected, i.e. some but not all of the subnodes are selected

 The entire node is selected, i.e. all of the subnodes are selected

The controls in the *Reset* window are manipulated with the roll-key, the cursor keys and the *ENTER* key:

 Toggle between the *Cancel* and the *Reset* buttons

 Toggle between the control buttons *(Cancel, Reset)* and the tree view

Roll-key Toggles between the *Cancel* and the *Reset* buttons (when turned) or activates a button (when pressed). In the tree view, the roll-key moves the control frame up and down (when turned) or expands/compresses a node (when pressed). Pressing the roll-key on a lowest-level node selects or deselects the node.

ENTER Activates a button or selects/deselects a node including all subnodes.

Reset

The *Reset* button resets all settings in the selected function groups and test modes.

A box pops up to confirm the reset. While the reset is performed, the message *Reset in progress* is displayed. All running measurements are aborted and a connection to a DUT is dropped. Then the *Reset* popup window is closed and the R&S® CBT returns to the function group and test mode that was active when the reset was initiated.

Note: *A reset of the active function group is faster because no additional software modules must be loaded.*

A reset of all instrument settings can also be performed during the startup procedure; see Default *softkey in section Startup Menu on p. 4.1.*

The reset button restores the default values for manual control. In cases where the remote control commands use distinct default values (e.g. the repetition modes) only the manual default values are restored.

Remote control
`SYSTem:PRESet[:ALL]` (base system)

Compare:	`SYSTem:RESet[:ALL]`	(default parameters in remote control, base system)
	`SYSTem:RESet:CURRent`	(default parameters in remote control, all function groups)

Cancel

The *Cancel* button cancels the selection that has been made and closes the menu. *Cancel* is selected by default when the *Reset* menu is opened.

Remote control
–

Print Menu (PRINT Menu)

The popup window *Print* permits to print the current screen as configured in the *Print* tab of the *Setup* menu. It is called up on pressing the *PRINT* key (*SYSTEM* keypad).

The screenshot is recorded immediately after PRINT is pressed. There is no danger of losing data while selecting a destination and filename.

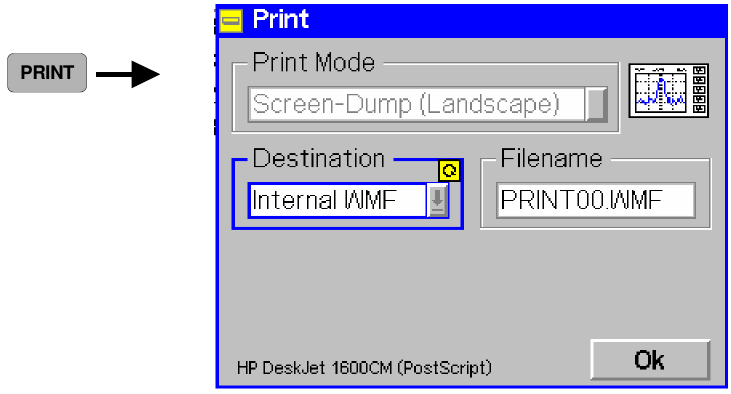


Fig. 4-4 Popup window Print

Print Mode

The *Print Mode* select field permits to specify the data type for the output:

Screen-Dump (Landscape) Copy of the current display in landscape format

An example of a screen-dump copy is shown in a preview to the right of the select field.

Destination

The *Destination* select field permits to specify the output destination for the data:

Printer Output to external printer connected via the parallel or the serial interface. The printer is configured in the *Setup – Print* tab; see p. 4.8.

Internal Storing in the current printer format to directory Internal\userdata\print\<Dir> where <Dir> is the target directory specified in the *Filename Default* input field of the *Setup – Print* tab. If <Dir> is not explicitly defined, the files are written to Internal\userdata\print.

Internal WMF Storing in *.wmf format.

Filename

If the data is to be written to a file, a file name can be specified in the *Filename* input field. By default, print files are stored with the file name defined in the *Setup – Print* tab (see p. 4.8). The question marks (??) in this default name are replaced by current numbers starting with zero (auto-increment function). If a file name used before is specified, or if a file where the question mark has been replaced by "99" is already stored in the target directory, a message box *Print: overwrite existing file Yes/No* pops up. Pressing *No* aborts the print procedure and closes the *Print* popup menu.

Note: *A third question mark in the file name extends the auto-increment function so that up to 999 print files can be stored. Keep in mind the capacity of the internal hard disk when using this feature.*

Comment

The input field *Comment* contains a comment (comprising up to 160 characters) for the current output. This field is not available if a *.wmf output is generated. When the output is sent to a printer the comment is written across the upper edge of the page.

Printer format

The current printer format is indicated below the *Comment* input field. To change this format, open the *Setup –print* tab (see p. 4.8) to select another printer.

Ok

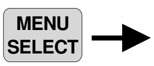
The *Ok* button starts the data output and closes the *Print* menu.

To cancel the print process while preserving the current settings and close the *Print* menu press the *PRINT* key again.

Remote control
–

Menu Select

The *Menu Select* menu gives an overview of all available measurements that can be selected and called up directly from the menu. The measurements are arranged in tables showing their hierarchical structure. *Menu Select* appears after termination of the startup procedure of the R&S® CBT or after pressing the *Menu Select* key. It is closed after selection on pressing the *ENTER* key or the *MENU SELECT* key again. The *ESCAPE* key discards the current selection.



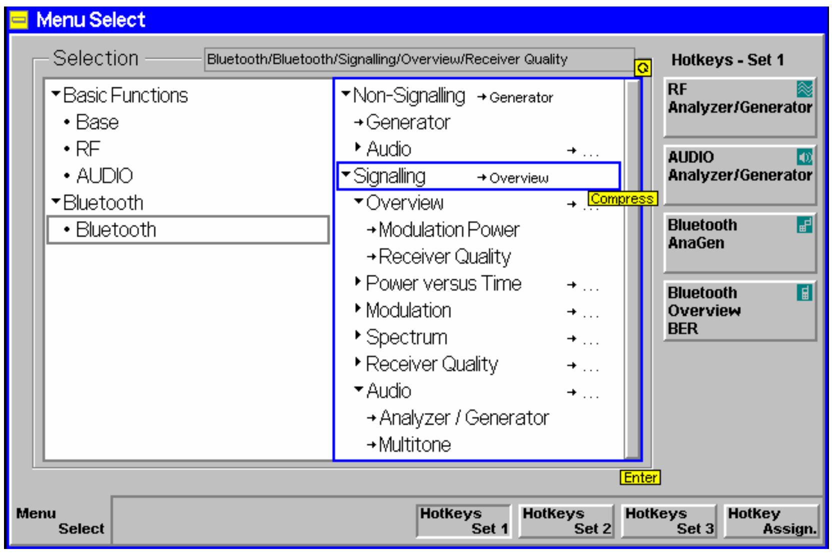


Fig. 4-5 Menu Select

Selection table: function groups

The left half of the *Selection* table contains all function groups available on the instrument. The R&S® CBT performs general RF measurements accessible via the function group:

RF	RF measurements, see below in this chapter

Specific Bluetooth measurements are performed within the function group:

Bluetooth	All types of Bluetooth version V1.1 and V2.0 measurements, see below in this chapter

Selection table: test modes and menus

When a function group is selected, the measurements within this group are displayed in the right half of the table. A measurement generally consists of measurement menus and specific configuration menus. A complete graphical overview of all menus of the R&S® CBT basic system and the function groups *RF* and *Bluetooth* can be found at the end of Chapter 3 in this manual.

The *Bluetooth* function group is divided into two independent test modes:

Non Signalling	Module tests; measurements without transmission of signalling parameters and call setup.
Signalling	Measurements with signalling and call setup to the device under test.

The test modes form the header lines of expandable table sections. A measurement may be available in both test modes of a function group, therefore, to uniquely define a measurement, it is necessary to specify its name, the test mode (if applicable) and the function group.

Hotkey Assign.

The *Hotkey Assign.* hotkey activates the assign mode used to assign a softkey to the function group, signalling mode and measurement menu currently selected.

The three softkeys of the *Menu Select* menu belonging to *Hotkeys Set 1* have a default assignment. In normal mode, each hotkey gives direct access to the menu assigned to it. Another two sets, each containing six softkeys, can be accessed by pressing the *Hotkeys Set 2* or *Hotkeys Set 3* hotkeys, respectively.

In the assign mode, the *Hotkey Assign.* softkey turns into *Exit Assign.* softkey and *Hotkey Assignment* is displayed in the header of the *Menu Select* menu.

➢ To assign a softkey (or to change the current assignment), select the desired function group, mode and menu, and press *Hotkey Assign.* followed by the softkey. Press *Exit Assign.* to quit the assign mode.

➢ To cancel a hotkey assignment, press *Hotkey Assign.* followed by the *DEL* (delete) key and the softkey. Press *Exit Assign.* to quit the assign mode.

Note 1: *An empty configuration (all hotkeys de-assigned) will not be stored after* Exit Assign. *Instead the R&S® CBT restores the default hotkey assignment of the current function group.*

Note 2: *A user-defined assignment is retained even after a Reset of all function groups* (Reset *key, see p. 4.3).*

Remote control
The R&S® CBT uses extended addressing: The instrument itself is identified by the primary GPIB address. Moreover, a secondary address must be assigned to any combination of a function group and a signalling mode. This is done with the command

```
SYSTem:REMote:ADDRess:SECondary <Address>,<FGrp>|NONE
```

Primary and secondary address handling is described in the remote control Chapters (in particular, refer to chapter 5 and the program examples in chapter 7).

Hotkeys Set 1

The *Hotkeys Set 1* hotkey selects the softkey set 1 for display. The hotkey is active in normal mode and in assign mode; see description of previous hotkey.

The two hotkeys *Hotkeys Set 2* and *Hotkeys Set 3* are analogous to *Hotkeys Set 1.*

Bluetooth AnaGen

The labeling of each softkey on the right side of the menu contains the function group, an icon indicating the test mode, and the measurement assigned to the softkey. The function of the softkeys is as follows:

- In normal mode, pressing a softkey calls up the corresponding measurement.
- In assign mode, pressing a softkey assigns this softkey to the measurement selected in the *Selection* table. Pressing the *DEL* (delete) key and then the softkey cancels the current assignment.

Popup Menu Setup

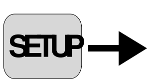
The popup menu *Setup* contains several tabs used to adapt the R&S® CBT to user requirements. The menus are opened by pressing the *Setup* key. It is possible to change between the tabs by pressing the associated hotkeys.

Printer Settings (Setup – Print)

The *Setup – Print* menu controls the output of data from the R&S® CBT to a printer or a storage medium. The following configurations are provided:

- Printer type and port selection *(Printer)*
- Page settings for the selected printer *(Page Settings)*
- A header for the printed page *(Header)*
- Default file name and directory *(Filename Default)*

Some of the *Setup – Print* configurations serve as default settings and can be modified in the *Print* popup menu before the print process is started (see p. 4.4).



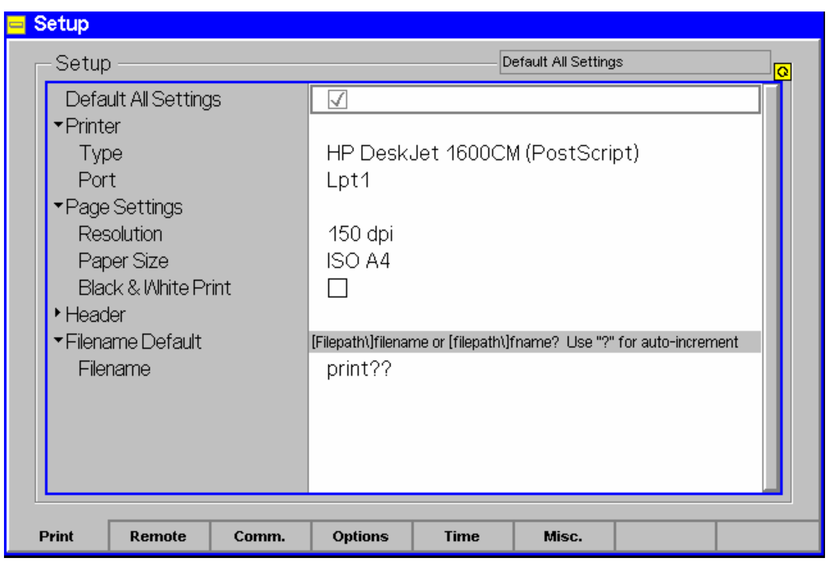


Fig. 4-6 Printer configuration menu (Setup – Print)

Default Settings The *Default All Settings* switch assigns default values to all settings in the *Print* tab (the default values are quoted in the command description in Chapter 6 of this manual).

Printer The *Printer* table section selects a printer type and the printer port. The connection of a printer is described in Chapter 1.

Page Settings The *Page Settings* section activates the input of the page settings for the selected printer.

Resolution	Fixed 150 dpi printer resolution
Paper Size	Selection of ISO A4 or US LETTER paper
Black & White print	Color (check box off) or black & white printer

Header

The *Header* section defines and activates header for the printed page.

Print header — Print the header defined in the *Header Text* input field when a page is printed. An additional comment for every single page can be defined in the *Print* popup menu (see p. 4.4).

Header Text — Input field for a header with a maximum length of two lines.

Print Date & Time — Inclusion of the current date and time in the header, provided that a header is to be printed.

Filename Default

The *Filename Default* section defines a default file name and directory for an output that is written to an internal or external storage medium.

It is possible to specify a path separated from the filename by a backslash "\" in order to create a directory structure on the storage medium. This path is relative to directory Internal\userdata\print of the R&S® CBT hard disk *(Internal* storage).

Auto-increment function

A question mark within the file name is replaced by current numbers that are automatically incremented, starting with zero. The file name *PRINT??* means that the first file stored will be *PRINT00*, the next one will be *PRINT01* etc. To create more than 100 different print files, another name or destination must be specified.

Note: *A third question mark in the file name extends the auto-increment function so that up to 999 print files can be stored. Keep in mind the capacity of the internal hard disk when using this feature.*

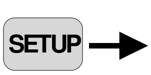
Remote control

–

Remote-control Settings (Setup – Remote)

The remote-control menu *(Setup Remote)* defines the remote-control parameters of the R&S® CBT:

- Selection of the interface *(SCPI-Connection)*,Setting of the IEC-bus address of the R&S® CBT *(Primary Address)*,
- Selection of the desired function group *(Second. Address)*.



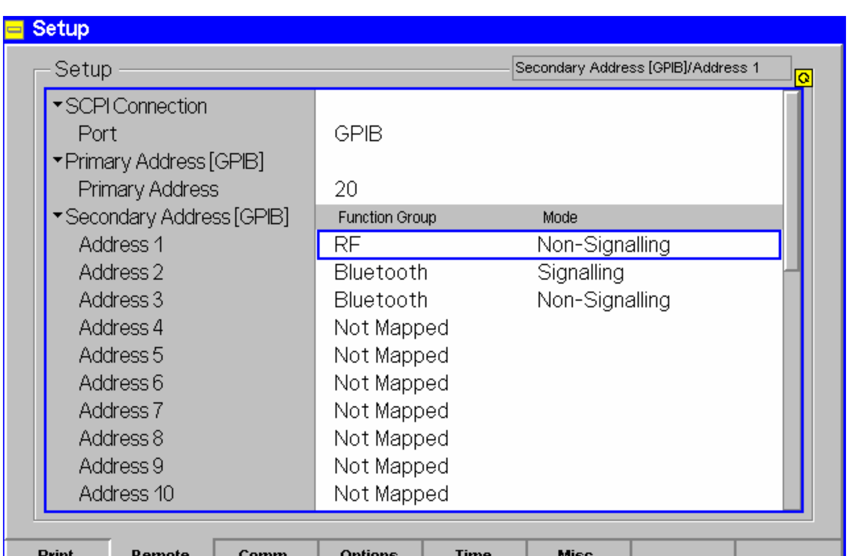


Fig. 4-7 IEC-bus menu

SCPI Connect

The *SCPI Connection* section determines the remote-control interface of the R&S® CBT.

The following interface settings are available:

GPIB + COM1	Auto-detection of the interface, the instruments accepts commands from either the GPIB or COM 1 interface
GPIB	IEEE-bus interface according to IEEE 488
COM 1	Serial (RS-232-C) interface COM 1

For the characteristics of the interfaces see Chapter 1 and Chapter 8, "Hardware Interfaces".

Primary Address [GPIB]

The *Primary Address* section sets the IEC-bus address of the R&S® CBT. The default setting is 20; addresses 0 to 30 can be assigned.

The IEEE-bus address is addressed in the remote-control commands in the form of the associated primary address, see Chapter 5, *Switchover to Remote Control*, and Chapter 7, *Program Examples*.

Remote control

```
SYSTem:COMMunicate:GPIB[:SELF]:ADDRess  0 to 30
SYSTem:REMote:ADDRess:PRIMary  0 to 30
```

Secondary Address [GPIB]

The *Secondary Address* section assigns secondary addresses to up to 29 function group and test mode combinations (secondary address 0 is always mapped to the base system; no re-mapping is possible). The available function groups (e.g. *RF Non Signalling*, *Bluetooth Signalling* etc.) can be displayed and selected with the roll-key after an *Address n* field is activated. The default assignment of secondary addresses can be changed e.g. to re-use remote control scripts developed for an R&S CMU.

The network and the test (signalling) mode are addressed in the remote-control commands in the form of the associated *secondary address*, see Chapter 5, *Setting the Device Addresses,* and Chapter 7, *Program Examples*.

Remote control

```
SYSTem:REMote:ADDRess:SECondary  1 to 29,<FgrpName> | NONE
```

Local/Remote Mode: Disconnect on Loc ➠ Rem

Defines the behavior of the R&S® CBT in a local to remote transition. The command is valid for all function groups and test modes, however, its effect depends on the test mode *(Signalling* or *Non Signalling* tests):

Disconnection on (box checked)	In *Signalling* mode, the connection or call is dropped and the R&S® CBT returns to its default signalling state *SBY*. In *Non Signalling* mode, all generators are switched off.
Disconnection off	In *Signalling* mode, all signalling states are maintained. This makes it possible to switch the instrument to remote control without dropping a call or connection. In *Non Signalling* mode, the current operating state of all generators is maintained.

Remote control

```
SYSTem:GTRMode:COMPatible ON | OFF
```

Local/Remote Mode: Task Priority Management

Determines the behavior of the R&S® CBT if conflicting measurements are run in parallel.

Task Priority Management

On (box checked) All measurements are releasable: A new measurement has priority over a running measurement.

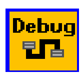
Off All measurements are persistent: A running measurement has priority over a new measurement.

The *Task Priority Management* setting is not changed after a reset.

Remote control
`SYSTem:REMote:TPManagement ON | OFF`

Local/Remote Mode: Remote Debug Mode

Switches the remote debug mode on or off. A debug icon indicates that the debug mode is on.



In remote debug mode, the MMI can be used to visualize, monitor, or check the results of measurements controlled via the remote interface. To make this possible, the behavior of the instrument with respect to measurement and generator control, measurement statistics, and signalling is changed; see section *Remote Debug Mode* on p. 4.12.

When the remote debug mode is enabled or disabled, the current measurement is reset and the instrument settings are adjusted according to Table 4-1 on p. 4.12. The remote debug mode has no impact on the measurement performance of the instrument. It is not changed after a reset but disabled when the R&S CBT is re-started.

Remote control
`SYSTem:REMote:RDMode ON | OFF`

Report – Display

If *Report Display* is enabled (box checked), the input and output strings of the remote-control interface are displayed on the *Remote* screen. The remote display consists of three columns:

<Input/output> Colored symbols for input (–>) to the R&S® CBT, output (<–) or error messages (E).

Fct. Grp. Name of the addressed function group; see description of command `SYSTem:REMote:ADDRess:SECondary` in Chapter 6.

Command Input command string, response/output string of the R&S® CBT or error message.

This parameter is also available as a hotkey in the remote screen; see chapter 5.

Remote control
`TRACe:REMote:MODE:DISPlay ON | OFF`

Report – File

Report File can be activated (box checked) to write the input and output strings of the remote-control interface to a file named Remote.trc in the root directory of the internal hard disk *(INTERNAL* directory in the *Data* menu or directory C:\temp). The two parameters *Report Display* and *Report File* may be enabled (checked) at the same time.

This parameter is also available as a hotkey in the remote screen; see Chapter 5.

Remote control
`TRACe:REMote:MODE:FILE ON | OFF`

Remote Debug Mode

The remote debug mode is activated in the *Remote* tab of the *Setup* menu; see above. In this mode, the MMI can be used to visualize, monitor, or check the results of measurements controlled via the remote interface. To make this possible, the properties of the generators, measurements, and signalling are changed as follows:

Table 4-1 Differences between manual and remote debug mode

Parameter	Manual control	Remote debug mode
Measurements	Started automatically when the menu is opened. Aborted on leaving the menu in order to free the resources. Only measurements in a common menu can be running at the same time.	Measurement state as defined in the remote control script; it is not changed on switching from remote to local and vice versa. Non-conflicting measurements can be running at the same time (see also section *Task Priority Management* in Chapter 5).
Measurement statistics: Repetition Stop Condition	Default settings: Continuous (results updated continuously) None (no stop on error)	Default settings: Single shot (results acquired once) Stop on error
Generators	Generators required for a measurement are automatically started when the measurement menu is opened. They are aborted on leaving the menu in order to free the resources. Only generators in a common menu can be running at the same time.	Generator state as defined in the remote control script; it is not changed on switching from remote to local and vice versa. Non-conflicting generators can be running at the same time (see also section *Task Priority Management* in Chapter 5).
Signalling (for network tests)	*Connection Control* menu opened automatically when a *Signalling* function group is accessed. *BS Signal* (for mobile / UE tests) switched on.	No Connection Control menu opened. *BS Signal* must be switched on explicitly.

The following **example** illustrates the properties of the remote debug mode after a remote to local transition (the opposite local to remote transition is analogous).

`RF: CONF:SPEC:CONT:REP CONT, NONE, NONE`	Configure the spectrum measurement to run in continuous mode
`RF: INIT:SPEC`	Start the spectrum measurement
`RF: INIT:POW`	Start a power vs. time measurement
`GOTO LOCAL`	Switch over to local control

Result: Remote debug mode off	**Result: Remote debug mode on**
Active menu: *Power vs. Time* The measurement runs in continuous mode (results are updated continuously; the results acquired in the first single shot are lost). The *Spectrum* measurement is switched off.	Active menu: *Power vs. Time* The measurement is in the *HLT* state (the results acquired in the first single shot are displayed). The *Spectrum* measurement runs in the background.

Serial Interfaces (Setup – Comm.)

The interface menu *(Setup Comm.)* defines the transmission parameters of the serial outputs COM 1 and COM 2.

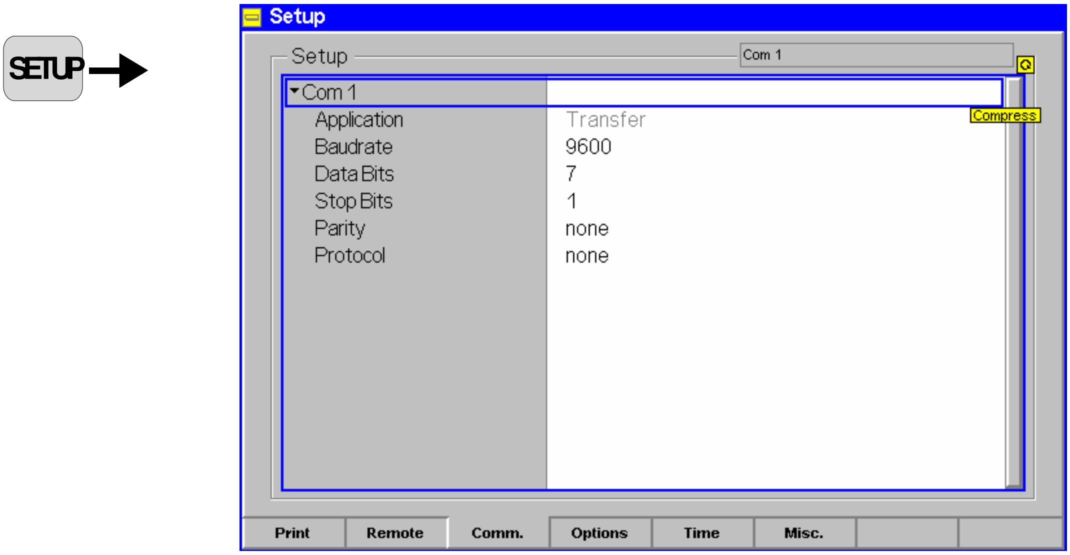


Fig. 4-8 Interface menu

COM 1 The COM 1 section defines the transmission parameters for the serial interface COM 1.

If required, the transmission parameters must be set such as to comply with the parameters of the addressed device (PC etc.). The interface characteristics are explained in detail in Chapter 8, *Hardware Interfaces*. The individual parameters are presented in *Table 4-2* below.

The *Application* field indicates whether the serial port is used as a printer connector *(Printer,* if COM 1 was selected as printer port in the *Print* tab; see p. 4.8) or for data transfer to the controller *(Transfer*, default setting). This parameter can not be changed in the *Comm.* tab.

Remote control
```
SYSTem:COMMunicate:SERial1:APPLication
SYSTem:COMMunicate:SERial1:TRANsmit:PACE... etc.
```

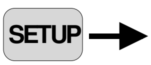
Table 4-2 Transmission parameters of the serial interfaces

Parameter	Meaning	Value range
Application	Addressed device	Transfer | Printer (fixed setting)
Baud Rate	Data transmission rate	110 | 300 | 600 | 1200 | 2400 | 4800 | 9600 | 19200 | 38400 | 57600 | 115200
Data Bits	Number of data bits	7 | 8
Stop Bits	Number of stop bits	1 | 2
Parity	Number of parity bits	none | odd | even
Protocol	Transmission protocol	none | XonXoff | CtsRts

Hardware and Software Options (Setup – Options)

The option menu *(Setup Options)* provides information on the type of instrument and the installed options, equipment and firmware versions *(Software Options, Hardware Options, Hardware Equipment, Firmware Versions)*. New software options purchased can be enabled in this menu using a code number.

NOTE *New software options are most conveniently installed using the Remote Service Tool or VersionManager described in chapter 1.*



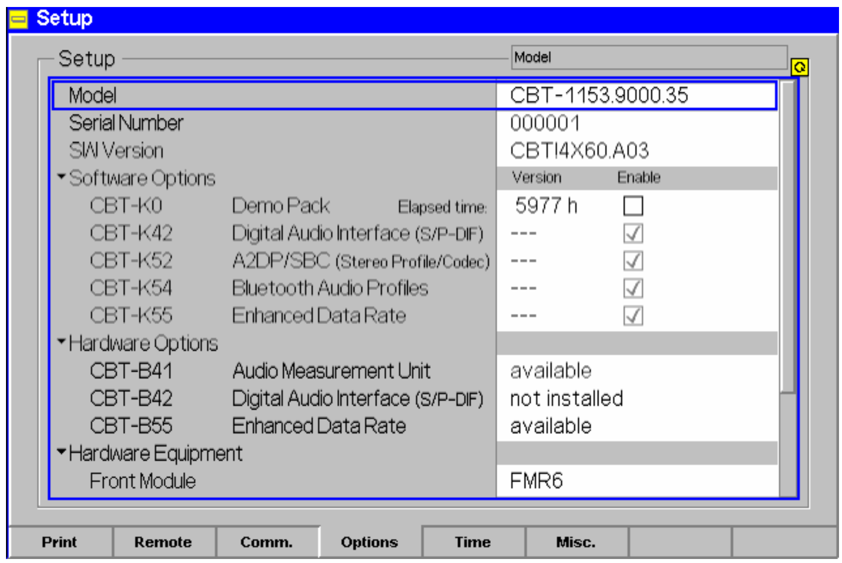


Fig. 4-9 Options menu

Info section: The three lines above the *Software Options* section contain the following information on the instrument.

Model	Instrument model
Serial No.	Serial number of the instrument
SW Version	Installed base system firmware with date of release

Remote control
`SYSTem:OPTions:INFO?`
addition information about the installed firmware options can be queried via `SYSTem:OPTions:INFO:CURRent?` in all function groups and test modes.

Software Options The *Software Options* section contains a list of all software options for the R&S® CBT. The check boxes behind each software option determine the system configuration:

Enable Enable (box checked) or disable software option. Options purchased with a new unit are already enabled. Software options purchased later must be explicitly enabled with a key code to be functional; see below.

Remote control
`SYSTem:OPTions?`
`*OPT?`

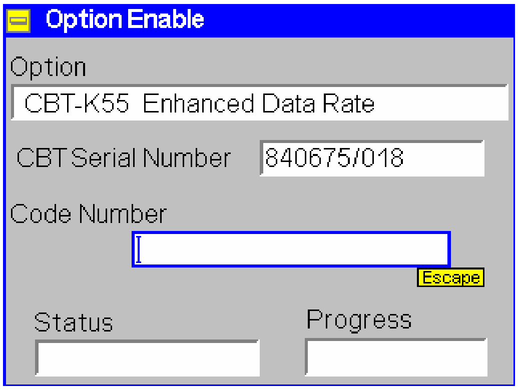
Enabling software options

Software options can be enabled or disabled in the *Enable* check boxes of the *Software Options* table. As all software options are already included in the firmware, enabling does not require any re-installation, but only a key code which is supplied with the option.

➢ Select the respective line in the list of software options.

➢ Press the *Enter* key.

The popup window *Option Enable* appears on the screen:



The *Option Enable* window contains the following fields:

Option	Short designation and name of option
CBT *Serial Number*	Serial number of the CBT basic instrument
Code Number	Code number of the option to be installed
Status	Indication of the next operating step to perform
Progress	Progress of the enabling procedure

Of the five fields, only the *Code Number* can be edited. The name of the option being enabled and the serial number of the CBT are automatically entered into the corresponding fields.

➢ Enter the code number of the option in the input field *Code Number*.

➢ Confirm the entry using *Enter*.

The option is automatically enabled.

Demo Pack option

The *Demo Pack* option R&S CBT-K0 enables the instrument as a demo unit for the first 1000 hours of its operation. The demo unit has all other installed software options enabled.

Elapsed Time shows the total number of operating hours of the instrument. This value is updated every time the instrument is re-started. After 1000 hours of operation have elapsed, it is no longer possible to enable the demo pack option (the *Enable* check box is gray and cleared).

Remote control

```
SYSTem:OPTion:ACTivation '<Key code>'
```

Hardware Equipment / Firmware Versions

The hardware accessories are listed in the *Hardware Equipment* section.

Note: *An comprehensive list of the hardware equipment of the instrument is provided in the Info menu; see p. 4.18.*

The FW version for the Digital Board (FPGA Digital) and RF Board (FPGA RF) is displayed in the *Firmware Versions* section. This information is mainly intended for service purposes.

Further information on the options can be found in the data sheet.

Remote control
```
SYSTem:OPTions?
*OPT?
```

Time Settings (Setup – Time)

The *Setup Time* tab shows and permits to change the following settings:

- The (current) time zone, time and time convention *(Time)*
- The (current) date *(Date)*

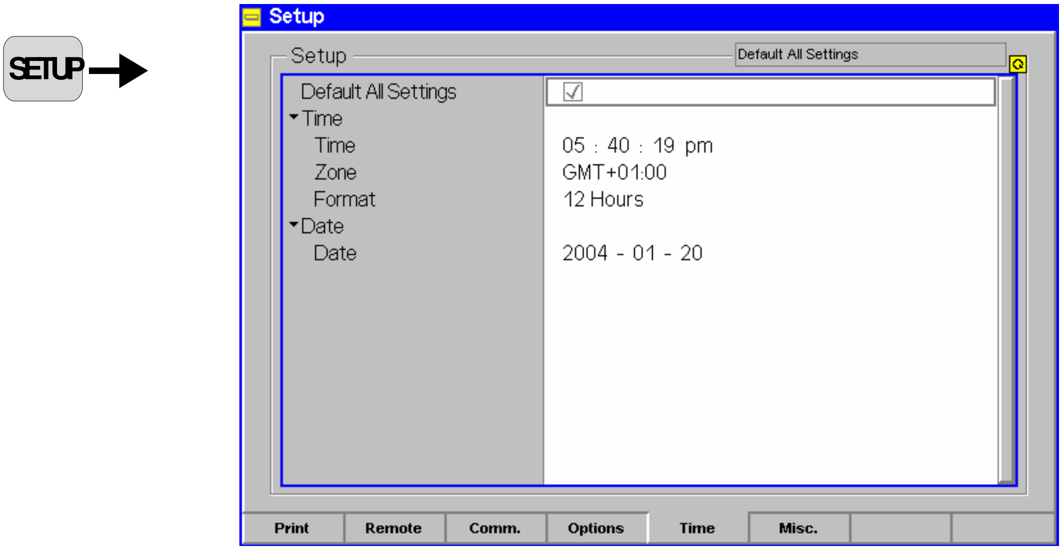


Fig. 4-10 Time menu

Default Settings

The *Default All Settings* switch assigns default values to all settings in the *Time* tab (the default values are quoted in the command description in Chapter 6 of this manual).

Remote Control
–

Time

The *Time* table section sets the current time and its display format:

hh:mm:ss.	Time in the format hours:minutes:seconds	
Zone	Selection of the time zone, Middle European time (Greenwich mean time (GMT) + 1 h) is set by default	
Format	12 Hours:	12:00:00 am ... 11:59:59 am 12:00:00 pm ... 11:59:59 pm
	24 Hours	0:00:00 ... 23:59:59

Remote control
`SYSTem:TIME:TIME`
`SYSTem:TIME:TZONe`

Date

The *Date* section defines the current date in the format yyyy-mm-dd (year-month-day).

Remote control
`SYSTem:DATe`

Acoustic Signal and Keyboard (Setup – Misc.)

The *Setup Misc.* menu activates the acoustic signal *(key beep),* configures the display, and selects the keyboard assignment *(Keyboard).*

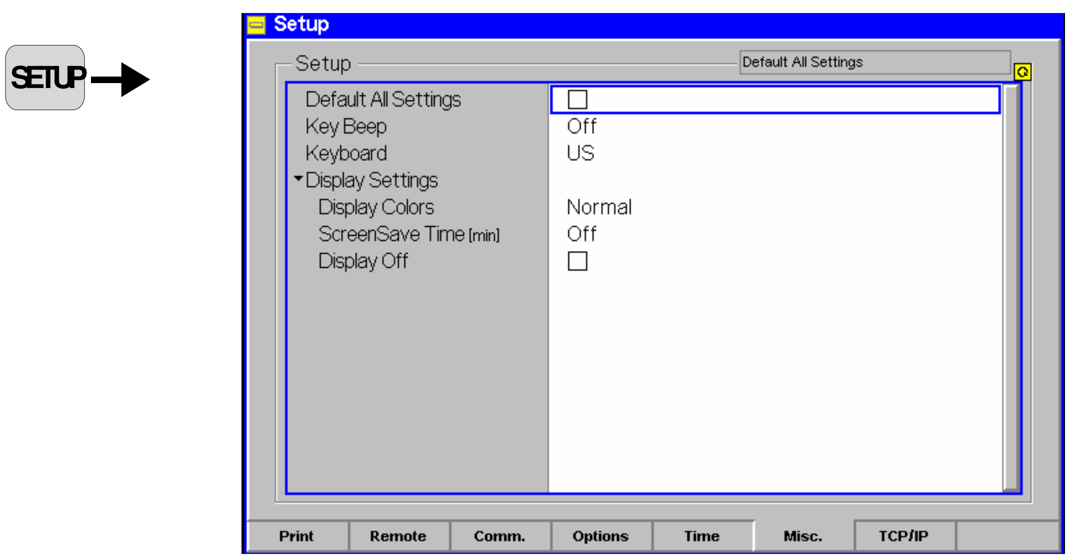


Fig. 4-11 Setup – Misc. menu

Key Beep

Key Beep switches the acoustic signal of the R&S® CBT on or off. If the key beep is *On* the R&S® CBT sends a discreet acoustic signal whenever a key is pressed. The default setting is *Off.*

Remote control
`SYSTem:MISC:KBEep`

Keyboard

Keyboard selects the keyboard assignment *(German* or *US* keyboard).

Remote control
`SYSTem:MISC:KEYBoard`

Display Settings The *Display Settings* configures the R&S® CBT LC display:

Display Color Selects the brightness of the display. In the *High Contrast* setting, the display is darker; the contrasts are enhanced.

Screen Save Time Defines a time in minutes after which the display will turn dark if no front panel key is pressed. Remote control commands have no influence on the screen saver.

Display Off Turns the display off. The display is turned on again by pressing any front panel key.

Remote control
`DISPlay[:WINDow] ON   I OFF`

System Information (Info)

The *Info* popup menu, which is opened by pressing the *INFO* key, displays comprehensive information on the instrument and its components. Part of the information is also displayed in the *Options* tab of the *Setup* menu; see p. 4.14.

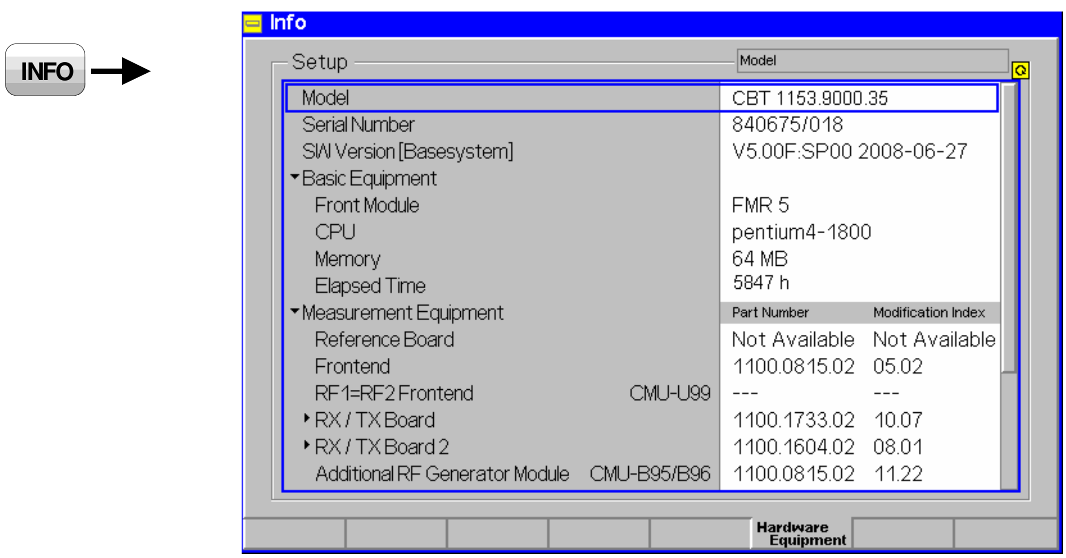


Fig. 4-12 Info – Hardware Equipment

Selftest (Maintenance)

The *Maintenance* popup menu, which is accessible via the *BASE* function group in the *Menu Select* menu, complements the *Info* menu (see p. 4.18 above) in providing service information, selftests and correction procedures that are aimed to improve particular measurements. The selftests are primarily intended for production and service purposes and therefore not needed during normal operation of the instrument. The following description serves as a general overview.

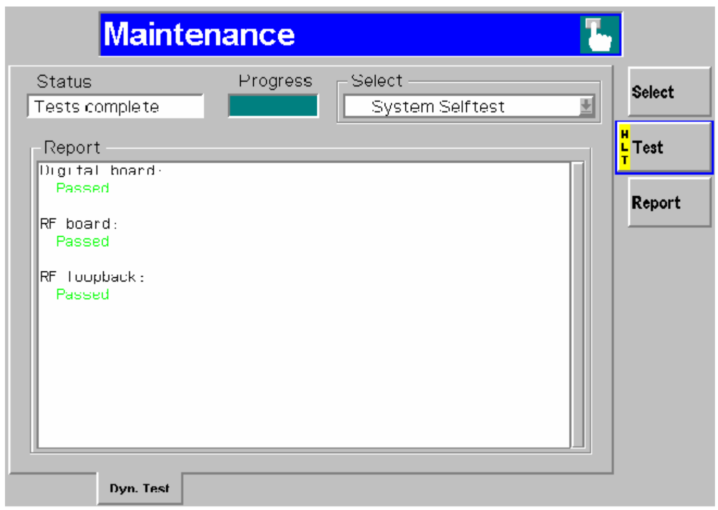


Fig. 4-13 Selftest – Maintenance menu

Select

The *Select* softkey selects the type of selftest or correction procedure to be performed.

The following tests are provided:

System Info — Provides information on the system memory and the hardware and software configuration. If *System Info* is selected and the *Test* activated (see below), the *R&S® CBT* lists all deliverable hardware and software options in the report table and indicates whether they are available on your *R&S® CBT*.

System Identity — Scans all modules and stores the part numbers and production data to file c:\identity.dat. In addition the available software versions are written to the log file C:\INTERNAL\LOG\VERSION.LOG.

Continuous Selftest — Continuous combined *System Selftest* and *Internal RF Loop* selftest. The continuous selftest is repeated until it is explicitly switched off.

System Selftest — Tests all modules one after another and displays a pass/fail message.

Internal RF Loop Test — Test of frequencies and levels at RF connector using the R&S® CBT's internal RF generator and analyzer with internal RF coupling. The loop 2 test is for future extensions.

The remaining tests are selftests for individual modules, e.g. Digital Board and RF Board. Besides, the following correction procedures are available:

RF Board	Tests all voltages generated on the RF board and also measures the actual temperature on the RF board.
Digital Board	Tests all remaining system voltages, included the voltages generated on the Digital Board.

Note: Notice messages after firmware updates

In most cases firmware updates don't affect the accuracy of the measurements. There are some exceptions where a correction procedure must be executed after the firmware update. The R&S® CBT displays a notice message whenever this happens. The box contains the name of the required correction procedure and appears during startup until the correction has been performed.

Remote control
–

Test

The *Test* softkey controls the selftest of the type selected via the *Select* softkey and displays the results in the *Report* table.

The status of the selftest *(RUN, OFF, HLT)* is indicated on the left side of the softkey. It can be changed after softkey selection (press once) by means of the *ON/OFF* key.

A short description of the current test appears in the *Status* output field; its progress is shown in the *Progress* bar.

Remote control
–

Report

The *Report* softkey activates the *Report* table, e.g. for scrolling.

Remote control
–

Data Handling (Data)

The *Data* popup menu, which is opened by pressing the *DATA* key, saves and recalls configuration files and manages the files in the internal memory that can be used for mass storage.

Saving Configurations (Data – Save)

The *Save* tab in the *Data* popup menu stores the current instrument settings to a configuration file. Configuration files have the extension *.SAV and contain the following information:

- All user-defined settings of a particular function group and test mode comprising all measurement settings (defined in the measurement configuration menus) and all general settings (defined in the *Connection Control* menu)
- For *Signalling* test mode, all settings concerning signalling (connection setup etc.)
- For the *Base* system, the current function group, test mode and measurement menu.

The configuration of several function groups and test modes can be written to a common configuration file. The configuration of the current session is automatically stored in the non volatile RAM before a session is terminated and re-activated when the R&S® CBT is started next time; see also Chapter 1, section *R&S® CBT VersionManager.*

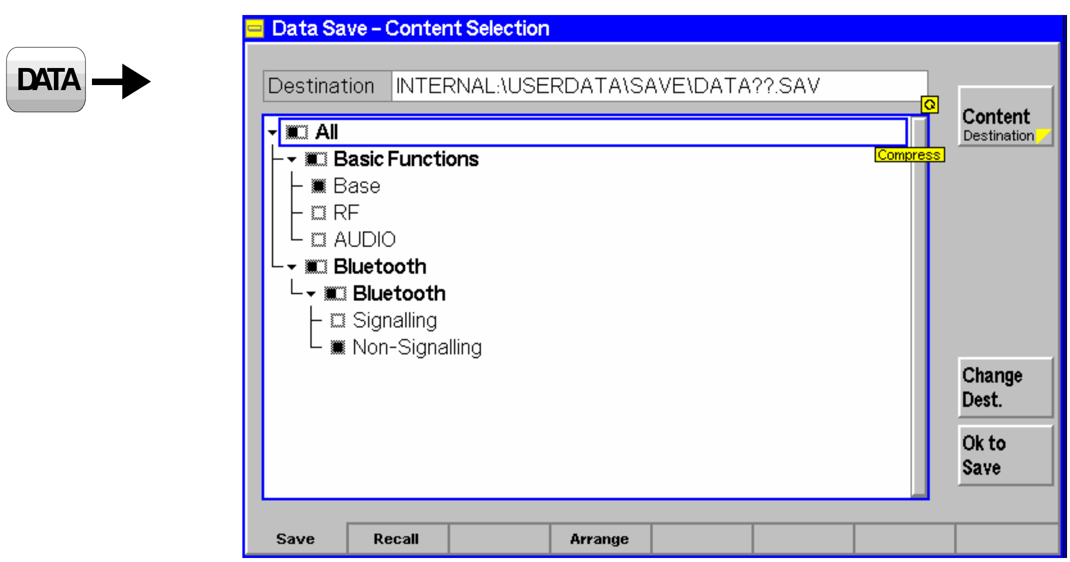


Fig. 4-14 Data – Save menu

Selection of function groups

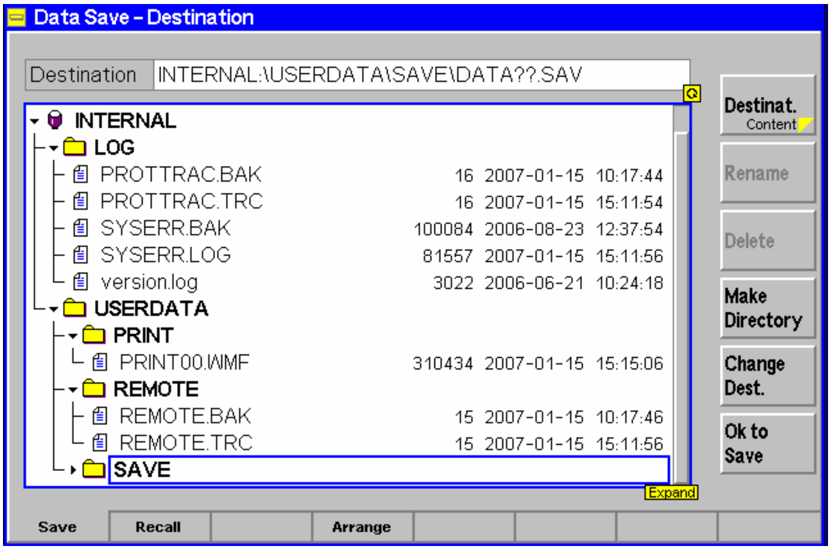
All function groups and test modes available on the instrument are arranged in a tree view showing the function groups and test modes to be saved to a configuration file. When the popup is opened, the configuration tree is expanded and the active function group and test mode is selected. The tree view is identical to the tree in the *Reset* menu (see section *Reset of Instrument Settings (RESET Key)* on p. 4.3).

The *Base* system is part of every software configuration and therefore selected by default irrespective of the current function group and mode. It is possible though to exclude the base system settings from the configuration file by deselecting the *Base* node.

Note: *If the base system is excluded from the configuration, the current function group, test mode and measurement menu are not stored to the configuration file. In this case it can be useful to write this information to the file comment; see Change Dest. softkey below.*

Content
Destination

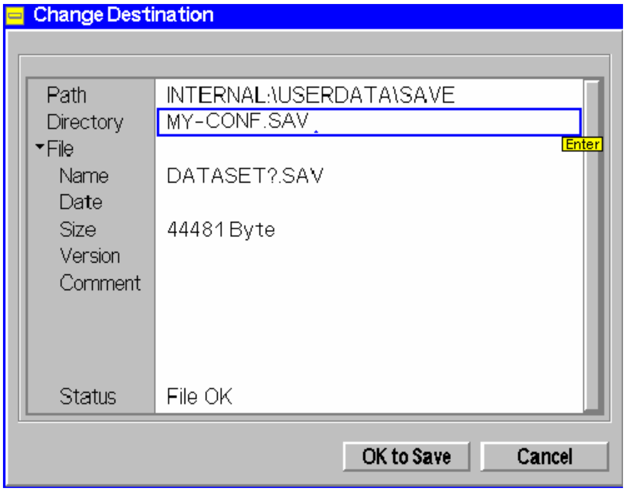
Content/Destination toggles between the configuration tree (see *Fig. 4-14 above*) and a view of the directories available for storing the configuration file (*.SAV). The *Destination* view is analogous to the *Arrange* tab; see section *File Manager (Data – Arrange)* on p. 4.25.



Remote control
–

Change
Dest.

The *Change Dest.* softkey opens a dialog to specify the name and path of the created configuration file and enter a *Comment* to be stored with the file. See also *View Info/Rename* softkey on p. 4.26.



Editing the *Change Destination* dialog is optional: By default, the R&S® CBT stores configuration files to the directory *INTERNAL\USERDATA\SAVE* and uses the file names DATASET?.SAV where the question mark is replaced by current numbers that are automatically incremented, starting with zero (auto-increment function). To create more than 100 different configuration files, another name or destination must be specified. The information stored in a configuration file can not be edited.

Note: *A third question mark in the file name extends the auto-increment function so that up to 999 configuration files can be stored. Keep in mind the capacity of the internal hard disk when using this feature.*

Selecting *OK to Save* closes the dialog window and stores the inputs made. Pressing *Cancel* or *Change Dest.* again without selecting *OK to Rename* closes the dialog box, discarding all inputs made.

Remote control
The path, directory, file name and comment of an existing configuration file can be changed using the `MMEMory` commands; see section *File Manager (Data – Arrange)* on p. 4.25.

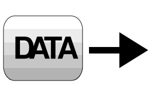
OK to Save

OK to Save saves the current configuration in all function groups and test modes selected in the configuration tree to the configuration file specified via *Change Dest.*

Remote control
```
MMEMory:SAVE:CURRent <FileName> [,<msus>]
MMEMory:SAVE[:ALL] <FileName> [,<msus>]
```

Loading Saved Configurations (Data – Recall)

The *Recall* tab in the *Data* popup menu recalls and activates a configuration previously stored with the *Save* tab; see section current instrument settings to a configuration file (*.SAV); see section *Saving Configurations (Data – Save)* on p. 4.21.



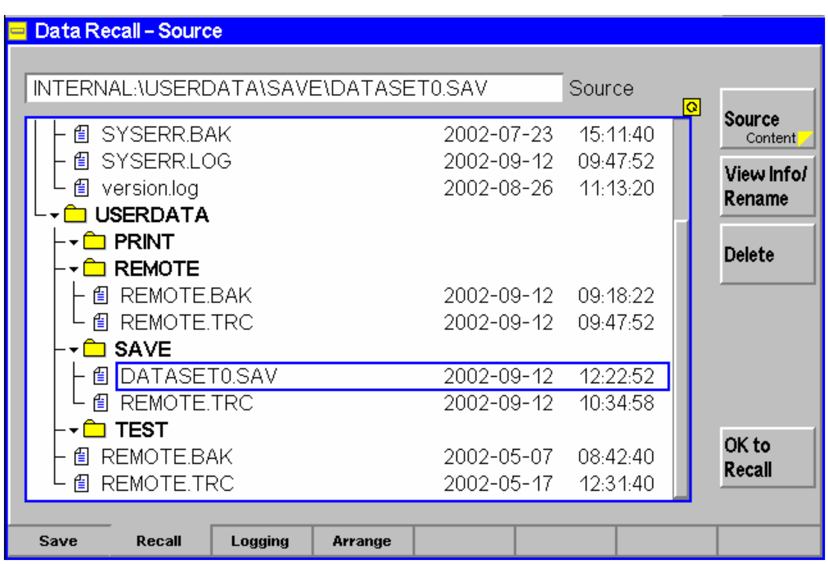


Fig. 4-15 Data – Recall menu

The *View Info/Rename* and *Delete* softkeys are equivalent to the softkeys of the same name in the *Arrange tab;* see section *File Manager (Data – Arrange)* on p. 4.25.

File selection

The stored files can be selected from a tree view in the center of the menu. The tree can be expanded and compressed using the roll-key and the *ON/OFF* key (see Chapter 3, *Expanding menu tables*). By default, configuration files are stored in the directory *INTERNAL\USERDATA\SAVE* and with the file names DATA??.SAV, where the question mark is replaced by a current number.

Source
Content

Source/Content toggles between the directory view (see Fig. 4-15 *above*) and the overview of function groups and test modes contained in a configuration file (configuration tree); see *Dir. View/Content* softkey on p. 4.26.

The configuration tree can be used for a partial recall of instrument settings: On recalling a configuration file, only the settings in the function groups and test modes selected in the configuration tree are overwritten. By default all function groups and test modes stored in the configuration file are selected.

Remote control
–

OK to Recall

OK to Recall recalls the selected configuration file and activates the stored settings for the function groups and test modes selected in the configuration tree.

The active function group, test mode and measurement menu is stored with the *Base* system settings when a configuration file is created. As a consequence the behavior of the R&S® CBT after a recall depends on whether or not the *Base* system settings are also recalled:

- After a recall including the base system settings the R&S® CBT enters the function group, test mode and measurement menu stored in the configuration file.
- After a recall excluding the base system (or a recall of a configuration file without base system information) the R&S® CBT returns to its current function group.

Note: *Recalling only a configuration of the active function group is faster because no additional software modules must be loaded.*

Before recalling and activating a configuration file, the instrument checks whether the settings are compatible with its current hardware configuration and software versions. If an incompatibility is detected, the configuration file is not recalled and an error message is generated. Configuration files are upward compatible and can be re-used in later firmware versions.

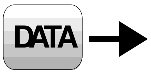
Remote control
```
MMEMory:RECall:CURRent <FileName> [,<msus>]
MMEMory:RECall[:ALL] <FileName> [,<msus>]
```

File Manager (Data – Arrange)

The *Arrange* tab in the *Data* popup menu manages the files in the internal and external memories that can be used for mass storage. The menu is particularly useful for handling files containing user data such as:

- Screenshots (*.wmf or printer format, see section *Print Menu (PRINT Menu)* on p. 4.4)
- Remote report files (ASCII text files, see description of the remote screen in Chapter 5)

An extended file management functionality is available in remote control; see `MMEMory` system in Chapter 6.



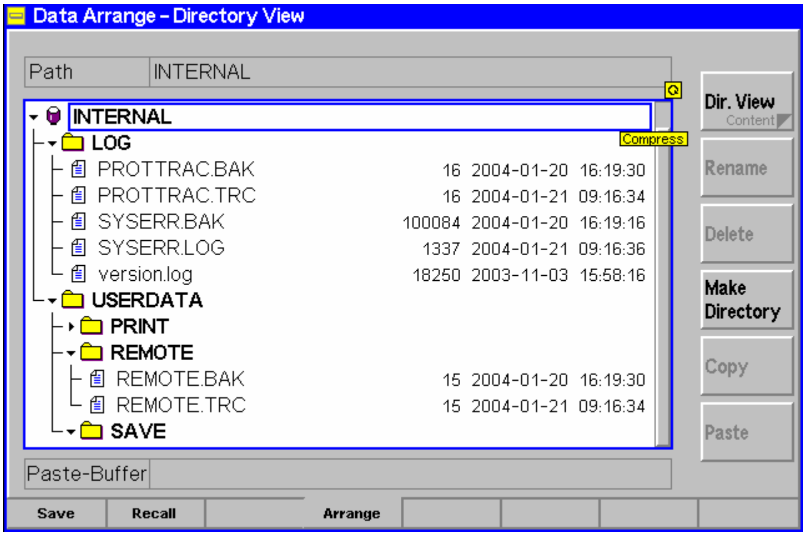


Fig. 4-16 Data – Arrange menu

File selection

The stored files can be selected from a tree view in the center of the menu. The tree can be expanded and compressed using the roll-key and the *ON/OFF* key (see Chapter 3, *Expanding menu tables*). It starts from the nodes for the *INTERNAL* mass storage devices:

INTERNAL Root directory of the section on the internal hard disk that is reserved for mass storage.

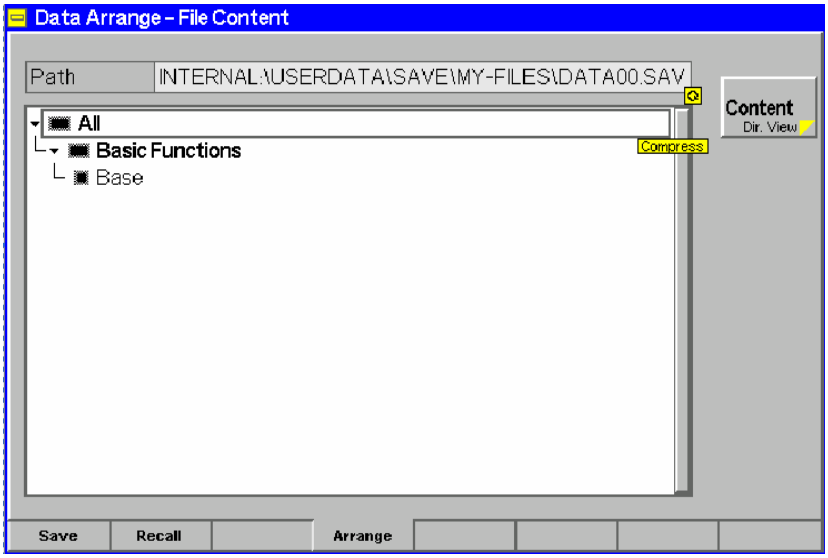
File indication / Paste Buffer

The output field above the tree view shows the path and name of the selected file. The *Paste Buffer* field below the tree view shows the path and name of a file that has been cut or copied to be pasted into another directory.

Remote control
`MMEMory:MSIS INTernal | EXTernal`

Dir. View
Content

Dir. View/Content toggles between the directory view (see *Fig. 4-16 above*) and the overview of function groups and test modes contained in a configuration file (*.SAV). The *Content* view is available for configuration files only:



The *Content* view shows the path and name of the configuration file and all function groups and test modes contained in the file. The tree view is for information only. It is analogous to the trees in the *Reset* menu (see section *Reset of Instrument Settings (RESET Key)* on p. 4.3.) and in the *Save* and *Recall* tabs of the *Data* menu, however, it only shows the function groups and test modes actually contained in the configuration file so that all rectangular symbols are black.

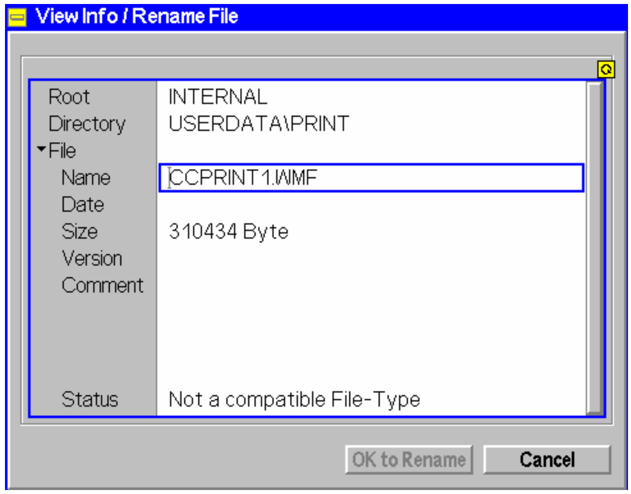
Remote control
–

View Info
Rename

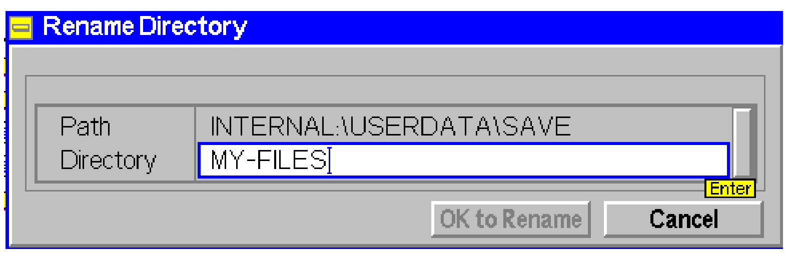
The *View Info/Rename* softkey opens a dialog to display and edit file information or assign a new name to the selected file or to a subdirectory.

The labeling of the softkey and its function depends on the selected node in the directory view:

- If a file is selected the softkey reads *View Info/Rename.* It opens a popup window showing the *Root* directory, the *Directory* plus other file information. The file *Name* and a *Comment* to be stored with the file can be edited. This can be done with the *DATA* keys on the front panel and the auxiliary editor (see Chapter 3) or even more conveniently using an external keyboard. The *Status* shows either *File OK* (for configuration files *.SAV) or *Not a compatible file type* (for all other file types).



- If a directory is selected, no particular information is needed so the softkey reads *Rename.* It opens a popup window to rename and move the directory by editing the *Path* and the *Directory* name. The path can be entered according to DOS conventions, if so desired. *Rename* is disabled (grayed) while the *INTERNAL* root directory is selected. Moreover, the maximum number of directory levels below the *INTERNAL* root directory is 5.



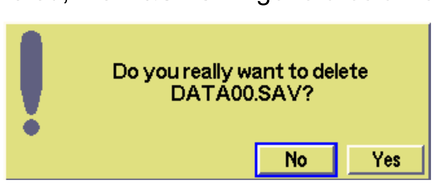
Selecting *OK to Rename* closes the dialog windows and renames the file or directory. Pressing *Cancel* or *View Info/Rename* again without selecting *OK to Rename* closes the dialog box without renaming the file.

Remote control

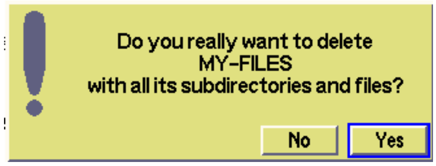
```
MMEMory:INFO? <FileName> [,<msus>]
MMEMory:MOVE <FileSource>[,<msus1>], <FileDest> [,<msus2>]
```

Delete

The *Delete* softkey deletes the selected file or directory. Before an individual file is deleted, the R&S® CBT generates a warning:



Before a directory is deleted, the R&S® CBT generates a similar warning:



Selecting *Yes* deletes the file or directory; selecting *No* closes the warning messages without deleting.

Remote control
```
MMEMory:DELete <FileName>, [INTernal | EXTernal]
MMEMory:RMDir <DirName>, [INTernal | EXTernal]
```

Make Directory

The *Make Directory* softkey creates a new directory. The name and path of the new directory are entered into a *Make Directory* dialog box; see *Rename Directory* above.

Remote control
```
MMEMory:MKDir <Dir_Name>[,<msus>]
```

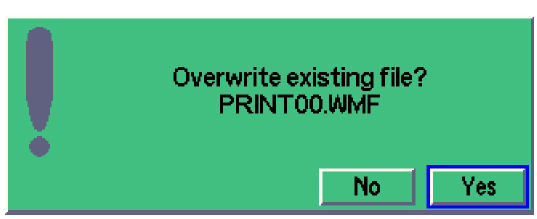
Copy

The *Copy* softkey stores the selected file or directory into the *Paste Buffer* so it can be copied to other directories (see *Paste* softkey below). The original file or directory is not deleted, so the *Copy* function duplicates a file or a directory with all its contents.

Remote control
No direct equivalent. To replace the Copy/Paste mechanism use the command
```
MMEMory:COPY <FileSource>[,<msus1>], <FileDest> [,<msus2>]
```

Paste

The *Paste* softkey stores the file or directory copied into the *Paste Buffer* to the current directory. It is disabled (grayed) if the *Paste Buffer* is empty. A copied file can be stored several times to different directories and storage devices. Pasting the file does not affect the *Paste Buffer*.
If the current directory contains a file or subdirectory with the same name; a warning is generated:



Selecting *Yes* overwrites the existing file or directory; selecting *No* closes the warning message without pasting the content of the buffer.

Remote control
No direct equivalent. To replace the Copy/Paste mechanism use the command
```
MMEMory:COPY <FileSource>[,<msus1>], <FileDest> [,<msus2>]
```

Bluetooth Non Signalling Mode

This section provides detailed information on function group *Bluetooth Non Signalling*. In this mode, it is possible to generate an RF signal with Bluetooth specifications, to configure the RF input and output connectors of the R&S® CBT, and to define RF reference and synchronization signals.

It is also possible to measure the *Power* and *Modulation* of the received *Bluetooth* packets. To perform *Spectrum* and *Receiver Quality* measurements on Bluetooth devices, the Signalling mode must be active; see section *Bluetooth Signalling Mode* on page 4.38.

Measurement Menu Analyzer/Generator

The *Analyzer/Generator* menu configures the RF output signal of the R&S® CBT.

The RF output signal carries Bluetooth packets with a definite *RF Level* and *Frequency* and with a *Payload* pattern that can be selected via the softkeys of the *Analyzer/Generator* menu. The signal is bursted; the transmission of a packet starts every 6.25 ms, which means that there is one packet transmitted every 10th slot.

The *Packet Type,* the *Length of Test Sequence,* and the *BD Address Master* can also be set in the *Analyzer/Generator* menu, so that the Bluetooth generator signal in *Non Signalling* mode carries Bluetooth packets with configurable type and length. The transmitted Bluetooth address is the same as the CBT uses in *Signalling* mode. The parameters correspond to the Signalling parameters *BD Address CBT, Packet Type*, and *Length of Test Sequence;* for a detailed description refer to sections *Bluetooth Signalling Mode – Connection Control – Master Sig.* and *Bluetooth Signalling Mode – Connection Control – Slave Sig.*

The *Analyzer/Generator* menu is opened from the *Menu Select* menu (with associated key at the front of instrument).

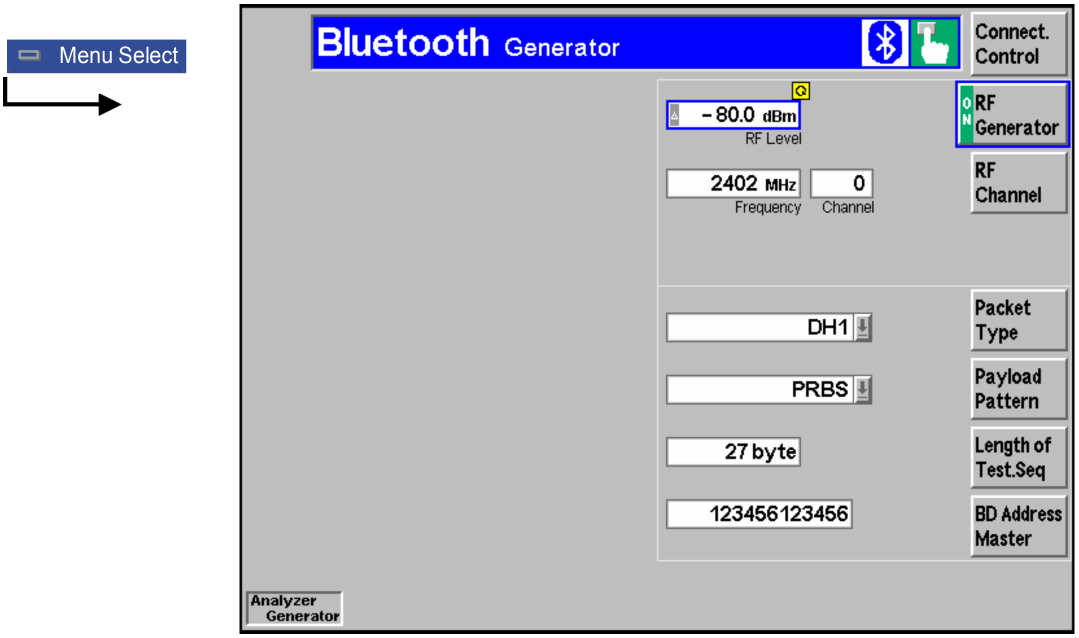
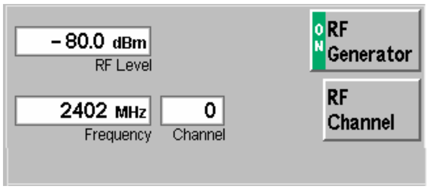


Fig. 4-36 Measurement menu Analyzer/Generator

RF Generator Panel



The *RF Generator* panel contains softkeys which allow the configuration of:

- The *RF Level* of the generator
- The *RF Channel* number or *Frequency*
-

RF Generator

The *RF Generator* softkey controls the RF generator and indicates its operating status *(ON | OFF)*.

The level is entered in dBm. The RF generator can be switched on or off after softkey selection (press once) using the *ON/OFF* key.

NOTE

The maximum RF Level for EDR packets (with option R&S CBT-K55) is –3 dB below the maximum level for Basic Rate packets. If an EDR packet type is selected while the selected level is above the maximum EDR level, then the RF Level is automatically reduced.

Remote control

```
INITiate:RFGenerator; ABORt:RFGenerator
FETCh:RFGenerator:STATus?
SOURce:RFGenerator:LEVel <Level>
```

External attenuation

If an external gain or attenuation is used and reported to the instrument (see softkey *Ext. Att. Output*) the RF generator level is adjusted to maintain the specified power after the attenuation or gain. As a consequence, all levels indicated are referenced to the input of the DUT and no longer correspond to the actual level at the output connectors of the R&S® CBT (see section *AF/RF Connectors (Connection Control – AF/RF Connectors)* on page 4.33). The default value for the generator power is also shifted provided that the generator can output the required power, compensating for the external attenuation or gain.

Error messages

If the level defined for *RF Level* is too high or too low, a window will appear with the error message *"<RF_Level> is out of range. <Permissible max/min. value> is limit*." and three buttons:

Accept	Permissible max/min. value is accepted as *Level*,
Re-edit	The *Level* is entered once again,
Cancel	The last valid input is maintained.

RF Channel

The *RF Channel* softkey defines the channel number (if applicable) or the frequency of the generated RF signal.

RF frequencies can be entered in multiples of the Bluetooth channel width of 1 MHz. Bluetooth channel numbers and frequencies are unambiguously defined for the USA and most of Europe and the rest of the world (see the description of the different frequency hopping schemes on page 4.159). Following this specification, the channel structure is as follows:

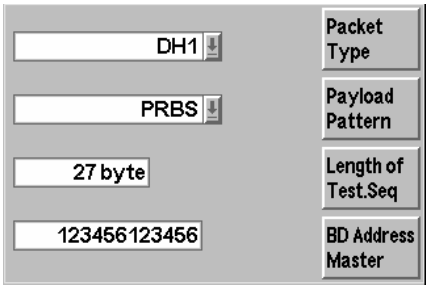
$$f_k = 2402.0\,\text{MHz} + k \cdot 1\,\text{MHz}, \quad k = 0,...,93$$

In this frequency band (i.e. in the range from 2402 MHz up to and including 2495 MHz), it is sufficient to enter only one value (frequency **or** channel number); the other one is automatically determined by the R&S® CBT. Out-of-band frequencies are not allowed.

Remote control

```
SOURCe:RFGenerator:FREQuency:UNIT <Unit>
SOURCe:RFGenerator:FREQuency <Frequency>
```

Generator Modulation Panel



The *Generator Modulation* panel contains the softkeys for configuration of the RF generator signal. These softkeys allow the selection of packet type and length of test sequence, configuration of the payload pattern, and setting of the Bluetooth Device address (Master).

Packet Type

The *Packet Type* softkey identifies which type of packet will be transmitted by the R&S CBT on its generator signal.

Valid entries for packet type are as follows:
DH1, DH3, DH5

1. E21P, E23P, E25P
2. E31P, E33P, E35P
3. OFF – No signal superimposed, 'empty' carrier (continuous wave)

Note: The EDR packet types listed in 2 and 3 above become available when CBT software option K55 is installed.

Remote control

```
SOURce:RFGenerator:PTYPe
DH1 | DH3 | DH5 | E21P | E23P | E25P | E31P | E33P | E35P
Note that the EDR packet types above (all except for DH1,
DH2, DH3) are only available when CBT software option R&S
CBT-K55 is installed.
```

Description of Packet Types

The packet types supported by the R&S CBT are described below:

Type	Header (Bytes)	User Payload (Bytes)	Timeslots (Max)
DH1	1	0 to 27	1
DH3	2	0 to 183	3
DH5	2	0 to 339	5

With the EDR options R&S CBT-B55 and R&S CBT-K55 installed, the following packet types are also supported:

Type	Header (Bytes)	User Payload (Bytes)	Timeslots (Max)
2-DH1 (E21P)	2	0 to 54	1
2-DH3 (E23P)	2	0 to 367	3
2-DH5 (E25P)	2	0 to 679	5
3-DH1 (E31P)	2	0 to 83	1
3-DH3 (E33P)	2	0 to 553	3
3-DH5 (E35P)	2	0 to 1021	5

All supported packet types have the same format as shown below:

Access Code	***Header***	***Payload***	***CRC***
72 bits	54 bits	0 - 1021 bytes (see table above)	16 bits

Payload Pattern

The *Payload Pattern* softkey defines a bit sequence that is modulated onto the RF generator signal.

The following bit sequences can be selected:

OFFPRBS	Pseudo random bit sequence (PRBS-9 sequence)
All 0	Continuous sequence consisting of zeros only
All 1	Continuous sequence consisting of ones only
11110000 etc.	Specific bit sequences, to be periodically repeated

Remote control

```
SOURce:RFGenerator:BMODulation <pattern>
PRBS | ALL0 | ALL1 | P44 | P22 | P11
```

Length of Test Sequence

The *Length of Test Sequence* softkey defines the payload length for the transmitted packets. The allowable range of values depends on the type of packet transmitted.

The valid lengths, in bytes, for each packet type are as follows:

OFF	No signal superimposed, "empty" carrier (continuous wave)
DH1	0 to 27
DH3	0 to 183
DH5	0 to 339

For EDR packet types only (requires software option CBT-K55)

2-DH1	0 to 54
2-DH3	0 to 367
2-DH5	0 to 679
3-DH1	0 to 83
3-DH3	0 to 552
3-DH5	0 to 1021

Remote control

```
SOURce:RFGenerator:PLENgth <Length>
```

BD Address Master

The *BD Address Master* softkey is used to set the Bluetooth Device address for the R&S CBT.

Remote Control

```
SOURce:RFGenerator:BDADdress <string>
```

Connection Control

The popup menu *Connection Control* contains three tabs to configure the inputs and outputs of the R&S® CBT and the respective signals in the function group *Bluetooth Non Signalling.*

The menu group is activated via the softkey *Connect. Control* to the right of the header of each measurement menu. The individual tabs *(Generator, AF/RF* and *Sync.)* can be accessed via the hotkeys at the lower edge of the screen.

Control of RF Output Signals (Connection Control – Generator)

The *Generator* tab configures the signals generated by the RF generator of the R&S® CBT.

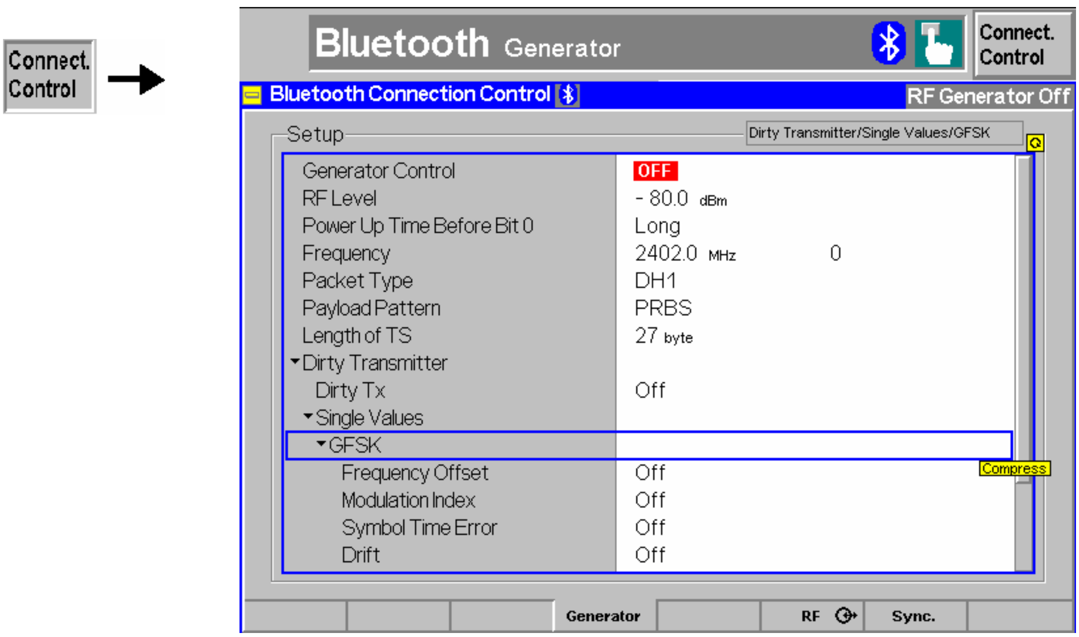


Fig. 4-37 Connection Control – output signals

This tab provides settings in addition to those for signal configurations in the *Generator* menu (see page 4.29), and includes the single-valued *Dirty Transmitter* settings (which are a subset of the *Dirty Transmitter* settings available in *Signalling* mode; see section *Signal of the R&S CBT (Connection Control – Master Sig.)* on p. 4.149).

Power-up Time before Bit Zero The time interval between the start of the power ramp and the time of bit zero (t_{P0}) can be set to either *Long* or *Short.* Note that setting a *Short* time corresponds to 3 µs, which is the value quoted in the Bluetooth RF test specification.

Remote control `SOURce:RFGenerator:PTBZero <Time>`

Frequency Offset

The *Frequency Offset* softkey defines an offset for the frequency set under *RF Channel*. The range of the *Frequency Offset* is such that any intermediate frequency between two *RF Channels* can be covered.

With options R&S CBT-B55/K55 the frequency offset can be set independently for the GFSK and DPSK modulated portions of the generated EDR packets (packet types *2-DH1* to *3-DH5)*.

Remote control

```
SOURce:RFGenerator[:SDTX]:FOFFset <Freq. Offset>
SOURce:RFGenerator:ESDTx:FOFFset <Freq. Offset>
```

Modulation Index

The *Modulation Index* softkey defines the ratio between the actual frequency deviation of the R&S CBT and a frequency deviation of 500 kHz.

*Modulation Index * 500 kHz = Frequency deviation of RF signal.*

Off is equivalent to a modulation index of 0.32, corresponding to the nominal Bluetooth frequency deviation of 160 kHz.

Remote control

```
SOURce:RFGenerator[:SDTX]:MINDex <Mod. Index>
```

Symbol Time Error

The *Symbol Time Error* softkey defines a timing error for the RF generator signal relative to the ideal slot timing. Allowable values are either "OFF", or a Symbol Time Error in ppm.

With options R&S CBT-B55/K55 the symbol time error can be set independently for the GFSK and DPSK modulated portions of the generated EDR packets (packet types *2-DH1* to *3-DH5)*.

Remote control

```
SOURce:RFGenerator:SDTX:STERror <Error>
SOURce:RFGenerator:ESDTx:STERror <Error>
```

Drift

This command enables or disables the periodic, packet-dependent frequency drift.

With options R&S CBT-B55/K55 the drift can be set independently for the GFSK and DPSK modulated portions of the generated EDR packets (packet types *2-DH1* to *3-DH5)*.

Remote control

```
SOURce:RFGenerator:SDTX:FDRift ON | OFF
SOURce:RFGenerator:ESDTx:FDRift ON | OFF
```

AF/RF Connectors (Connection Control – AF/RF Connectors)

The *AF/RF* tab sets an external attenuation for RF output and input signals *(Ext. Att. Output, Ext. Att. Input).* All settings are analogous to those in function group *RF Non Signalling;* see section *RF Connectors (Connection Control – RF)*.

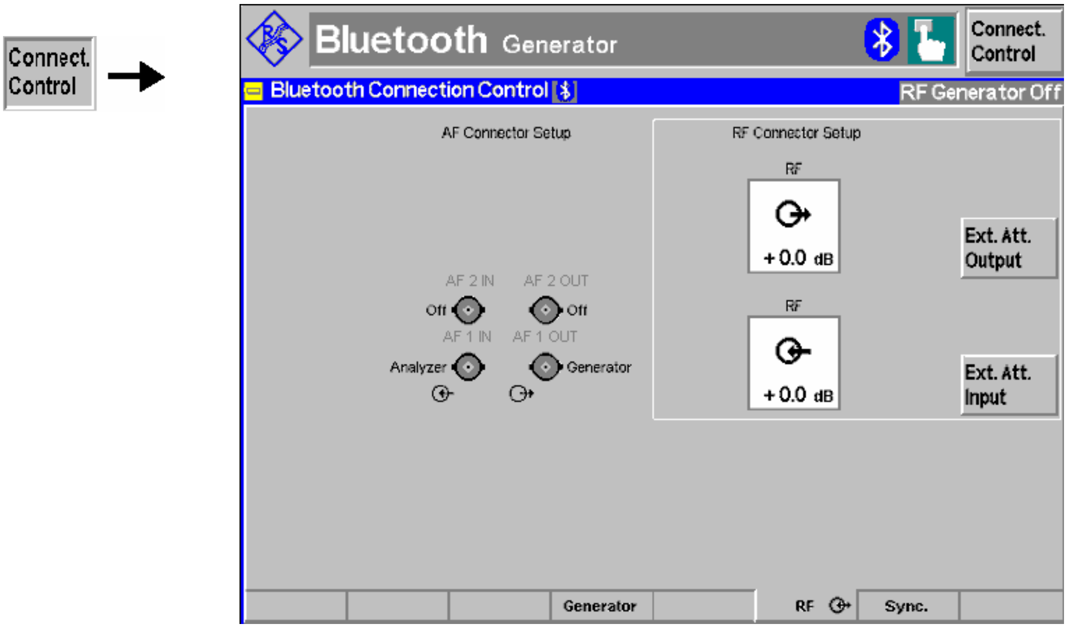


Fig. 4-38 Connection Control – RF connectors

Reference Frequency (Connection Control – Sync.)

The *Sync.* tab defines the reference signals for synchronization. The settings are analogous to the ones in function group *RF Non Signalling;* see section *Reference Frequency (Connection Control – Sync.)*.

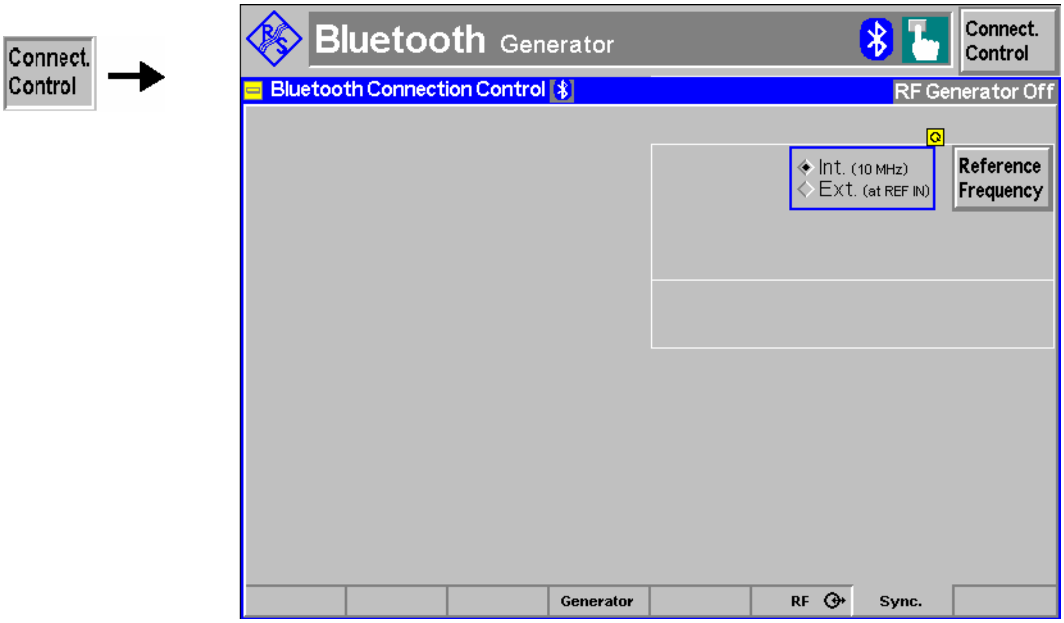


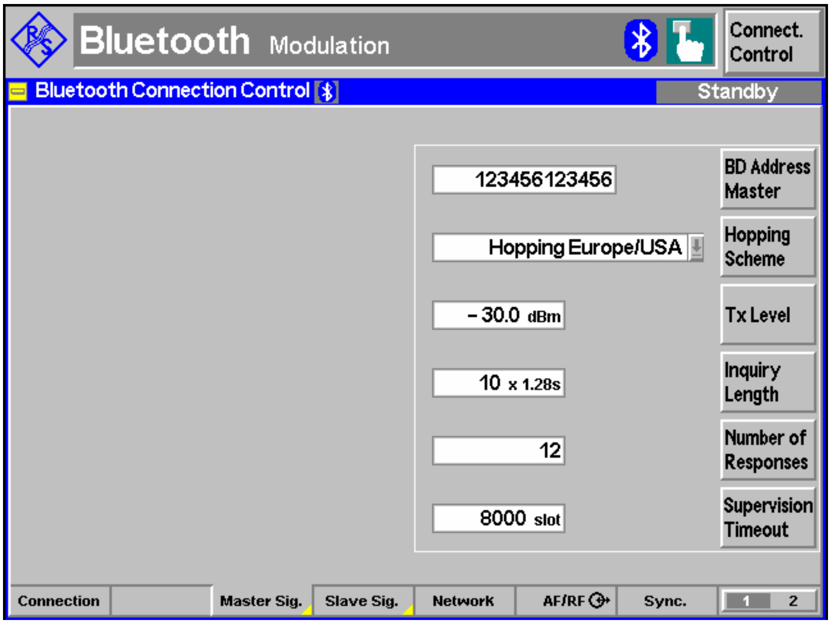
Fig. 4-39 Connection Control – Synchronization

TX Tests in Non Signalling Mode

In *Non Signalling* mode, the R&S CBT does not provide any measurement menus. However, with a suitably configured *Bluetooth* DUT, it is possible to perform non signalling *Power* and *Modulation* measurements using the *Signaling* measurement menus. The R&S CBT uses a power trigger and the known access code of the received *Bluetooth* packets to establish timing synchronization. No transfer of signalling information and no connection setup is required.

Test procedure To perform non signalling measurements,

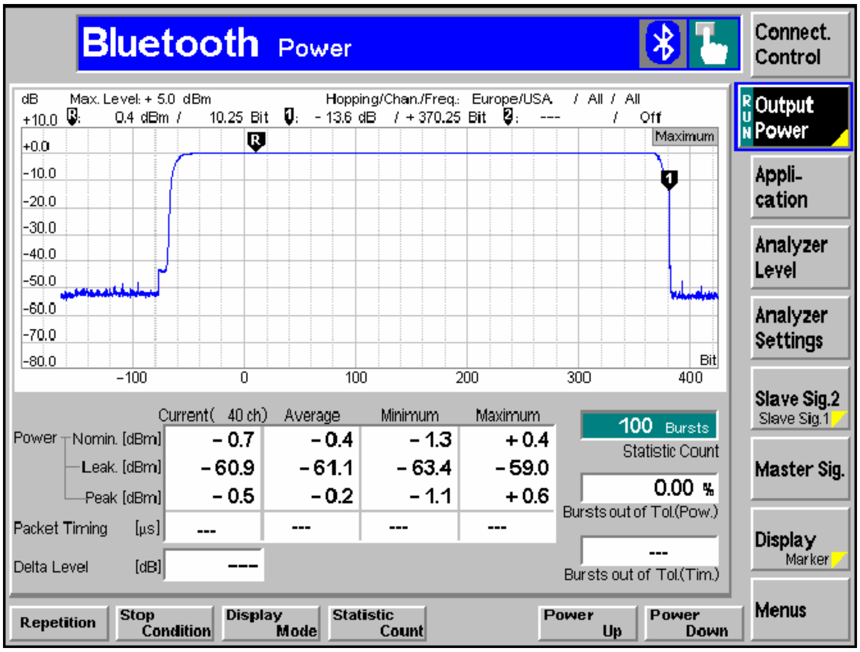
1. Command your DUT into a standalone non signalling TX mode where it transmits *Bluetooth* packets of a definite type and on a single channel.
2. Press the *Menu Select* key on the front panel of the instrument and select *Bluetooth – Signalling – Power versus Time.*
3. In the *Connection Control* menu opened, select the *Master Sig.* tab and set the *BD Address Master* equal to the address that the DUT uses to generate its access code.



The DUT derives its access code from the Lower Address Part (LAP, the last 6 hex digits) of the *BD Address Master.*

4. Press *ESCAPE* to close the *Connection Control* menu and access the *Power* measurement menu.
5. Use the softkeys and hotkeys in the *Power* menu to perform the following settings:
   Analyzer Level – Trigger Source: Power
   Analyzer Level – RF Max. Level: <expected nominal power> + 5 dB
   Analyzer Settings – Measure Mode: Single
   Analyzer Settings – Measured Channel: <Bluetooth Channel of the DUT>
   Slave Sig. 1 –Packet Type: <Packet Type of the DUT>
   Slave Sig. 1 – Pattern Type: <Transmitted bit pattern>

The diagram shows the measured packets:



The *Packet Timing* and *Delta Level* results are not available in non signalling mode. The same holds for the derived *Bursts out of Tol (Tim.)* result; see below.

Measurement results

The non signalling measurement provides the *Power* and *Modulation* results with the exceptions listed below. *Spectrum* measurements and RX tests *(Receiver Quality)* are not supported.

The R&S CBT supports all *Bluetooth* packet types including EDR packets for non signalling tests.

Table 4-3 Invalid measurement results in non signalling mode

Result	Comment
Packet Timing	Requires a timing reference, derived from the master signal
Burst out of Tol. (Tim.)	Statistical value, derived from the *Packet Timing* results
Delta Level	Requires power up/down commands to be sent to the DUT
Modulation – Encoding	To be measured with a hopping slave signal

Bluetooth Signalling Mode

This section provides detailed information on the measurement and configuration menus defined in function group *Bluetooth Signalling*. It is organized like a typical measurement session including the following stages:

- Connection to a device under test *(Connection Control – Signalling)*,
- Overview of measurements *(Overview),*
- Measurement menus *(Power, Modulation, Receiver Quality):* Performing measurements, acquiring measurement results, specific measurement configurations,
- Global configurations and general settings *(Connection Control, Group Configuration).*

The most important menus of the function group *Bluetooth Signalling* are shown in an overview at the end of Chapter 3.

Connection Setup (Connection Control – Signalling)

The popup menu *Connection Control* controls the signalling procedures (connection setup and release, services, signalling parameters) and determines the input connector and output connector with the external attenuation values, the reference frequency, RF input path and trigger settings.

Signalling measurements are performed with a connection to the DUT via radio link (test mode, signalling state *Test Mode)*, so the first tabs for setting up the connection (*Connection Control – Connection)* appear immediately after selection of the function group *Bluetooth Signalling* in the *Menu Select* menu. Alternatively, pressing the *Connect. Control* softkey at the top right in every measurement menu can also activate the *Connection Control* menu; the individual tabs can be accessed via the hotkey bar at the lower edge of the screen. Pressing the *Escape* key closes the *Connection Control* menu and activates one of the measurement menus.

In the following the first three tabs *Connection Control – Connection* displayed immediately after activation of the function group are described. A description of the remaining tab of the *Connection Control* menu is relegated to the end of this chapter (see section *Connection Control* on page 4.139).

The term "signalling" refers to all procedures that are required for connection setup and release and for control of a connection in the radio network. A distinction is made between different signalling states; see Table 4-3 below.

A number of control commands which can be initiated from the R&S® CBT switch between these states. In addition, transitions between the states may occur accidentally (e.g. *Connection failed;* in Fig. 4-1, processes of this type are indicated by dashed lines). The signalling states are explained in more detail in the following sections.

A lot of applications within the function group *Bluetooth Signalling* are only possible or useful in a particular signalling state (for example, an Inquiry can be attempted in the Standby state only, see Fig. 4-40 below). Accordingly, the appearance of the *Connection Control* menu changes depending on the signalling state.

Table 4-3 Short description of R&S® CBT signalling states

Signalling State	Description	Measurements possible	See page
Standby	The R&S® CBT transmits no signal	–	4.40
Inquiry	The R&S® CBT transmits an inquiry signal to detect Bluetooth devices within its domain. A list of all connectable devices is compiled during this phase, and the R&S® CBT remembers information about the devices.	–	4.41

Signalling State	Description	Measurements possible	See page
Paging	The R&S® CBT transmits a signal to synchronize and try to connect to a known Bluetooth device. From this state, either the *Test Mode* or the *Connected* state can be reached.	–	4.43
Connected	An ACL (Asynchronous Connection-Less link) connection has been established. The R&S® CBT acts as a master in the *Active* state and can command the DUT to one of the special modes (submodes) *Hold, Sniff, Park, Audio,* but also to its internal *Test Mode*.	TX measurements on NULL packets returned by the DUT	4.137
Test Mode	An ACL connection to the Bluetooth device under test has been established. The R&S® CBT acts as a Bluetooth master and the DUT has been commanded into its internal test mode. **Note:** Before attempting a connection to the *Test Mode*, the internal test mode of the DUT must be locally enabled according to the instructions of the Bluetooth standard.	All TX and RX measurements	4.139
Hold	An ACL connection to the DUT has been established and the DUT is in its *Hold* state.	Power consumption of the DUT (locally)	4.144
Sniff	An ACL connection to the DUT has been established and the DUT is in its *Sniff* state.	Power consumption of the DUT (locally)	4.143
Park	An ACL connection to the DUT has been established and the DUT is in its *Park* state.	Power consumption of the DUT (locally)	4.145
Audio	The R&S® CBT has established an SCO (Synchronous Connection-Oriented) link on top of the ACL connection.	Audio meas. according to different scenarios and TX measurements on SCO packets returned by the DUT	4.147

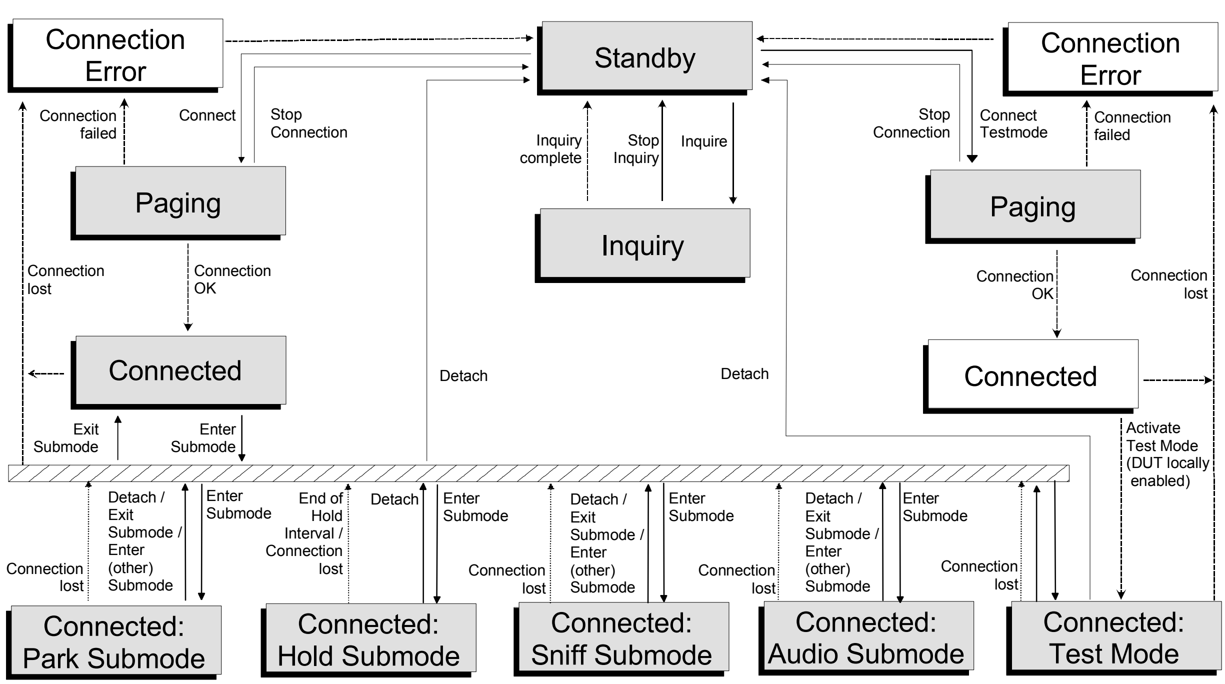


Fig. 4-40 Bluetooth signalling state machine

Corresponding to the different signalling states, different versions of the *Connection* menu are displayed. When a signalling state is reached, the corresponding menu is opened automatically (exceptions: see *Connect. Control Guidance* parameter in section *Display Control (Connection Control – Misc)* on p. 4.170.).

Connection Control: Standby State

The *Connection (Standby)* tab provides information on:

- The master and slave signal parameters
- The paging mode
- Besides, it activates an inquiry or a connection to a particular Bluetooth device.

The *Connection (Standby)* tab is opened when the function group *Bluetooth Signalling* is selected, or if a connection is dropped *(Stop connection* softkey in the *Paging* state or *Detach* softkey in the *Test Mode* state*)*. It is replaced by the *Connection (Inquiry)* menu while the R&S® CBT searches for the Bluetooth devices within its range or by the *Connection (Paging)* menu when it attempts a connection.

In the standby state, the R&S® CBT does not transmit anything to a potential DUT. All signalling is off. Prior to an inquiry, the Bluetooth devices that are within range are not known by the R&S® CBT. A default device or a device with a known BD_Address (Bluetooth Device Address) can be connected to (this will be the only device shown within the *Device to page* pull down list).

When an inquiry is finished, a list of potential DUTs (devices that are within the R&S® CBT domain) is compiled and the R&S® CBT remembers information about the DUTs, e.g. the *Page Scan Repetition Mode* or the clock offset. A device to connect to can be selected from the *Device to page* pull down list containing the default device to page and all devices found during inquiry. The R&S® CBT uses the information obtained from the DUTs to optimize the connection setup; in particular it overwrites the *Page Scan Repetition Mode* setting (see p. 4.151).

Note: *It is not necessary that an inquiry be made if a device's BD_Address is known. Connections without previous inquiry can still be very fast, provided that the Page Scan Repetition Mode in the MMI matches the DUT's setting and the DUT's page scan is optimally configured.*

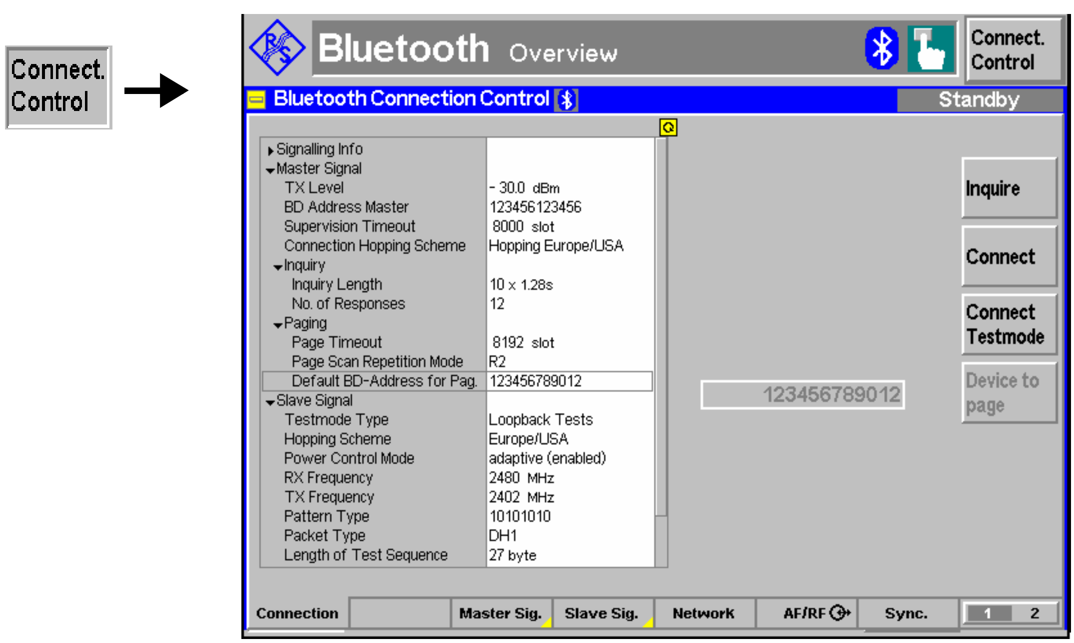


Fig. 4-41 Connection Control – Connection (Standby)

Signalling Info The table *Signalling Info* is to display signalling information retrieved from the DUT.

Remote control `SENSe:SINFo...?`

Master Signal

The table *Master Signal* indicates important signalling parameters that the R&S® CBT (acting as a Bluetooth master) uses to inquire and page Bluetooth slaves in its range. These parameters are set in the *Master Sig.* tab and explained in more detail there (see section *Signal of the R&S CBT (Connection Control – Master Sig.)* on p. 4.149.).

Remote control `CONFigure:NETWork:MSIGnalling...?`

Slave Signal

The table *Slave Signal* indicates parameters that control the behavior of the DUT (acting as a Bluetooth slave) while it is in its test mode. These parameters are set in the *Slave Sig.* tab and explained in more detail there (see section *Behavior of the DUT (Connection Control – Slave Sig.)* on p. 4.149.).

Remote control
```
CONFigure:SSIGnal...?
PROCedure:SSIGnal...?
```

Inquire

The *Inquire* softkey is used to search for all devices that are in the R&S® CBT's domain. This will switch the menu to the *Inquiry* state.

Remote control `PROCedure:SIGNalling:ACTion INQuiry`

Connect

The *Connect* softkey is used to set up an ACL connection to a DUT using the address selected in the *Device to page* editor.

This will switch the menu to the *Paging* and then to the *Connected* state from where it can be placed to either one of the special substates *(Hold, Sniff, Park, Audio)* or the *Test Mode* state.

Remote control `PROCedure:SIGNalling:ACTion PAGE`

Connect Testmode

The *Connect Testmode* softkey is used to connect to a DUT using the address selected in the *Device to page* editor in order to force it into its internal test mode.

This will switch the menu to the *Paging* and then to the *Test Mode* state.

Remote control `PROCedure:SIGNalling:ACTion TEST`

Device to Page

The *Device to Page* softkey activates a pull-down list to select a device that the R&S® CBT can connect to.

Prior to an inquiry the list will only contain a default device address which can be set in the paging parameter configuration menu.

Remote control
```
FETCh:SIGNalling:PTARgets?
CONFigure:SIGNalling:PTARget <Target>
```

Connection Control: Inquiry State

The *Connection (Inquiry)* tab provides information on:

- The master and slave signal parameters
- The paging mode

- Besides, it contains a softkey *(Stop Inquiry)* that stops the inquiry and leads back to the *Connection (Standby)* tab.

The *Connection (Inquiry)* tab is opened when an inquiry is attempted from the *Standby* state. The R&S® CBT returns back to the *Connection (Standby)* tab after the inquiry is completed or deliberately stopped *(Stop Inquiry).*

Within the *Inquiry* state, the R&S® CBT continuously transmits inquiry packets. The length of the inquiry period *(Inquiry Length)* and all other inquiry parameters can be set in the *Master Signal* tab, see section *Signal of the R&S CBT (Connection Control – Master* Sig.) on p. 4.149. All devices that are within range will acknowledge this inquiry and inform the R&S® CBT that they are within range. The R&S® CBT will create a list of all devices that responded. The inquiry may be stopped at any point in time.

Connect. Control →

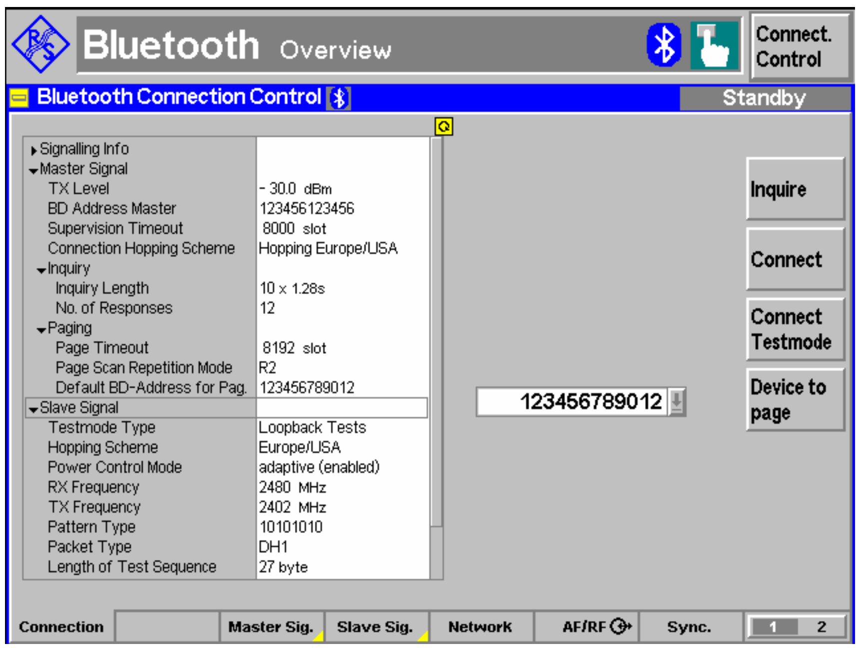


Fig. 4-42 Connection Control – Connection (Inquiry)

The info table in the left half of the menu is described in section *Connection Control: Standby State* on page 4.40.

Devices found The *Devices found* table lists the BD_Addresses of all Bluetooth devices that responded to the inquiry. The entries are written to the *Device to page* pull-down list from where a particular device can be selected once the R&S® CBT has returned back to the *Standby* state (see section *Connection Control: Standby State* on page 4.40.).

Remote control `FETCh:SIGNalling:PTARgets?`

Stop Inquiry

The *Stop Inquiry* softkey stops the inquiry phase. This will return the CBT to the *Standby* state.

The inquiry is also stopped after the *Inquiry Length* which can be set in the *Master Signal* tab, see section *Signal of the R&S CBT (Connection Control – Master* Sig.) on p. 4.149.

Remote control `PROCedure:SIGNalling:ACTion SINQuiry`

Connection Control: Paging State

The *Connection (Paging)* tab provides information on

- The master and slave signal parameters
- The paging mode
- Besides, it allows to stop the connection setup to a particular Bluetooth device *(Stop Connect)*.

The *Connection (Paging)* tab is opened while the R&S® CBT (acting as a Bluetooth master) attempts a connection to a particular Bluetooth device *(Connect* or *Connect Testmode* softkeys in the *Standby* state). It is replaced by the *Connection (Test Mode)* or *Connection (Connected)* tab as soon as the connection is OK[1] or by the *Connection (Standby)* tab when the connection is deliberately stopped or when a connection error occurred (see *Fig. 4-40* on page 4.39).

In the *Paging* state, the R&S® CBT attempts to connect to a selected device. Two types of connections are provided:

- If a test mode connection is set up (softkey *Connect Testmode* in the *Connection (Standby)* tab), the R&S® CBT establishes an ACL connection, acting as a Bluetooth master, and immediately provides the necessary signalling to place the DUT into its internal test mode.
- If a normal ACL connection is set up (softkey *Connect* in the *Connection (Standby)* tab), the R&S® CBT establishes an ACL connection, acting as a Bluetooth master in the *Active* state.

Any type of connection will be made using the parameters specified in the *Master Signal* tab, see section *Signal of the R&S CBT (Connection Control – Master Sig.)* on p. 4.149.

Note: *Before attempting a test mode connection, the internal test mode of the DUT must be locally enabled according to the instructions of the Bluetooth standard. Otherwise, the connection will fail, and the R&S® CBT will display the message* Device is not enabled for test mode – Cancel/Retry. *The connection process can be continued after enabling the device and pressing* Retry.

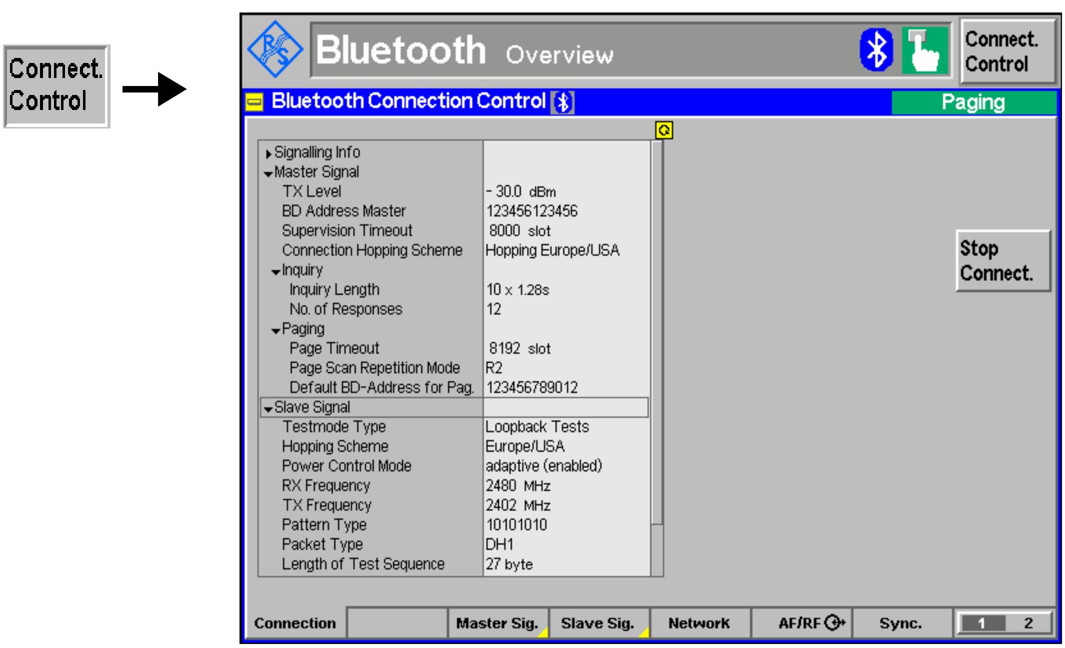


Fig. 4-43 Connection Control – Connection (Paging)

The info table in the left half of the menu is described in section *Connection Control: Standby State* on page 4.40.

[1] By default, the R&S® CBT skips the *Connection (Test Mode)* menu and opens the selected measurement menu; see section Display Control (Connection Control – Misc) on p. 4.170.

Stop Connect

The *Stop Connect.* softkey stops the connection phase.

This will return the R&S® CBT to the *Standby* state.

Remote control `PROCedure:SIGNalling:ACTion SCONnect`

Overview of the Function Group

The *Overview* menu displays the essential results of the *Power, Modulation* and *Receiver Quality* measurements and provides access to the most important measurement settings. In particular, it configures the signal transmitted by the R&S® CBT *(Master Sig.)* and controls the behavior of the Bluetooth DUT in test mode *(Slave Sig.)*.

- The measurement control softkey *Modulation/Power* below the *Connect. Control* softkey changes to *RX Quality*, depending on the application selected. This softkey controls the measurement, indicates its status *(RUN | HALT | OFF)*, and opens the configuration menu *Overview Configuration*. The hotkeys associated with the measurement control softkey define the scope of the measurement.
- The other softkeys on the right side are combined with various hotkeys (e.g. the hotkey *Measure Mode* belongs to the softkey *Analyzer Settings)*. The softkey/hotkey combinations provide test settings and switch between different measurements.

Types of settings

The purpose of the *Overview* menu is to provide quick access to the most common *Modulation, Power* and *Receiver Quality* measurements and to present the basic measurement results at a glance. The two measurement applications *Modulation/Power* and *Receiver Quality* can be selected with the *Application* softkey. The remaining softkeys/hotkey combinations provide two different types of settings:

- General settings are valid for all Bluetooth applications in *Signalling* mode. Changing general settings in any application will have an impact on all measurements and applications of the function group. All general settings are also provided in the *Connection Control* menu (see p. 4.134.). Examples of general settings are the RF input level and trigger settings (softkey *Analyzer Level)* and the configuration of the RF generator (softkey *Master Sig.)*.
- Specific settings are relevant for one application only, or they can be set independently for several applications. Changing specific settings in an application will not affect the other measurements and applications of the function group. No specific settings are provided in the *Connection Control* menu (see p. 4.134.). Examples of specific settings are the *Repetition* mode (to be set independently for all applications) and Frequency Deviation Algorithm (relevant for the *Modulation* application only).

Measurement results

The output fields in the left half of the *Overview* menu show the current measurement results. The results depend on the application selected. They are described in detail in section *Measurement Results* on p. 4.48 f.

The results displayed in the *Overview* menu represent only a small fraction of the power, modulation and receiver quality results that the R&S® CBT is able to acquire. A comprehensive set of test results is displayed in the *Power*, *Modulation* and *Receiver Quality* measurement menus; see sections *Power Measurements on p.* 4.54., *Modulation Measurements* on p. 4.75., and *Receiver Quality Measurements* on p. 4.120. In particular, the *Power* and *Modulation* menus show many quantities as functions of time.

Note: *Several parameters can be set independently for the* Modulation/Power *and for the* Receiver Quality *measurement. As long as the* Receiver Quality *measurement is running (measurement status* RUN *or* HLT), *the corresponding settings are valid for all* Overview *measurements. In particular, the R&S® CBT uses a loopback test mode and the* Master Sig. *and* Slave Sig. *settings for* Receiver Quality *tests. The* Modulation/Power *settings come into effect as soon as the* Receiver Quality *measurement is switched* OFF.

The *Overview* menu is opened from the *Menu Select* menu (with associated key at the front of the instrument) and after closing the configuration menu *Connection Control - Connection (*using the *Escape* key or automatically after establishing a connection). From the *Overview* menu, the remaining measurement menus of the function group *(Power, Modulation, Receiver Quality)* are accessible via hotkeys.

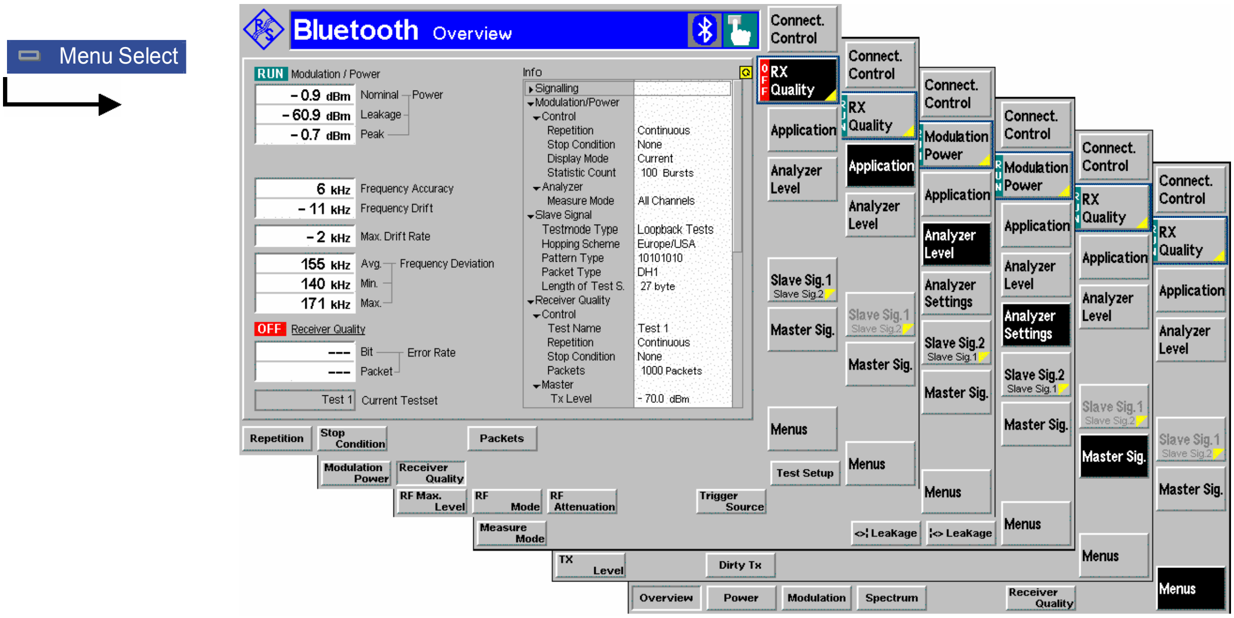


Fig. 4-44 Overview of measurements – Overview menu

Measurement Control

Each *Overview* application is controlled by means of the measurement control softkey below the *Connect. Control* softkey and the associated hotkeys.

Modulation Power

The *Modulation Power* softkey (which changes to *RX Quality,* depending on the application selected) controls the measurement application and indicates its status *(RUN | HLT | OFF).* This status can be changed after softkey selection (pressing once) by means of the *ON/OFF* key or the *CONT/HALT* key. The status can be set independently for both applications.

The applications *Modulation/Power* and *Receiver Quality* can be run in parallel, so the results for both applications are displayed simultaneously. Switchover between these two applications does not change the course of the measurement.

Note 1: *The combined* Modulation/Power *measurement is independent of the separate Power and Modulation measurements: It can be run or stopped regardless of the current measurement state of the separate measurements. It corresponds to the POWer:MPR command group in remote control.*

Note 2: *The combined Modulation/Power measurement uses the Frequency Deviation Algorithm and the Filter Bandwidth settings defined in the Modulation Configuration menu (see section* *Measurement Control (Modulation Configuration – Control) on p. 4.93.**).*

Remote control
`INITiate:POWer:MPR` etc.
`FETCh:POWer:MPR:STATus?`

`INITiate:RXQuality:BER` etc.
`FETCh:RXQuality:BER?`

Measurement configuration

The configuration settings for the *Modulation/Power* and *Receiver Quality* measurements are directly accessible from the *Overview* menu. They are collected in a common configuration menu that is opened on pressing the measurement control softkey a second time.

Selecting the Application

Appli-cation

The *Application* softkey selects the measurement application. The measurement control softkey (second softkey below *Connect. Control)* indicates the current application. Some of the hotkeys associated with the different softkeys, the *Setup* table, and the results in the *Analyzer/Generator* menu also vary as a function of the application. The corresponding measurement results are explained in section *Measurement Results* on p. 4.48.

Modulation Power

The *Modulation Power* hotkey selects the combined measurement of essential power and modulation results excluding the measurement curves.

Remote control
The *Modulation/Power* application is selected by the keyword `MPR` in the 3rd level of the `POWer` commands, e.g. `CONFigure:POWer:MPR...`

RX Quality

The *RX Quality* hotkey selects the measurement of essential receiver quality results.

Note: *When a Receiver Quality measurement is initiated the settings of the current test setup are used; see section* *Measurement Configurations (Overview Configuration) on p. 4.49.*

Remote control
The *Receiver Quality* application is selected by the keyword `BER` in the 3rd level of the `RXQuality` commands, e.g. `CONFigure:RXQuality:BER...`

Application-Specific Settings

As outlined in section *Overview of the Function Group on p.* 4.45., some of the hotkey/softkey combinations in the *Overview* menu change when selecting a different application. However, most *Overview* settings are coupled to the corresponding settings in the *Power, Modulation* and *Receiver Quality* menus. Changes made in the *Overview* menu overwrite these *Power, Modulation* and *Receiver Quality* settings and vice versa. Exceptions are listed below.

Independent Settings

The scope of the *Power Modulation* measurement and its measurement mode is not coupled to the corresponding settings in the *Power* or in the *Modulation* measurement. The following hotkeys do not overwrite the settings in any other measurement menus:

Modulation Power – Repetition
Modulation Power – Stop Condition
Modulation Power – Display Mode
Modulation Power – Statistic Count
Analyzer Settings – Measure Mode

Analyzer Settings – Measured Channel
Analyzer Settings – Measured Frequency

Remote control
In remote control, the independent settings are accessed by the following `POWer:MPR` configuration commands:

```
CONFigure:POWer:MPR:CONTrol:STATistics <Statistic_Count>
CONFigure:POWer:MPR:CONTrol:REPetition
      <Repetition>, <Stop_Cond>, <Step_Mode>
CONFigure:POWer:MPR:MMODe <Mode>
CONFigure:POWer:MPR:FREQuency <Meas_Frequency>
CONFigure:POWer:MPR:FREQuency:UNIT <Unit>
```

The display mode has no direct equivalent in remote control. The results of the four display modes are always returned together.

Description of settings

- The settings to be made in the *Modulation/Power* application are described in sections *Test Settings* on p. 4.55. and on p. 4.79.
- The settings to be made in the *Receiver Quality* application are described in section *Test Settings* on p. 4.123..

Setup table

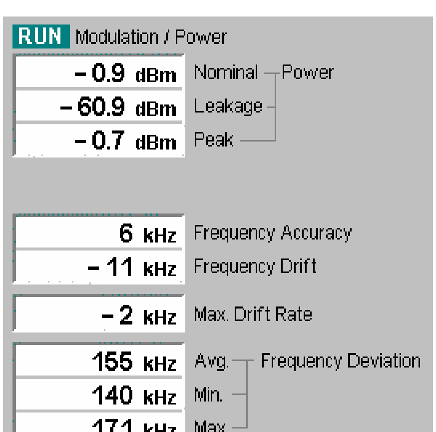
The *Setup* table in the right half of the *Overview* menu contains a comprehensive list of features supported by the DUT. This information is collected during the connection phase; it is also indicated in the *Connection (Test Mode)* menu. For a detailed description see page 4.139.

After the first start of the R&S® CBT, the default values for all *Signalling Info* parameters (listed in the remote control command description in Chapter 6) are displayed. For some parameters (e.g. *Version*, *Class of Dev.* etc.) there are no default values, so the R&S® CBT indicates invalid results ("---"). After a *Detach* from a DUT the info about that DUT is still displayed unless a different “device to page” is selected by the user.

The table also gives an overview of the measurement settings belonging to the different applications. The roll-key scrolls and expands the *Setup* table.

Measurement Results

All results of the *Overview* menu display in the left half of the menu:



The results for the *Modulation/Power* application are displayed in the upper part of the menu. The results appear in several output fields. A header line indicates the name of the application and its measurement status. The name of the selected application is underlined.

All results are measured according to the current test settings made in via softkey/hotkey combinations or in the configuration menu (see section *Measurement Configurations (Overview Configuration)* on p. 4.49.). In particular, the values represent *Current, Average, Maximum* or *Minimum* results, depending on the *Display Mode* setting in the *Control* tab of the configuration menu.

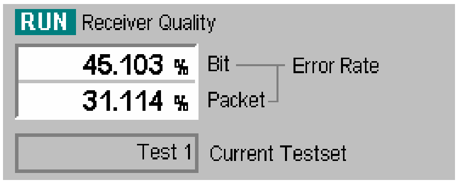
Results The results for the *Modulation/Power* application are explained in the following sections:

- The power results Nominal Power, Leakage Power and Peak Power are described in section *Measurement Results* on p. 4.61.
- The modulation results below are described in section *Measurement Results* on p. 4.81.

Remote control
`READ[:SCALar]:POWer:MPR?`
`FETCh[:SCALar]:POWer:MPR?`

Limit Check A red output field and an arrow pointing upwards or downwards indicates that the measurement exceeds the upper or lower limit set in the *Limits* tab of the configuration menu; see section *Limit Values (Overview Configuration – Limits)* on p. 4.52.

Remote control
`CALCulate[:SCALar]:POWer:MPR:MATChing:LIMit?`



The results for the *Receiver Quality* application are displayed in the lower part of the menu. The results appear in several output fields. A header line indicates the name of the application and its measurement status. The name of the selected application is underlined.

Results The results for the *Receiver Quality* application are explained in section *Measurement Results* on p. 4.126.

All results are measured according to the current test settings made in via softkey/hotkey combinations or in the configuration menu.

Note: *When a* Receiver Quality *measurement is initiated the settings of the current test setup are used; see section Measurement Configurations (Overview Configuration) on p. 4.49.*

Remote control
`READ[:SCALar]:RXQuality:BER?`
`FETCh[:SCALar]:RXQuality:BER?`

Limit Check A red output field and an arrow pointing upwards or downwards indicates that the measurement exceeds the upper or lower limit set in the *Limits* tab of the configuration menu; see section *Limit Values (Overview Configuration – Limits)* on p. 4.52..

Remote control
`CALCulate[:SCALar]:RXQuality:BER:MATChing:LIMit?`

Measurement Configurations (Overview Configuration)

The popup menu *Overview Configuration* contains five tabs which determine the parameters of the *Modulation/Power* and the *Receiver Quality* measurement including the error tolerances.

The popup menu *Overview Configuration* is activated by pressing the measurement control softkey in the *Overview* menu a second time. It is possible to change between the tabs by pressing the associated hotkeys.

Measurement Control (Overview Configuration – Control)

The *Control* tab controls the measurement by determining:

- The *Repetition* mode, *Stop Condition, Display Mode* and *Statistic Count* for the *Modulation/Power* application.
- The *Test Name, Repetition* mode, *Stop Condition* and *Number of Packets* to be sent for each *Receiver Quality* setup.

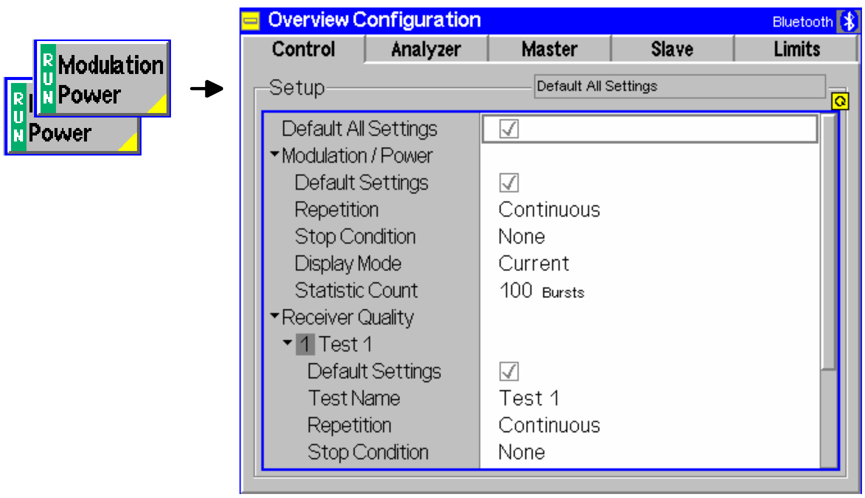


Fig. 4-45 Overview Configuration – Control

Default Settings The *Default All Settings* switch assigns default values to all settings in the *Control* tab (the default values are quoted in the command description in chapter 6 of this manual). Besides, independent default switches are provided for the *Modulation/Power* application and the different *Receiver Quality* test setups.

Remote Control

```
DEFault:Power:MPR:CONTrol  ON | OFF
DEFault:RXQuality:BER:TSETup<nr> ON | OFF
```

Modulation/ Power The *Modulation/Power* settings define the scope of the *Modulation/Power* application. The meaning of the settings is as explained in section *Measurement Control (Power Configuration – Control)* on p. 4.67.

Note: *The scope of the* Modulation/Power *measurement is not coupled to the corresponding settings in the* Power *or in the* Modulation *measurement. The parameters in the* Control *tab do not overwrite the settings in any other measurement menus.*

Remote control

```
CONFigure:POWer:MPR:CONTrol:STATistics <Statistic_Count>
CONFigure:POWer:MPR:CONTrol:REPetition
      <Repetition>, <Stop_Cond>, <Step_Mode>
```

The display mode has no direct equivalent in remote control. The results of the four display modes are always returned together.

Receiver Quality The *Receiver Quality* settings define the scope of the *Receiver Quality* application in up to 5 different test setups. The meaning of the settings is as explained in section *Measurement Control (Receiver Quality Configuration – Control)* on p. 4.129.

Note: *The* Receiver Quality *settings overwrite the corresponding settings in the* Receiver Quality Configuration *menu and vice versa.*

Analyzer Settings (Overview Configuration – Analyzer)

The *Analyzer* tab defines the R&S® CBT analyzer settings for the *Modulation/Power* application. It sets:

- The number of channels to be measured *(Measure Mode)*.
- The channel numbers for the simultaneous *(Simult. Meas.)* and single *(Single Meas.)* measurement mode

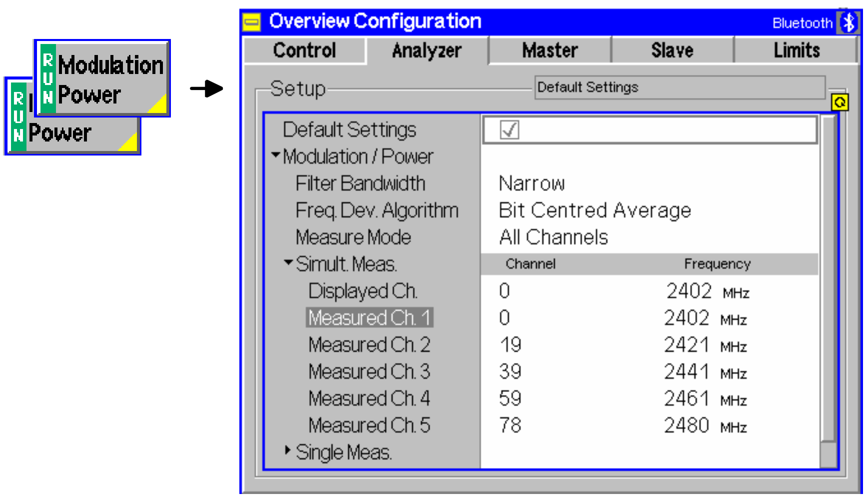


Fig. 4-46 Overview Configuration – Analyzer

Default Settings The *Default All Settings* switch assigns default values to all settings in the *Analyzer* tab (the default values are quoted in the command description in chapter 6 of this manual).

Remote Control –

Modulation/ Power The *Modulation/Power* settings define the analyzer settings for the *Modulation/Power* application. The meaning of the settings is as explained in section *Analyzer Settings (Power Configuration – Analyzer)* on p. 4.69..

Note: *The analyzer settings for the* Power Modulation *measurement are not coupled to the corresponding settings in the* Power *or in the* Modulation *measurement. The parameters in the* Analyzer *tab do not overwrite the settings in any other measurement menus.*

Remote control
```
CONFigure:POWer:MPR:MMODe <Mode>
CONFigure:POWer:MPR:FREQuency <Meas_Frequency>
CONFigure:POWer:MPR:FREQuency:UNIT <Unit>
```

BER Levels (Overview Configuration – Master)

The *Master* tab defines the RF generator level of the R&S® CBT at which the *Receiver Quality* measurement is performed. The settings are identical to the *BER* settings in the *Master* tab of the *Receiver Quality Configuration* menu; see section *BER Levels (Receiver Quality Configuration – Master)* on p. 4.131.

BER Loopback Settings (Overview Configuration – Slave)

The *Slave* tab defines the properties of the loopback test mode that is used for the *Receiver Quality* measurement. The settings are identical to the *BER* settings in the *Slave* tab of the *Receiver Quality Configuration* menu; see section *BER Loopback Settings (Receiver Quality Configuration – Slave)* on p. 4.132..

Limit Values (Overview Configuration – Limits)

The *Limits* tab defines tolerances for all measured results in the *Modulation/Power* and the *Receiver Quality* application.

Note: *All Limit settings overwrite the corresponding settings in the* Power, Modulation *and* Receiver Quality Configuration *menu and vice versa. In remote control, the commands of the* `POWer:TIME`, `MODulation:DEViation` *and* `RXQuality:BER:TSETup<nr>` *subsystems must be used to set limit values for the Overview measurement.*

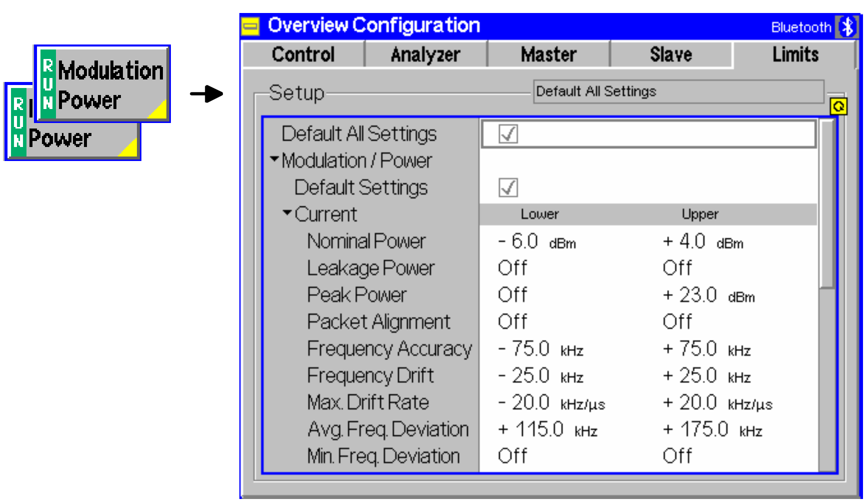


Fig. 4-1 Overview Configuration – Limits

Default Settings The *Default All Settings* switch assigns default values to all settings in the *Limits* tab (the default values are quoted in the command description in chapter 6 of this manual). Besides, independent default switches are provided for the *Modulation/Power* application and the different *Receiver Quality* test setups.

Remote Control

```
DEFault:POWer:TIME:LIMit  ON | OFF
DEFault:MODulation:DEViation:LIMit ON | OFF
DEFault:RXQuality:BER:TSETup<nr>:LIMit ON | OFF
```

Modulation/ Power

The *Modulation/Power* settings define limits for the *Modulation/Power* application. The settings are explained in sections *Limit Values (Power Configuration – Limits)* on p. 4.71. and *Limit Values (Modulation Configuration – Limits)* on p. 4.96.

Remote control
`CONFigure:POWer:TIME...:LIMIT...`
`CONFigure:MODulation:DEViation...:LIMIT...`

Receiver Quality

The *Receiver Quality* settings define limits for the *Receiver Quality* application in up to 5 different test setups. The meaning of the settings is as explained in section

Limit Values (Receiver Quality Configuration – Limits) on p. 4.133.

Power Measurements

The menu group *Power* comprises the functions for measuring the power of the received RF burst signal as a function of time. The measurement results are displayed in the graphical measurement menu *Power,* with the popup menu *Power Configuration* being used for configuration of the measurements.

The *Power* measurement group determines the transmitter output power of the *Bluetooth* DUT and verifies whether the peak and average RF-output power and the emissions inside the operating frequency range are within the limits. A simple application example for Power measurements is given in chapter 2, *Getting Started.*

The *Power* measurement is performed in the time domain (zero span mode) and on consecutive packets with a length of 1, 3, or 5 timeslots (one timeslot comprising 625 bits corresponding to a transmission time of 625 µs). The R&S® CBT takes measurement curves over the whole display range and calculates the *Peak Power*, *Nominal Power*, *Leakage Power* and the timing error of the packet *(Packet Timing)*.

Installation of the R&S CBT-B55 hardware option, in conjunction with the R&S CBT-K55 software option, provides support for EDR packets and expands the range of available power measurements. To measure the power of EDR packets, the CBT determines the average power within both the GFSK and the DPSK portions and calculates the *EDR Relative Transmit Power.* This corresponds to the test pupose (TP) TRM/CA/10/C described in the Bluetooth test specification.

In addition, a limit check is performed on all the measured quantities.

To obtain valid power results, the following conditions must be fulfilled:

- A trigger is provided.
- The preamble of the measured Bluetooth signal is correct (i.e. either 0101 or 1010).
- The R&S® CBT correlates to the expected access code in order to detect bit zero.
- The power in the center of the burst is above a threshold of approx. –35 dB below full scale.
- The power in the preamble and at the end of the burst is above 50% of the power in the center of the burst.
- The power ramp down center is detected in the window between –10 µs and +35 µs after the last bit in the burst.

Measurement Menu (Power)

The graphical measurement menu *Power* shows the results of the burst analysis (power vs. time measurement).

- The measurement control softkeys *Output Power* and *Relative Power* (see below) control the power vs. time measurement, indicate its status *(RUN | HLT | OFF)* and also open the configuration menu *Power Config*.
- The other softkeys to the right of the test diagram are combined with various hotkeys (e.g. the *hotkeys RF Max. Level, RF Mode,* and *RF Attenuation* etc. belong to the softkey *Analyzer Level).* The softkey/hotkey combinations provide test settings and switch over between different measurements.

The measurement menu *Power* can be accessed from any other measurement menu of the *Bluetooth Signalling* function group using the *Power* hotkey. It can also be opened from the *Menu Select* menu (with the associated key at the front of the instrument).

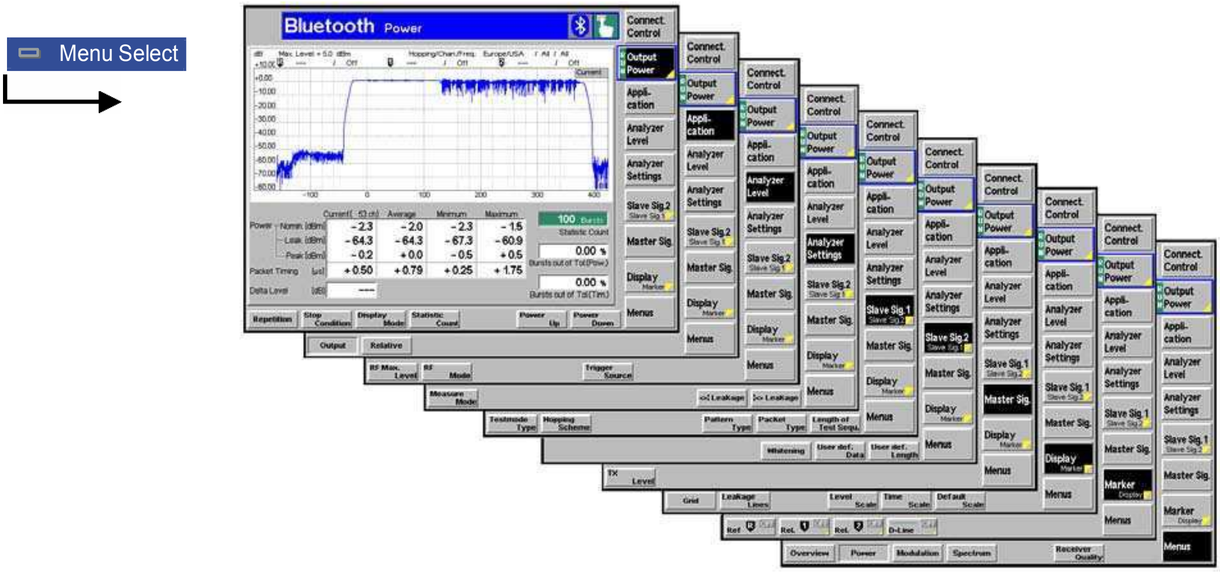


Fig. 4-47 Measurement menu Power

Test Settings

The basic settings for the *Power* measurement are directly accessible from the measurement menu via softkey/hotkey combinations. The entry of values is described in section *Test Settings* on p. 4.46. The *Power* menu provides general settings *(Analyzer Level, Slave Sig., Master Sig.)* and settings that are specific to the *Power* measurement; see definition in section *Overview of the Function Group* on p. 4.45.

Many of the basic settings are also accessible from the *Power Configuration* popup menu. They are explained in more detail in the *Measurement Configurations (Power Configuration)* section on page 4.66.

Measurement Control

With EDR options R&S CBT-B55/K55 installed, the *Power* measurement is controlled by the *Application* softkey and one of the two measurement control softkeys *Output Power* or *Relative Power* (below the *Connect. Control* softkey), along with associated hotkeys.

Output Power

The *Output Power* softkey controls the power measurement and indicates its status *(RUN | HLT | OFF)*. This status can be changed after softkey selection (pressing once) by means of the *ON/OFF* key or the *CONT/HALT* key.

Remote control

```
INITiate:POWer:TIME
ABORt:POWer:TIME
STOP:POWer:TIME
CONTINUE:POWer:TIME
FETCh:POWer:TIME:STATus?
```

Relative Power

The *Relative Power* softkey controls the power measurement and indicates its status *(RUN | HLT | OFF)*. This status can be changed after softkey selection (pressing once) by means of the *ON/OFF* key or the *CONT/HALT* key.

Remote control
```
INITiate:POWer:RELative
ABORt:POWer:RELative
STOP:POWer:RELative
CONTinue:POWer:RELative
FETCh:POWer:RELative:STATus?
```

Measurement configuration

Pressing the *Output Power* or *Relative Power* softkey a second time opens the popup menu *Power Configuration* (see page 4.66). In addition, the measurement control softkeys provide hotkeys to define the scope of the measurement. All these settings are described in more detail in section *Measurement Control (Power Configuration – Control)* on page 4.67.

Repetition

The hotkey *Repetition* determines the repetition mode of the measurement *(Single Shot* or *Continuous* measurement).

Remote control
```
CONFigure:POWer:TIME:CONTrol:REPetition
      <Repetition>,<StopCond>,<Stepmode>
CONFigure:POWer:RELative:CONTrol:REPetition
      <Repetition>,<StopCond>,<Stepmode>
```

Stop Condition

The *Stop Condition* hotkey sets a stop condition for the measurement *(None* or *On Limit Failure)*.

Remote control
```
CONFigure:POWer:TIME:CONTrol:REPetition
             <Repetition>,<StopCond>,<Stepmode>
CONFigure:POWer:RELative:CONTrol:REPetition
             <Repetition>,<StopCond>,<Stepmode>
```

Display Mode

The hotkey *Display Mode* determines the display mode of the measurement curve.

Remote control
no display mode set, the four measurement curves are accessible via
```
FETCh:ARRAy:POWer:TIME:CURRent?
FETCh:ARRAy:POWer:TIME:MINimum?
FETCh:ARRAy:POWer:TIME:MAXimum?
FETCh:ARRAy:POWer:TIME:AVERage?
FETCh:ARRAy:POWer:RELative:CURRent?
FETCh:ARRAy:POWer:RELative:MINimum?
FETCh:ARRAy:POWer:RELative:MAXimum?
FETCh:ARRAy:POWer:RELative:AVERage?
```
etc.

Statistic Count

The *Statistic Count* hotkey defines the number of bursts per statistic cycle.

Remote control
```
CONFigure:POWer:TIME:CONTrol
      <Mode>,1 ... 1000 | NONE
CONFigure:POWer:RELative:CONTrol
      <Mode>,1 ... 1000 | NONE
```

Power Up

The *Power Up* hotkey sends an increase power request to the DUT. This softkey can be pressed repeatedly; the resulting power increase is indicated as *Delta Power* in the output table in the *Power* measurement menu.

Remote control
`PROCedure:PCONtrol:STEP UP`
`PROCedure:PCONtrol:STATe?` (query power control state of the DUT)

Power Down

The *Power Down* hotkey sends a decrease power request to the DUT. This softkey can be pressed repeatedly; the resulting power decrease is indicated as *Delta Power* in the output table in the *Power* measurement menu.

Remote control
`PROCedure:PCONtrol:STEP DOWN`
`PROCedure:PCONtrol:STATe?` (query power control state of the DUT)

Application

Pressing the *Application* softkey makes available the two hotkeys *Output* and *Relative*, to select which power measurement is active in the display, either *Output Power* or *Relative Power*.

Remote control
No additional Remote Control commands required. The *Output Power* and *Relative Power* applications are controlled by commands in the `…POWer:TIME…` and `…POWer:RELative…` groups, respectively.

General Settings

The settings of the following softkeys are valid for all Bluetooth measurement groups and therefore also available in the *Connection Control* menu.

Analyzer Level

The *Analyzer Level* softkey controls the level in the RF input signal path and provides the trigger settings for the *Power* measurement.

The input level and trigger settings are also provided in the *Trigger* and *Analyzer* tabs of the *Connection Control* menu. For a detailed description see section *Trigger (Group Configuration – Trigger)* on p. 4.168. and section *Input Path (Connection Control – Analyzer)* on p. 4.169.

Slave Sig.

The *Slave Sig.* softkey controls the behavior of the DUT (acting as a Bluetooth slave) while it is in its test mode.

The settings are also provided in the *Slave Sig.* tab of the *Connection Control* menu. For a detailed description see section *Behavior of the DUT (Connection Control – Slave Sig.)* on p. 4.156.

Master Sig.

The *Master Sig.* softkey sets various parameters to configure how the R&S® CBT (acting as a Bluetooth master) performs an inquiry and sets up a connection.

The *Master Sig.* settings are also provided in the *Master Sig.* tab of the *Connection Control* menu. For a detailed description see section *Signal of the R&S CBT (Connection Control – Master Sig.)* on p. 4.149.

Specific Power Settings

The settings of the following softkeys are specific to *Power* measurements. They are not available in the *Connection Control* menu.

Analyzer Settings

The *Analyzer Settings* softkey determines the RF channels that are being monitored within the measurement. The settings are also provided in the *Power Configuration* menu. For a detailed description see section *Analyzer Settings (Power Configuration – Analyzer)* on p. 4.69.

Measure Mode

The *Measure Mode* hotkey selects how many channels are to be measured and whether the results are to be kept separate or aggregated.

Remote control
```
CONFigure:POWer:TIME:MMODe ALL | SINGle | SIMultaneous
CONFigure:POWer:RELative:MMODe ALL | SINGle | SIMultaneous
```

Measured Channel

The *Measured Channel* hotkey sets the RF channel to be measured if the *Measure Mode* is set to *Single.* The R&S® CBT will monitor only signals on the selected Bluetooth *Measured Channel*. No other channels will be measured and displayed.

When a *Measured Channel* is selected, the *Measured Frequency* is updated to correspond to the selected channel.

Remote control
```
CONFigure:POWer:TIME:MFRequency:UNIT CH
CONFigure:POWer:TIME:MFRequency <Channel>
CONFigure:POWer:RELative:MFRequency:UNIT CH
CONFigure:POWer:RELative:MFRequency <Channel>
```

Displayed Channel

The *Displayed Channel* hotkey sets the RF channel to be displayed if the *Measure Mode* is set to *Simultaneous*. More specifically, *Displayed Channel* selects the channel that all scalar results in the output fields below the diagram, including the limit check, belong to. The measurement curve, on the other hand, corresponds to the currently measured channel and is updated each time that another channel is measured; see section *Analyzer Settings (Power Configuration – Analyzer)* on p. 4.69. and section *Measurement Results* on page 4.81.

The scalar measurement results of all five channels are always stored separately until the end of the measurement cycle. In the *HLT* state, it is possible to step through the *Displayed Channels* and compare the five sets of results.

When a *Displayed Channel* is selected, the *Displayed Frequency* is updated to correspond to the selected channel.

The entire channel sequence for the *Simultaneous* mode is set in the configuration menu; see section *Analyzer Settings (Power Configuration – Analyzer)* on p. 4.69.

Remote control No command, screen configuration only.

(Pre) Leakage

The *(Pre) Leakage* hotkey selects the *Start* and the *Span* of the leakage pre-area. The leakage pre-area is a time domain before the ramp-up of the burst where the leakage power is measured; see Fig. 4-49 on p. 4.63. The leakage areas can be marked in the diagram; see *Leakage Lines* hotkey on p. 4.60.

The start of the pre-leakage area is defined relative to bit 0 of the packet. The leakage area doesn't have to be outside the burst. A possible application is to measure the power at the burst edges, averaged over a variable time interval.

Remote control –

(Post Leakage

The (Post) Leakage hotkey selects the Start and the Span of the leakage post-area. The leakage post-area is a time domain after the ramp-down of the burst where the leakage power is measured; see *Fig. 4-49* on p. 4.63. The leakage areas can be marked in the diagram; see *Leakage Lines* hotkey on p. 4.60.

The start of the post-leakage area is defined relative to the last bit of the packet. The leakage area doesn't have to be outside the burst. A possible application is to measure the power at the burst edges, averaged over a variable time interval.

Remote control –

Marker Display

The *Marker/Display* softkey positions up to 3 markers and a D-line in the test diagram and displays their values.

If pressed once again, the selected *Marker/Display* softkey changes to the *Display/Marker* softkey, see below.

Markers — are graphical tools for marking points on the measurement curve and for numerical output of measured values. The measurement menu Power provides a reference marker and two further markers which permit to measure spacings (delta marker 1 and 2).
The coordinates of the three markers are indicated in the format Ordinate value (level)/abscissa value (time) in a parameter line above the test diagram. The position of the reference marker is expressed in absolute units (level in dBm and time in bits), the delta marker by absolute or relative values (relative level in dB or time differences from the reference marker).

D-line — The D-line (display line) is a horizontal line that can be positioned on the test diagram at will to mark and read out level values.

Ref R

The hotkey *Ref. R* switches the reference marker on or off (use the *ON/OFF* key).

The reference marker is represented by the symbol R in the test diagram. The marker position (abscissa) is defined in the input field *Ref. Marker R*. The marker can be positioned to arbitrary time values. It is switched off in the default setting *(Off).* The marker level is given by the measurement curve at the marker position.

The position of all markers can be varied using the rotary knob.

Remote control
No command, screen configuration only.

Rel 1

The *Rel. 1* hotkey switches the delta marker 1 on or off (use the *ON/OFF* key).

The delta marker 1 is represented by the symbol 1 in the test diagram. The marker position (abscissa) is defined in the input field *Rel. Marker 1*. The marker can be positioned to arbitrary time values. If its position is outside the diagram area it will be invisible and its coordinates will be "- - - / <abscissa_value>". The marker is switched off in the default setting *(Off).* The marker level is given by the measurement curve at the marker position.

The toggle switch *Rel 1 Config* pops up when the hotkey is pressed for the second time. It defines whether the position of delta marker 1 is measured and indicated in absolute units (dBm) or relative to the reference marker.

Remote control
No command, screen configuration only.

Rel 2

The *Rel. 2* hotkey switches the delta marker 2 on or off (use the *ON/OFF* key). Functions and remote control are analogous to delta marker 1.

D-Line

The *D-Line* hotkey switches the D-line in the test diagram on or off.

The D-line is a horizontal, colored auxiliary line in the test diagram and is used for marking a level value and for measuring level differences. The level (ordinate) is determined in the input field *D-Line* and indicated on the D-line. The permissible value range is the diagram area, the default setting is Off.

The switch *D-Line Config.* is opened by pressing *D-Line* a second time and determines whether the D-line level is expressed in absolute units (in dBm, setting absolute) or relative to the Max. Level (in dB, setting relative).

Remote control
No command, screen configuration only.

Display Marker

The *Display/Marker* softkey zooms, shifts and configures the graphical display. It is selected by pressing the *Marker/Display* softkey a second time. If pressed once again, the selected *Display/Marker* softkey changes back to the *Marker/Display* softkey, see above.

Grid

The *Grid* hotkey switches the grid in the test diagram on or off.

Remote control
No command, screen configuration only.

Leakage Lines

The *Leakage Lines* hotkey switches the leakage lines in the test diagram on or off. Leakage lines are vertical lines marking the position of the pre-leakage and post-leakage areas in the diagram; see *Leakage* softkeys on p. 4.59. Switching off the leakage lines only affects the diagram; the leakage power is still available.
Remote control
No command, screen configuration only.

Level Scale

The *Level Scale* hotkey defines the y-axis (level) scale of the diagram. The entered *Max.* value defines the upper edge of the diagram relative to the average burst power. *Max. – Span* defines the lower edge of the diagram.

Remote control
No command, screen configuration only.

Time Scale

The *Time Scale* hotkey defines the x-axis (time) scale of the diagram and the measurement range. The entered *Start* value defines the left edge of the diagram relative to the first bit of the preamble (bit 0); see *Fig. 4-49* on p. 4.63. The *Span* defines the whole diagram width.

- The Start must be entered in bits. The minimum time (initial value) on the axis can be set between –200 bits and +3200 bits.
- The Span must be entered in timeslots. A Span of 1/16 slot, 1/8 slot, 1/4 slot, 1/2 slot, 1, 2, 3, 4, or 5 slots can be selected.

The sampling rate for the measurement curve is 4 samples per bit for 1-slot packets (DH1, see Packet Type parameter in section *Behavior of the DUT (Connection Control – Slave Sig.) on p.* 4.156.), 2 samples per bit for 3-slot packets (DH3), 1 sample per bit for 5-slot packets (DH5). For further information see remote control description in chapter 6.

Note: *This setting does not just scale the display, it also defines the area where the graph is measured. Therefore it may be necessary to set the measurement range even in remote control mode.*

Remote control
```
CONFigure:POWer:TIME:MRANge <Start>, <Span>
CONFigure:POWer:RELative:MRANge <Start>, <Span>
```

Default Scale

The *Default Scale* hotkey resets the x-axis (time) and the y-axis (level) scale to default.

Remote control
No command, screen configuration only.

Menus

The *Menus* softkey displays the hotkey bar for changing to other measurement menus.

Measurement Results

(a) *Output Power* Application

The values shown in the measurement menu *Power* can be divided into three groups:

- Setting values
- Scalar measurement results (single values)
- Arrays (the measurement curve represented as a function of time)

These values are indicated in two parameter lines, the test diagram, an output table plus additional output fields:

Parameter line 1|2

Test diagram

Output table
and output fields

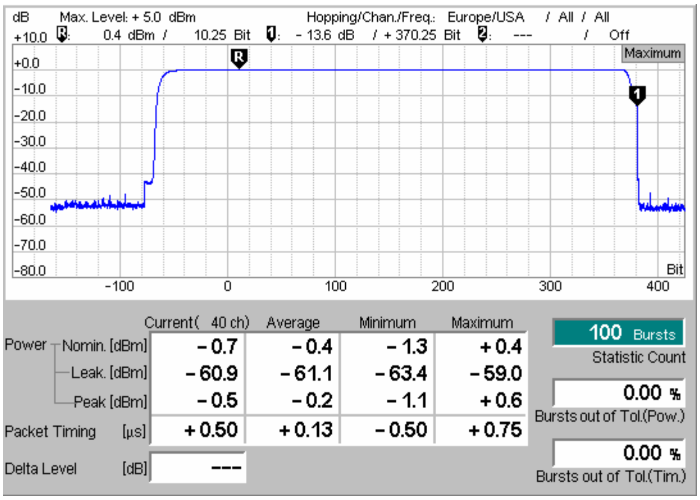


Fig. 4-48 Display of measurement results (*Output Power*)

Settings/ scalar measurement results Settings and scalar measurement results are indicated in the two parameter lines above and in the table and output fields below the test diagram.

1st parameter line The first parameter line contains the following settings:

Max. Level Maximum expected input level as set in *Max. Level* (see p. 4.169).

Attenuation Setting for the attenuation of the input level *(Normal, Low Noise, Low Distortion)*

Hopping/Chan./Freq Hopping scheme used by Signalling, measured RF channel and associated frequency

2nd parameter line The second parameter line contains the following marker values:

R Level and time of reference marker

1 Level and time of delta marker 1 (setting *absolute*) or difference from reference marker (setting *relative*)

2 Level and time of delta marker 2 (setting *absolute*) or difference from reference marker (setting *relative*)

Output fields The output fields show the following setting value:

Statistic Count Number of bursts per statistics cycle. The colored bar indicates the relative measurement progress in the cycle.

In addition, the following scalar results are indicated:

Burst out of Tol. Percentage of bursts measured that violate the tolerance limits for current bursts defined in the *Limits* tab of the configuration menu, see page 4.71. Two results are indicated, the first one refers to the power limits, the second one to the packet timing limits.

Delta Level Difference between the previous and the current value of the *Average Nominal Power,* if an *Up* or *Down* power control message was sent to the DUT; see Power Up and Power Down softkeys on page 4.56. The display changes back to invalid results ("- - -") for a new connection.

Output table The following scalar values are calculated for the current burst first *(Current)*. From the current results the average referenced to a statistic count *(Average,* see averaging rules in chapter 3) and the maximum and minimum values over all bursts measured so far *(Maximum, Minimum)* are calculated. Measurements that are not within their limits are indicated with a red background.

Nominal Power Average burst power during the carrier-on state. The nominal power is measured as the part of the burst starting at the detected 1st bit of the preamble (bit 0) to the last bit of the burst (see *Fig. 4-49* below). The nominal power determines the 0-dB line in the test diagram.

Leakage Power Average power during the carrier-off state. The leakage power is measured as the part of the slot comprising the leakage pre-area and the leakage post-area (see *Fig. 4-49* below).

Peak Power Maximum power level within the whole burst, i.e. between the first sample of the leakage pre-area and the last sample of the leakage post-area.

Packet Timing Offset between the measured burst time and the slot time derived from the master's (R&S® CBT's) clock (this means when bit 0 of a packet arrives in terms of the start of the slot).

Note: *The Packet Timing results are invalid unless the Signalling Trigger is set; see section Trigger (Group Configuration – Trigger) on p. 4.168.*

Limit Check A red output field and an arrow pointing upwards or downwards indicates that the measurement result exceeds the upper or lower limit set in the *Limits* tab of the *Power Configuration* menu, see p. 4.71.

Remote control Settings are read out using the query corresponding to the setting command (setting command with appended question mark). Results are read out using queries. For scalar measurement results:

```
READ[:SCALar]:POWer:TIME
FETCh[:SCALar]:POWer:TIME?
```

(to determine the *Delta Level,* two power results must be subtracted from each other)

```
CALCulate[:SCALar]:POWer:TIME:MATChing:LIMit?
```

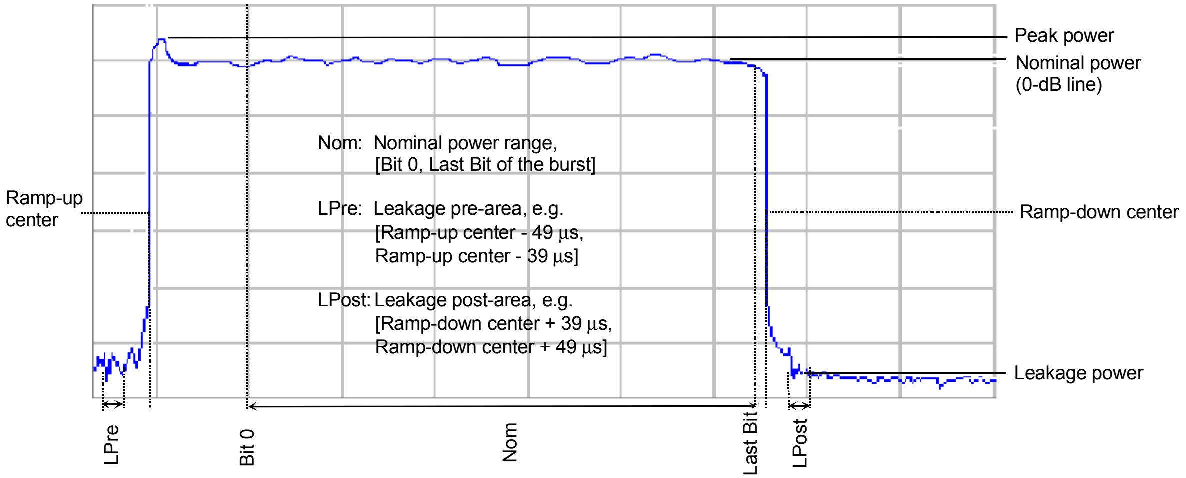


Fig. 4-49 Definition of Peak, Nominal, and Leakage Power

Measurement curves (arrays)

The measurement result is displayed as a continuous measurement curve (trace) in the test diagram together with the limit lines, markers and the D-line, if activated.

The trace in the *Power* measurement menu shows the measured burst power (in dB) as a function of time (in bits). The display result depends on the test settings made before, especially on the display mode for the trace *(Minimum, Maximum, Average, Current),* which is indicated in the upper right corner of the diagram.

The scale of the x-axis can be adjusted via the *Time Scale Start* and *Time Scale Span* hotkeys.

Aggregated vs. separate results

In the *Simultaneous* measure mode (see *Measure Mode* softkey on p. 4.58), the measurement curve is either aggregated over all measured channels (Display Mode *Average, Minimum, Maximum)* or belongs to the last measured channel (Display Mode Current). All scalar results including the *Statistic Count* and the limit check correspond to the cannel selected via the hotkey *Displayed Channel.*

Remote control

`READ:ARRay:POWer:TIME:CURRent?`
`FETCh:ARRay:POWer:TIME:CURRent?` etc.

Configurable leakage area

It is possible to display and change the areas where leakage power is measured (leakage pre-area, leakage post-area).

- To vary the start and span of the leakage areas, select *Analyzer Settings – <>|Leakage* or *|<>Leakage* (for a full description of the hotkeys and how to use them see *Leakage* softkeys on p. 4.59.)
- To display or hide the leakage lines, which mark the current leakage measurement areas, select *Display – Leakage Lines (*see *Leakage Lines* hotkey on p. 4.60).

Note that the leakage area is not required to be outside the burst. A possible application is to measure the power at the burst edges, averaged over a variable time interval.

Remote control

–

(b) *Relative Power* Application

The *Relative Power* application is provided specifically for analysis of EDR packets, and requires the B55 hardware option and K55 software option to be installed. The CBT measures EDR power by determining the average power both in the GFSK and in the DPSK portions of an EDR packet.

The values shown in the measurement menu *Power* can be divided into three groups:

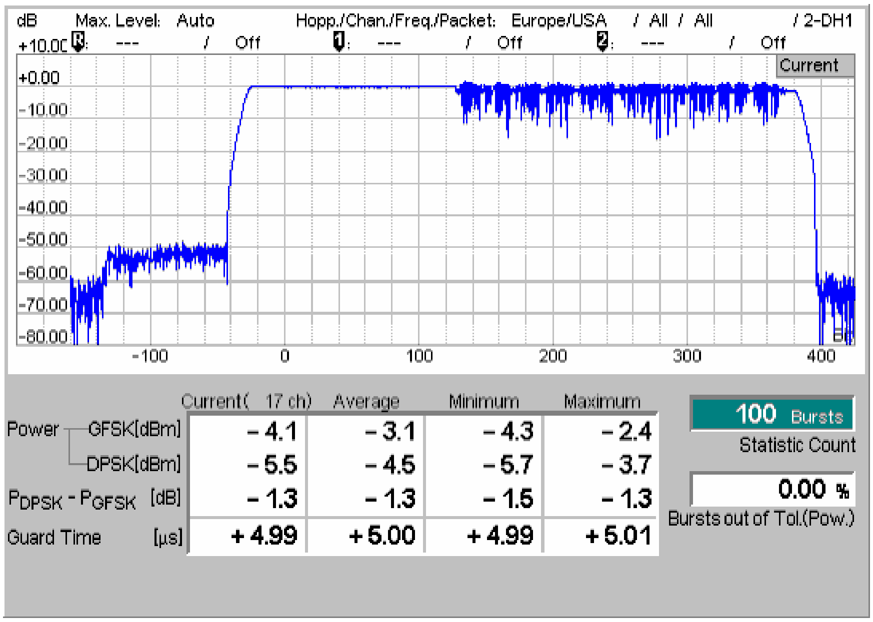
- Setting values
- Scalar measurement results (single values)
- Arrays (the measurement curve represented as a function of time)

These values are indicated in two parameter lines, the test diagram, and an output table, plus additional output fields:

Parameter line 1|2

Test diagram

Output table
and output fields



EDR Packet
measurement
definition

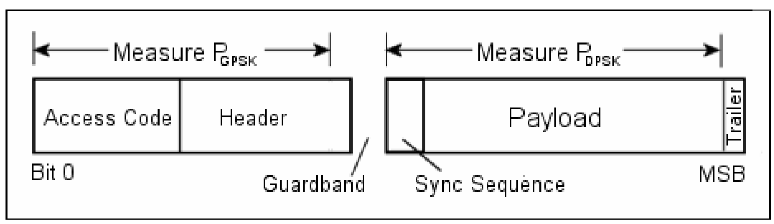


Fig. 4-50 Display of measurement results (*Relative Power*)

Settings/ scalar measurement results, and Output Fields

The two parameter lines, showing settings and scalar measurement results, and the output fields, are fully described under *Output Power* Application (see above).

Output table

The following scalar values are calculated for the current burst first *(Current)*. From the current results the average referenced to a statistic count *(Average,* see averaging rules in chapter 3) and the maximum and minimum values over all bursts measured so far *(Maximum, Minimum)* are calculated. Measurements that are not within their limits are indicated with a red background.

GFSK Power Average GFSK power (dBm) during the carrier-on state. GFSK power is measured from the detected 1st bit of the preamble (bit 0) to the last bit of the packet header (see Fig. 4-15).

DPSK Power Average DPSK power (dBm) during the carrier-on state. DPSK power is measured from the first bit of the synchronization sequence to the last bit of the packet, excluding the trailer bits. This is shown in Fig. 4-15.

P_{DPSK} - P_{GFSK} The difference should be between –4 dB and +1 dB.

Guard Time Legth of the guardband between the packet header and the synchronization sequence. The guardband is a field used for physical layer change of modulation scheme.

Limit Check A red output field and an arrow pointing upwards or downwards indicates that the measurement result exceeds the upper or lower limit set in the *Limits* tab of the *Power Configuration* menu, see p.4.71.

Remote control Settings are read out using the query corresponding to the setting command (setting command with appended question mark). Results are read out using commands which only exist as queries.

For scalar measurement results:

```
READ[:SCALar]:POWer:RELative?
FETCh[:SCALar]:POWer:RELative?
CALCulate[:SCALar]:POWer:RELative:MATChing:LIMit?
```

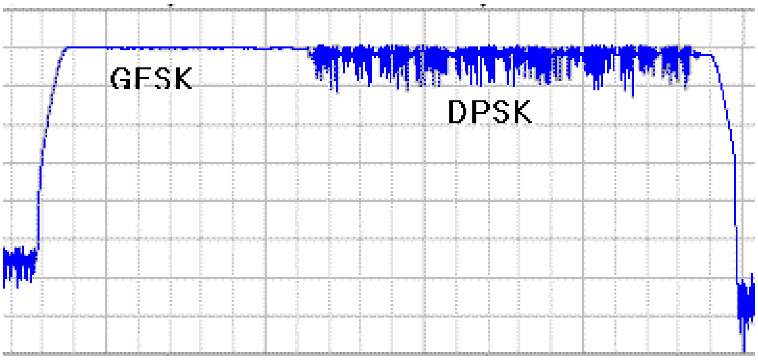


Fig. 4-51 Modulation Types in the Relative Power Curve

Measurement curves (arrays) The measurement result is displayed as a continuous measurement curve (trace) in the test diagram together with the limit lines, markers and the D-line, if activated.

The trace in the *Power* measurement menu shows the measured burst power (in dB) as a function of time. The display result depends on the test settings made before, especially on the display mode for the trace *(Minimum, Maximum, Average, Current),* which is indicated in the upper right corner of the diagram.

The scale of the x-axis can be adjusted via the *Time Scale Start* and *Time Scale Span* hotkeys.

Aggregated vs. separate results In the *Simultaneous* measure mode (see *Measure Mode* softkey on p. 4.58), the measurement curve is either aggregated over all measured channels (Display Mode *Average, Minimum, Maximum)* or belongs to the last measured channel (Display Mode Current). All scalar results including the *Statistic Count* and the limit check correspond to the channel selected via the hotkey *Displayed Channel.*

Remote control

```
READ:ARRay:POWer:RELative:CURRent?
FETCh:ARRay:POWer:RELative:CURRent?
```

Measurement Configurations (Power Configuration)

The popup menu *Power Configuration* contains three tabs to determine the parameters of the power measurement including the error tolerances.

The popup menu *Power Configuration* is activated by pressing the softkey *Power* a second time. It is possible to change between the tabs by pressing the associated hotkeys.

Measurement Control (Power Configuration – Control)

The *Control* tab controls the power measurement by defining

- The Repetition mode
- The Stop Condition for the measurement
- The type of measurement curve displayed (Display Mode)
- The number of bursts/evaluation periods forming a statistics cycle (Statistic Count)

Besides, it configures the graphical diagram by adding or removing the *Grid*.

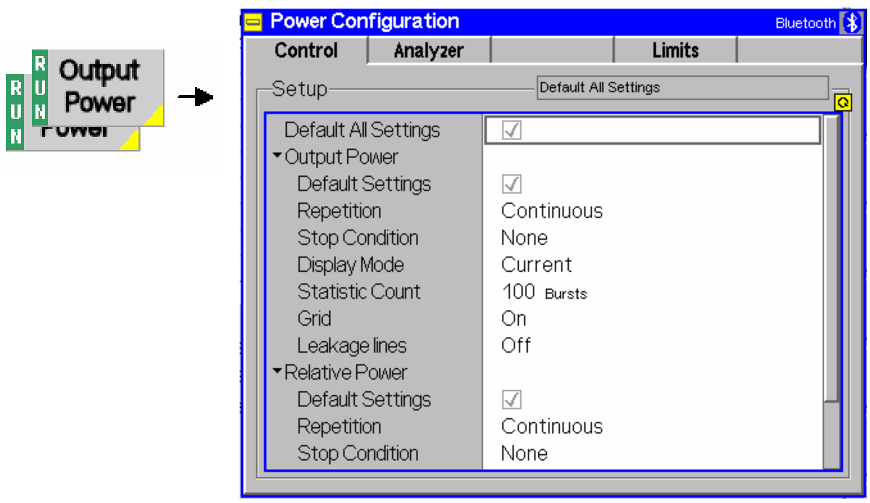


Fig. 4-52 Power Configuration – Control

Default Settings The *Default* switch assigns default values to all settings in the *Control* tab (the default values are quoted in the command description in chapter 6 of this manual).

Remote Control
```
DEFault:Power:TIME:CONTrol  ON | OFF
DEFault:Power:RELative:CONTrol  ON | OFF
```

Repetition *Repetition* determines the repetition mode:

Single Shot Single-shot measurement: The measurement is stopped after a statistics cycle, i.e. after the number of bursts/evaluation periods set in the configuration menu *Statistics* (page 4.69). It is stopped even earlier if the stop condition *On Limit failure* is set and if any of the tolerances are exceeded during this cycle. A stopped measurement is indicated by the status display *HLT* in the softkey *Power*.

Continuous Continuous measurement: The R&S® CBT continues the measurement until it is terminated explicitly, or until the stop condition (see below) is met. The output is continuously updated. An ongoing measurement is indicated by the status display *RUN* in the softkey *Power*.

Single shot should be selected to obtain a measurement result under fixed conditions. The continuous mode is suitable for monitoring the evolution of a measured quantity in time, for example for adjustments.

Note: *In remote mode, the counting measurement (counting mode) is available as a further measurement mode with a defined number of measurement cycles to be performed, see chapter 6 of this manual.*

The Repetition *mode set in manual control is valid in manual control only. Changing this parameter in manual control does not alter the repetition mode in remote control and vice versa. The default repetition mode in remote control is* `SINGleshot`*.*

Remote control
```
CONFigure:Power:TIME:CONTrol:REPetition
    CONTinuous | SINGleshot | 1 ... 10000,<StopCondition>,
                                                  <Stepmode>
CONFigure:Power:RELative:CONTrol:REPetition
      <Repetition>,<StopCondition>, <Stepmode>
```

Stop Condition *Stop Condition* defines a stop condition for the measurement:

None	Continue measurement even if tolerance is exceeded
On Limit Failure	Stop measurement if tolerance is exceeded

Remote control
```
CONFigure:Power:TIME:CONTrol:REPetition
         <REPetition>,SONerror | NONE,<Stepmode>
CONFigure:Power:RELative:CONTrol:REPetition
      <REPetition>,SONerror | NONE,<Stepmode>
```

Display Mode *Display Mode* defines which of the four measured and calculated traces is displayed. The traces differ in the way the burst power *p(t)* at a fixed point in time *t* is calculated if the measurement extends over several bursts (see also chapter 3):

Current	Measured value for current burst
Average	Average value over a number of bursts
Minimum	Minimum over all measured bursts
Maximum	Maximum over all measured bursts

The number of bursts for calculation of the statistics values *Minimum, Maximum* and *Average* – and thus the result – depends on the repetition mode set (see section *Measurement Control (Power Configuration – Control)* on page 4.67). In detail, this implies:

Single shot	Display of minimum, maximum and average value from the performed statistics cycle.
Continuous	Display of minimum and maximum from all bursts already measured. The **average value**, however, is calculated according to the rules in chapter 3, section *General Settings*.

Remote control No display mode needs to be set, the four traces are accessible via
```
FETCh:ARRAy:POWer:TIME:CURRent?
FETCh:ARRAy:POWer:TIME:AVERage?
FETCh:ARRAy:POWer:TIME:MINimum?
FETCh:ARRAy:POWer:TIME:MAXimum?
FETCh:ARRAy:POWer:RELative:CURRent?
FETCh:ARRAy:POWer:RELative:AVERage?
FETCh:ARRAy:POWer:RELative:MINimum?
FETCh:ARRAy:POWer:RELative:MAXimum?
```
etc.

Statistic Count *Statistic Count* defines the length of the statistics cycle in bursts.

The settings *1* and *Off* (press *ON/OFF* key) are equivalent. A statistics cycle is equal to the duration of one single-shot measurement (see section *Measurement Control (Power Configuration – Control)* on page 4.67).

Remote control `CONFigure:Power:TIME:CONTrol`

```
         <MODE>,1 ... 1000 | OFF
CONFigure:Power:RELative:CONTrol
        <MODE>,1 ... 1000 | OFF
```

Grid The *Grid* parameter switches the grid in the graphical test diagram on or off. In the default setting, the grid is switched on.

Remote control No command, screen configuration only

Analyzer Settings (Power Configuration – Analyzer)

The *Analyzer* tab defines the R&S® CBT analyzer settings for *Power* measurements. It sets:

- The number of channels to be measured *(Measure Mode)*.
- The channel numbers for the simultaneous *(Simult. Meas.)* and single *(Single Meas.)* measurement mode

Note: *The analyzer settings for the* Power *measurement are not coupled to the corresponding settings in the* Overview *or in the* Modulation *measurement. The parameters in the* Analyzer *tab do not overwrite the settings in any other measurement menus.*

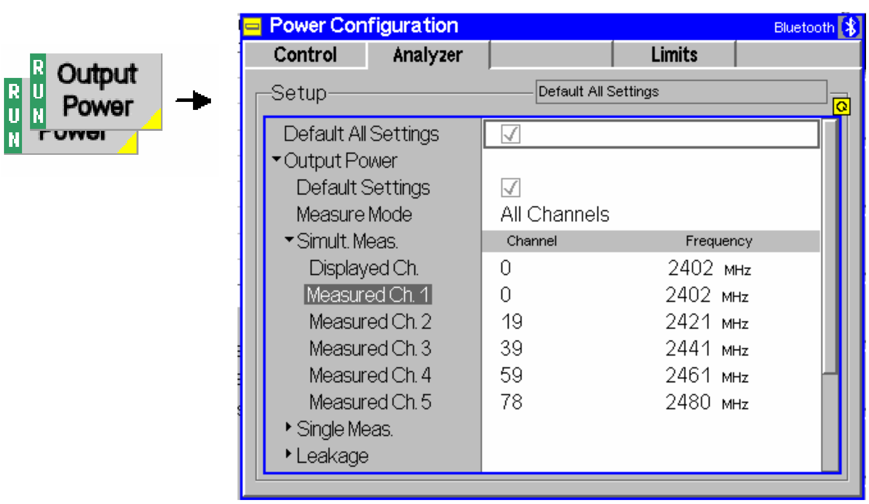


Fig. 4-53 Power Configuration – Analyzer

With EDR options installed (B55/K55), *Relative Power* is available as well as *Output Power*. The Analyzer Settings are the same for both, except that the Relative Power options omit settings for Leakage Lines.

Default Settings The *Default All Settings* switch assigns default values to all settings in the *Analyzer* tab (the default values are quoted in the command description in chapter 6 of this manual).

Remote Control -

Measure Mode The *Measure Mode* hotkey selects how many channels are to be measured and whether the results are to be kept separate or aggregated. The following options are available:

All channels All available channels are measured. In this mode, the *Simult. Meas.* and the *Single Meas.* settings are not taken into account.

The current channel is displayed in brackets above the scalar result table in the measurement menu so it is always clear which channel the current results belong to.

Single — Measurements are performed only on bursts from the channel selected via the *Measured Channel* hotkey.

Simultaneous — Measurements are performed in the *Measured Ch(annel)* sequence selected in the *Simult. Meas.* section and the scalar results are kept separate for each channel. One single shot is terminated when all five channels have reached the *statistic count*. All scalar results in the output fields and the table below the diagram including the limit check correspond to the *Displayed Ch.* in the *Simult. Meas.* section. In contrast, the measurement curve corresponds to the currently measured channel and is updated each time that another channel is measured.

Note: *The* Measure Mode *only selects the channels that are considered for measurement or for display. It does not affect the actual channel sequence generated by the Bluetooth DUT. This sequence is independently configured via the* Hopping Scheme *parameter,* *see p. 4.159.*

When selecting Single *or* Simultaneous *Measure Mode, make sure that your Hopping Scheme settings are compatible! In particular, to perform a Simultaneous measurement, the Bluetooth DUT must be able to transmit on all of up to five selected measurement channels. If a channel is not supported, the* R&S® *CBT will wait for signals from this channel and cease to update results on the other channels. The output table will show invalid results ("---") for the missing channel. This might seem as if the measurement had stopped although the Output Power softkey still indicates RUN.*

Remote control
`CONFigure:POWer:TIME:MMODe <Mode>`
`CONFigure:POWer:RELative:MMODe <Mode>`

Simult. Meas. The *Simult. Meas.* section selects the RF channel to be displayed and indicates the five measured channels if the *Measure Mode* is set to *Simultaneous*. More specifically, *Displayed Channel* selects the channel for which all scalar results in the output fields and the table below the diagram including the limit check are displayed. The measurement curve corresponds to the currently measured channel and is updated each time that another channel is measured.

When a *Channel* is selected, the *Frequency* is updated to correspond with the selected channel.

It is possible to measure on less than five channels simultaneously by switching any of the five channels *Off* (using the *ON/OFF* key). If two channels are set to the same channel number the new setting prevails and the other channel is switched *Off*.

Remote control
`CONFigure:POWer:TIME:MFRequency:SIMultaneous`
`CONFigure:POWer:RELative:MFRequency:SIMultaneous`

Single Meas. The *Single Meas.* section selects the RF channel to be measured if the *Measure Mode* is set to *Single.* The R&S® CBT will monitor only for signals on the selected

Bluetooth *Measured Channel*. No other channels will be measured and displayed.

When a *Channel* is selected, the *Frequency* is updated to correspond with the selected channel and vice versa.

Remote control

```
CONFigure:POWer:TIME:MMODe <Mode>
CONFigure:POWer:TIME:MFRequency <Meas_Frequency>
CONFigure:POWer:TIME:MFRequency:UNIT <Unit>
CONFigure:POWer:RELative:MMODe <Mode>
CONFigure:POWer:RELative:MFRequency <Meas_Frequency>
CONFigure:POWer:RELative:MFRequency:UNIT <Unit>
```

Limit Values (Power Configuration – Limits)

(a) Limits: *Output Power*

The *Limits* tab defines tolerances for the *Nominal Power, Leakage Power, Peak Power* and *Packet Timing*. Upper and lower limits can be set independently for the *Current, Average, Minimum* and *Maximum* values indicated in the output table of the *Power* measurement menu (see section *Measurement Results* on page 4.61.).

Bluetooth devices are divided into three power classes according to their maximum output power; see *Table 4-4 below*. For power class 1 equipment power control capability is required in the output power range between +4 dBm and +20 dBm in order to optimize power consumption and the overall interference level. The power steps shall form a monotonic sequence with a step size between 2 dB and 8 dB. Power control is tested by means of the *Power Up* and *Power Down* hotkeys; they are described on p.4.56.

Table 4-4 Bluetooth power classes

Power Class	**Maximum Output Power** P_{max} (⇒ Peak Power)	**Nominal Output Power** (⇒ Nominal Power)	**Min. Output Power** P_{min} (at max. power setting)	**Power Control**
1	20 dBm	not applicable	0 dBm	P_{min} < +4 dBm to P_{max} Optional: Pmin*) to P_{max}
2	4 dBm	0 dBm	–6 dBm	Optional: P_{min}*) to P_{max}
3	0 dBm	not applicable	not applicable	Optional: P_{min}*) to P_{max}

*) A lower power limit P_{min} < –30 dBm is suggested but not mandatory.

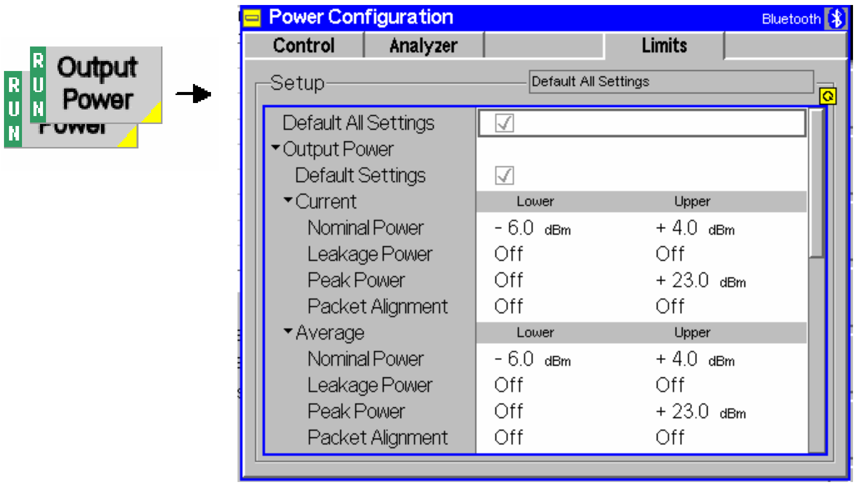


Fig. 4-54 Power Configuration – Limits (*Output Power*)

The table in the *Limits* tab contains four sets of parameters, which are the limits for the *Nominal Power,* the *Leakage Power,* the *Peak Power,* and the *Packet Timing* measurement. The four parameter sets are arranged as follows:

Default The *Default* switch assigns default values to all limit settings of the current measured quantity (the default values are quoted in the command description in Chapter 6 of this manual).

Remote control `DEFault:POWer:TIME:LIMit ON | OFF`

Burst Power/ Packet Timing The table sets upper and lower limits for the measurement and enables or disables the limit check. The burst power limits are set independently for the *Current*, *Average*, *Maximum*, and *Minimum* burst power results; see *Display Mode* setting in section *Measurement Control (Power Configuration – Control)* on p. 4.67. They are expressed in absolute power units (in dBm, for the *Nominal Power,* the *Leakage Power,* and the *Peak Power)* or in µs *(Packet Timing).*

Lower Lower limit of a particular measurement and trace. If the measurement falls below this value then the result will be out of tolerance.

Upper Upper limit of a particular measurement and trace. If the measurement rises above this value then the result will be out of tolerance.

Any lower or upper limit check can be disabled by means of the *ON/OFF* key.

Remote control

```
CONFigure:POWer:CURRent:LIMit:SCALar:ASYMmetric:UPPer:VALue
CONFigure:POWer:CURRent:LIMit:SCALar:ASYMmetric:LOWer:VALue
         <Nom_Power>,<Leak_Power>,<Peak_Power>
CONFigure:POWer:CURRent:LIMit:SCALar:ASYMmetric:UPPer:ENABle
CONFigure:POWer:CURRent:LIMit:SCALar:ASYMmetric:LOWer:ENABle
         ON | OFF
CONFigure:POWer:PTIMing:CAMMax:LIMit:SCALar:ASYMmetric:... etc.
```

(b) Limits: *Relative Power*

Relative Power measurements and results are only available after installation of EDR options (B55/K55) for the R&S CBT.

The *Limits* tab defines tolerances for the *GFSK Power (P_{GFSK}), DPSK Power (P_{DPSK})*, and the *Relative Power (P_{DPSK} - P_{GFSK})*. Upper and lower limits can be set independently for the *Current, Average, Minimum* and *Maximum* values indicated in the output table of the *Power* measurement menu (see the *Relative Power* section of *Measurement Results* on page 4.64).

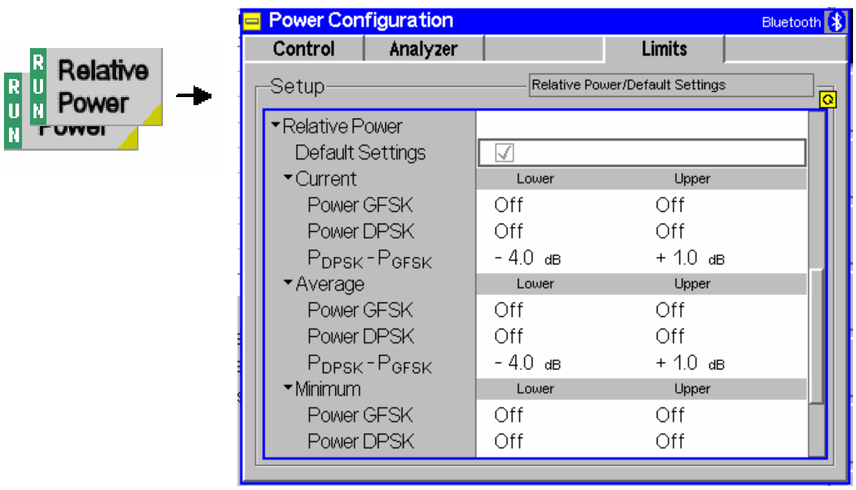


Fig. 4-55 Power Configuration – Limits (*Relative Power*)

The table in the *Limits* tab contains four sets of parameters, which are the limits for the *GFSK Power (P_{GFSK}), DPSK Power (P_{DPSK})*, and the *Relative Power (P_{DPSK} - P_{GFSK})* measurements. Note that the Bluetooth Radio Specification defines only a Current Limit for Relative Power:

$$(P_{GFSK} - 4dB) < P_{DPSK} < (P_{GFSK} + 1dB)$$

In addition, the guard time starting at the end of the last GFSK symbol of the header and ending at the start of the reference symbol of the synchronization sequence shall be between 4.75 µs and 5.25 µs.

The four parameter sets are arranged as follows:

Default The *Default* switch assigns default values to all limit settings of the current measured quantity (the default values are quoted in the command description in Chapter 6 of this manual).

Remote control `DEFault:POWer:RELative:LIMit ON | OFF`

Power GFSK / Power DPSK / Relative Power (P_{DPSK} - P_{GFSK}) Guard Time The table sets upper and lower limits for the measurement and enables or disables the limit check. The burst power limits are set independently for the *Current*, *Average*, *Maximum*, and *Minimum* burst power results; see *Display Mode* setting in section *Measurement Control (Power Configuration – Control)* on p. 4.67. They are expressed in absolute power units (dBm) for P_{GFSK} and P_{DPSK}, in dB for the Relative Power (P_{DPSK} – P_{GFSK}), and in µs for the guard time.

Lower Lower limit of a particular measurement and trace. If the measurement falls below this value then the result will be out of tolerance.

Upper Upper limit of a particular measurement and trace. If the measurement rises above this value then the result will be out of tolerance.

Any lower or upper limit check can be disabled by means of the *ON/OFF* key.

Remote control

```
CONFigure:POWer:RELative:CURRent:LIMit:SCALar:ASYMmetric:UPPer:VALue
       <GFSK_Power>,<DPSK_Power>,<Relative_Power>, <guard_time>
CONFigure:POWer:RELative:CURRent:LIMit:SCALar:ASYMmetric:LOWer:VALue
       <GFSK_Power>,<DPSK_Power>,<Relative_Power>, <guard_time>
CONFigure:POWer:RELative:CURRent:LIMit:SCALar:ASYMmetric:UPPer
       :ENABle  ON | OFF …
CONFigure:POWer:RELative:CURRent:LIMit:SCALar:ASYMmetric:LOWer
       :ENABle  ON | OFF …
CONFigure:POWer:RELative:CURRent:LIMit:SCALar:ASYMmetric
       :COMBined:VALue  <GFSK_Upp> … <guard_time_low>
CONFigure:POWer:RELative:CURRent:LIMit:SCALar:ASYMmetric
       :COMBined:ENABle ON | OFF …
```

...etc.

Modulation Measurements

The menu group *Modulation* comprises the functions for measurement of the modulation parameters described below and for matching of the respective tolerance limits. With B55/K55 hardware and software options installed on the CBT, support for Enhanced Data Rate (EDR) packets becomes available, in addition to Basic Rate packets.

The measurement results are displayed in the graphical measurement menu *Modulation,* and the popup menu *Modulation Configuration* is used for configuration of the measurements.

The purpose of the *Modulation* measurement is to verify modulation accuracy and carrier frequency stability for the RF signal from the DUT, and also to check that performance meets the requirements of the standard.

Basic Rate Packets

The modulation scheme used for Basic Rate packets is GFSK (Gaussian Frequency Shift Keying), with a BT = 0.5.

GFSK is a binary frequency modulation technique in which a binary one is represented by a positive frequency deviation, a binary zero by a negative frequency deviation. The data rate transmitted is 1 Mbit per second.

Enhanced Data Rate (EDR) Packets

GFSK modulation is still used in the header of an EDR packet, but the payload is encoded using DPSK modulation. which enables higher data rates. The DPSK modulation can be either QPSK (π/4DQPSK) or differential 8PSK (8DPSK). Modulation measurements on EDR packets requires the R&S CBT-B55 hardware option, in conjunction with the R&S CBT-K55 software option.

The following quantities are measured, and checked for tolerance matching:

(a) *GFSK*

Frequency Accuracy	Difference between the measured transmitted frequency and the intended transmitted frequency in the preamble at the beginning of the packet.
Frequency Drift	Maximum of the difference between the measured frequency at the start of the packet and the frequencies in the payload in kHz.
Maximum Drift Rate	Maximum slope of the frequency drift in the payload.
Frequency Deviation	Frequency deviation originating from the frequency modulation, measured and displayed over the whole packet.

(b) *DPSK (with option R&S CBT-K55)*

Frequency Stability ω_i	Initial carrier frequency error in the GFSK portion of the burst
Freq. Stability $\omega_o + \omega_i$	Overall frequency error in the DPSK portion
Freq. Stability ω_o *Max*	Maximum measured value for compensated frequency error, ω_0 (DPSK portion)
RMS DEVM	RMS DEVM for the entire burst. The payload in the DPSK portion of the burst is divided into blocks of 50 symbols. An RMS DEVM value is calculated for each block. The *Current* RMS DEVM value is the maximum of the RMS DEVM values of all blocks within the burst. The *Maximum, Minimum* and *Average* statistics are based on this 'maximum' RMS DEVM calculated within the bursts.
Peak DEVM	Maximum DEVM measured over all payload symbols
99% DEVM	The percentage of measured symbols whose *DEVM* does not exceed a user-defined threshold.

With the *Modulation DPSK* application, the R&S CBT covers the test purpose (TP) TRM/CA/11/C (EDR Carrier Frequency Stability and Modulation Accuracy) described in the Bluetooth test specification. The I/Q vectors in the DPSK-modulated portions of the burst can be analyzed in the diagrams of the I/Q analyzer application.

(c) *Encoding (with option R&S CBT-K55)*

BER	Bit error rate for packets transmitted by the Bluetooth EUT
Packets with 0 bit errors	Percentage of packets that the R&S CBT received with zero bit errors

section *Test Settings for the Encoding Measurement* on p. 4.76.

The measurement of these quantities is explained in more detail in section *Measurement Results* on page 4.80. Two measurement filters with different bandwidths and two different algorithms for averaging are provided; see section *Analyzer Settings (Modulation Configuration – Analyzer)* on p. 4.94.

To obtain valid modulation results, the following conditions must be fulfilled:

- A trigger is provided.
- The preamble of the measured Bluetooth signal is correct (i.e. either 0101 or 1010).
- The R&S® CBT correlates to the expected access code in order to detect bit zero.
- Power ramp up and ramp down are detected.
- The DUT transmits the correct payload data length as defined in the transmitter test mode configuration; see *Length of Test Sequence* on p. 4.160.
- Most modulation results are valid only if a transmitter *Testmode Type* with an appropriate payload pattern is selected (see p. 4.158). For an overview see Table 4–5 below.

Table 4–5 Validity of modulation measurement results

Payload Pattern	**1010**	**11110000**	**0000, 1111, PRBS, User Defined**
Frequency accuracy	X	X	X
Frequency drift	X		
Maximum drift rate	X		
Frequency deviation	X	X	

Note: *To make sure that the modulation measurement is not performed on incorrect packets, which would lead to incorrect measurement results, the modulation measurement checks the packet type and payload pattern of the received packets. If the packet type and payload is not what is expected, the packet is rejected and an error message* Burst has wrong packet type / Burst has wrong payload *is generated (see Chapter 9).*

The packet type is always checked, except in the case of whitened loopback where the header is scrambled and therefore the packet type ID can't be checked.

The Basic Rate packet payload is always checked, in non-whitened loopback mode, if a 1010 or 11110000 pattern is expected.

Test Settings for the Encoding Measurement

According to the Bluetooth test *specification (test* purpose TRM/CA/12/C) the *Encoding* measurement must be performed with the following settings:

Testmode Type: TX Tests, hopping off (equal transmit and receive frequencies of 2402 MHz, 2441 MHz, and 2480 MHz), 2-DH1 or 3-DH1 packets with maximum length payload containing a PRBS9 pattern.

Preconditions The *Modulation Encoding* measurement requires the EDR options R&S CBT-K55/B55. The measurement must be performed in *TX Tests* mode to avoid bit errors on the path from the R&S CBT to the EUT.

R&S CBT configuration

To configure your R&S CBT in accordance with the test requirements,

1. Press MENU Select and select the *Bluetooth – Signalling – Modulation – Encoding* measurement.
2. *Reset* the *Bluetooth Signalling* function group (see detailed measurement examples in Chapter 2).

The *Connection* tab of the *Connection Control* menu is displayed.

3. Close the *Connection Control* menu to access the *Modulation Encoding* measurement menu.
4. Press the *Slave Sig. 1* softkey and use the associated hotkeys to configure the EUT according to the test requirements: *Hopping Scheme: RX/TX single freq., RX/TX Frequency: 2402 MHz, Pattern Type: Static PRBS, Packet Type: 2-DH1, Length of Test Sequ.: 54 byte.* With a firmware version V4.37 and higher, the required *TX Tests* mode is selected automatically while the *Encoding* application is active; the *Slave Sig. 1 – Testmode Type* hotkey is suppressed)
5. Reopen the *Connection Control* menu and press *Connect Testmode* to initiate a connection between the R&S CBT and your Bluetooth EUT.

The *Connection Control* menu is closed; the results of the *Modulation Encoding* measurement appear in the measurement menu.

6. Press *Slave Sig.* again and repeat the measurement using a different packet type and RX/TX frequency.

Modified test settings

In *TX Tests* mode, you can vary your test settings in order to assess the encoding accuracy with different conditions. For example, you can select a different (EDR or Basic Rate) packet type and patter or change the statistical settings in the *Control* tab of the *Connection Control* menu.

Calculation of I/Q Analyzer Diagrams and Phase Difference

The I/Q diagrams (with option R&S CBT-K55) show the constellation points (or vector diagrams) for the DPSK modulated portion of the EDR bursts, starting from the S_{ref} symbol in the EDR synchronisation sequence (shown in the following diagram).

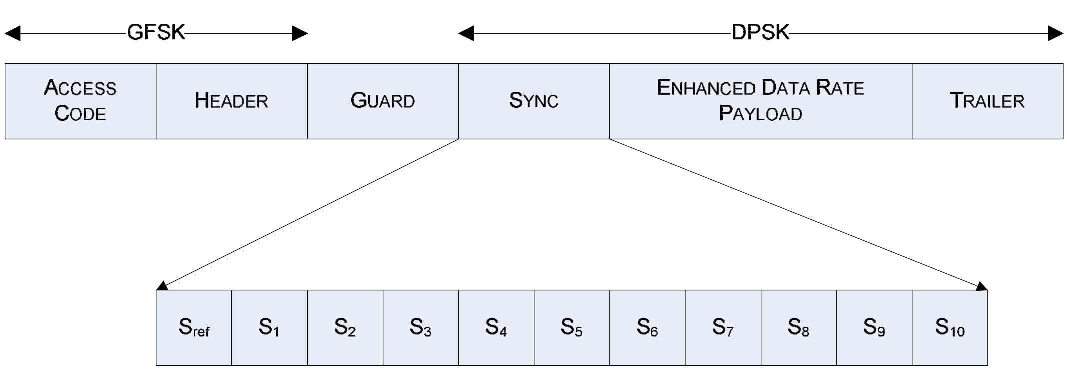


Fig. 4-56 EDR packet format

Symbol analysis and error correction

To acquire the I/Q vectors, the R&S CBT divides the DPSK portion of the burst in adjacent blocks of 50 symbols. Each block is compensated for its individual carrier frequency and timing offset. The first block starts from symbol S_1 in the EDR synchronization sequence. The last symbol in each block provides the phase reference that is necessary to demodulate the (differentially modulated) symbols in the next block. The S_{ref} symbol is used as a reference for the first block.

The I/Q values can be displayed in three different diagram types (see also section *I/Q Analyzer DPSK* on p. 4.87).

Absolute I/Q symbols

The absolute I/Q diagrams show the (normalized) I/Q vectors of the S_{ref} symbol and in N blocks of 50 symbols; the diagrams contain 50*N + 1 consecutive symbols. Normalization means that the average magnitude of all I/Q vectors equals to 1. The number N of blocks per packet depends on the packet type and on the number of payload bytes (the *Length of Test Sequence* defined in the *Slave Sig.* tab of the *Connection Control* menu). For 2-DHx and 3-DHx packets, it is calculated according to the following schemes.

Packet type	**2-DHx (π/4-DQPSK modulation)**	**3-DHx packets (8DPSK modulation)**
Number of bits in the synch sequence (used for analysis)	20	30
Payload Header (in bits)	16	16
User payload (in bits)	n * 8 (where n is the *Length of Test Sequence* set in the R&S CBT)	n * 8 (where n is the *Length of Test Sequence* set in the R&S CBT)
CRC code (in bits)	16	16
Trailer (in bits)	4	6
Total number of bits used for EDR modulation analysis	(20 + 16 + 8n + 16 + 4) = 56 + 8n	(30 + 16 + 8n + 16 + 6) = 68 + 8n
—> **Number N of blocks of 50 symbols analyzed**	**floor [(56+8n) / 2]**	**floor [(68+8n) / 3]**

Differential I/Q symbols

The differential I/Q diagrams show the normalized I/Q amplitude of each symbol and its phase difference compared to the previous symbol:

$$differential\_symbol = re^{j\phi}$$

$$Last\_symbol = ae^{j\alpha}, Current\_symbol = be^{j\beta}$$

$$r = b, \phi = \beta - \alpha$$

The S_{ref} symbol provides the initial phase reference; the diagrams contain 50*N symbol points.

DEVM

These diagrams show the differential error vector (see figure on p. 4.84) for each symbol which is calculated according to the Bluetooth Radio Specification; see also *Frequency Stability and DEVM* on p. 4.84. The DEVM is based on the phase difference between consecutive symbols, so the diagrams contain 50*N results.

Phase difference

The phase difference Φ for each symbol is measured as described above. In the *Phase Difference* application, the phase difference in rad is normalized to the value range [–1, 1] (for ideal signals), i.e. Φ —> Φ (in rad) / π.

Note the following differences between the *Phase Difference* application and the *I/Q Analyzer:*

- The *Phase Difference* results are also calculated for the guard symbols.
- The results are displayed regardless of the detection of the correct EDR synchronizaton sequence.

Refer to section *Phase Difference* on p. 4.90 for detailed information.

Prerequisites I/Q symbols can be displayed for EDR Bluetooth bursts only.

I/Q symbols will not be displayed for any EDR Bluetooth bursts without valid EDR synchronization sequence or less than 50 valid DPSK symbols (excluding the S_{ref}). Moreover, remaining symbols from fractional blocks at the end of the burst are not displayed.

Measurement Menu (Modulation)

The graphical measurement menu *Modulation* shows the results of the burst analysis (frequency deviation versus time measurement for GFSK, and DEVM versus time for DPSK).

- The measurement control softkey*Modulation GFSK*/*Modulation DPSK/Modulation Encoding,* depending on the selected application indicates the measurement status *(RUN | HLT | OFF)* and opens the configuration menu *Modulation Configuration* (press a second time).
- The other softkeys to the right of the test diagram are combined with various hotkeys. If a softkey is selected and an associated hotkey pressed, a popup window will appear which indicates a setting or enables an entry (see section *Measurement Menu (Power)* on page 4.54).

The measurement menu *Modulation* can be accessed from any other measurement menu of function group *Bluetooth Signalling* using the *Modulation* hotkey. It can be opened also from the *Menu Select* menu (with the associated key at the front of the instrument).

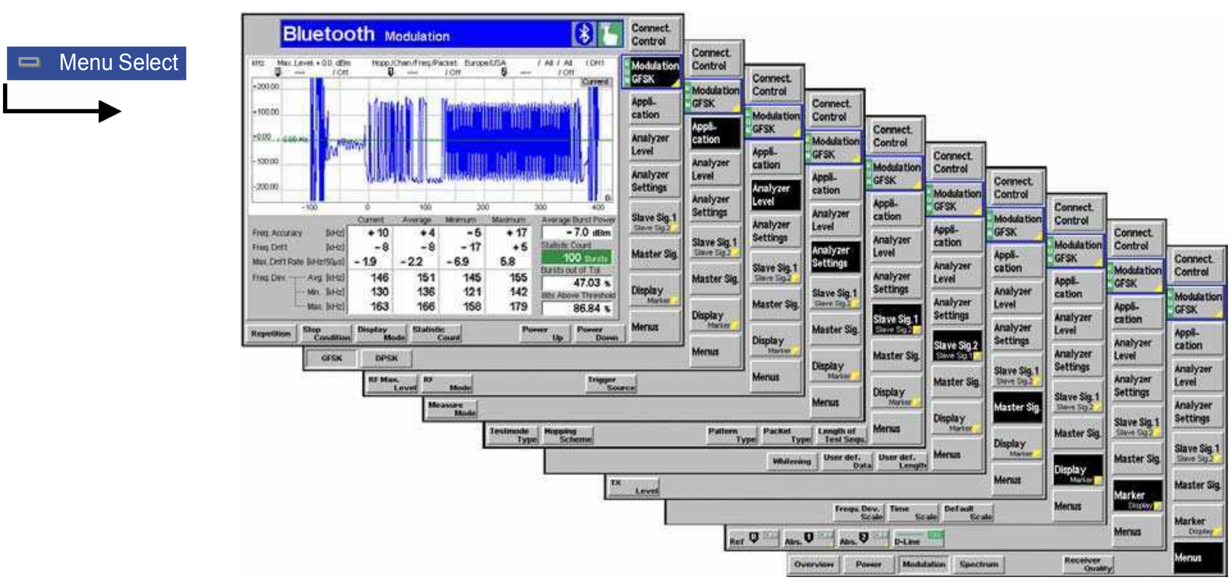


Fig. 4-57 Measurement menu Modulation

Test Settings

The *Analyzer Level, Analyzer Settings, Slave Sig., Master Sig., Marker/Display* and *Menus* test settings are identical with those in the *Power* menu (see section *Test Settings* on page 4.55). The *Modulation* and *Application* measurement control softkeys are analogous to the *Output Power* and *Application* softkeys described in section *Test Settings* on page 4.55.

Application Pressing the *Application* softkey makes available the hotkeys *GFSK, DPSK, Encoding*, *I/Q Analyzer DPSK, Phase Difference,* to select which modulation measurement is active in the display.

Remote control No additional Remote Control commands required. The *GFSK*, *DPSK, Encoding, I/Q Analyzer DPSK,* and *Phase Difference* applications are controlled by commands in the `…MODulation:DEViation…`, `…MODulation:DPSKeying…`,

…MODulation:ENCoding…, …MODulation:IQANalyzer:DPSKeying…, and …MODulation:PDIFference… subsystems, respectively.

Display Marker

The *Display/Marker* softkey zooms or shifts the graphical display. It is selected by pressing the *Marker/Display* softkey a second time. If pressed once again, the selected *Display/Marker* softkey changes back to the *Marker/Display* softkey.

Freq. Dev. Scale

The *Freq. Dev. Scale* hotkey defines the y-axis (frequency deviation) scale of the diagram when the *GFSK* application is active. The entered *Max.* value (in kHz) defines the upper edge of the diagram. *Max. – Span* defines the lower edge of the diagram.

Remote control
No command, screen configuration only.

DEVM Scale

The *DEVM Scale* hotkey defines the y-axis scale of the diagram when the *DPSK* application is active. The entered *Start* value defines the lower edge of the diagram, *Start + Span* the upper edge.

Remote control
No command, screen configuration only.

Time Scale

The *Time Scale* hotkey defines the x-axis (time) scale of the diagram and the measurement range. The entered *Start* value defines the left edge of the diagram relative to the first bit of the preamble (bit 0); see Fig. 4-49 on p. 4.63. The *Span* defines the whole diagram width.

- The Start must be entered in bits for *GFSK*, symbols for *DPSK*. The minimum time (initial value) on the axis can be set between –200 and +3200 bits/symbols.
- The Span must be entered in timeslots. A Span of 1/16 slot, 1/8 slot, 1/4 slot, 1/2 slot, or 1 slot can be selected.

The sampling rate for the measurement curve is 4 samples per bit, irrespective of the *Time Scale Span* set. For further information see remote control description in chapter 6.

Note: *This setting does not just scale the display, it also defines the area where the graph is measured. Therefore it may be necessary to set the measurement range even in remote control mode.*

Remote control
```
CONFigure:MODulation:DEViation:MRANge <Start>, <Span>
CONFigure:MODulation:DPSKeying:MRANge <Start>, <Span>
CONFigure:MODulation:PDIFference:MRANge <Start>, <Span>
```

Default Scale

The *Default Scale* hotkey resets the x-axis (time) and the y-axis (level) scale to their defaults.

Remote control
No command, screen configuration only.

Zoom

The *Zoom* hotkey scales and shifts the *I/Q Analyzer* diagrams; see section *Measurement Control (Modulation Configuration – Control)* on p. 4.93.

Remote control
No command, screen configuration only.

Measurement Results

The values shown in the *Modulation* measurement menu can be divided into three groups:

- Setting values
- Scalar measurement results (single values)
- Arrays (traces plotted as a function of time)

The results are indicated in two parameter lines, the test diagram, an output table plus additional output fields. The *Modulation Encoding* menu shows only scalar values and contains no diagram. The measurement menus for the other applications are analogous.

Modulation GFSK, Modulation DPSK

The measurement menus for the applications *Modulation GFSK* and *Modulation DPSK* contain a measurement diagram and various output fields.

Parameter line

Test diagram

Output fields

and table

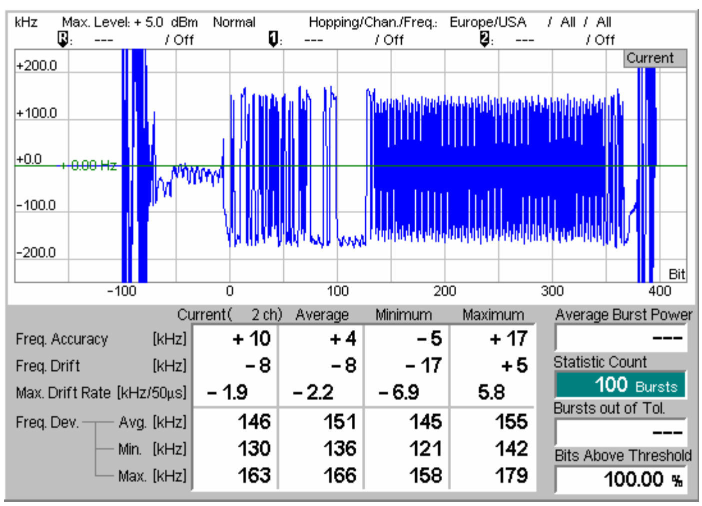


Fig. 4-58 Display of *GFSK* measurement results (Modulation menu)

Parameter line

Test diagram

Output fields

and table

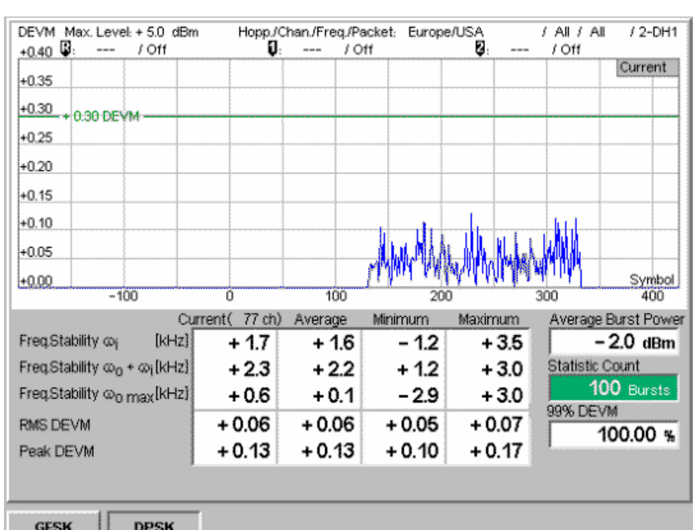


Fig. 4-59 Display of *DPSK* measurement results (Modulation menu)

Settings/ Scalar results Scalar measurement results and settings are indicated in the two parameter lines above the test diagram and in the output table below.

1st parameter line The first parameter line contains the following settings:

Max. Level Maximum input level set as in *Input Level - Mode* (see section *Input Path (Connection Control – Analyzer)* on page 4.169).

Attenuation Input path setting *(Normal, Low Noise, Low Distortion).*

Hopping Chan./Freq. Hopping scheme used by Signalling (see section *Connection Control in Test Mode (Test Mode)* on page 4.139.), measured RF channel and associated frequency.

Packet Type Packet type currently selected for the DUT (DH1, DH3, etc.).

Remote control The settings are read out using the query corresponding to the setting command (setting command with appended question mark).

2nd parameter line The second parameter line contains the following marker values:

R Level and time of reference marker

1 Level and time of delta marker 1 (setting *absolute*) or difference from reference marker (setting *relative*)

2 Level and time of delta marker 2 (setting *absolute*) or difference from reference marker (setting *relative*)

Output fields The following scalar values are displayed next to the output table, on the right hand side:

Avge. Burst Power Nominal power of the current burst; see *Fig. 4-49* on p. 4.63. The limit check of the *Average Burst Power* is independent of the limit settings in the *Power Configuration* menu (see section *Limit Values (Power Configuration – Limits)* on p. 4.71.): The background of the display goes red if the measured nominal power is less than 12 dB below the *Max. Level* (see above, 1st parameter line). This is an indication that the TX power of the DUT should be increased or the *Max. Level* reduced.

Statistic Count Length of statistics cycle in bursts/packets. The colored bar indicates the relative measurement progress in the statistics cycle.

For GFSK only:

Bursts out of Tolerance Percentage of bursts that exceed the tolerance limits.

Bits above Threshold Percentage of bits in the current statistics cycle where the frequency deviation is above the tolerance limit. This result is relevant for test cases stipulating that the frequency deviation at a given minimum percentage of bits must be above a limit, e.g. the test of the modulation index (TRM/CA/07/C). The tolerance limit and the minimum percentage are set in the *Modulation Configuration* menu; see section Limit Values (Modulation Configuration - Limits) on p. 4.96.

In accordance with the test specification this result is only calculated while the test is performed with an alternating 01010101 pattern.

DPSK only:

99% DEVM

The percentage of measured symbols whose *DEVM* does not exceed a user-defined threshold. The field displays in red when the percentage falls below a user-defined limit. The threshold and percentage values are set in the Modulation Configuration menu; see section Limit Values (Modulation Configuration – Limits) on page 4.96.

Output table

The following scalar values are calculated for the current burst first *(Current)*. From the current results the average referenced to a statistic count *(Average,* see averaging rules in chapter 3) and the maximum and minimum values over all bursts measured so far *(Maximum, Minimum)* are calculated.

Note: *To obtain valid modulation measurement results, a number of conditions must be fulfilled. In particular, the measurement depends on payload pattern selected via the Testmode Type softkey (see p. 4.158); for an overview see Table 4–5 on page 4.76.*

The following quantities are calculated in accordance with *Bluetooth RF Specification 1.1, Rev. 0.91* for GFSK measurements, and *v2.0 + EDR* for *DPSK* measurements.

(a) for Modulation GFSK

Frequency Accuracy Difference between the measured transmitted frequency and the intended transmitted frequency (the nominal Bluetooth channel frequency) at the beginning of the packet (4-bit constant preamble preceding the information bits) in kHz. To obtain the measured frequency, integration is done from the center of the 1st bit in the preamble to the center of the 1st bit following the preamble (4 complete bit periods, see *Fig. 4-60 below*).

Frequency Drift Difference between the measured frequency at the start of the packet (the value used to calculate the *Frequency Accuracy*) and the frequency in the payload in kHz. To obtain the latter, the payload is grouped into 10-bit groups and the maximum of the individual frequency drifts is calculated:

$$Frequency\ Drift = \mathrm{Max}_{\mathrm{n}}[\ f(t_n) - f(t_0)\ ]; \quad n = 1,\ ...,\ n_{\max}$$

where the t_n denote the time at the 10-bit groups, t_0 the time at the start of the packet. The first and the last bit of the payload is not considered; the same holds for incomplete 10-bit groups at the end of the payload (spare bits, see *Fig. 4-60 below*). The R&S® CBT expects the pattern type and the payload length as configured in the test mode settings (see section *Behavior of the DUT (Connection Control – Slave Sig.) on p.* 4.156.).

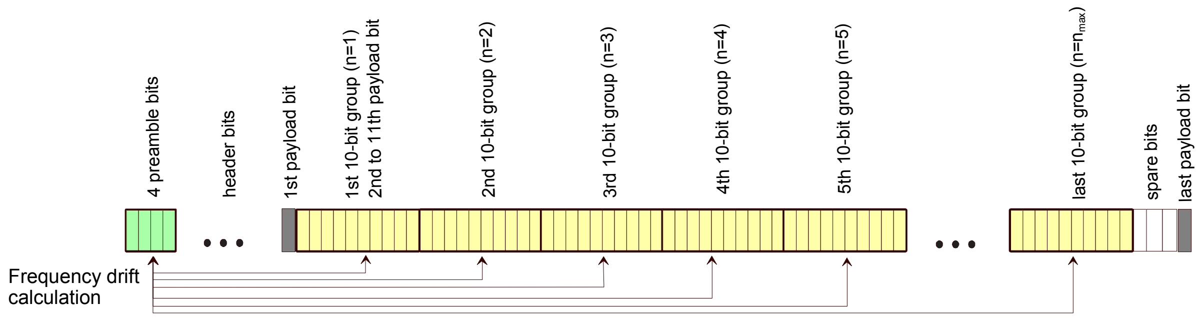


Fig. 4-60 Calculation of Frequency Drift

Maximum Drift Rate The maximum of the drift rate anywhere within the packet payload. The drift rate is a function of time; it is an estimate for the first derivative of the frequency drift with respect to time. In practice, the maximum drift rate is calculated from the measured frequency f in the burst as follows:

$$Max.\ Drift\ Rate = \mathrm{Max}_{\mathrm{n}} \frac{f(t_n) - f(t_{n-5})}{t_n - t_{n-5}}; \quad n = 6,\ ...,\ n_{\max}$$

where the t_n denote the time at the 10-bit groups used to calculate the frequency drift and the time difference of any 2 compared 10-bit groups $t_n - t_{n-5}$ amounts to 50 µs (i.e. 50 bit periods or 5 10-bit groups).

Again, the first and the last bit of the payload is not considered; the same holds for incomplete 10-bit groups at the end of the payload (spare bits). This implies that the payload length must at least 62 bits, otherwise the *Maximum Drift Rate* measurement result will be invalid.

Frequency Deviation The frequency deviation is first calculated over the whole packet payload without border bits[1]. Each bit is oversampled four times. This yields the measurement curve in the graphical display.

To obtain the scalar results *Freq. Dev. Avg./Max./Min.*, the whole payload is divided into adjacent segments with a length of 8 bits and the average frequency f_{avg} on each of these segments is calculated. The next steps depend on the payload pattern type:

- For a 0101 pattern, the maximum frequency deviation from f_{avg} is calculated for each bit i within the segment (i = 1 to 8). All these positive values are recorded as $\Delta f_{max,i}$.
- For a 00001111 pattern, the average frequency deviation from f_{avg} is calculated for bits 2, 3, 6 and 7 of the segment. These 4 positive values are recorded as $\Delta f_{max,i}$.

The quantities *Freq. Dev. Avg./Max./Min* represent the arithmetic mean value, the maximum, and the minimum of all $\Delta f_{max,i}$.within the payload.

(b) for Modulation DPSK

[1] The definition of border bits depends on the payload type. For a 0101 pattern they comprise one bit at the beginning and one bit at the end of the packet. For a 00001111 pattern they comprise 4 bits at the beginning and 4 bits at the end of the packet.

Frequency Stability and DEVM

At the baseband level, EDR continues to use the 1.6 kHz slot rate and 1 MHz symbol rate as is used for Basic Rate packets. The 2x and 3x times data rates, relative to Basic Rate packets, are achieved by DPSK encoding of the payload. The mandatory 2x rate uses π/4-DQPSK, and the optional 3x rate uses 8DPSK.

A graphical representation of the Error Vector calculation is shown below (b).

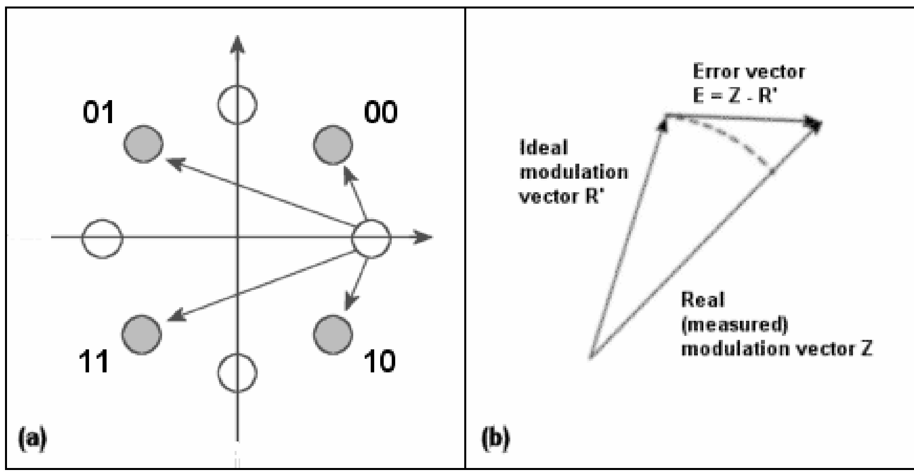


Fig. 4-61 Definition of the DEVM

Since the ideal modulation vector, R', defines the trajectory between two points on the constellation diagram (with little concern for the axes and origin) the magnitude of the error vector, E, is referred to as the "differential" Error Vector Magnitude (DEVM).

In the results of the Modulation measurement menu, the DEVM is expressed as the ratio |E| / |R'|. To achieve the DEVM results, the CBT proceeds as follows:

The initial center frequency error, ω_i, is calculated for the GFSK portion of the packet, and is used to compensate the DPSK portion. The payload is partitioned into non-overlapping 50-symbol blocks (remaining symbols omitted from analysis), and for each of these blocks ω_o, $\omega_o + \omega_i$, and RMS DEVM are recorded. The DEVM for each symbol is then calculated using ω_o for the block that contains it.

Modulation Menu Results:

Freq. Stability ω_i	The initial carrier frequency error, ω_i, for the Basic Rate (GFSK) portion of the packet.
Freq. Stability ω_o+ω_i	Overall frequency error in the DPSK portion.
Freq. Stability ω_o Max	Maximum measured value for compensated frequency error, ω_o (DPSK portion).
RMS DEVM	RMS DEVM for each payload block (payload is divided into blocks of 50 symbols).
Peak DEVM	Maximum DEVM measured over all payload symbols.

Limit Check A red output field and an arrow pointing upwards or downwards indicates that the measurement result exceeds the upper or lower limit set in the *Limits* tab of the *Modulation Configuration* menu, see p. 4.96.

Remote control `READ[:SCALar]:MODulation:DEViation?` etc.

```
FETCh[:SCALar]:MODulation:DEViation:BATHreshold?
CALCulate:MODulation:DEViation:LIMit:MATChing?
READ[:SCALar]:MODulation:DPSKeying?
CALCulate:SCALar:MODulation:DPSKeying:MATChing:LIMit?
```

Traces (arrays) The continuous trace in the test diagram for GFSK shows the frequency deviation (in kHz) in the packet as a function of time (in bits). The continuous trace in the test diagram for DPSK shows DEVM for each measured symbol as a function of time (in symbols). The display mode *(Current, Average, Minimum, Maximum)* for the trace is indicated in the upper right corner of the diagram.

The display range of the trace can be adjusted by means of the *Freq. Dev/DEVM Scale* and *Time Scale* hotkeys; see section *Test Settings* on page 4.79.

Aggregated vs. separate results: In the *Simultaneous* measure mode (see *Measure Mode* softkey on p. 4.58), the measurement curve is either aggregated over all measured channels (Display Mode Average, Minimum, Maximum) or belongs to the last measured channel (Display Mode Current). All scalar results, including the *Statistic Count* and the limit check, correspond to the channel selected via the hotkey *Displayed Channel.*

Remote control: `READ:ARRay:MODulation:DEViation:CURRent?`
`READ:ARRay:MODulation:DPSKeying:CURRent?` etc.

Modulation Encoding

The test settings of the *Modulation Encoding* measurement and the results are displayed in the tables in the center of the menu. For a description of the test specification and the corresponding settings refer to section *Test Settings for the Encoding Measurement* on p. 4.76.

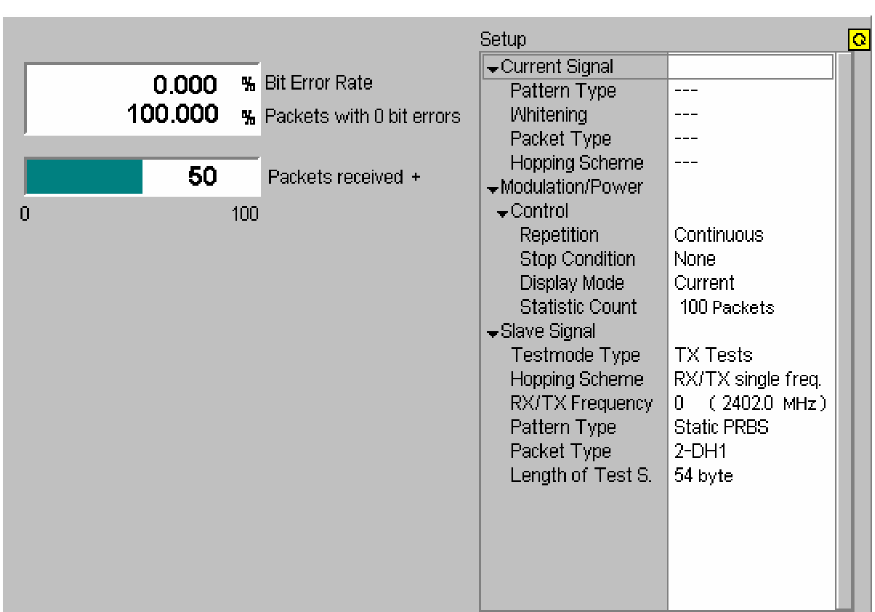


Fig. 4-62 Display of *Encoding* measurement results (Modulation menu)

Results

The output in the left half of the menu shows the results of the *Modulation Encoding* measurement.

Bit Error Rate Bit Error Rate, ratio of bits received in error to the total number of received bits.

Packets with 0 bit errors Percentage of received packets with zero errors.

Packets received A bar below the table indicates the relative measurement progress, i.e. the ratio between the current number of received packets and the total number of packets per measurement cycle. The number of packets per cycle (the *Statistic Count* defined in the *Control* tab of the *Modulation Configuration* menu) is indicated below the bar.

Limit Check

If the limit check is enabled, a red output field indicates that the measurement result exceeds/falls below the upper limit set in the *Limits* tab of the *Receiver Quality* configuration menu; see p. 4.71.

Remote control

```
READ[:SCALar]:MODulation:ENCoding?
FETCh[:SCALar]:MODulation:ENCoding?
CALCulate:MODulation:ENCoding:MATChing:LIMit?
```

Settings

The *Settings* table gives an overview of the current measurement configuration. This includes the statistical settings from the *Control* tab of the *Modulation Configuration* menu and the slave signal settings *(Slave Sig. 1 / Slave Sig. 2* softkey or *Slave Sig.* tab of the *Connection Control* menu).

Remote control

See sections *Measurement Control (Modulation Configuration – Control)* on p. 4.93 and *Behavior of the DUT (Connection Control – Slave Sig.)* on p. 4.156.

I/Q Analyzer DPSK

The *I/Q Analyz. DPSK* application provides six different graphical menus. These I/Q diagrams show the following results for the DPSK-modulated portion of the EDR packets (see section *Calculation of I/Q Analyzer Diagrams and Phase Difference* on p. 4.77):

- Absolute I/Q vectors at the decision points (symbol times)
- Differential I/Q vectors at the decision points
- Differential error vector at the decision points

The three types of results can be displayed as distinct points (constellation diagrams) or as a polygonal curve (vector diagrams). The diagram type is selected by means of the *Wave Form Type* and *Symbol Mode* parameters in the configuration menu; see section *Measurement Control (Modulation Configuration – Control)* on page 4.93.

Due to the different modulation schemes, $\pi/4$-DQPSK-modulated (2-DHx) packets and 8DPSK-modulated (3-DHx) packets produce different pattern types in the constellation diagrams.

a) Absolute results

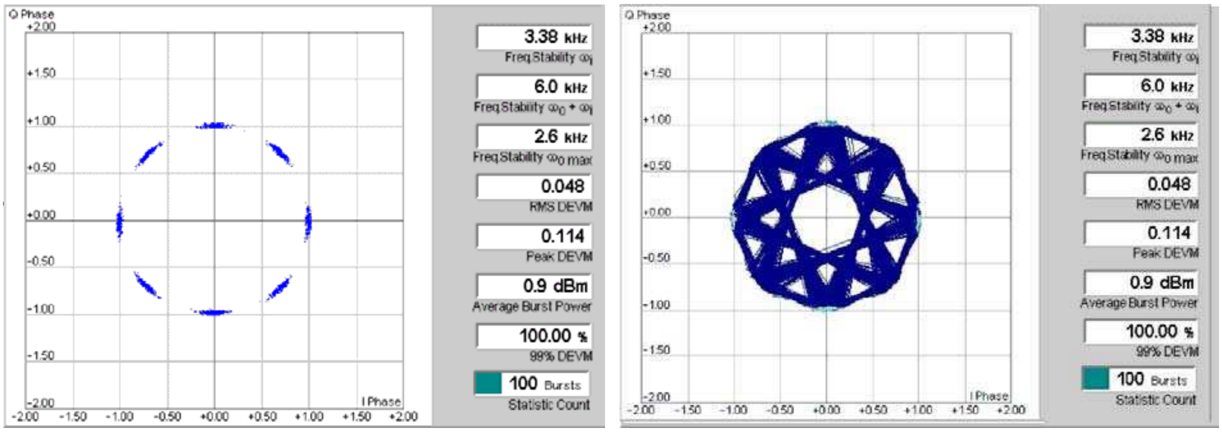


Fig. 4-63 I/Q Analyzer DPSK: absolute results (8DPSK modulation)

Scalar results The scalar modulation parameters indicated in the output fields on the right side are also shown in the other *Modulation* applications; see e.g. section *Calculation of I/Q Analyzer Diagrams and Phase Difference* on p. 4.77.

Limit Check If the limit check is enabled, a red output field indicates that the measurement result exceeds/falls below the upper limit set in the *Limits* tab of the *Receiver Quality* configuration menu; see p. 4.71.

Remote control
`READ[:SCALar]:MODulation:IQANalyzer:DPSKeying?` etc.
`CALCulate:MODulation:IQANalyzer:DPSKeying:MATChing:LIMit?`

Diagrams The absolute constellation and vector diagrams trace the π/4-DQPSK or 8DPSK modulation vector in the normalized I/Q plane over a single packet. The normalized I amplitude <I> scales the horizontal axis, the normalized Q amplitude <Q> scales the vertical axis. The phase angle is given by

$$\varphi = \arctan(<Q>/<I>),$$

and the normalization is chosen so that the signal amplitude at the constellation points averaged over the measurement length is equal to 1.

The two diagrams differ in the way the result is displayed.

Constellation diagram In the *Constellation* diagram the modulation vector is only traced at the constellation points; the diagram shows a dot for each symbol. The constellation diagram of an ideal π/4-DQPSK-modulated signal contains 4 constellation points with relative angles of π/2. The constellation diagram of an ideal 8DPSK-modulated signal contains 8 constellation points with relative angles of π/4. Large variations of the absolute symbol positions in the constellation diagram indicate the possibility of poor modulation accuracy (large DEVM, see below).

Vector diagram In the *Vector* diagram the diagram shows a continuous polygonal curve. The vector diagram shows that both modulation schemes allow transitions between each pair of constellation points.

Settings To customize the graphical representation it is possible to zoom the diagrams, keeping the origin at fixed position, and to display or remove the grid *(Display* softkey).

Remote control (for all diagram types)

```
READ:ARRay:MODulation:IQANalyzer:DPSKeying:IPHASe?
READ:ARRay:MODulation:IQANalyzer:DPSKeying:QPHASe?
```
etc.

b) Differential results

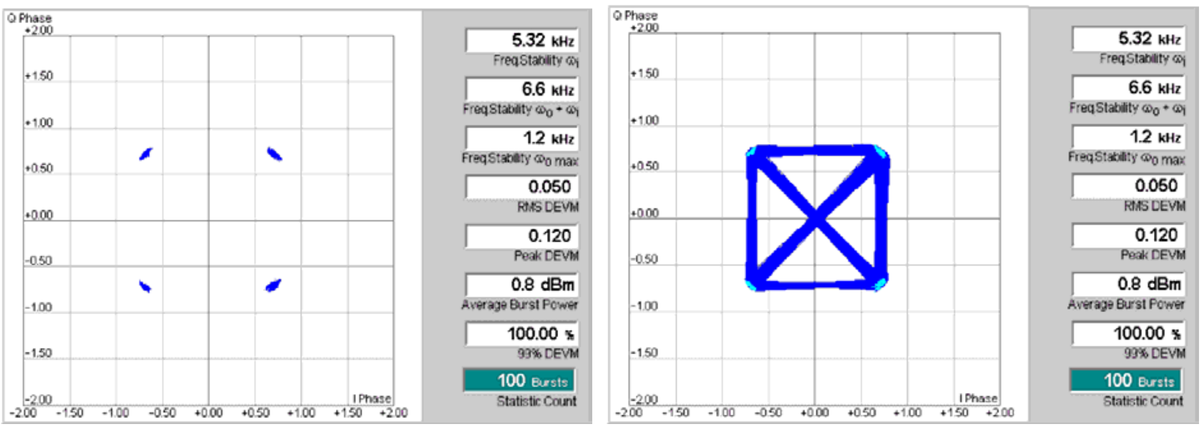


Fig. 4-64 I/Q Analyzer DPSK: differential results (π/4-DQPSK modulation)

Scalar results and remote control commands are equal for all diagram types.

Diagrams

The differential constellation and vector diagrams trace the differential π/4-DQPSK or 8DPSK modulation vector in the normalized I/Q plane over a single packet. The differential modulation vector represents the normalized I/Q amplitude of each symbol and its phase difference compared to the previous symbol: These diagrams show the transitions between consecutive DPSK symbols in the two different EDR modulation schemes:

- For π/4-DQPSK-modulated signals, differential symbols occur at phases ±π/4, ±3π/4.
- For 8DPSK-modulated signals, differential symbols occur at phases 0, ±π/4, ±π/2, ±3π/4, π.

Large variations of the differential symbol positions in the constellation diagram indicate poor modulation accuracy (large DEVM, see below).

c) Differential error vector

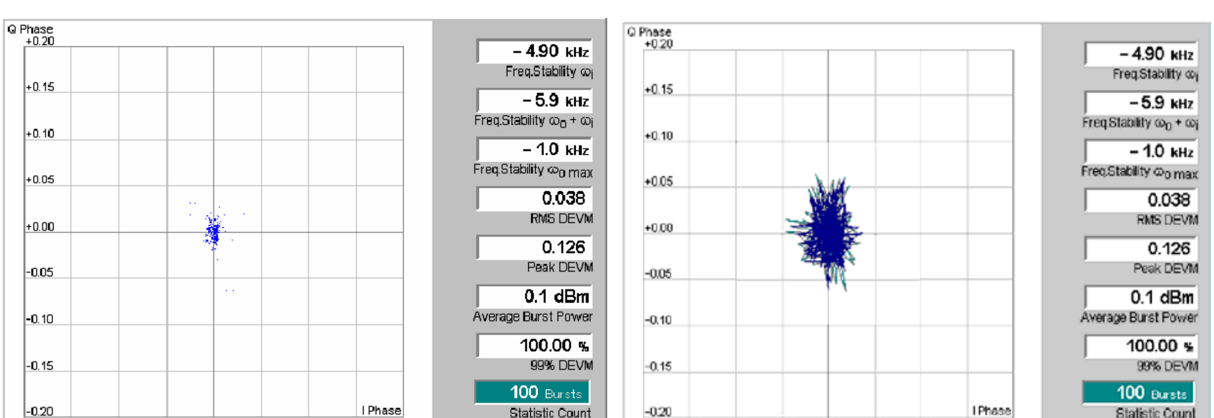


Fig. 4-65 I/Q Analyzer DPSK: DEVM results

Scalar results and remote control commands are equal for all diagram types.

Diagrams These diagrams trace the differential error vectors in the normalized I/Q plane over a single packet. The amplitude of a symbol in this diagram is the DEVM for the corresponding symbol within the Bluetooth burst. The closer the vectors are to the origin, the smaller the RMS DEVM (i.e., the better the modulation accuracy) and vice versa.

The differential error vector with the largest magnitude corresponds to the peak DEVM in the Bluetooth burst.

Phase Difference

The *Phase Difference* application shows the normalized phase difference of each symbol relative to the preceding symbol (see section *Calculation of I/Q Analyzer Diagrams and Phase Difference* on p. 4.77). The phase differences are displayed in rad/π (the phase differences in rad are divided by π). Ideally,

- π/4-DQPSK-modulated symbols (2-DHx packets) have normalized phase differences of ±1/4, ±3/4,
- 8DPSK-modulated symbols (3-DHx packets) have normalized phase differences of 0, ±1/4, ±1/2 ±3/4, or 1.

The binary EDR data can be read from the normalized phase differences according to the mapping tables in the Bluetooth Radio Specification (k denotes the symbol number, b_{2k} is the binary value no. 2k associated with symbol no. k).

Table 4-6: π/4 DQPSK mapping

Phase difference ϕ_k (rad)	**Normalized phase difference ϕ_k (rad/π)**	b_{2k-1}	b_{2k}
π/4	1/4	0	0
3π/4	3/4	0	1
-3π/4	-3/4	1	1
-π/4	-1/4	1	0

Table 4-7: 8DPSK mapping

Phase difference ϕ_k (rad)	**Normalized phase difference ϕ_k (rad/π)**	b_{3k-2}	b_{3k-1}	b_{3k}
0	0	0	0	0
π/4	1/4	0	0	1
π/2	1/2	0	1	1
3π/4	3/4	0	1	0
π	1	1	1	0
-3π/4	-3/4	1	1	1
-π/2	-1/2	1	0	1
-π/4	-1/4	1	0	0

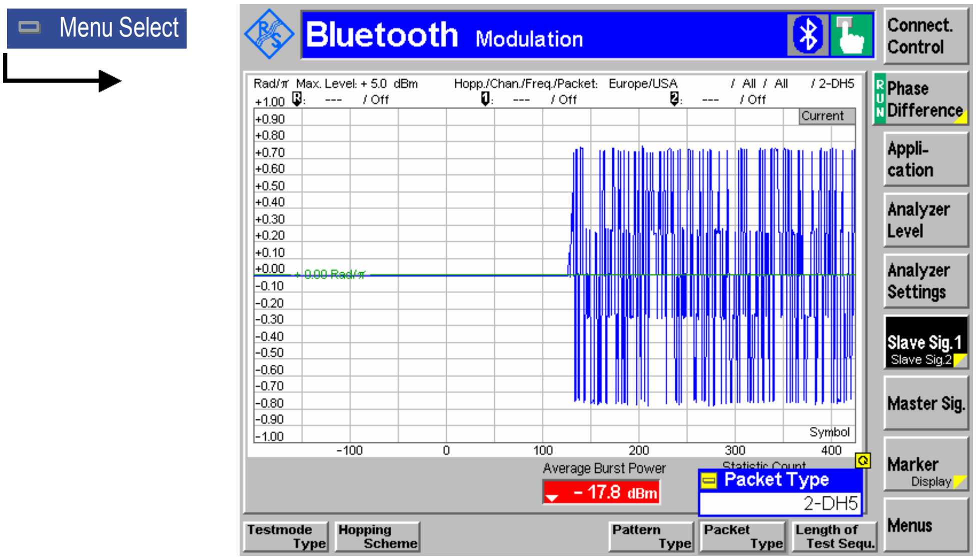


Fig. 4-66 Phase difference results

Scalar results The scalar results indicated in the output fields below the diagram are also shown in the other *Modulation* applications; see e.g. section *Modulation GFSK, Modulation DPSK* on p. 4.81.

Limit Check No limit check is provided for the *Phase Difference* application. Use the other *Modulation* applications, e.g. *I/Q Analyzer,* to check whether the modulation accuracy complies with tolerances.

Remote control: –

Diagram The diagram shows a curve of the measured normalized phase difference vs. time (symbol number). One value is plotted for each symbol. The phase differences are most conveniently read using markers. For a signal with good modulation accuracy, all values should be in the vicinity of the values quoted above.

The phase difference for the GFSK modulated part of the Bluetooth EDR burst and of the first guard symbol is set to zero. The phase difference between the second and first guard symbol is the first one to be displayed. The R&S CBT displays phase differences up to the middle of the signal power down ramp. This means that it is possible to decode all symbols starting with the second guard symbol, e.g. in order to verify the synchronization sequence and trailer symbols in the EDR packets (test purpose TP/PHAS/TRX/VB-07-E from the Bluetooth Baseband Test Specification).

Phase differences are displayed regardless of the detection of the correct EDR synchronization sequence.

Settings To customize the graphical representation it is possible to zoom the axis and to display or remove the grid *(Display* softkey).

Remote control (for all diagram types)
`READ:ARRay:MODulation:PDIFference:CURRent?` etc.

Example: Guard period results In the figure below, the markers are positioned as follows:

Reference Marker R	First guard symbol phase difference, initialized to 0
Marker 1	Phase difference at symbol S1 of EDR synchronization sequence

Marker 2	Last phase difference within the EDR synchronization sequence

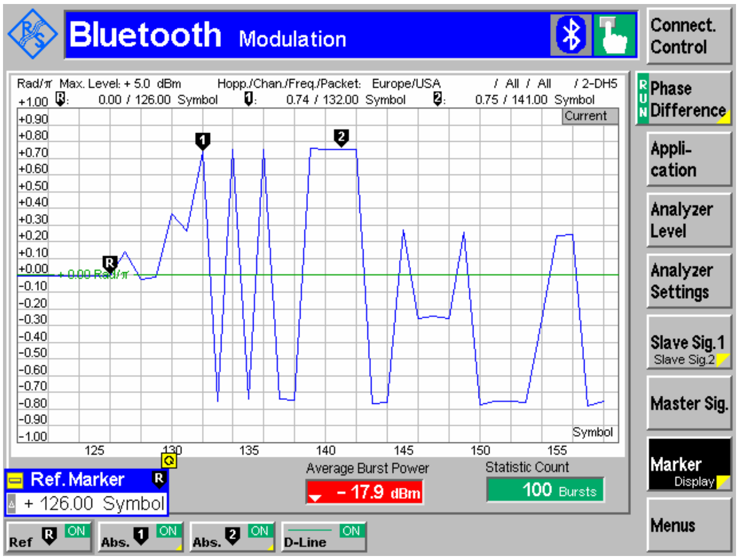


Fig. 2 Phase Difference Graph: Guard Period and Synchronization Sequence

CRC and trailer symbols

Phase differences are also displayed for “symbols” beyond the end of the Bluetooth EDR burst. This is done by calculating the phase differences between signals sampled at symbol time intervals beyond the Bluetooth burst, up to the middle of the signal power down ramp. In the figure below, the markers are positioned as follows:

Reference Marker R	Last payload symbol phase difference
Marker 1	Last CRC symbol phase difference
Marker 2	Last trailer symbol phase difference

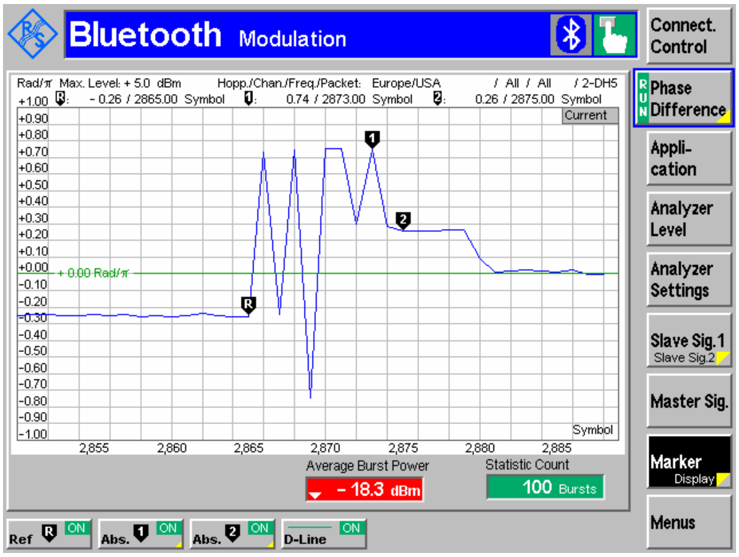


Fig. 3 CRC and Trailer Symbols for 2-DH5 packet with 10101010 pattern payload

Measurement Configurations (Modulation Configuration)

The popup menu *Modulation Configuration* contains three tabs which determine the parameters of the *Modulation* measurement.

The popup menu *Modulation Configuration* is activated by pressing the *Modulation* measurement control softkey in the top right of the graphical measurement menu *Modulation* a second time. By pressing the associated hotkeys, it is possible to change between the tabs.

Measurement Control (Modulation Configuration – Control)

The *Control* tab controls the *Modulation* measurement by defining:

- Statistical settings *(Repetition* mode, *Stop Condition, Display Mode, Statistic Count)*
- The diagram type for the *I/Q Analyzer DPSK* application *(Wave Form Type, Symbol Mode)*

In addition, it configures the graphical diagram by adding or removing the *Grid*.

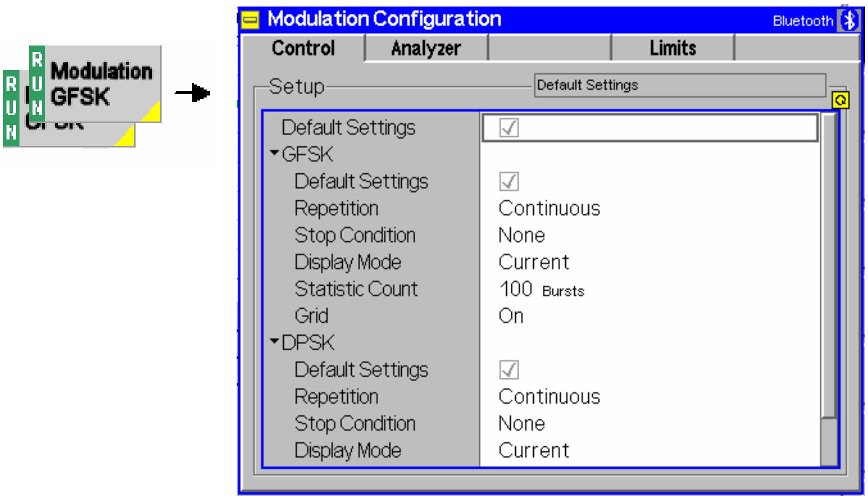


Fig. 4-67 Modulation Configuration – Control

The statistical settings are consistent with those of the *Control* tab in the *Power Configuration* menu (see page 4.67). In the remote-control commands, the keywords `POWer:TIME` and `POWer:RELative` are replaced by `...MODulation:DEViation...`, `...MODulation:DPSKeying...`, `...MODulation:ENCoding...`, `...MODulation:IQANalyzer:DPSKeying...` or `...MODulation:PDIFference...`.

The following additional settings select the diagram type for the *I/Q Analyzer DPSK* application and zoom the diagram.

Waveform Type Specifies whether the results in the *I/Q Analyzer DPSK* diagrams are displayed as distinct points (constellation diagrams) or as a polygonal curve (vector diagrams). The vector diagrams also show the transitions between consecutive constellation points.

Remote control – (display configuration)

Symbol Mode Selects the type of results in the *I/Q Analyzer DPSK* diagrams:

Absolute Absolute I/Q vectors at the decision points (symbol times)

Differential Differential I/Q vectors at the decision points (absolute magnitude and phase difference relative to the previous symbol)

Error Differential Error Vector Magnitude (DEVM) at the decision points

For details concerning the calculation refer to section *Calculation of I/Q Analyzer Diagrams and Phase Difference* on p. 4.77.

Remote control `CONFigure:MODulation:IQANalyzer:DPSKeying:SYMBol:MODE ABS | DIFF | ERR`

Zoom *Zoom* magnifies the diagram with an equal factor in horizontal and vertical direction, leaving the center (i.e. the intersection between the I and Q axis) at fixed position:

Normal The normalized I and Q amplitudes range between –2 and +2.

Factor n The normalized I and Q amplitudes range between –2/n and +2/n, where n = 2, 5, 10, 20.

In addition to the zoom factor it is possible to shift the diagram in horizontal or vertical direction using the *Zoom* hotkey associated with the *Display* softkey.

Remote control No command, display configuration only.

Analyzer Settings (Modulation Configuration – Analyzer)

The *Analyzer* tab defines the R&S® CBT analyzer settings for *Modulation GFSK, Modulation DPSK* and *I/Q Analyzer DPSK* measurements. It provides the following types of settings:

- Settings related to signal processing and data acquisition *(Filter Bandwidth, Freq. Dev. Algorithm)*
- The number of channels to be measured *(Measure Mode)*
- The channel numbers for the simultaneous *(Simult. Meas.)* and single *(Single Meas.)* measurement mode

Note: *The* Measure Mode *and channel settings for the* Modulation *measurement are not coupled to the corresponding settings in the* Overview *or in the* Power *measurement. The parameters in the* Analyzer *tab do not overwrite the settings in any other measurement menus. In contrast the* Frequency Deviation Algorithm *and the* Filter Bandwidth *settings are also used for the* Power/Modulation *application in the* Overview *measurement.*

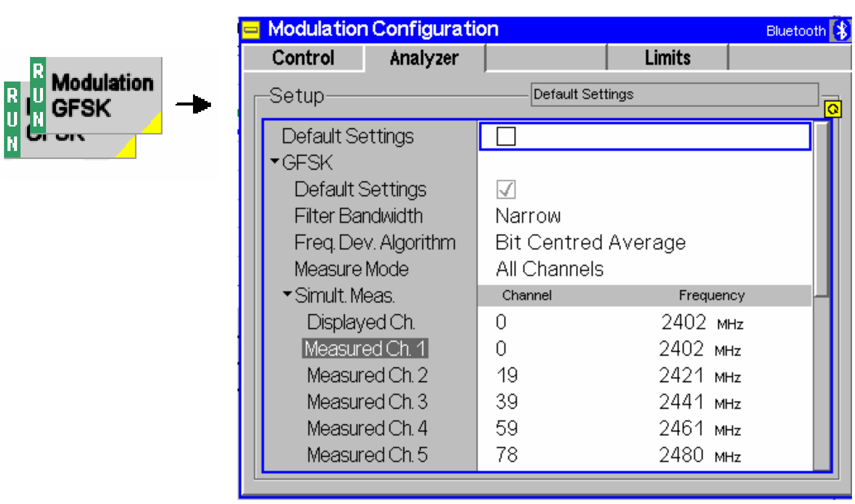


Fig. 4-68 Modulation Configuration – Analyzer

All *Measure Mode* related settings are analogous to those of the *Analyzer* tab in the *Power Configuration* menu (see page 4.69). In the remote-control commands, the keywords `POWer:TIME` and `POWer:RELative` are replaced by `…MODulation:DEViation…`, `…MODulation:DPSKeying…`,

`…MODulation:ENCoding…`, `…MODulation:IQANalyzer:DPSKeying…`, or `…MODulation:PDIFference…`. The following settings are not provided in the *Power Configuration* menu:

Filter Bandwidth Selects the resolution bandwidth of the measurement filter used for *Modulation* measurements. The (default) *wide* band and the *narrow* band filter match the two alternative filter settings stipulated in the revised Bluetooth RF test specification. The bandwidths are 1.3 MHz *(Narrow)* and approx. 2.0 MHz *(Wide).*

Remote control
```
CONFigure:MODulation:DEViation:FILTer:BWIDth  WIDE | NARR
CONFigure:POWer:MPR:FILTer:BWIDth  WIDE | NARR
CONFigure:MODulation:DPSKeying:FILTer:BWIDth  WIDE | NARR
CONFigure:POWer:MPE:FILTer:BWIDth  WIDE | NARR
```

Freq. Deviation Algorithm Defines how the R&S® CBT averages the frequency deviation and calculates the average frequency over a 01010101 bit sequence. The following options are provided to take into account differing interpretations of the Bluetooth RF Test Specification:

Integration Average The R&S® CBT calculates the mean value of all samples acquired during the bit sequence. This is the same algorithm used for a 00001111 bit sequence.

Bit Centered Average The R&S® CBT calculates the mean value of all samples at the centers of all bits of the sequence.

With an asymmetrical frequency deviation signal, the algorithms can give slightly different measurement results.

Remote control
```
CONFigure:MODulation:DEViation:FDALgorithm  BCAV | IAV
```

Limit Values (Modulation Configuration – Limits)

The tab *Limits* defines upper and lower error limits for the results obtained in the *Modulation* measurement. All relevant quantities are explained in section *Measurement Results* on p. 4.81.
Note that when the EDR options R&S CBT-B55/K55 are installed, the *Modulation* measurement menu supports the *DPSK, Encoding* and the *I/Q Analyzer* applications in addition to *GFSK*. This also extends the range of available limit values.

Conformance requirements

A poor modulation accuracy of the transmitter increases the transmission errors in the radio channel from a Bluetooth slave to the master. According to the Bluetooth test specification, the following limits apply to the *Modulation* measurement results-

Modulation GFSK

In the *Modulation GFSK* measurement (TRM/CA/07/C, TRM/CA/08/C, TRM/CA/09/C), all *Current* results must fulfill the following conditions:

- Frequency accuracy between –75 kHz and +75 kHz
- Frequency drift between –25 kHz and +25 kHz for one slot packets, between –40 kHz and +40 kHz for three or five slot packets
- Maximum drift rate between –20 kHz / 50 µs and +20 kHz / 50 µs
- Average frequency deviation between +115 kHz and +175 kHz
- At least 99.9% of all frequency deviations above the threshold value of +115 kHz

Modulation DPSK

In the *Modulation DPSK* measurement (TRM/CA/12/C), all *Current* results must fulfil the following conditions:

- Frequency stability values: ω_i and $(\omega_0 + \omega_i)$ between –75 kHz and + 75 kHz, ω_{0max} between –10 kHz and +10 kHz
- RMS DEVM below 0.20 for p/4-DQPSK, below 0.13 for 8DPSK
- Peak DEVM below 0.35 for p/4-DQPSK, below 0.25 for 8DPSK
- 99% DEVM threshold below 0.30

Modulation Encoding

In the *Modulation Encoding* measurement (TRM/CA/12/C), at least 99% of the transmitted 2-DH1 or 3-DH1 packets must be received with zero bit errors.

I/Q Analyzer DPSK

The limit settings in the *I/Q Analyzer DPSK* measurement are analogous to the *Modulation DPSK* limits.

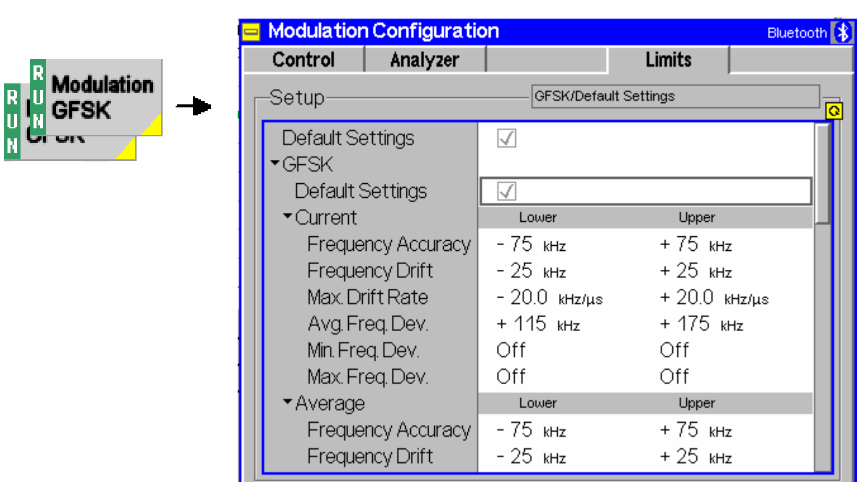


Fig. 4-69 Modulation Configuration – Limits (*GFSK*)

The table in the *Limits* tab provides six parameter sets for *Modulation GFSK*, defining limits for the *Frequency Accuracy,* the *Frequency Drift,* the *Maximum Drift Rate,* and the *Frequency Deviation* measurement. Independent limits can be set for the average of the frequency deviation over the whole packet, for its maximum, and for its minimum value.

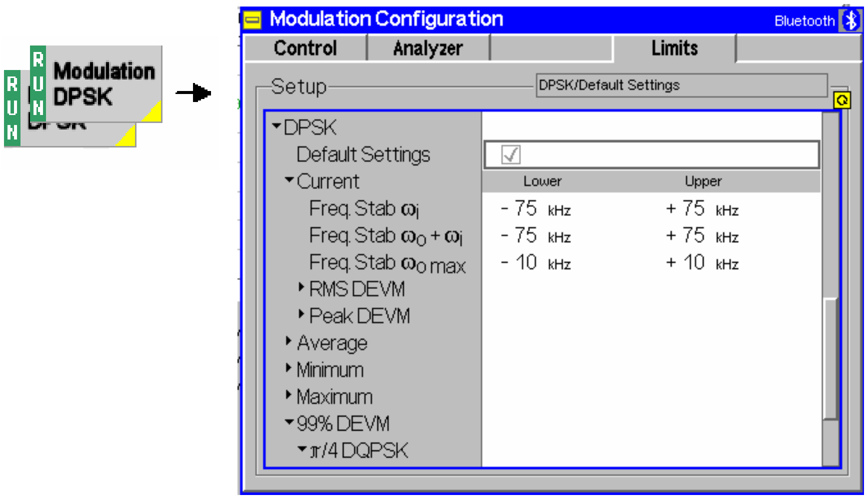


Fig. 4-70 Modulation Configuration – Limits (*DPSK*)

For the *DPSK* and *I/Q Analyzer DPSK* applications, the table in the *Limits* tab provides six parameter sets, which allow the definition of limits for:

(i) Frequency Stability --- the initial center frequency error, ω_i, the compensated frequency error in the DPSK portion, ω_o, and the overall uncompensated frequency error, $\omega_o + \omega_i$.
(ii) RMS DEVM --- for all π/4-DQPSK blocks and for all 8DQPSK blocks.
(iii) Peak DEVM --- for all π/4-DQPSK symbols and for all 8DQPSK symbols.

The parameter sets are arranged as follows:

Default The *Default* switch assigns default values to all limit settings of the current measured quantity (the default values are quoted in the command description in chapter 6 of this manual).

Remote control

```
DEFault:MODulation:DEViation:LIMit  ON | OFF
DEFault:MODulation:DPSKeying:LIMit  ON | OFF
DEFault:MODulation:IQANalyzer:DPSKeying:LIMit  ON | OFF
```

Current/ Average/ Minimum/ Maximum

The table sets upper and lower limits for the current measurement and enables or disables the limit check. The limits are set independently for the *Current*, *Average*, *Maximum*, and *Minimum* modulation results; see *Display Mode* setting in section *Measurement Control (Power Configuration – Control)* on p. 4.67.

Lower Lower limit of a particular measurement and trace. If the measurement falls below this value then the result will be out of tolerance.

Upper Upper limit of a particular measurement and trace. If the measurement rises above this value then the result will be out of tolerance.

Any lower or upper limit check can be disabled by means of the *ON/OFF* key.

Remote control

```
CONFigure:MODulation:DEViation:CURRent:LIMit:SCALar:
         ASYMmetric:UPPer:VALue
CONFigure:MODulation:DEViation:CURRent:LIMit:SCALar:
         ASYMmetric:LOWer:VALue
CONFigure:MODulation:DEViation:CURRent:LIMit:SCALar:
         ASYMmetric:UPPer:ENABle ON | OFF
CONFigure:MODulation:DEViation:CURRent:LIMit:SCALar:
         ASYMmetric:LOWer:ENABle ON | OFF  etc.
CONFigure:MODulation:<Application>:CURRent:LIMit:SCALar:
         ASYMmetric:UPPer:VALue
CONFigure:MODulation:<Application>:CURRent:LIMit:SCALar:
         ASYMmetric:LOWer:VALue
CONFigure:MODulation:<Application>:CURRent:LIMit:SCALar:
         ASYMmetric:UPPer:ENABle ON | OFF
CONFigure:MODulation:<Application>:CURRent:LIMit:SCALar:
         ASYMmetric:LOWer:ENABle ON | OFF  etc.
where <Application> = DPSKeying | IQANalyzer:DPSKeying
```

Bits Above Threshold

The table sets the criteria for the *Bits Above Threshold* result displayed in the measurement menu:

Threshold Lower limit for the frequency deviation.

Conformance Limit Minimum percentage of bits where the frequency deviation must lie above the *Threshold*.

The DUT passes the test if the frequency deviation is above the *Threshold* for at least *Conformance Limit %* of all measured bits.

Remote control

```
CONFigure:MODulation:DEViation:BATHreshold:
         THReshold[:VALue]
CONFigure:MODulation:DEViation:BATHreshold:
         THReshold:ENABLE ON | OFF
CONFigure:MODulation:DEViation:BATHreshold:
         CLIMit[:VALue]
CONFigure:MODulation:DEViation:BATHreshold:
         ENABle ON | OFF
```

For the *DPSK* and *I/Q Analyzer DPSK* applications, the following additional limits can be set:

99% DEVM

The table sets the criteria for the *99% DEVM* result displayed in the measurement menu:

Threshold Upper limit for the DEVM values.

Conformance Limit Minimum percentage of measured symbols whose DEVM must be less than or equal to the *Threshold*.

The DUT passes the test if at least *Conformance Limit %* of all measured symbols have a DEVM that does not exceed the *Threshold*.

Remote control

```
CONFigure:MODulation:DPSKeying:DEVMagnitude:THReshold[:VALue]
CONFigure:MODulation:DPSKeying:CLIMit:ENABLE ON | OFF
CONFigure:MODulation: DPSKeying:CLIMit[:VALue]
CONFigure:MODulation:IQANalyzer:DPSKeying:DEVMagnitude
         :THReshold[:VALue]
CONFigure:MODulation:IQANalyzer:DPSKeying:CLIMit:ENABLE
CONFigure:MODulation:IQANalyzer:DPSKeying:CLIMit[:VALue]
```

For the *Modulation Encoding* application, the following additional limits can be set:

Encoding – BER Upper limit for the bit error rate obtained in each measurement cycle comprising the *Statistic Count* (number of packets) selected in the *Control* tab of the *Modulation Configuration* menu. *Off* disables the limit check.

Remote control

```
CONFigure:MODulation:ENCoding:CURRent:LIMit:SCALar
         :ASYMmetric:UPPer:VALue
CONFigure:MODulation:ENCoding:CURRent:LIMit:SCALar
         :ASYMmetric:UPPer:ENABle  ON | OFF
CONFigure:MODulation:ENCoding[:COMBined]:LIMit:SCALar
         :ASYMmetric:UPPer:VALue
CONFigure:MODulation:ENCoding[:COMBined]:LIMit:SCALar
         :ASYMmetric:UPPer:ENABle  ON | OFF
```

Encoding – Packets with 0 bit errors Lower limit for the percentage of packets decoded with zero errors in each measurement cycle comprising the *Statistic Count* (number of packets) selected in the *Control* tab of the *Modulation Configuration* menu. *Off* disables the limit check.

Remote control

```
CONFigure:MODulation:ENCoding:CURRent:LIMit:SCALar
         :ASYMmetric:LOWer:VALue
CONFigure:MODulation:ENCoding:CURRent:LIMit:SCALar
         :ASYMmetric:LOWer:ENABle  ON | OFF
CONFigure:MODulation:ENCoding[:COMBined]:LIMit:SCALar
         :ASYMmetric:UPPer:VALue
CONFigure:MODulation:ENCoding[:COMBined]:LIMit:SCALar
         :ASYMmetric:UPPer:ENABle  ON | OFF
```

Spectrum Measurements

The *Spectrum* menu group measures the output RF spectrum emissions in the frequency domain. The measurement results are displayed in the graphical measurement menu *Spectrum,* with the popup menu *Spectrum Configuration* providing all measurement settings.

The *Spectrum* measurement is to verify that emissions in the Bluetooth operating frequency range are within the limits. An excess amount of off-carrier power increases interference and decreases the system capacity. The off-carrier power can be assessed by different parameters:

ACP
: The Adjacent Channel Power (ACP) corresponds to the absolute power that the Bluetooth device transmits in an off-carrier Bluetooth channel. According to the Bluetooth radio specification (test case TRM/CA/06), the ACP must be measured at 10 distinct, equidistant frequencies distributed across the channel width and with a *Statistic Count* of 10 sweeps at each of the measured frequencies. The sweep points must be smoothed out using an *Average* detector before the maximum value of each sweep is calculated. The relevant ACP values are obtained from the sweep maxima using the *Maximum* display mode.

: The standard specifies a 100-kHz resolution bandwidth, no hopping, and DH1 packets with a PRBS 9 payload to be transmitted to the DUT. The measurement procedure of the R&S CBT is faster than is required by the test procedure of the Bluetooth radio specification, but it provides equivalent results.

20 dB bandwidth
: The 20 dB bandwidth is the width of the frequency band around the peak of the emission where the transmit power drops by less than 20 dB. It is measured as the difference between the two frequencies $f_H - f_L$, where:

- f_H denotes the highest frequency at which the transmit power drops not more than 20 dB below the peak power.
- f_L denotes the smallest frequency at which the transmit power drops not more than 20 dB below the peak power.

: According to the Bluetooth radio specification, the 20 dB bandwidth must be measured in a 10-kHz resolution bandwidth using the *Maximum* display mode, no hopping, and the longest supported packets (i.e. DH5 if possible). A small 20 dB bandwidth means that the transmit power is well focused, and hence the off-carrier emissions are small. An example is shown in Fig. 4-71 below.

Frequency Range
: The *Frequency Range* measurement provides the lower and upper limit frequencies where the signal power crosses a specified power threshold; see section *Frequency Range Application* on p. 4.102.

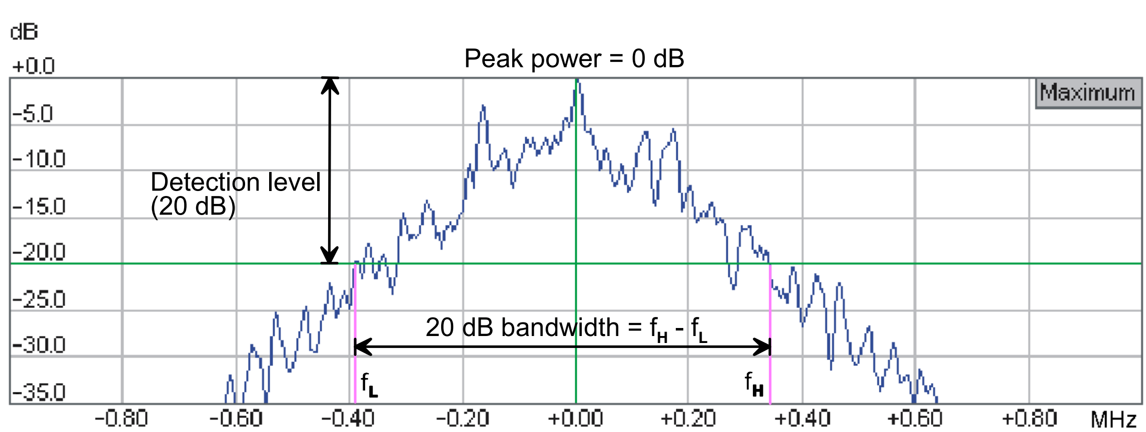
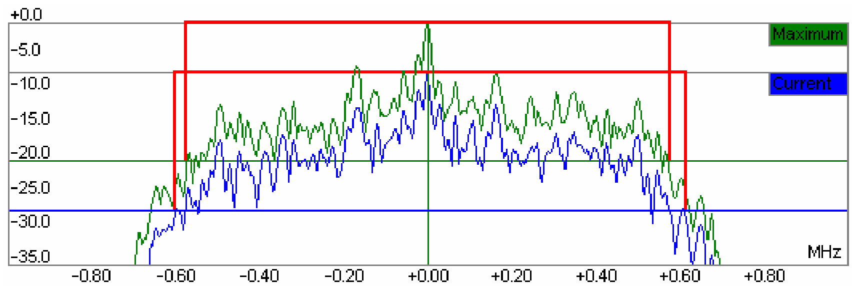


Fig. 4-71 20 dB bandwidth measurement

The 20 dB bandwidth for the *Maximum* measurement curve quite often turns out to be **smaller** than the *Current* 20 dB bandwidth (refer to Chapter 3 for a description of the display modes *Current, Minimum, Maximum, Average)*. This effect is due to variations in the DUTs TX power in the center of the channel which lead to a sharp peak of the *Maximum* trace. An example of a maximum curve with a relatively high central power (and thus a small 20 dB bandwidth) is shown in the figure below.



Performing a measurement

In the default configuration most of the *Spectrum* measurement settings comply with the requirements for the ACP and 20 dB bandwidth test cases in the Bluetooth radio specification. The settings to be made manually are listed below.

ACP

With a firmware version V4.37 and higher, frequency hopping is automatically disabled while the *ACP* application is active (equivalent to *Connection Control – Slave Sig. – Hopping Scheme: RX/TX single freq.;* the *Slave Sig. 1 – Hopping Scheme* hotkey is suppressed). The packet type is DH1 as required by the specification. The payload pattern can be adjusted in addition; see below.

20 dB Bandwidth

The payload pattern and the packet type should be adjusted:

➢ In the measurement menu, press *Slave Sig.1 – Pattern Type* and select a PRBS pattern (preferably the *Dynamic PRBS* pattern).

➢ Press *Slave Sig. 1 – Packet Type* and select the longest packet type supported by your EUT (preferably DH5). In addition, select the longest *Length of Test Sequence* (for DH5 packets:339 bytes).

The measurement is performed on the *Maximum* measurement curve, in loopback mode and with hopping enabled. If desired (e.g. for production tests) it is possible to disable hopping and measure on a single frequency (see above).

Frequency Range

With a firmware version V4.37 and higher, frequency hopping is automatically disabled while the *Frequency Range* application is active (equivalent to *Connection Control – Slave Sig. – Hopping Scheme: RX/TX single freq.;* the *Slave Sig. 1 – Hopping Scheme* hotkey is suppressed).

According to the test specification, the measurement must be performed in two different frequency ranges. Suppose your Bluetooth device operates in the range between 2402 MHz (channel 0) and 2480 MHz (channel 78).

➢ To determine the lower limit frequency f_L, set the DUT to the lowest TX frequency *(Slave Sig. 1 – TX Frequency: 0),* then press *Analyzer Settings* and select the following measurement window: *Start Channel:* –3 (2399 MHz), *Meas. Window Size: 7 Ch.*

➢ To determine the upper limit frequency f_H, set the DUT to the highest TX frequency *(Slave Sig. 1 – TX Frequency: 78),* then press *Analyzer Settings* and select the following measurement window: *Start Channel:* 73 (2475 MHz), *Meas. Window Size: 11 Ch.*

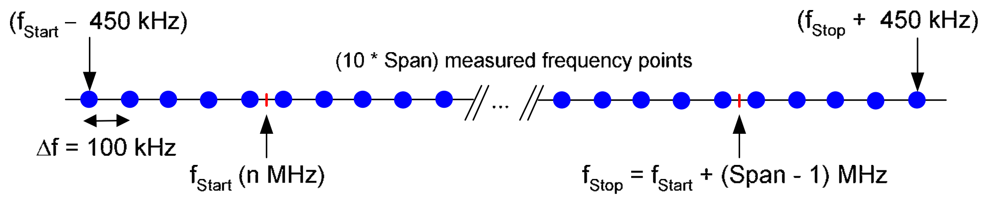
A condensed programming example for a *Frequency Range* measurement is reported in chapter 6.

Note: *While the Spectrum measurement is running the Supervision Timeout is automatically set to zero (i.e. to infinite timeout period) and grayed; the Master Sig. tab indicates 0 due to spectrum measurement. This ensures that the connection is not lost while the CBT measures at off-carrier frequencies. During a Spectrum measurement a discontinued* *signal will generally not terminate the connection. The previous Supervision Timeout is restored after another TX or RX measurement is selected.*

Frequency Range Application

The *Frequency Range* application (`SPECtrum:FRANge…`) of the *Spectrum* measurement covers test case TRM/CA/04/C of the Bluetooth Radio Specification. The application measures the power of the Bluetooth signal from the DUT at up to 110 frequency points using a fixed 100 kHz partition. The power results are used to interpolate the lower and upper limit frequencies where the signal power crosses a specified power threshold.

Test Procedure The R&S CBT analyzer settings are the same as for the *Spectrum – ACP* measurement. The Bluetooth signal is measured in a resolution bandwidth of 100 kHz and with a video bandwidth of 300 kHz, with a peak detector, and with a configurable number of averaged sweeps. The R&S measures 1 complete burst at each measured frequency point. The frequency points are set by means of two parameters, *Start Channel* (start frequency f_{Start}) and *Meas. Window Size* (frequency span). The parameters can be accessed via the *Analyzer Settings* softkey or in the *Analyzer* tab of the *Connection Control* menu.

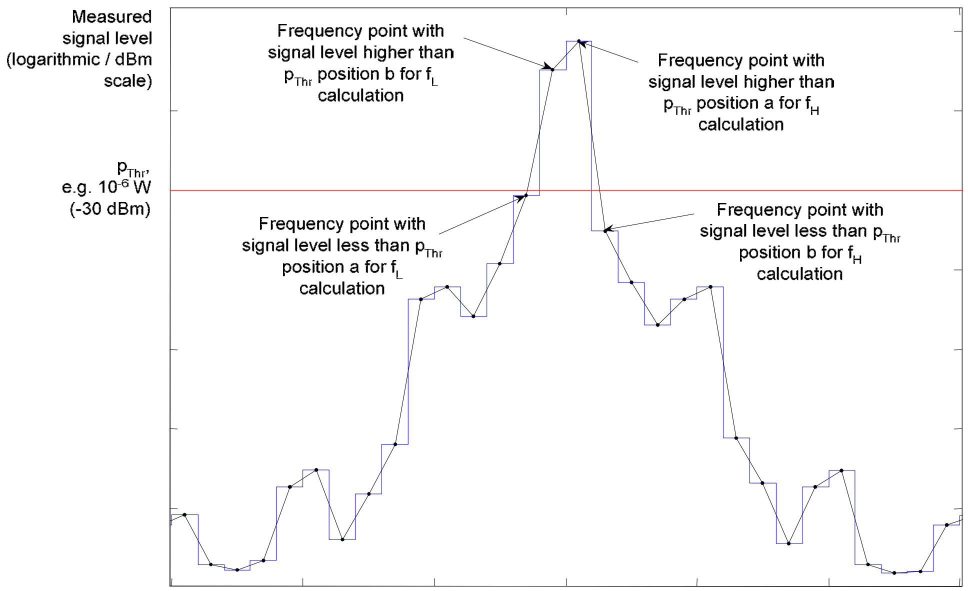


Interpolation From the signal power at each frequency point, the R&S CBT calculates the limit frequencies of f_L and f_H from the test specification by linear interpolation of the measured logarithmic power values:

- f_L is the lowest frequency in the measured range where the power drops below the threshold value p_{Thr} (*Threshold* value in the *Analyzer* tab of the *Connection Control* menu), which is predefined as –30 dBm in accordance with the specification.
- f_H is the highest frequency in the measured range where the power drops below the threshold value.

The two limit frequencies f_x (x = L or H) are calculated as follows:

$$f_x = \left(\frac{f_b - f_a}{p_b - p_a}\right) \cdot \left(p_{Thr} - p_a\right) + f_a$$



ACP for EDR Packets

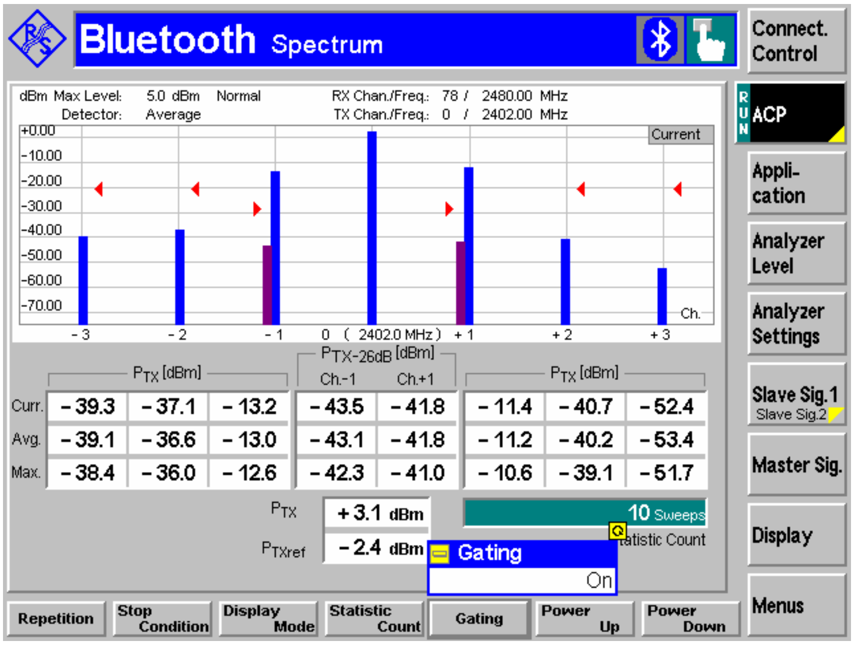
With option R&S CBT-K55, the *Spectrum – ACP* measurements for basic rate packets (Bluetooth Test Specification, test case TRM/CA/06) is extended for EDR packets (test case TRM/CA/13). The *Spectrum – ACP* application incorporates the measurement of both packet types; some of the results are available for EDR tests only.

Test Procedure The test procedures for basic rate and EDR packets are similar, however, the EDR measurement is gated so that only the guard period, the DPSK portion of the packet, and the power down ramp is measured. A new measurement $P_{TX-26\ dB}$ is introduced. The test procedure is automatically adjusted if gating is switched on. The additional test results for EDR measurements are described in section *Adjacent Channel Power (ACP)* on p. 4.107).

Performing a EDR ACP measurement In the default configuration most of the *Spectrum* measurement settings comply with the requirements for the ACP test cases in the Bluetooth radio specification. The settings to be made manually are listed below.

ACP settings Adjust the following settings in order to perform an in-band spurious emissions ("gated ACP") measurement:

- In the measurement menu, press *ACP – Gating: On* to select the EDR test procedure (see figure below).
- Press *Slave Sig. 1 – Pattern Type* and select a PRBS pattern (preferably the *Static PRBS* pattern).
- To perform EDR ACP tests, select *Slave Sig. 1 – Pattern Type: 2-DH5 or 3-DH5*.



Measurement Menu (Spectrum)

The graphical measurement menu *Spectrum* displays the measurement results for the output RF spectrum emissions.

- The measurement control softkey *ACP* (which changes to *Bandwidth* if this application is selected) controls the measurement, indicates its status *(RUN | HLT | OFF)* and opens the configuration menu *Spectrum Configuration*. The hotkeys associated to the measurement control softkey define the scope of the *Spectrum* measurement.
- The softkeys *Application, Analyzer Level, Analyzer Settings, Slave Sig., Master Sig., Display* and *Menus* to the right of the test diagram are combined with various hotkeys. The softkey/hotkey combinations provide test settings and switch over between different measurements. The entry of values is described in section *Measurement Menu (Power)* on page 4.54.

The measurement menu *Spectrum* can be accessed from any other measurement menu of the Bluetooth function group using the *Spectrum* hotkey. It can be opened also from the *Menu Select* main menu (with the associated key at the front of the instrument).

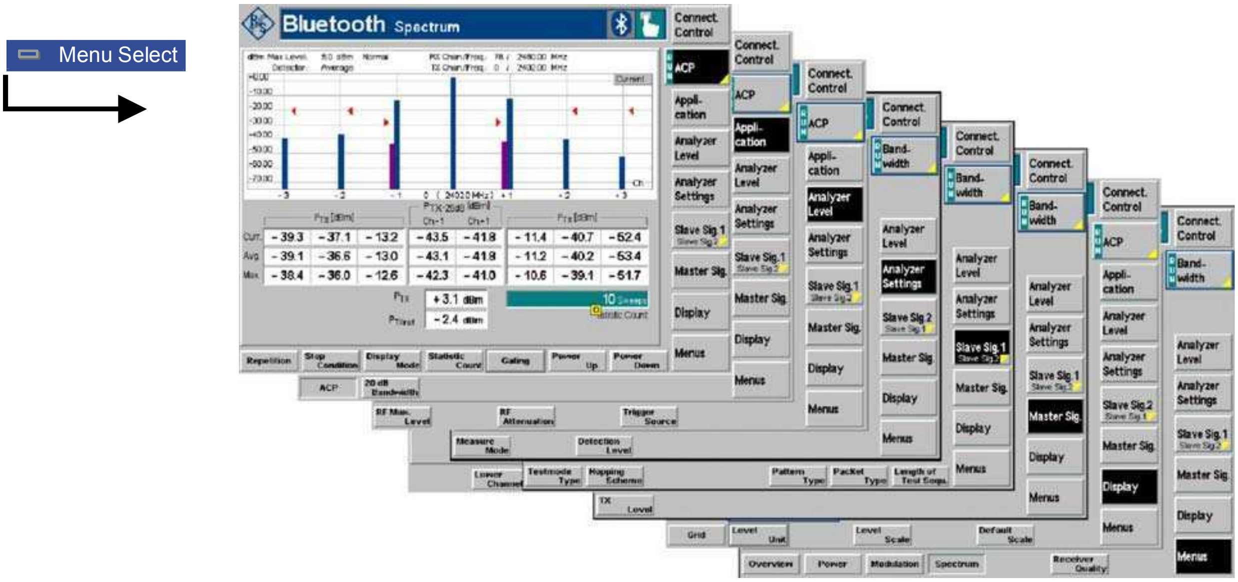


Fig. 4-72 Measurement menu Spectrum

Test Settings

Most of the softkey/hotkey settings are identical with those in the *Power* menu described on page 4.54. The following softkeys and hotkeys differ from the *Power* measurement:

ACP

The *ACP* softkey (which changes to *Bandwidth* if this application is selected)controls the *Spectrum* measurement and indicates its status *(RUN | HLT | OFF)*.

This status can be changed after softkey selection (pressing once) by means of the *ON/OFF* key or the *CONT/HALT* key.

Remote control
`INITiate:SPECtrum:<Application>`
`ABORt:SPECtrum:<Application>`
`STOP:SPECtrum:<Application>`
`CONTinue:SPECtrum:<Application>` etc.
Where `<Application> = ACPower | BWIDth`

Measurement configuration

Pressing the measurement control softkey twice opens the popup menu *Spectrum Configuration* (see page 4.114.). Besides various hotkeys defining the scope of the measurement are associated to the measurement control softkey. These hotkeys are identical with the parameters set in the *Control* tab of the *Spectrum Configuration* menu (see section *Measurement Control (Spectrum Configuration – Control)* on page 4.114.).

Application

The *Application* softkey selects the measurement method and the measured quantities. For a detailed description see background information in section *Spectrum Measurements* on p. 4.98.

Each application has its own measurement menu. The configuration settings for all *Spectrum* applications are listed in a common popup menu (see p. 4.112.).

ACP

Selects the measurement of the Adjacent Channel Power in seven distinct channels (in the active channel *(Center Channel)*, in three channels below, and in three channels above the active channel).

Remote control
The *ACP* application is identified by the keyword `:ACPower` in the 3rd level of the `Spectrum` commands, e.g. `CONFigure:SPECtrum:ACPower...`

20 dB Bandwidth

Selects the measurement of the 20 dB bandwidth of the active channel.

Remote control
The *20 dB Bandwidth* application is identified by the keyword `:BWIDth` in the 3rd level of the `Spectrum` commands, e.g. `CONFigure:SPECtrum:BWIDth...`

Frequency Range

Selects the measurement of the lower and upper limit frequencies where the signal power crosses a specified power threshold.

Remote control
The *Frequency Range* application is identified by the keyword `:FRANge` in the 3rd level of the `Spectrum` commands, e.g. `CONFigure:SPECtrum:FRANge...`

Analyzer Settings

Selects the measured RF channels. The settings depend on the application; they are also provided in the *Analyzer* tab of the *Spectrum Configuration* menu (see section *Measurement Control (Spectrum Configuration – Control)* on page 4.114).

The following additional hotkey is available in the *ACP* application:

Detector Mode

Selects the detector for the ACP measurement. The detector mode defines a first data processing stage where an averaged or maximized curve is calculated from the entire set of raw measurement points obtained during a sweep at fixed frequency.

Average Several consecutive sweep points are replaced by their linear average so that the measurement curve is smoothed out. If combined with the *Maximum* display mode this detector mode yields the adjacent channel power according to the Bluetooth radio specification.

Peak The signal level is the maximum of all sweep points.

RMS Several consecutive sweep points are replaced by their RMS average so that the signal power is correctly averaged. Like the *Average* detector this setting smoothes out the measurement curve.

The R&S® CBT detector settings are analogous to the detector settings known from spectrum analyzers.

Remote control
`CONFigure:SPECtrum:ACPower:DMODe AVG | RMS | PEAK`

The following additional hotkey is available in the *20 dB Bandwidth* application:

Measure Mode

Defines which channels are measured if frequency hopping is enabled.

All Channels All channels that are part of the current hopping scheme are measured. If the hopping scheme *Europe/USA* is active, the measured channel (the *Current Channel* displayed in the measurement menu) changes continuously. If hopping is disabled *(RX/TX single freq.),* the *Spectrum* measurement is performed on this single frequency.

Single Measurements are performed on the *Measured Channel* that appears next to *Measure Mode* if *Single* is selected. The *Measured Channel* can be set in the in the configuration menu as well; see section *Analyzer Settings (Spectrum Configuration – Analyzer)* on p. 4.116. If the hopping scheme *Europe/USA* is active, the measurement rate is slowed down because new measurement results can be acquired only when the hop channel coincides with the *Measured Channel*. If hopping is disabled, then the *Measured Channel* must be set equal to the *RX/TX single freq.* of the DUT; otherwise the measurement would wait forever for the selected *Measured Channel* to occur.

Remote control
`CONFigure:SPECtrum:BWIDth:MMODe <Level>`

Display

Provides hotkeys to change the appearance of the diagrams. Changing the *Display* settings has no impact on the number and position of the measurement points.

Level Unit

Changes between absolute (dBm) and relative (dB) display of the adjacent channel powers in the output table below the *ACP* bar graph. The relative values are referenced to the center channel power.

Remote control
`CONFigure:SPECtrum:ACPower:LUNit`

The remaining hotkeys show or hide the grid and change the level scale of the diagrams. These functions have no remote control commands assigned.

Measurement Results

The *Spectrum* menu group contains two separate measurement menus corresponding to the applications *ACP* and *20 dB Bandwidth*. These menus contain different test diagrams.

Adjacent Channel Power (ACP)

The *ACP* measurement menu shows the Adjacent Channel Power in seven distinct channels (in the active channel *(Center Channel)*, in three channels below, and in three channels above the active channel). In an EDR ACP measurement, the ACP in the two channels closest to the active channel (channels no. –1 and +1) is calculated in two different ways. The results and the corresponding measurement settings are indicated in two parameter lines, the test diagram (bar graph) and a tabular overview:

Parameter lines

Bar graph

Output table

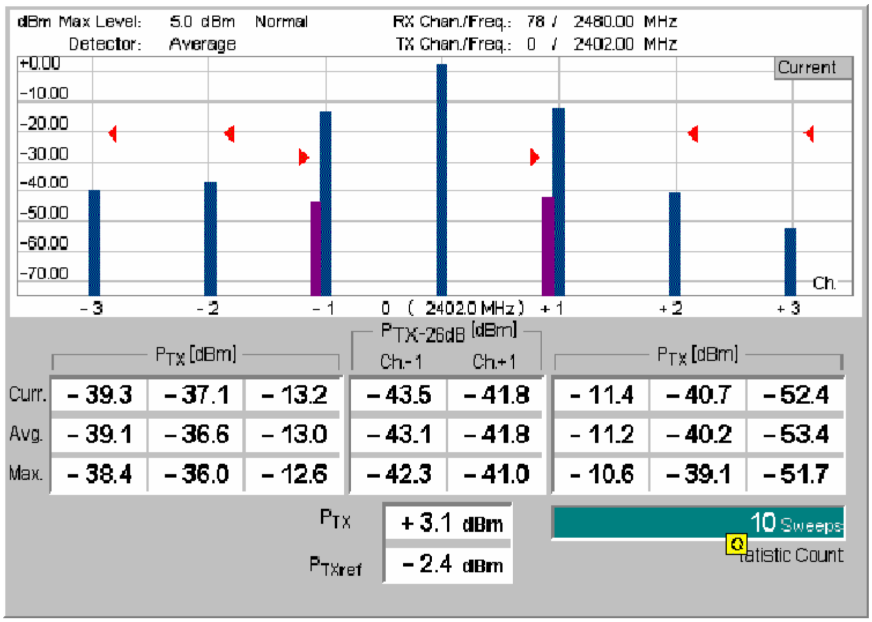


Fig. 4-73 Display of results (EDR ACP)

Parameter lines The essential analyzer settings (as set via the *Analyzer Level* and the *Analyzer Settings* softkeys) are indicated in two parameter lines across the top of the measurement menu:

Max. Level	Maximum input level *(Analyzer Level – Max. Level)*
Attenuation	Input path setting *(Analyzer Level – RF Attenuation;* set to *Normal, Low Noise* or *Low Distortion)*
RX Chan./Freq.	Current receive frequency of the DUT and corresponding channel
Detector	Detector mode *(ACP – Detector Mode)*
TX Chan./Freq.	Current transmit frequency of the DUT and corresponding channel.

Remote control
The settings are read out using the query corresponding to the setting command (setting command with appended question mark).

Bar graph The bar graph shows the channel power P_{TX} in the *Center Channel* (active Tx channel of the DUT, central bar) and the ACP in three *Upper Channels* and in three *Lower Channels*. The upper channels are at frequencies above the center channel frequency; the lower channels are at frequencies below the center channel frequency. All channels can be selected using the *Analyzer Settings* softkey or the *Analyzer* tab of the *Spectrum Configuration* menu.
The additional purple bars at channels no. –1 and +1 are only displayed for EDR ACP tests; they correspond to the channel powers $P_{TX\,-\,26\,dB}$ described below (see *Output values)*.

The bar graph uses an absolute power scale (in dBm). The appearance of the diagram and the scale can be changed using the *Display* softkey and the associated hotkeys. The *Display Mode (ACP – Display Mode,* set to *Current* by default) is also indicated in the diagram.

The red triangles indicate the upper relative limits for the ACP in the upper and lower channels, to be defined in the *Spectrum Configuration – Limits* menu (see section *Spectrum Limits (Spectrum Configuration – Limits)* on p. 4.117).

Remote control:
See below: `READ[:SCALar]:SPECtrum:ACPower?` etc.

Output values

The output table below the bar graph shows the ACP in three *Upper Channels* and in three *Lower Channels* (P_{TX} values). The three rows contain the *Current* ACP values and the average *(Avg.)* and maximum *(Max.)* ACP values of the entire measurement. The power in the *Center Channel* P_{TX} is displayed below.

In accordance with the Bluetooth Test Specification, all P_{TX} results are summed over 10 different frequencies at –450 kHz, –350 kHz…+450 kHz relative to the channel frequency. If the EDR test procedure is active *(ACP – Gating: On),* the R&S CBT calculates the following additional results:

- The ACP values for channel –1 and +1 are summed over the five frequencies which are opposed to the center frequency (–450 kHz…–50 kHz for channel –1 and +50 kHz…+450 kHz for channel +1). This yields the $P_{TX-26\,dB}$ values shown in the central columns.
- For the center channel, the maximum of the 10 different frequencies is displayed as reference power P_{TXref}.

The additional results are not available (marked invalid) while gating is off.

Display – Level Scale changes the unit of the ACP values between dBm (absolute powers) and dB (relative to the center channel power). The *Statistic Count* field indicates the number of sweeps per statistics cycle *(ACP – Statistic Count)*. The colored bar indicates the relative measurement progress within the statistics cycle.

Note: *Due to the measurement algorithm the meaning of the* Current *ACP results and of the* Statistic Count *differs from other R&S® CBT measurements. The* Current *ACP results correspond to the results of an internal sweep; their update interval is much smaller than the duration of a single shot measurement, which requires several sweeps at different frequencies.*

Remote control

```
READ[:SCALar]:SPECtrum:ACPower?
FETCh[:SCALar]:SPECtrum:ACPower?
READ[:SCALar]:SPECtrum:ACPower:EXTended?
FETCh[:SCALar]:SPECtrum:ACPower:EXTended?
FETCh:SPECtrum:ACPower:STATus?
```

Limit Check

A red output field in the in the output table indicates that the ACP exceeds the upper limit set in the *Limits* tab of the *Spectrum* configuration menu. Limits are available for the following ACP results:

- The ACP values P_{TX} in channels –3, –2, –1, +1, +2, +3.
- The ACP values $P_{Delta} = P_{TX-26\,dB} - P_{TXref}$ in channels –1 and +1.

Note that the EDR test case in the Bluetooth test specification (TRM/CA/13) does not specify anything concerning P_{TX} in channels –1 and +1. The limit check can be disabled, see section *Spectrum Limits (Spectrum Configuration – Limits)* on p. 4.117.

Remote control:

```
CALCulate[:SCALAR]:SPECtrum:ACPower:MATChing:LIMit?
```

20 dB Bandwidth

The *20 dB Bandwidth* measurement menu shows the spectrum emissions in a frequency range around the center frequency of the *Current Channel* plus a statistical evaluation of the bandwidth. The results and the corresponding measurement settings are indicated in two parameter lines, the test diagram and a tabular overview:

Parameter lines

Diagram

Output tables

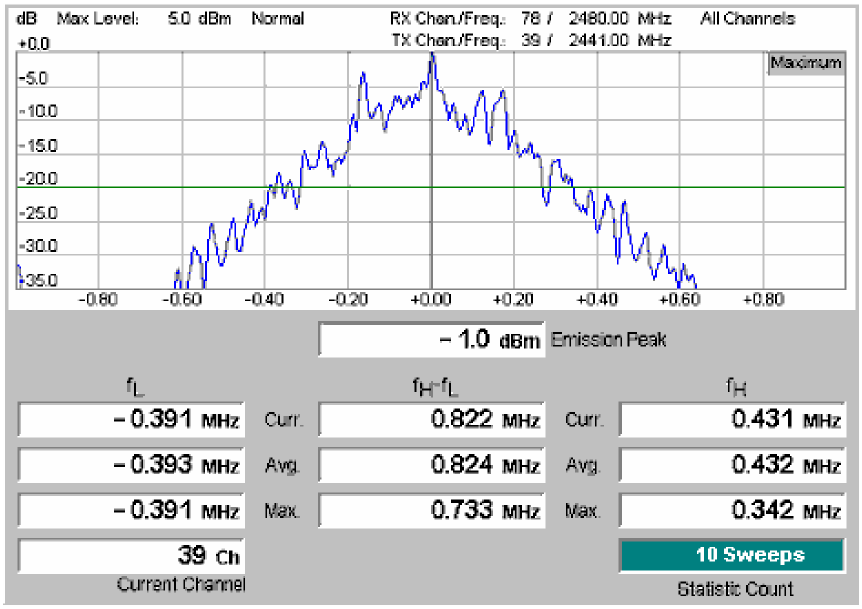


Fig. 4-74 Display of results (20 dB Bandwidth)

Parameter lines

The essential analyzer settings (as set via the *Analyzer Level* and the *Analyzer Settings* softkeys) are indicated in two parameter lines across the top of the measurement menu:

Max. Level	Maximum input level *(Analyzer Level – Max. Level)*
Attenuation	Input path setting *(Analyzer Level – Mode;* set to *Normal, Low Noise* or *Low Distortion)*
RX Chan./Freq.	Current receive frequency of the DUT and corresponding channel
Measure Mode	Measured channels *(Analyzer Settings – Measure Mode)*
TX Chan./Freq.	Current transmit frequency of the DUT and corresponding channel. This can be different from the measured channel; see description of the *Meas. Mode* on p. 4.107.

Remote control
The settings are read out using the query corresponding to the setting command (setting command with appended question mark).

Diagram

The diagram shows the spectrum emissions in a frequency range around the center frequency of the *Current Channel*. The default scale corresponds to the situation in Fig. 4-74 on p. 4.110:

- The horizontal axis covers a symmetrical, 2-MHz wide frequency range around the nominal center frequency of the measured Bluetooth channel.
- The vertical axis shows the output power relative to the emission peak power which is normalized to 0 dB. The absolute value Emission Peak is indicated below the diagram.

The diagram scaling can be changed using the *Frequency Scale* and *Level Scale* hotkeys associated with the *Display* softkey. The *Display Mode (Bandwidth – Display Mode,* set to *Maximum* by default) is also indicated in the diagram.

A horizontal colored line shows the *Detection Level (Analyzer Settings – Detection Level);* a vertical colored line crosses the emission peak. The measurement curve changes when a different bit pattern with a shorter period is transferred *(Slave Sig. 1 – Pattern Type).*

Remote control: `READ:ARRay:SPECtrum:BWIDth?`
`FETCh:ARRay:SPECtrum:BWIDth?`

Output values

The output table below the diagram shows the following values:

Emission Peak	Absolute power at the peak of the emission in dBm. Like the measurement curve in the diagram, the *Emission Peak* power is measured in a narrow (10-kHz) resolution bandwidth, so its value is generally below the *Nominal Power* obtained in a *Power* measurement.
f_L, f_H – f_L, f_H	Frequencies f_L and f_H where the transmit power drops 20 dB below the emission peak power and 20 dB bandwidth; see Fig. 4-71 on p. 4.100. The 20 dB value can be varied using *Analyzer Settings – Detection Level.* Results are provided for the *Current,* the *Average* and the *Maximum* measurement curve (see description of the display mode in chapter 3 of the operating manual).
Current Channel	Current measured channel; see description of the *Meas. Mode* on p. 4.107.
Statistic Count	Number of sweeps per statistics cycle. The colored bar indicates the relative measurement progress in the statistics cycle.

Remote control
`READ[:SCALar]:SPECtrum:BWIDth?`
`FETCh[:SCALar]:SPECtrum:BWIDth?`

Limit Check

A red output field in the f_H – f_L column indicates that the bandwidth exceeds the upper limit set in the *Limits* tab of the *Spectrum* configuration menu. The limit check can be disabled, see section *Spectrum Limits (Spectrum Configuration – Limits)* on p. 4.117.

Remote control:
`CALCulate[:SCALar]:SPECtrum:BWIDth:MATChing:LIMit?`

Frequency Range

The *Frequency Range* measurement menu shows the spectrum emissions in a frequency range around the TX frequency of the DUT. For a description of the measurement refer to section *Frequency Range Application* on p. 4.102.

The results and the corresponding measurement settings are indicated in two parameter lines, the test diagram and a tabular overview:

Parameter lines

Diagram

Output fields

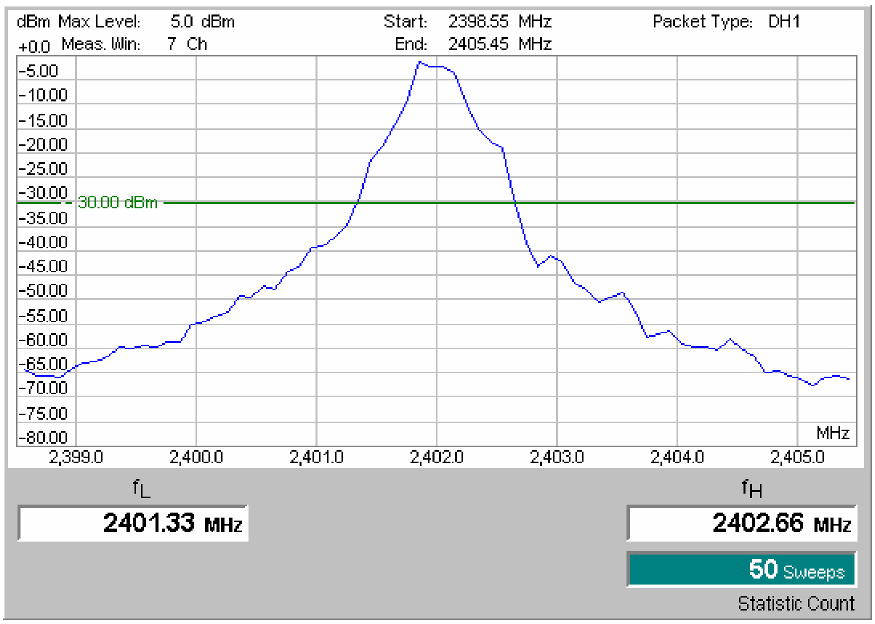


Fig. 4-75 Display of results (Frequency Range)

Parameter lines The essential analyzer settings (as set via the *Analyzer Level* and the *Analyzer Settings* softkeys) are indicated in two parameter lines across the top of the measurement menu:

Max. Level	Maximum input level *(Analyzer Level – Max. Level)*
Meas. Win.	Width (span) of the measurement window, integer number of channels
Start/End	Start and end frequency of the measurement window (first and last frequency point measured)
Packet Type	Packet type currently selected for the DUT (DH1, DH3, etc.).

Remote control
The settings are read out using the query corresponding to the setting command (setting command with appended question mark).

Diagram The diagram shows the spectrum emissions in a frequency range *(Analyzer Settings – Measurement Window)* around the current TX frequency of the DUT *(Slave Sig. 1 – TX Frequency* with hopping disabled). The default scale corresponds to the situation in Fig. 4-75 on p. 4.112:

- The horizontal axis covers a 7-MHz (7 channel) wide frequency range around the TX frequency.
- The vertical axis shows the absolute output power in dBm.

The vertical diagram scaling can be changed using the *Level Scale* hotkey associated with the *Display* softkey.

A horizontal colored line shows the *Threshold* value p_{Thr} for the calculation of the two limit frequencies f_L and f_H *(Analyzer Settings – Threshold)*. The measurement curve changes when a different bit pattern with a shorter period is transferred *(Slave Sig. 1 – Pattern Type).*

Remote control: `READ:ARRay:SPECtrum:FRANge?`
`FETCh:ARRay:SPECtrum:FRANge?`

Output values

The output fields below the diagram show the following values:

f_L	Lower limit frequency; the lowest frequency in the measurement window where the power drops below the threshold value p_{Thr}.
f_H	Upper limit frequency; the highest frequency in the measurement window where the power drops below the threshold value p_{Thr}.
Statistic Count	Number of sweeps per statistics cycle. Each sweep yields a complete measurement curve. The colored bar indicates the relative measurement progress in the first statistics cycle.

Remote control

```
READ[:SCALar]:SPECtrum:FRANge:LFRequency?
READ[:SCALar]:SPECtrum:FRANge:HFRequency?
FETCh[:SCALar]:SPECtrum:FRANge:LFRequency?
FETCh[:SCALar]:SPECtrum:FRANge:HFRequency?
```

Limit Check

A red output field f_L or f_H and an arrow pointing upwards/downwards indicates that the lower or upper limit value is out of tolerance. Limits for f_L and f_H are defined in the *Limits* tab of the *Spectrum* configuration menu. The limit check can be disabled, see section *Spectrum Limits (Spectrum Configuration – Limits)* on p. 4.117.

Remote control:

```
CALCulate[:SCALar]:SPECtrum:FRANge:MATChing:LIMit?
```

Measurement Configurations (Spectrum)

The popup menu *Spectrum Configuration* contains three tabs to define the parameters of the *Spectrum* measurement including the error tolerances.

The popup menu *Spectrum Configuration* is called up by pressing the measurement control softkey in the top right of the graphical measurement menu *Spectrum* twice (this softkey reads *ACP* or *Bandwidth*, depending on the selected application). The associated hotkeys change between the tabs.

Measurement Control (Spectrum Configuration – Control)

The settings in the *Control* tab define

- The Repetition mode
- The Stop Condition for the measurement
- The measurement curve displayed (Display Mode)
- The number of sweeps forming a statistics cycle (Statistic Count). In the ACP application this corresponds to the number of sweeps to be measured at each frequency.
- The basic rate or EDR test procedure for the ACP application (*ACP Gating*)

The default statistical settings ensure that the *Spectrum* measurement is performed in accordance with the Bluetooth radio specification.

As a further option, display of the *Grid* in the measurement diagram may be switched off.

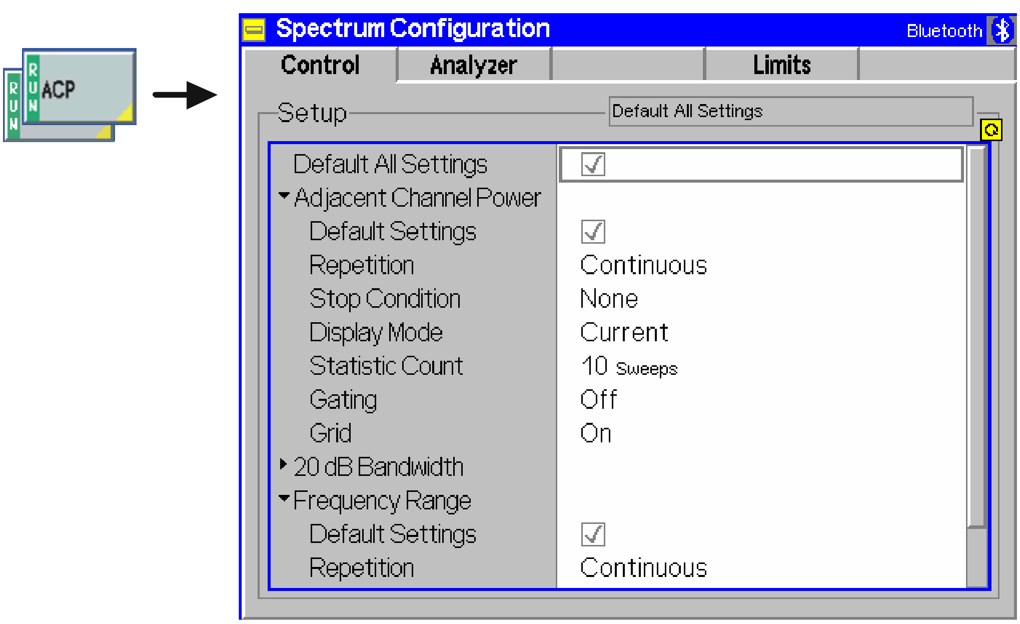


Fig. 4-76 Spectrum Configuration – Control

The settings comply with those of the *Control* tab of the *Power Configuration* menu described in the operating manual. In the remote-control commands, the keywords POWer:<Pow_Application> are to be replaced by SPECtrum:<Spec_Application>.

The following setting is *Spectrum*-specific:

Gating Changes the state of the ACP measurement.

- When *Gating* is off, the measurement is performed for basic-rate packets (test case TRM/CA/06).

- When *Gating* is enabled the measurement is performed for EDR packets (test case TRM/CA/13; with option R&S CBT-K55 only). The measurement interval is between the end of the GFSK part and the end of the burst (including the ramp down part). Moreover, the measurement results and the limit check are extended.

Remote control: `CONFigure:SPECtrum:ACPower:GATing <Enable>`

Analyzer Settings (Spectrum Configuration – Analyzer)

The settings in the *Analyzer* tab define

- All channels for the ACP measurement
- The (fixed) TX channel of the DUT (Measured Channel) for the 20 dB bandwidth measurement and the off-peak signal level at which the bandwidth is measured *(Detection Level)*
- The *Start Channel* and *Measurement Window* for the *Frequency Range* measurement and the *Threshold* power for the calculation of the lower and upper limit frequencies.

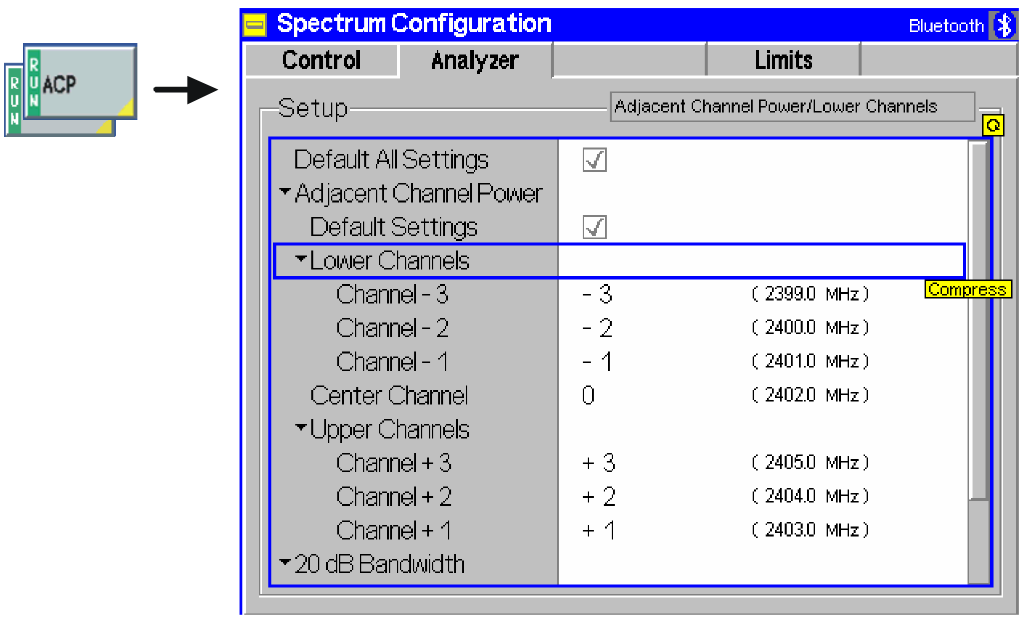


Fig. 4-77 Spectrum Configuration – Analyzer

The following settings apply to the *ACP* application:

Default Settings

The *Default All Settings* switch assigns default values to all settings in the *Analyzer* tab (the default values are quoted in the command description in chapter 6 of this manual). In addition, default switches for the individual applications are provided.

Remote control: –

Lower Channels / Center Channel / Upper Channels

Selects the Bluetooth channels where the ACP is measured. Channels can be set in the frequency range between 2398 MHz and 2499 MHz.

An adjacent channel number of n means that the adjacent channel frequency is equal to the center channel frequency + n MHz. n must be negative or zero for lower channels, it must be positive or zero for upper channels. Entering frequencies or (relative) channel numbers is equivalent.

Remote control
`CONFigure:SPECtrum:ACPower:MCHannel:RELative`
`CONFigure:SPECtrum:ACPower:CCHannel`

The following settings apply to the *20 dB Bandwidth* application:

Measured Channel Defines the Bluetooth TX channel of the DUT where the 20 dB Bandwidth is measured. The setting is only relevant for *Single* measurement mode; see description of the *Measure Mode* on p. 4.107.

Remote control
`CONFigure:SPECtrum:BWIDth:MCHannel <Channel>`

Detection Level Defines the off-peak signal level at which the bandwidth is measured; see Fig. 4-71 on p. 4.100. The default setting yields the 20 dB bandwidth from the Bluetooth radio specification.

Remote control
`CONFigure:SPECtrum:BWIDth:DLEVel <Level>`

The following settings apply to the *Frequency Range* application:

Threshold Threshold power in dBm for the calculation of the lower and upper limit frequencies f_L and f_H. The limit frequencies are calculated by linear interpolation; see section *Frequency Range Application* on p. 4.102.

Remote control
`CONFigure:SPECtrum:FRANge:THReshold <Threshold>`

Start Channel, Meas. Window Defines the frequency interval where the R&S CBT acquires measurement data; see section *Frequency Range Application* on p. 4.102.

Remote control
`CONFigure:SPECtrum:FRANge:MWINdow <Start>, <Span>`

Spectrum Limits (Spectrum Configuration – Limits)

The *Limits* tab defines upper limits for the ACP and the 20 dB bandwidth. The Bluetooth radio specification defines the following limits:

- For basic rate packets (test case TRM/CA/06), the Adjacent Channel Power (ACP) in channels ±2 away from the center channel, measured under the conditions described in section *ACP for EDR Packets* on p. 4.103 and with an *Avg.* detector, must be smaller than –20 dBm. The ACP in channels ≤–3 and ≥+3 must be smaller than –40 dBm[2]. Nothing is specified for the ACP measured with different detector modes.
- For EDR packets (test case TRM/CA/06), the Adjacent Channel Power (ACP) in channels ±2 away from the center channel, measured under the conditions described in section *ACP for EDR Packets* on p. 4.103 and using an *Avg.* detector, must be smaller than –20 dBm. The ACP in channels ≤–3 and ≥+3 must be smaller than –40 dBm[2]. The adjacent channel powers $P_{TX-26\,dB}$ in channels –1 and +1 must be at least –26 dB below the center channel power P_{TXref}. Nothing is specified for the ACP measured with different detector modes.
- The 20-dB bandwidth, measured under the conditions described in section *Spectrum Measurements* on p. 4.98, must not exceed 1 MHz. Nothing is specified for the bandwidth derived from the *Current* and *Average* curves.
- The upper and lower limit frequencies f_L and f_H, measured under the conditions of the *Frequency Range* measurement, must be in the allowed frequency band 2.4 GHz to 2.4835 GHz.

[2] The standard allows exceptions in up to three bands of 1 MHz width, where the ACP must be below –20 dBm. The R&S CBT uses a default limit of –20 dBm for channels ±3.

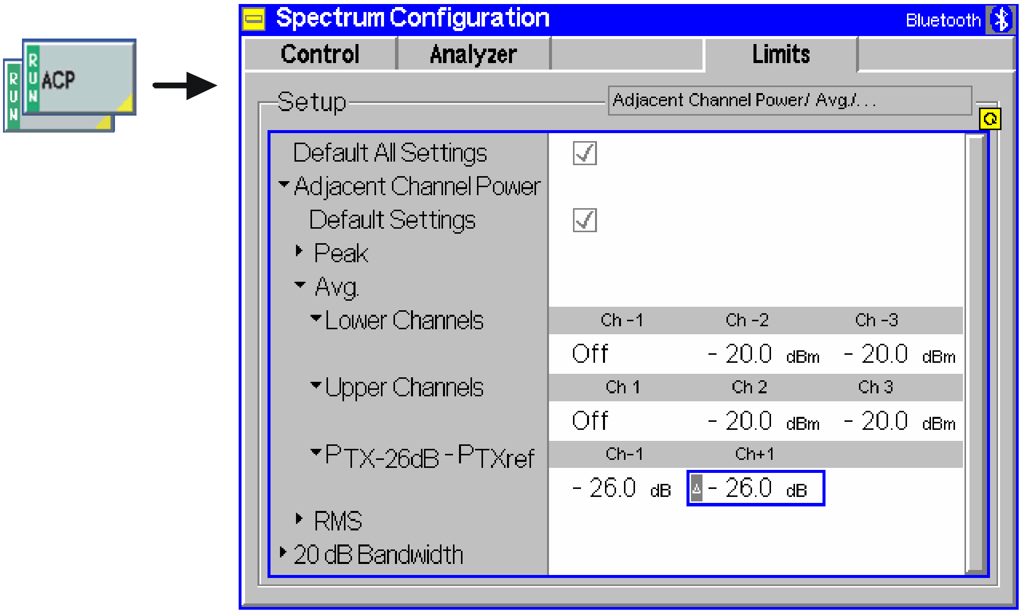


Fig. 4-78 Spectrum Configuration – Limits

Default Settings The *Default All Settings* switch assigns default values to all settings in the *Limits* tab (the default values are quoted in the command description in chapter 6 of this manual). In addition, default switches for the individual applications are provided.
Remote control: –

The following limits apply to the *ACP* application:

Lower Chan. / Upper Channels Upper limits for the ACP calculated with the *Peak, Average* and *RMS* detector mode, respectively. *Off* disables the limit check. The result of the limit check appears in the output fields for the ACP; see section *Adjacent Channel P* on p. 4.107.

The limits for the adjacent channel powers $P_{Delta} = P_{TX-26\,dB} - P_{TXref}$ in channels –1 and +1 are relevant for EDR ACP measurements *(ACP – Gating: On)*, where nothing concerning the P_{TX} limits in these two channels is specified.

Remote control

```
CONFigure:SPECtrum:ACPower:<Display>:<Detector>:
        LIMit:SCALar:ASYMmetric:<Channel>:VALue <Limit>
CONFigure:SPECtrum:ACPower:<Display>:<Detector>:
        LIMit:SCALar:ASYMmetric:<Channel>:ENABle <Enable>
CONFigure:SPECtrum:ACPower:<Display>:
        LIMit:SCALar:ASYMmetric:<Channel>:ENABle <Enable>
```

where
```
<Display> = CURRent | AVERage | MAXimum
<Detector> = PEAK | AVERage | RMS
<Channel> = UCHannel | LCHannel
```

The following limits apply to the *20 dB Bandwidth* application:

$f_H - f_L$ Current / $f_H - f_L$ Average / $f_H - f_L$ Maximum Upper limits for the bandwidths calculated from the *Current, Average* and *Maximum* measurement curves, respectively. *Off* disables the limit check. The result of the limit check appears in the output fields for the bandwidths; see section *20 dB Bandwidth* on p. 4.110.

Remote control

```
CONFigure:SPECtrum:BWIDth:CURRent:LIMit:SCALar:ASYMmetric
        :UPPer:VALue <Limit>
CONFigure:SPECtrum:BWIDth:AVERage:LIMit:SCALar:ASYMmetric
        :UPPer:VALue <Limit>
CONFigure:SPECtrum:BWIDth:MAXimum:LIMit:SCALar:ASYMmetric
        :UPPer:VALue <Limit>
```

The following limits apply to the *Frequency Range* application:

f_H and f_L Upper/Lower Limit

Upper and lower limits for the limit frequencies of the *Frequency Range* measurement (see section *Frequency Range Application* on p. 4.102). *Off* disables the limit check. The result of the limit check appears in the output fields for the limit frequencies; see section Frequency Range on p. 4.112.

Remote control

```
CONFigure:SPECtrum:FRANge:LIMit:SCALar:ASYMmetric
        [:COMBined]:VALue <FL_FH_Upper>, <FL_FH_Lower>
CONFigure:SPECtrum:FRANge:LIMit:SCALar:ASYMmetric
        [:COMBined]:ENABle <FL_FH_Upper>, <FL_FH_Lower>
```

Receiver Quality Measurements

The menu group *Receiver Quality* measures parameters that describe the sensitivity of the receiver of a Bluetooth device under test, in particular at low RF power levels.

The popup menu *Receiver Quality Configuration* is used for configuration of the measurements; the measurement results are directly indicated in the *Receiver Quality* menu.

Note: *The evaluation of the receiver quality is based on the bit by bit comparison of the payload transmitted by the R&S® CBT with the signal received, decoded, and returned by the device under test.*

Therefore, a Loopback *testmode type must be active where the DUT returns the signal received from the R&S® CBT unchanged; see* Testmode Type *softkey on p.* 4.158. *The R&S® CBT automatically activates a loopback mode when performing* Receiver Quality *tests. When the* Receiver Quality *measurement is switched off, the original testmode type settings will be restored.*

In addition to the loopback mode the Receiver Quality *measurement uses specific* Slave Sig. *and* Master Sig. *settings. In particular, the CBT is able to generate a non-ideal (dirty transmitter) signal. Receiver Quality measurements with restricted functionality are available outside of the testmode; see p. 4.121.*

Measured quantities

The basic evaluation periods in the *Receiver Quality* measurement are packets of different type and with variable data content. The R&S® CBT provides two complementary measurement results to assess the quality of the DUT receiver and the number of packets distorted in the DUT or on the return path to the R&S® CBT:

- The Bit Error Rate (BER) is the ratio of payload bits received in error to the total number of received payload bits in percent:

  BER = bit errors / total number of received payload bits * 100%

  A receiver quality measurement is only meaningful under the assumption that the return path from the DUT to the tester is perfect and has no impact on the BER results. Therefore only packets looped back with correct CRC and packet header are considered for the BER calculation (see Table 4-8 below). According to the requirements of the Bluetooth RF Test Specification, a minimum number of 1 600 000 payload bits must be received.

- The Packet Error Rate (PER) is the ratio of packets that are not considered for the BER calculation to the total number of transmitted packets in percent:

  PER = bad packets / total number of packets transmitted * 100%

  Bad packets comprise those that the DUT is unable to loop back (e.g. because the sync word is not found or the header error check (HEC) fails) and the ones that are looped back in error (see Table 4-8 below).

A NAK or ACK in the received packet has no influence on the BER/PER calculation, however, the percentage of NAKed packets is also displayed in the measurement menu.

In addition to the BER and PER results and the NAK rate the R&S® CBT displays information concerning the cause for packet errors; see section Measurement Results on p. 4.126.

BER Search In the *BER Search* mode, the R&S® CBT performs repeated single shot BER measurements at decreasing RF output levels *(TX levels)* until the target bit error rate *(Search Value BER)* is found or the maximum number of search cycles is exceeded. The TX level corresponding to the target bit error rate is returned as the *Search Result.* With an appropriate setting of the target bit error rate (0.10% according to the Bluetooth standard), this search result yields the *actual sensitivity level* of the receiver.

EDR Packets Options R&S CBT-B55/K55 support *BER* and *BER Search* measurements on EDR (2-DHx and 3-DHx) packets. Again, it is possible to use a non-ideal signal; see description of the *Dirty Transmitter* on p. 4.155.

Table 4-8 BER and PER measurement scenarios

R&S® CBT receives	Packet increases the PER	Packet considered for BER
Packet with correct CRC and correct packet header (HEC)	NO	YES
Packet with payload failure (CRC)	YES	NO
Packet with failure in the packet header (HEC)	YES	NO
Packet with wrong payload length	YES	NO
Null packet	YES	NO
No packet	YES	NO

Packet Error Tests outside of Testmode

While the R&S® CBT is connected to a DUT, but test mode is **not** active, the BER screen shows no bit error rates but displays the packet error rates described below.

Measurement settings The packet error tests described here may be performed with a “raw” connection (without any submode) or in the submodes that the R&S® CBT provides as an alternative to the test mode. No particular settings are required. All the loopback settings are only applicable to test mode, so none are relevant outside of test mode.

Principle of the measurement The measurement uses the POLL/NULL pairs which are sent when the connection is idle, which is the state when in a "raw" connection. The CBT periodically sends a POLL, and the DUT (should) reply with a NULL. With a degraded link, for example because the CBT is transmitting at a very low RF power level, the DUT may not "hear" the POLL, in which case it won't reply, causing one *Missing Packet* error. This represents a simple test of the receiver sensitivity, if one assumes the DUT to CBT path is perfect.

Note that the DUT **may** reply with a packet type other than NULL. It may reply with an ACL data packet, if it has data to send to the CBT. In audio mode it will normally send HV packets. This will not affect the measurement, which simply looks for the presence/absence of a packet from the DUT.

Measurement results
Outside of test mode, the R&S® CBT counts the packets received from the DUT and provides the following results (see description in section *Measurement Results* on p. 4.126):

- The percentage of *Missing Packet*s
- The percentage of *HEC Errors*
- The total *Packet Error Rate*, which is the sum of the two percentages.

Bit error measurements are only possible in test mode (with packet loopback).

Important note:

*Since bit error measurements aren't possible, the "statistic count" (packets received) can no longer be the count of packets taken into account for the BER measurement. Therefore, when **not** in test mode, this counter is re-defined as the number of opportunities for a packet to be received. Or, the number of times the CBT expects to receive a packet, whether or not a packet was actually successfully received.*

Remote Control
The results are also available in remote control mode. All the results which have no meaning outside of test mode (BER, other packet errors) are returned as NAN.

Measurement Menu (Receiver Quality)

The *Receiver Quality* menu shows the results and the most important parameters of the *Receiver Quality* measurement.

- The measurement control softkey BER (which changes to BER Search if this application is selected) indicates the status of the Receiver Quality measurement (RUN, HLT, OFF) and opens the configuration menu Receiver Quality Configuration.
- The other softkeys on the right softkey bar are combined with various hotkeys. When a softkey is selected and an associated hotkey pressed, a popup window appears which indicates a setting or allows the user to enter a value (see section *Test Settings* on page 4.55).
- In the tables in the center of the menu, the test settings of the current *Receiver Quality* measurement and the results are displayed.

The measurement menu *Receiver Quality* can be opened from the *Menu Select* menu (with the associated key at the front of the instrument) or from any other measurement menu in function group *Bluetooth Signalling* using the hotkey *Receiver Quality*.

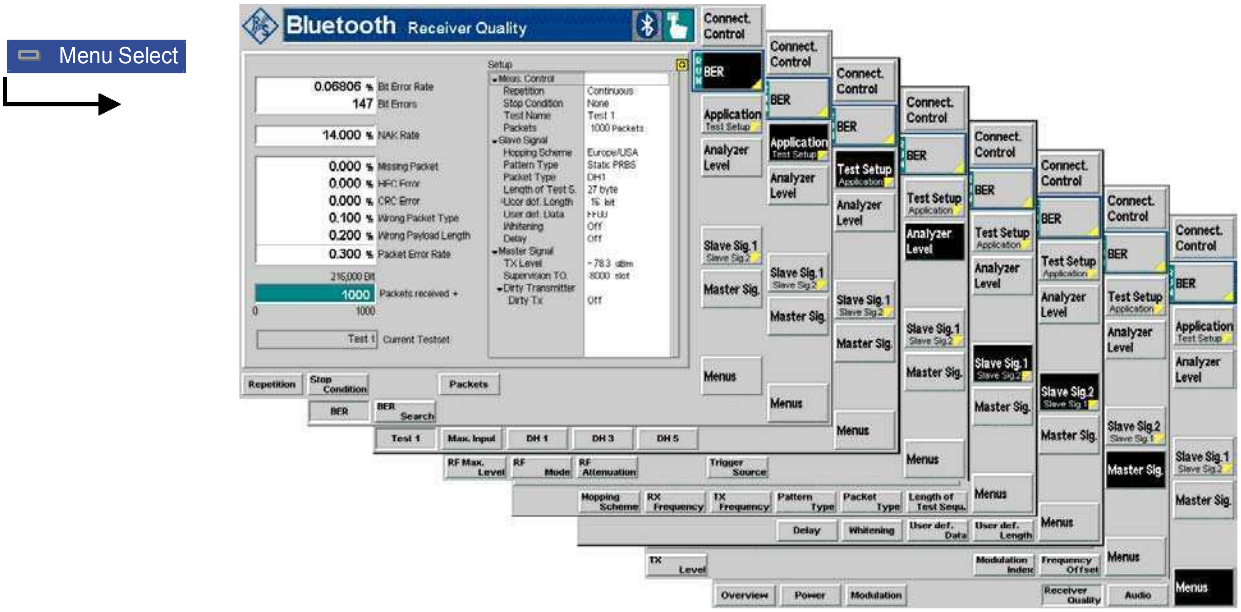


Fig. 4-79 Receiver Quality (BER)

Test Settings

The *Analyzer Level, Slave Sig.,* and *Menus* test settings are mostly identical with those in the *Power* menu (see section *Test Settings* on page 4.55). The *BER* measurement control softkey (which changes to *BER Search* if this application is selected) is analogous to the *Output Power* softkey described in section *Test Settings* on page 4.55. The remaining softkeys and hotkeys have no direct equivalent in other measurement menus. The differences to *Power* and *Modulation* measurements are:

- No *Meas. Mode* can be set in the *Receiver Quality* measurement group. The measurement is always performed on all channels of the current hopping scheme (corresponding to the *Meas. Mode* setting All). If the BER has to be measured on only one channel then the Single Frequency Hopping Scheme can be used.
- The *Slave Sig. 1* section doesn't offer a *Testmode Type* setting, the testmode type for receiver quality measurements is always *Loopback*.
- The *Slave Sig. 2* section allows to configure the *Loopback Delay* which is only relevant for receiver quality measurements.

Measurement Control

The *Receiver Quality* measurement is controlled by means of the measurement control softkey below the *Connect. Control* softkey and the associated hotkeys.

BER

The *BER* softkey (which changes to *BER Search* if this application is selected) controls the measurement application and indicates its status *(RUN | HLT | OFF)*. This status can be changed after softkey selection (pressing once) by means of the *ON/OFF* key or the *CONT/HALT* key. The status can be set independently for both applications.

Remote control

```
INITiate:RXQuality:<application>
ABORt:RXQuality:<application>
STOP:RXQuality:<application>
CONTINUE:RXQuality:<application>
FETCh:RXQuality:<application>:STATus?
```

where `<application> = BER | SBER`

Measurement configuration

Pressing the *BER* softkey a second time opens the popup menu *Receiver Quality Configuration* (see page 4.129). Besides, the measurement control softkey provides hotkeys to define the scope of the measurement. All these settings are described in more detail in section *Measurement Control (Receiver Quality Configuration – Control)* on p. 4.129.

Repetition

The hotkey *Repetition* determines the repetition mode of the measurement *(Single Shot* or *Continuous* measurement); see section *Measurement Control (Power Configuration – Control)* on page 4.67). The hotkey is not available in *BER Search* mode.

Remote control

```
CONFigure:RXQuality:BER:CONTrol:REPetition
      <Repetition>,<StopCond>,<Stepmode>
```

Stop Condition

The *Stop Condition* hotkey sets a stop condition for the *BER* measurement *(None* or *On Limit Failure)*. The hotkey is not available in *BER Search* mode.

Remote control

```
CONFigure:RXQuality:BER:CONTrol:REPetition
      <Repetition>,<StopCond>,<Stepmode>
```

Packets

The *Packets* hotkey determines the number of packets to be sent in a single shot *BER* measurement or in a single iteration cycle within a *BER Search* measurement. The hotkey is not available in *BER Search* mode.

Remote control

```
CONFigure:RXQuality:BER:TSETup<nr>:CONTrol:STATistics
            <Packets>
CONFigure:RXQuality:SBER:CONTrol:STATistics
            <Packets>, <Search_Value>, <Search_Cycles>
```

Search Value

The *Search Value* hotkey determines the target bit error rate for the *BER Search* measurement. The hotkey is not available while the *BER* application is active.

Remote control

```
CONFigure:RXQuality:SBER:CONTrol:STATistics
            <Packets>, <Search_Value>, <Search_Cycles>
```

Search Cycles

The *Search Cycles* hotkey determines the number of iteration cycles within a *BER Search* measurement. The hotkey is not available while the *BER* application is active.

Remote control

```
CONFigure:RXQuality:SBER:CONTrol:STATistics
            <Packets>, <Search_Value>, <Search_Cycles>
```

Specific Receiver Quality Settings

The settings of the following softkeys are specific to *Receiver Quality* measurements. They are not available in the *Connection Control* menu.

Application
Test Setup

The *Application/Test Setup* softkey selects the application, the test setup, and the repetition mode. If pressed once again in the *BER* application, the selected *Application/Test Setup* softkey changes to the *Test Setup/Application* softkey, see below.

The alternative applications *BER* and *BER Search* are displayed in separate measurement menus. When an application is selected, the corresponding measurement menu is displayed. The configuration settings for both applications, however, are listed in a common popup-menu (see p. 4.129.).

BER

The *BER* hotkey selects the bit error rate measurement. In this mode, the bit error rate *(BER)* and the packet error rate *(PER)* can be measured under various conditions, see section *Measurement Results* on page 4.126.

Remote control
No explicit switchover command. All single shot measurements are identified by the 2nd/3rd level keywords `...RXQuality:BER...`

BER
Search

The *BER Search* hotkey selects the measurement of the TX level corresponding to a definite target bit error rate. The *Search* mode consists of a repeated single-shot BER measurement with decreasing RF output level until a certain bit error rate is found or the maximum number of search cycles is exceeded (see *Search Cycles* hotkey below). The search algorithm is explained in the paragraph on *Search Cycles* on page 4.131.

The bit error rate searched for is defined via the *Search Value* softkey associated with the *BER Search* measurement control softkey. The search is restricted to a particular range of TX levels (see *Master Sig.* softkey below).

Remote control
No explicit switchover command. All single shot measurements are identified by the 2nd/3rd level keywords `...RXQuality:SBER...`

Test Setup
Application

The *Test Setup/Application* softkey selects the test setup for BER measurements. The softkey is not available in *BER Search* mode.

If pressed once again, the selected *Test Setup/Application* softkey changes to the *Application/Test Setup* softkey, see above.

Test 1

The *Test 1* hotkey selects the test setup named *Test 1*.

Test setups are BER configuration files defined in the *Receiver Quality Configuration* menu (see page 4.129). By default the five available test setups are named *Test 1, Max. Input, DH1, DH3, DH5;* the first five hotkeys associated with the *Test Setup/Application* softkey are labeled with the same names. The test setup names can be defined from within the configuration menu.

Remote control
`CONFigure:RXQuality:BER:TSETup <TestSetup>`

The test setup number is referenced by a numeric suffix in the BER commands `(...RXQuality:BER:TSETup<nr>:...)`.

Master Sig.

The *Master Sig.* softkey sets the R&S® CBT output level for the *BER* application or the level range to be used in the *BER Search* application. These settings are only used for *Receiver Quality* tests; they are described in more detail in section *BER Levels (Receiver Quality Configuration – Master)* on p. 4.131.

Moreover the *Dirty Tx* hotkey associated with the *Master Sig.* softkey defines the parameters for the non-ideal master signal (dirty transmitter). The dirty transmitter settings are also provided in the *Master Sig.* tab of the *Connection Control* menu; see detailed description on p. 4.155. The *Dirty Transmitter Scope* parameter in the *Master Sig.* tab defines whether the dirty transmitter is always active or only used while a *Receiver Quality* measurement is running.

Measurement Results

The test settings of the current *Receiver Quality* measurement and the results are displayed in the tables of the menu.

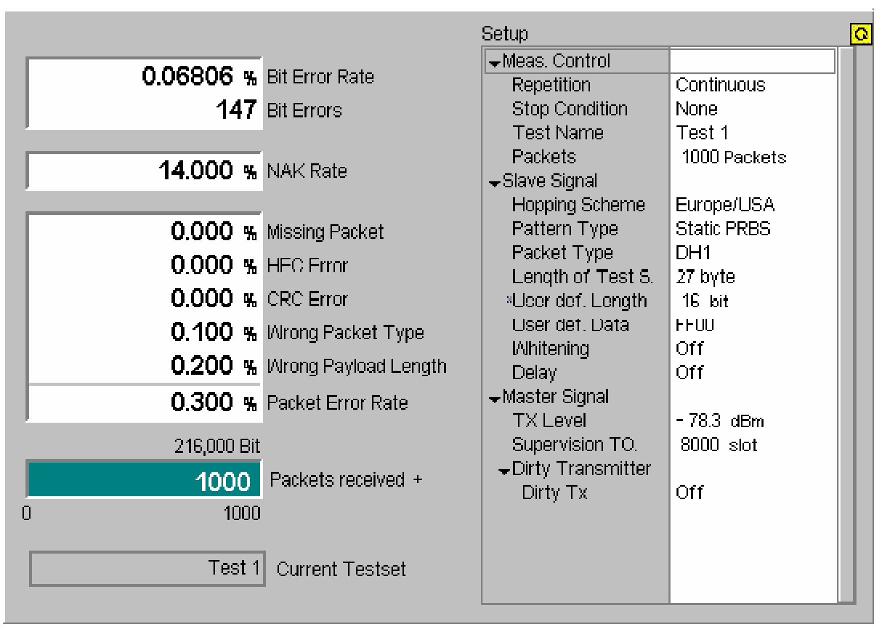


Fig. 4-80 Display of test settings and measurement results (BER)

The measurement results in the left upper table depend on the selected application (see definitions at the beginning of section *Receiver Quality Measurements* on page 4.120).

BER

In the *BER* application the following results are displayed:

Bit Error Rate	Bit error rate, percentage of faulty bits received
Bit Errors	Total number of faulty bits received
NAK Rate	Percentage of packets transmitted by the R&S CBT which were not acknowledged by the DUT, i.e. which would normally require retransmission (but note that data packets are not actually retransmitted when in test mode). To acknowledge a packet, the DUT must respond with a packet whose acknowledgment indication (ARQN) header bit is set, so a “not acknowledge” condition can be signified either explicitly (by the DUT returning a packet with the ARQN header bit set to zero) or implicitly (by no ARQN header bit being received; this condition would also count as a missing packet or HEC error, see below).

The events causing a packet to contribute to the packet error rate are mutually exclusive and form the following hierarchy.

Missing Packet	The transmitted packet could not be received by the R&S CBT. Either the packet was not looped back, or the R&S CBT did not find a valid access code.
HEC Error	The packet was looped back and received by the R&S CBT, however, the Header Error Check at the R&S CBT failed. The received packet contained unrecoverable bit errors in the header.
CRC Error	The packet is received by the DUT without HEC error and looped back, however, Cyclic Redundancy Check at the R&S CBT failed. A failed CRC indicates at least one bit error in the payload.
Wrong packet type	None of the previous errors occurred, however, the received packet is of a different type to that originally transmitted by the R&S CBT.
Wrong payload length	None of the previous errors occurred, however, the received packet contains a different payload length to that transmitted by the R&S CBT.
Packet Error Rate	Packet error rate, percentage of bad packets received. This is equal to the sum of the percentages of the individual packet error types.
Packets received	Total number of packets successfully received, i.e. packets that are taken into account for the BER measurement. Received bad packets only contribute to the PER measurement but do not affect this packet counter (see Table 4-8 on p. 4.121). The number of bits received is displayed above the *Packets received* field.
Packets	Graphical information box showing the progression through the current statistics cycle. The total length of the statistics cycle *(statistic count)* is indicated below the progress bar.
Curr. Test Setup	Name of the test setups currently used. The name and properties of the test setups can be defined in the configuration menu; see section *Measurement Control (Receiver Quality Configuration – Control)* on p. 4.129.

Remote Control `READ[:SCALar]:RXQuality:BER? etc.`
`READ[:SCALar]:RXQuality:BER:DETail? etc.`

BER Search In the *BER Search* application the following results are displayed:

Bit Error Rate Bit error rate in the last iteration cycle.

Packet Error Rate Packet error rate in the last iteration cycle.

Packets received Total number of packets successfully received, i.e. packets that are taken into account for the BER measurement. The graphical information box shows the progression through the current statistics cycle. The total length of the current statistics cycle *(statistic count)* is indicated below the progress bar.

TX Level Current TX level of the R&S® CBT.

Search Result RF generator level of the R&S® CBT (i.e. the input level of the DUT, if a possible external attenuation is correctly reported, see p. 4.34.) for which the target bit error rate is met. With an appropriate definition of the target bit error rate, this yields the *actual sensitivity level* of the DUT.

Remote Control `READ[:SCALar]:RXQuality:SBER? etc.`

Limit Check A red output field and an arrow pointing upwards or downwards indicates that the measurement result exceeds the upper or lower limit set in the *Limits* tab of the *Receiver Quality* menu, see p. 4.133.

There is no limit check for the *BER Search* application; if the search fails, an invalid *Search Result* ("---") is indicated.

Remote Control `CALCulate:RXQuality:BER:MATching:LIMit?`

Setup The table *Setup* gives an overview of the configuration of the current measurement. This includes the settings made via the softkeys and hotkeys of the *Receiver Quality* menu or in the *Receiver Quality Configuration* menu; see p. 4.129. The parameter list depends on the current application.

Remote control See sections *Test Settings* on page 4.123 and description of the *Receiver Quality Configuration* menu on p. 4.129.

Measurement Configurations (Receiver Quality Configuration)

The popup menu *Receiver Quality Configuration* contains four tabs to determine the parameters for the bit error rate measurement.

The popup menu *Receiver Quality Configuration* is opened by pressing the measurement control softkey *BER/BER Search* in the *Receiver Quality* menu a second time. It is possible to change between the tabs by pressing the associated hotkeys.

Measurement Control (Receiver Quality Configuration – Control)

The *Control* tab controls the *Receiver Quality* measurement by defining:

- The names of the individual BER test setups *(Test Name)*
- The *Repetition* mode and *Stop Condition* for the individual BER test setups
- The number of packets to be sent in a single shot *BER* measurement or in a *BER Search* iteration cycle *(Packets)*
- The target bit error rate *(Search Value)* and the number of *Search Cycles* for the *BER Search* application *(Packets)*

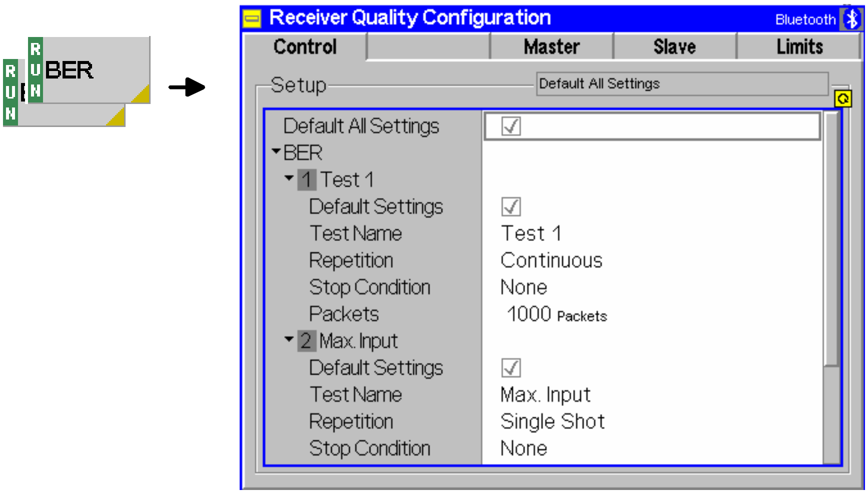


Fig. 4-81 Receiver Quality – Control

Default Settings The *Default All Settings* switch overwrites all settings in the *Control* tab with default values (the default values are quoted in the command description in chapter 6 of this manual). Besides, there are default switches acting on every individual *BER* test setup and on the *BER Search* mode.

Remote control
```
DEFault:RXQuality:BER:TSETup<nr>
DEFault:RXQuality:SBER
```

BER – Test Setup The *BER* table section defines up to five user-specific configuration files for *Receiver Quality* measurements (application *BER* only). The test setups are named *Test 1, Max. Input, DH1, DH3, DH5* and can be selected via the first five hotkeys associated with the *Test Setup* softkey.

The parameters of the five test setups have predefined values. These values have been selected according to the different test conditions stipulated in the Bluetooth RF Test Specification but can be changed any time:

Test 1 Standard TX level for BER measurements, DH1 packets, limited

		number of bits per measurement cycle for quick evaluation
	Max. Input	Like *Test 1* but with a much higher TX level
	DH1	Like *Test 1* but with a higher number of packets in order to reach a minimum number of 1.6 million transferred bits
	DH3	Like *DH1* but with DH3 packets
	DH5	Like *DH1* but with DH5 packets

Remote control — A numeric suffix in the RXQuality commands `(...RXQuality:BER:TSETup<nr>:...)` denotes the application number.

Test Name — The *Test Name* option assigns a name to each of the 5 test setups (application *BER* only). In the *Test Setup* hotkeys, the individual test setups are referenced with their *Test Names*.

Remote control —

Repetition — The *Repetition* parameter defines whether the measurement is to be performed in *Single Shot* or in *Continuous* mode (application *BER* only). All settings are analogous to the *Power* menu; see section *Measurement Control (Power Configuration – Control)* on p. 4.67.

Remote control

```
CONFigure:RXQuality:TSETup<nr>:CONTrol:REPetition
                <Repetition>,<Stop_Condition>
```

Stop Condition — The *Stop Condition* parameter defines whether or not the measurement is to be stopped when a limit check fails (application *BER* only). All settings are analogous to the *Power* menu; see section *Measurement Control (Power Configuration – Control)* on p. 4.67.

Remote control

```
CONFigure:RXQuality:TSETup<nr>:CONTrol:REPetition
                <Repetition>,<Stop_Condition>
```

Packets — The *Packets* parameters define the number of packets within a statistics cycle. The statistics cycle comprises a definite number of packets that the R&S CBT could receive successfully; see description of *Packets received* on p. 4.127. The settings *1* and *Off* (press *ON/OFF* key) are equivalent.

- In *BER* application, the duration of each single-shot measurement equals to the statistics cycle.
- In *BER Search* application, each iteration step comprises one statistics cycle.

Remote control

```
CONFigure:RXQuality:BER:TSETup<nr>:CONTrol:STATistics
                <Packets>
CONFigure:RXQuality:SBER:CONTrol:STATistics
                <Packets>, <Search_Value>, <Search_Cycles>
```

Search Value — *Search Value* defines the target bit error rate for the *BER Search* application. The *BER Search* consists of determining the TX Level of the R&S® CBT at which the *Search Value* is met.

Remote control

```
CONFigure:RXQuality:SBER:CONTrol:STATistics
                <Packets>, <Search_Value>, <Search_Cycles>
```

Search Cycles The *Search Cycles* parameter defines the number of search cycles to conduct the *BER Search* measurement over. Each cycle consists of the number of packets declared in the *Packet* field.

The BER Search is performed as follows:

The TX level range between the *Srch. Lower Level.* and *Srch. Upper Level* is covered with n equidistant test points where n is the number of search cycles. The search is started at *Srch. Upper Level* and continued point by point until the difference between the actual BER value and the *Search Value* changes sign. The corresponding TX Level represents the *Search Result*.

If no *Search Result* can be found (e.g. because the TX level range was not appropriately defined), then the search ends after the last cycle and the search result is invalid ("---").

Remote control

```
CONFigure:RXQuality:SBER:CONTrol:STATistics
                  <Packets>, <Search_Value>, <Search_Cycles>
```

BER Levels (Receiver Quality Configuration – Master)

The *Master* tab defines the R&S® CBT RF generator level *(TX Level)* settings for the *Receiver Quality* measurement. The levels are independent of the *TX Level* for transmitter tests which is set in the *Master Sig.* tab of the *Connection Control menu* (see p. 4.149.).

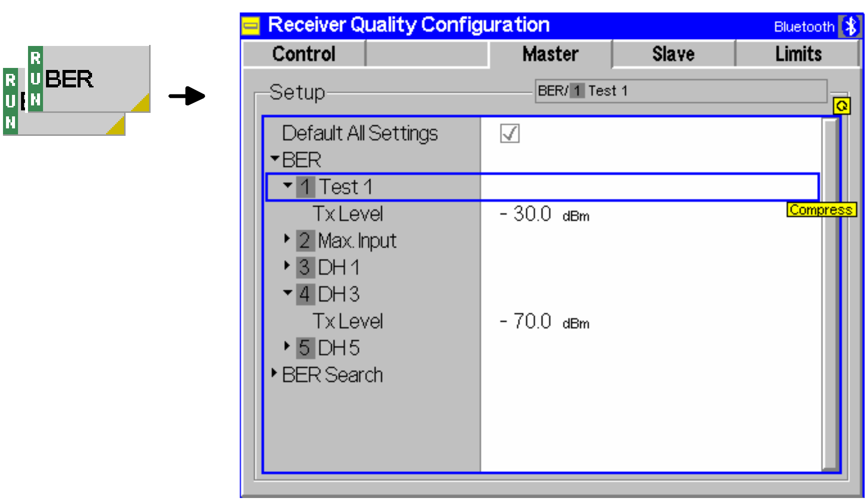


Fig. 4-82 Receiver Quality – Master

Default Settings The *Default All Settings* switch overwrites all settings in the *Master* tab with default values (the default values are quoted in the command description in chapter 6 of this manual).

Remote control –

TX Level The *TX Level* parameter defines the RF generator level of the R&S® CBT at which the *Receiver Quality* measurement is performed. The purpose of the TX Level depends on the application:

- In a *BER* measurement, a single TX level is defined. The R&S® CBT measures the bit error rate at this TX level.
- In a *BER Search* measurement, a TX level range with an upper and a lower limit *(Srch. Lower Level, Srch. Upper Level)* is defined. Within this range, the R&S® CBT determines a TX level corresponding to a particular bit error

rate. The search algorithm is explained in the paragraph on *Search Cycles* on page 4.131.

Remote control `CONFigure:RXQuality:BER:TSETup<nr>:LEVel <Level>`
`CONFigure:RXQuality:SBER:LEVel <Lower_Level>, <Upper_Level>`

BER Loopback Settings (Receiver Quality Configuration – Slave)

The *Slave* tab defines the characteristics of the *Loopback* test mode used for *Receiver Quality* measurements.

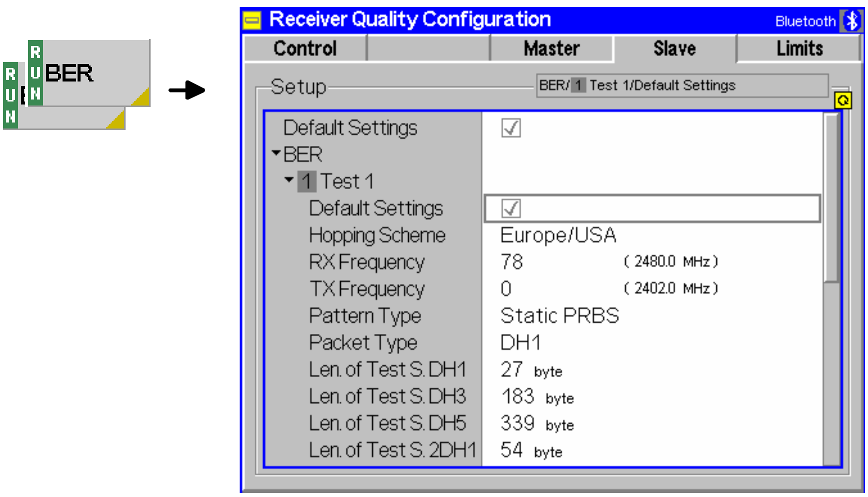


Fig. 4-83 Receiver Quality – Slave

Default Settings The *Default All Settings* switch overwrites all settings in the *Slave* tab with default values (the default values are quoted in the command description in chapter 6 of this manual). Besides, there are default switches acting on every individual *BER* test setup and on the *BER Search* mode.

Remote control –

BER/
BER Search The table sets the parameters of the particular loopback test mode that is used for the *Receiver Quality* measurement. The parameters can be set indepently for the individual *BER* test setups and for the *BER Search* application.

All settings are analogous to the *Loopback* test settings accessible from the *Slave Sig.* tab of the *Connection Control* menu; see p. 4.156. Note, however, that the *Slave Sig.* settings (that are used for *Power* and *Modulation* measurements) and the *Receiver Quality Configuration* settings represent different parameter sets that do not overwrite each other.

The following parameter is provided for *Receiver Quality* measurements only:

Delay Defines the timing for loopback tests (normal loopback or loopback with delay; see *Fig. 4-100* on page 4.159). This setting is only relevant for receiver quality measurements.

Note: *If the loopback delay setting does not correspond to the configuration of the DUT the R&S® CBT will not be able to associate the data looped back with the data transmitted and the* Receiver Quality *measurement will fail.*

With option R&S CBT-K55 the R&S CBT provides the additional Enhanced Data Rate (EDR) packet types *2-DH1, 2-DH3, 2-DH5, 3-DH1, 3-DH3,* and *3-DH5.* These packet types are described in section *Generator Modulation Panel* on p. 4.31.

Remote control `CONFigure:RXQuality:BER:TSETup<nr>...`
`CONFigure:RXQuality:SBER...`

Limit Values (Receiver Quality Configuration – Limits)

The *Limits* tab defines upper limits for the *Receiver Quality* parameters. All limits are defined independently for the individual *BER* test setups.

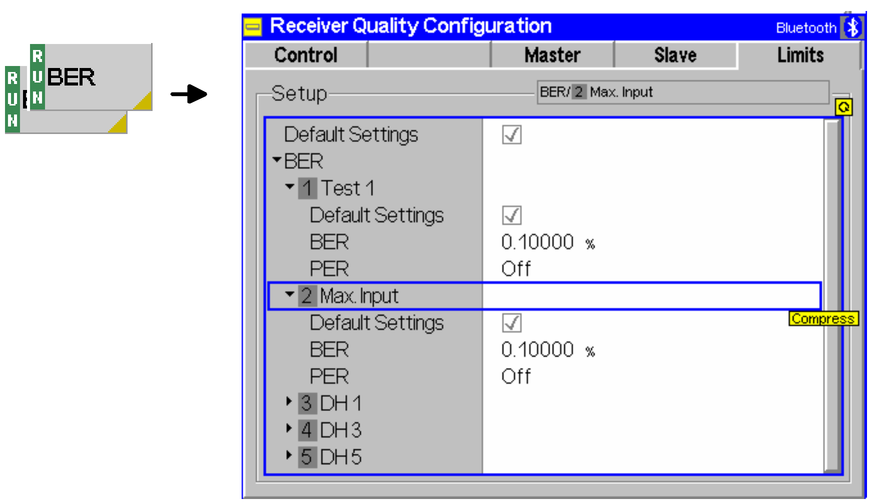


Fig. 4-84 Receiver Quality Configuration – Limits

Default Settings The *Default All Settings* switch overwrites all settings in the *Limits* tab with default values (the default values are quoted in the command description in chapter 6 of this manual). Besides, there are default switches acting on every individual *BER* test setup and on the *BER Search* mode.

Remote control `DEFault:RXQuality:BER:TSETup<nr>:LIMit ON | OFF`

BER Upper limit for the raw bit error rate in the value range 0% to 100%. According to the standard, the measured BER must be ≤ 0.1% at a reference TX level of –70 dBm at the input of the DUT receiver. A value of 100% effectively disables the limit check.

PER Upper limit for the packet error rate in the value range 0% to 100%.

Remote control `CONFigure:RXQuality:BER:TSETup<nr>:LIMit...`

Audio Measurements

The R&S CBT is equipped with a speech codec, which makes it suitable for testing the audio circuit of a Bluetooth DUT. The two BNC connectors *AF IN* and *AF OUT* at the front panel of the instrument serve as input and output connectors for analog speech signals. Audio signals can be modulated on the RF carrier signal and transferred from and to the DUT while a Bluetooth connection is established. As a prerequisite, the R&S CBT must be placed to its *Audio* signalling state; see section *Connection Control in Audio State* on p. 4.147.

Audio Test Scenarios

In the *Audio* signalling state a variety of audio measurements can be carried out. The tests depend on the external test setup and the test equipment available. Below we list some typical test scenarios and operating sequences.

Scenario 1: Receive Audio

A receive audio test consists of demodulating the SCO speech data from the RF signal transmitted by a Bluetooth DUT and converting the data stream into an analog audio signal which can be evaluated at the audio output connector *AF OUT*..

Note: *This test scenario may be combined with scenario 2, transmit audio.*

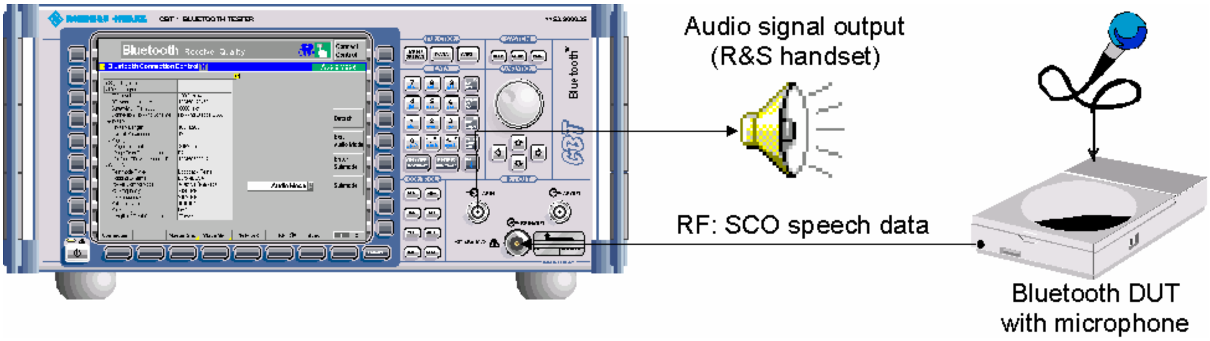


Fig. 4-85 Receive audio tests

To perform a receive audio test,

1. Connect your Bluetooth device to the R&S CBT using the standard bidirectional RF connector RF ⊖.
2. Set up a connection to the DUT (see Chapter 2). Before accessing the *Audio* signalling state, open the *Network* tab of the *Connection Control* menu and make sure that the *Bit Stream* is set either to *Analog In/Out* or, for lower sensitivity of the speech coder, to *Analog In/Out (Low)*.
3. Activate the *Audio* signalling state to establish an SCO link between the R&S CBT and the DUT.
4. Configure your DUT to provide an RF signal modulated with SCO speech data.

The R&S CBT receives the RF signal, demodulates the speech data and routes it to the speech codec where it is converted to an analog audio signal.

5. Tap off the signal at the *AF OUT* connector.

Scenario 2: Transmit Audio

A transmit audio test consists of generating a Bluetooth RF signal carrying SCO speech data that the DUT will demodulate and possibly convert into an analog audio signal. The audio input signal is fed in at the audio input connector *AF IN*.

Note: *This test scenario may be combined with scenario 1, receive audio.*

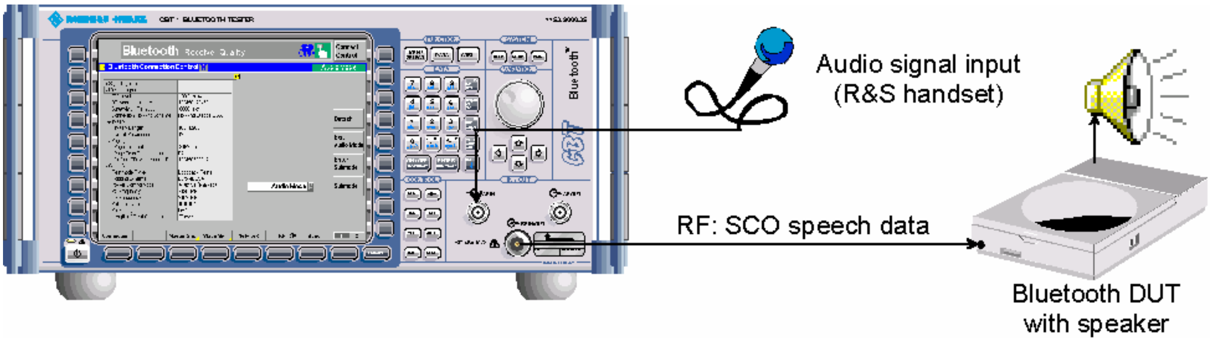


Fig. 4-86 Transmit audio tests

To perform a transmit audio test,

1. Connect your Bluetooth device to the R&S CBT using the standard bidirectional RF connector RF ⊙.
2. Set up a connection to the DUT (see Chapter 2). Before accessing the *Audio* signalling state, open the *Network* tab of the *Connection Control* menu and make sure that the *Bit Stream* is set to *Analog In/Out* or, for lower sensitivity of the speech coder, to *Analog In/Out (Low)*.
3. Activate the *Audio* signalling state to establish an SCO link between the R&S CBT and the DUT.
4. Apply an analog audio signal at *AF IN* and evaluate the SCO speech data at the DUT.

Scenario 3: Echo

In an echo test scenario the R&S® CBT receives SCO speech data from the DUT and loops back this data after a specific delay time.

Note: *This test scenario cannot be combined with scenarios 1 and 2.*

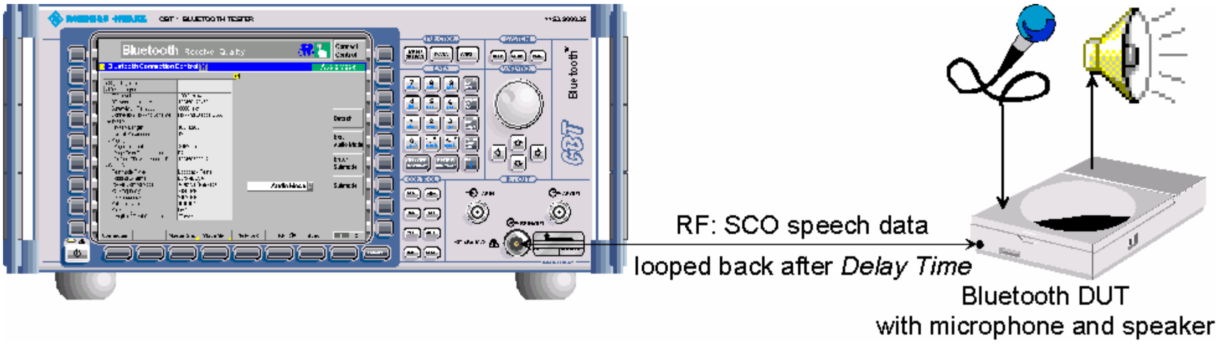


Fig. 4-87 Echo tests

To perform an echo test,

1. Connect your Bluetooth device to the R&S® CBT using the standard bidirectional RF connector R&S® RF ⊙.

2. Set up a connection to the DUT (see Chapter 2). Before accessing the *Audio* signalling state, open the *Network* tab of the *Connection Control* menu and set the *Bit Stream* to *Echo*.
3. In the same tab, select the *Delay Time,* i.e. the time after which the R&S® CBT loops back the received speech data to the DUT.
4. Activate the *Audio* signalling state to establish an SCO link between the R&S® CBT and the DUT.
5. Configure your DUT to provide an RF signal modulated with SCO speech data and evaluate the looped-back speech data at the DUT.

Connection Control (Contd.)

The popup menu *Connection Control* controls the signalling procedures (connection setup and release, services, signalling parameters) and determines the inputs and outputs with the e**x**ternal attenuation values, the reference frequency, RF input path and trigger settings.

Signalling measurements are performed with a connection to the DUT via radio link (test mode, signalling state *Test Mode* or special submodes), so the first tabs for setting up the connection (*Connection Control – Signalling)* appear immediately after selection of the function group *Bluetooth Signalling* in the *Menu Select* menu*.* Alternatively, the *Connection Control* menu can be displayed by pressing the softkey *Connect. Control* at the top right in every measurement menu; the individual tabs can be accessed via the hotkey bar at the lower edge of the screen. By pressing the *Escape* key, the *Connection Control* menu is closed and the R&S® CBT changes to the test mode.

The tabs *Connection Control – Connection* displayed immediately after the function group is activated are described at the beginning of section *Bluetooth Signalling* on p. 4.38. The remaining tabs of the *Connection Control - Connection* menu are described below.

Connection Control in Connected State

The *Connection (Connected)* tab provides information on

- A selection of signalling parameters of the DUT *(Signalling Info)*
- The master and slave signal parameters
- It contains softkeys that lead to other signalling states (see *Fig. 4-40*):
- Release connection to DUT, quit the test mode (*Detach* -> state *Standby)*
- Activate a special submode (Enter Submode -> Submode state)

The *Connection (Connected)* tab is opened after an attempted ACL connection to the DUT could be established. It is replaced by the *Connection (Standby)* tab when the connection is lost or deliberately released *(Detach* softkey), see *Fig. 4-40*. It is replaced by the *Connection (<Submode>)* tab after the selected submode is activated.

Note: *If the connection is lost during operation (e.g. because of a low signal level), a warning will appear. At the same time, bit 2 is set in the STATus:OPERation register. Prior to further operation, confirm the reception of the message by pressing the* ENTER *key.*

In the *Connected* state the R&S® CBT maintains an ACL link to the DUT, acting as a Bluetooth master capable of forcing the DUT (slave) into one of the special submodes.

In this "just connected" state, only link control information needs to be exchanged so that the DUT transmits NULL packets. Measurements are still possible:

- *Power* and *Modulation* measurements will measure the NULL packets returned by the DUT and display as much information as possible. Null packets are packets with a fixed total length of 126 bit. They have no payload and therefore consist of the channel access code and packet header only. The results are basically the same as the results for a DH1 packet with payload length zero: All power results (including *Power Control* tests) are available. The *Modulation* measurement returns only the frequency accuracy as the other quantities must be determined with a definite payload pattern.
- Receiver quality measurements are not possible in *Connected* state since there is no payload.

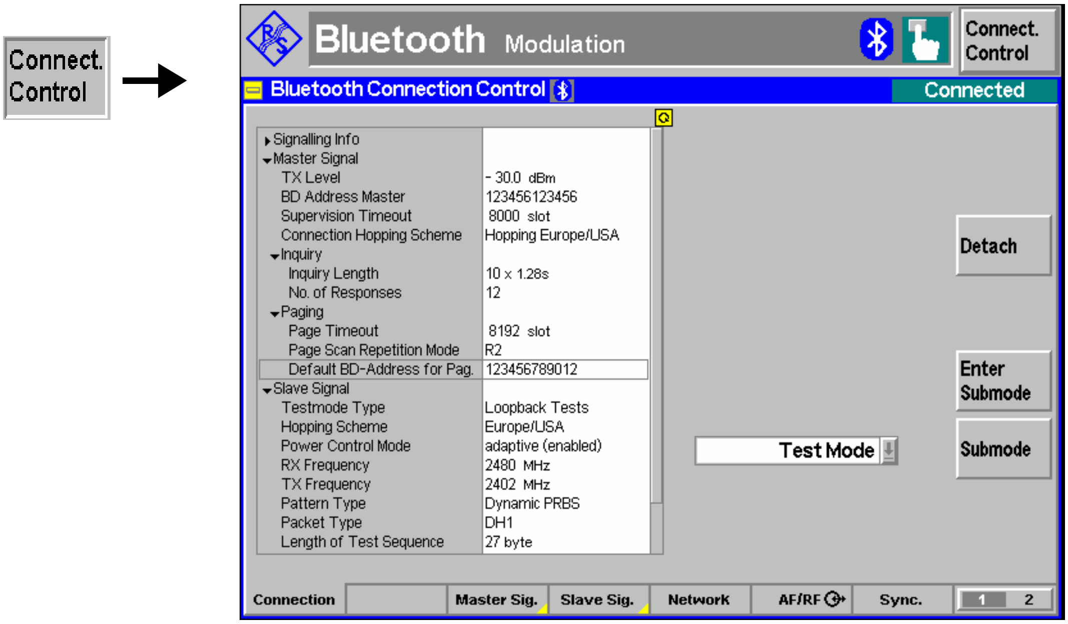


Fig. 4-88 Connection Control – Connection (Connected)

The info table in the left half of the menu is described in section *Connection Control: Standby State* on page 4.40.

Detach

The *Detach* softkey releases the connection between the R&S® CBT and the DUT.

The R&S® CBT returns to the *Standby* signalling state; see *Fig. 4-40* on p. 4.39.

Note: *The detach procedure can take some time during which the R&S® CBT enters the transitory* Disconnecting *state and waits for confirmation from the DUT. In the* Disconnecting *state the* Force Standby *softkey allows to immediately terminating the disconnecting procedure and forcet the R&S® CBT into the* Standby *state.*

Remote control `PROCedure:SIGNalling:ACTion DETach`
Force Standby: `PROCedure:SIGNalling:ACTion FSTY`

Enter Submode

The *Enter Submode* softkey activates the special mode selected in the *Submode* pull-down list.

Note: *The* Enter Submode *softkey is provided in the* Connected *state as well as in the submodes* Test Mode, Audio, Sniff, Park, *and* Hold. *Depending on the DUT, switchover between different submodes may be limited. If a particular transition fails, first return to the* Connected *state and then enter the desired submode.*

Remote control `PROCedure:SIGNalling:ACTion SNIFf | HOLD | PARK | AUDio | TEST`

Submode

The *Submode* softkey activates a pull-down list to select one of the following submodes:

Test Mode The DUT is in its internal test mode; all TX and RX measurements are possible; see section *Connection Control in Test Mode (Test Mode)* on p. 4.139.

Hold	The DUT is in its special *Hold* state; power consumption measurements can be made; see section *Connection Control in Hold State* on p. 4.144.
Sniff	The DUT is in its special *Sniff* state; power consumption measurements can be made; see section *Connection Control in Sniff State* on p. 4.143.
Park	The DUT is in its special *Park* state; power consumption measurements can be made; see section *Connection Control in Park State* on p. 4.145.
Audio	An SCO link is established on top of the ACL link; audio measurements can be made; see section *Connection Control in Audio State* on p. 4.147.

Pressing the *Enter Submode* softkey activates the selected submode.

Remote control No separate command; see *Enter Submode* softkey.

Connection Control in Test Mode (Test Mode)

The *Connection (Test Mode)* tab provides information on

- A selection of signalling parameters of the DUT *(Signalling Info)*
- The master and slave signal parameters
- It contains softkeys that lead to other signalling states (see *Fig. 4-40*):
- Activate a different submode (*Enter Submode* -> *Submode* state)
- Deactivate the test mode of the DUT (Exit Testmode -> state Connected)
- Deactivate the test mode and release connection to DUT (Detach -> state Standby)

The *Connection (Test Mode)* tab is opened after an attempted test mode connection to the DUT could be established, or if the test mode is activated while the R&S® CBT is in the *Connected* state or in the *Sniff, Park* or *Audio* substates. It is replaced by the *Connection (Standby)* tab when the connection is lost or deliberately released *(Detach* softkey). It is replaced by the *Connection (Connected)* tab if the test mode of the DUT is deactivated *(Exit Test Mode* softkey). It is replaced by the *Connection (Audio), Connection (Hold), Connection (Sniff)* or *Connection (Park)* tab if one of the corresponding submodes is activated (*Enter Submode* softkey); see *Fig. 4-40*.

Note: *If the connection is lost during operation (e.g. because of a low signal level), a warning will appear. At the same time, bit 2 is set in the STATus:OPERation register. Prior to further operation, of the user has to acknowledge the message by pressing the* ENTER *key.*

The **test mode** is a special state of the Bluetooth model designed for testing the Bluetooth transmitter and receiver. In this mode, the R&S® CBT and the DUT form a piconet where the R&S® CBT acts as a master and has full control over the test procedure. The DUT acts as a slave. While in test mode, the DUT must not support normal operation. All transmitter and receiver measurements described in this manual can be made in the test mode.

The R&S® CBT is able to configure a broad range of test mode parameters. These parameters are set in the *Slave Sig.* tab (see p. 4.149.) which is available in all signalling states of the R&S® CBT.

The DUT is in test mode as soon as the *Test Mode* signalling state is reached. After leaving the test mode *(Detach* softkey, power-off etc.), the DUT and the R&S® CBT return to the *Standby* state.

Note: *Before attempting a connection, the internal test mode of the device to be tested must be locally enabled according to the instructions of the Bluetooth standard. Otherwise, the connection will fail, and the R&S® CBT will display the message* Device is not enabled for test mode – Cancel/Retry*. The connection process can be continued after enabling the device and pressing* Retry*.*

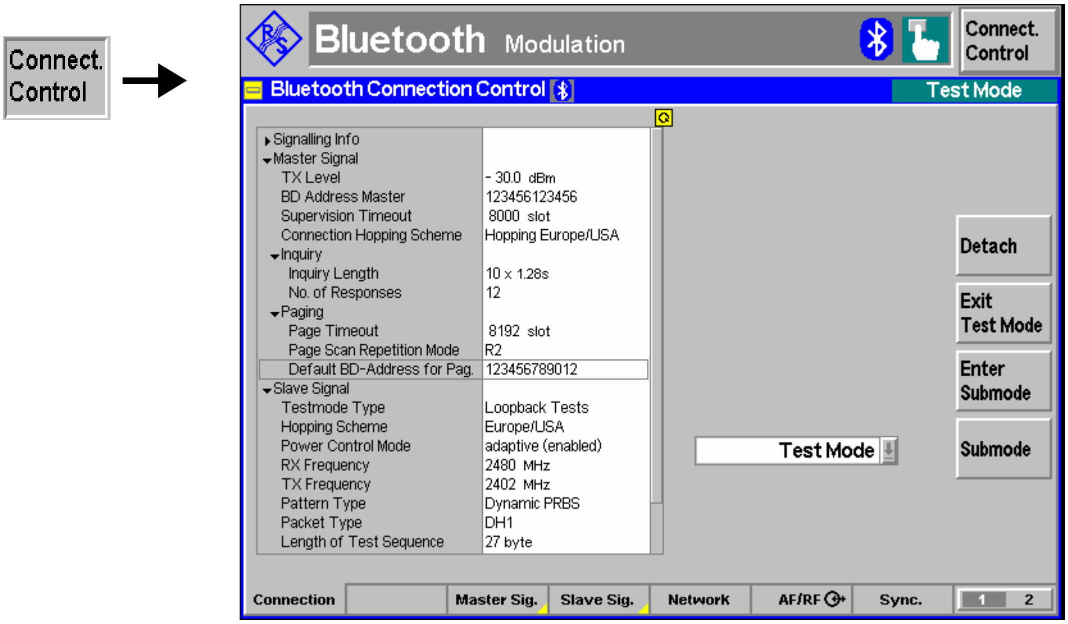


Fig. 4-89 Connection Control – Connection (Test Mode)

The info table in the left half of the menu and the *Power* softkey is described in section *Connection Control: Standby State* on page 4.40. The *Detach, Enter Submode* and *Submode* softkeys are described in section *Connection Control in Connected State* on p. 4.137.

Signalling Info The *Signalling Info* table displays signalling information that was retrieved from the DUT. The information is available only if an *Inquiry* was done before establishing the connection.

Note: *To speed up the connection, it is possible to prevent the R&S® CBT from reading the* Device Name, Version, *and* Supported Features *signalling parameters, see parameter Read Signalling Info on p. 4.152. The* Class of Device *and* Paging *parameters are filled in when a device was found during inquiry.*

Device Name *Device Name* contains a textual description of the DUTs name. The name received from the DUT can be up to 255 characters long, however, this name is truncated to display only what can fit within the list.

Remote control `[:SENSe]:SINFo:NAME?`

Version The *Version* section contains a set of version values of the DUT.

LMP Version LMP (Link Manager Protocol) version is the Bluetooth LMP version retrieved from the DUT (e.g. 1.1 or 2.0). The information whether the LMP version is 1.0 or ≥ 1.1 is used by the R&S® CBT in test mode. The R&S CBT reports version V2.0 as its own Bluetooth version.

Company ID The Company ID is the manufacturer code of the DUT. The value returned from the device is a 16-bit value, however, the value corresponds to a textual description i.e. 0 = Ericsson; 1 = Nokia; 2 = Intel; 3= IBM; 4 = Toshiba; etc.

Device Version The device version is a company's internal version number, this is represented as a 16-bit value.

Remote control
```
[:SENSe]:SINFo:VERSion?
[:SENSe]:SINFo:COMPany?
```

BD_Addr

BD_Address contains the BD_address of the DUT. The field is a 12 digit hex value. There are three sub fields for this field: LAP, NAP and UAP:

LAP Lower address part. The field is a 6 digit hex value (24 bit).

NAP Non-specific address part. The field is a 2 digit hex value (8 bit).

UAP Upper address part. The field is a 4 digit hex value (16 bit).

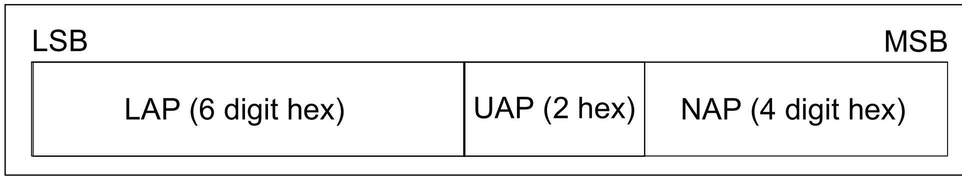


Fig. 4-90 Bluetooth address format

Remote control `[:SENSe]:SINFo:BDADdress?` Response: `'<addrress>'`

Class of Device

The *Class of Device* section consists of three sets of fields. These are *Service Classes*, *Major Device Class* and *Minor Device Class*.

Service Classes Lists a set of fields that represent the services the DUT supports, each being a yes or no value (whether the service is supported or not). The following services are available:

Limited Discoverable Mode *Object Transfer*
Networking *Audio*
Rendering *Telephony*
Capturing *Information*

Major Device Class Gives the type of the DUT, this is determined by the main function of the DUT. There is a possibility of up to 32 different possible classes (most of which are reserved for future use). The possible *Major Device Classes* are:

Miscellaneous *Audio*
Computer *Peripheral*
Phone *LAN Access Point*
Unclassified (specific device code not assigned)

Major Device Class The minor class devices are to be interpreted only in the context of the major device class. The minor device class gives a more descriptive use of the DUT.

Table 4-9 below contains the possible values for the minor device class for each major device class.

Remote control `[:SENSe]:SINFo:CLASs:SERVice?`
`[:SENSe]:SINFo:CLASs?`

Table 4-9 Major and minor device classes

Computer Major Class	**Phone Major Class**	**LAN Access Point Major Class**	**Audio Major Class**
Unclassified	Unclassified	Fully available	Unclassified
Desktop workstation	Cellular	1-17% utilized	Device conforms to headset profile
Server-class computer	Cordless	17-33% utilized	
Laptop	Smart phone	33-50% utilized	
Handheld PC/PDA	Wired modem	50-67% utilized	
Pal sized PC/PDA		67-83% utilized	
		83-99% utilized	
		No service available	

Paging

The *Paging* section shows the paging properties of the device under test. The paging properties of the device under test are Page scan mode, Scan Period and Scan repetition.

Page Scan Mode Bluetooth currently specifies four page scan modes for use during paging, one mandatory and three optional.

Scan Period Indicates the period in which the page scan mode is applied. Currently three modes exist P0, P1 and P2.

Scan Repetition Indicates the interval between two consecutive page scan windows. Currently three modes exist: R0, R1 and R2.

Remote control `[SENSe:]SINFo:PAGing?`

Supported Features

The *Supported Features* list determines the capabilities of the device under test, each is giving a YES or NO value indicating whether the feature is available. All features are optional; they may or may not be supported by a Bluetooth device. The features list is listed below.

3-Slot Packets	*5-Slot Packets*
Encryption	*Slot offset*
Timing Accuracy	*Role Switch*
Hold Mode	*Sniff Mode*
Park Mode	*RSSI*
Channel Quality driven Data Rate	*SCO Link*
HV2 Packets	*HV3 Packets*
μ-law log	*A-law log*
CVSD	*Paging Scheme*
Power Control	*Transparent SCO*
Flow Control Lag	
EDR ACL 2 Mbps	*EDR ACL 3 Mbps*
3-Slot EDR ACL Packets	*5-Slot EDR ACL Packets*

Note: *If an attempt is made to send power control messages to a DUT that does not support power control (see Power Up hotkey on p. 4.56), then the R&S® CBT prompts with an error message.*

Remote control `[SENSe:]SINFo:FEATure...?`
`[SENSe:]SINFo:FEATure:LFRequest?`

Master Signal

The table *Master Signal* indicates important signalling parameters that the R&S® CBT (acting as a Bluetooth master) uses to inquire for Bluetooth slaves in its range. These parameters are set in the *Master Sig.* tab and explained in more detail there (see section *Signal of the R&S CBT (Connection Control – Master Sig.)* on p. 4.149.).

Remote control `CONFigure:MSIGnal...?`

Slave Signal

The table *Slave Signal* indicates important signal parameters of the DUT acting as a Bluetooth slave. These parameters are set in the *Slave Sig.* tab and explained in more detail there (see section *Behavior of the DUT (Connection Control – Slave Sig.)* on p. 4.149.).

Remote control `CONFigure:MSIGnal...?`

Paging The table *Paging* indicates paging parameters to be used for connection and synchronization to a DUT. These parameters are set in the *Master Sig.* tab and explained there in more detail (see section *Signal of the R&S CBT (Connection Control – Master Sig.)* on p. 4.149.).

Remote control `CONFigure:MSIGnal:PAGing...?`

Exit Testmode

The *Exit Testmode* softkey deactivates the test mode at the DUT.

The DUT leaves its internal test mode. The R&S® CBT returns to the *Connected* signalling state; see *Fig. 4-40* on p. 4.39.

Remote control `PROCedure:SIGNalling:ACTion STESt`

Detach

The *Detach* softkey releases the connection between the R&S® CBT and the DUT.

The R&S® CBT returns to the *Standby* signalling state; see *Fig. 4-40* on p. 4.39.

Note: *The detach procedure can take some time during which theR&S® CBT enters the transitory* Disconnecting *state and waits for confirmation from the DUT. In the* Disconnecting *state the* Force Standby *softkey allows to immediately terminating the disconnecting procedure and forcet the R&S® CBT into the* Standby *state.*

Remote control `PROCedure:SIGNalling:ACTion DETach`
Force Standby: `PROCedure:SIGNalling:ACTion FSTY`

Connection Control in Sniff State

The *Connection (Sniff)* tab provides information on

- A selection of signalling parameters of the DUT *(Signalling Info)*
- The master and slave signal parameters
- It contains softkeys that lead to another signalling state (see *Fig. 4-40*):
- Activate a different submode (*Enter Submode -> Submode* state)
- Release the Sniff state (Exit Sniff Mode -> Connected state)
- Release connection to DUT (Detach -> state Standby)

The *Connection (Sniff)* tab is opened if the *Sniff* mode is activated while the R&S® CBT is in the *Connected* state or in the *Test Mode, Park,* or *Audio* substates. It is replaced by the *Connection (Standby)* tab when the connection is lost or deliberately released *(Detach* softkey). It is replaced by the *Connection (Connected)* tab if the *Sniff* mode of the DUT is deactivated *(Exit Sniff Mode* softkey). It is replaced by the *Connection (Audio), Connection (Hold), Connection (Park)* or *Connection (Test Mode)* tab if one of the corresponding submodes is activated (*Enter Submode* softkey); see *Fig. 4-40*.

Note: *If the connection is lost during operation (e.g. because of a low signal level), a warning will appear. At the same time, bit 2 is set in the STATus:OPERation register. Prior to further operation, confirm the reception of the message by pressing the* ENTER *key.*

In the **Sniff** state the R&S® CBT allows the DUT to participate in the piconet only in periodic intervals *(Sniff Intervals).* During the intervals the DUT wakes up to listen for transmissions from the R&S® CBT and re-synchronize its clock offset. In-between the intervals, the DUT's listen activity is suspended so that the R&S® CBT can not start transmission. The *Sniff Interval* and the other parameters of the Sniff mode can be set in the *Network* tab before the *Sniff* state is reached; see page 4.162. The Sniff mode must be terminated explicitly by the R&S® CBT; see *Exit Sniff Mode* below.

The main application of the *Sniff* state is to test the power consumption of the DUT. This must be done locally at the DUT.

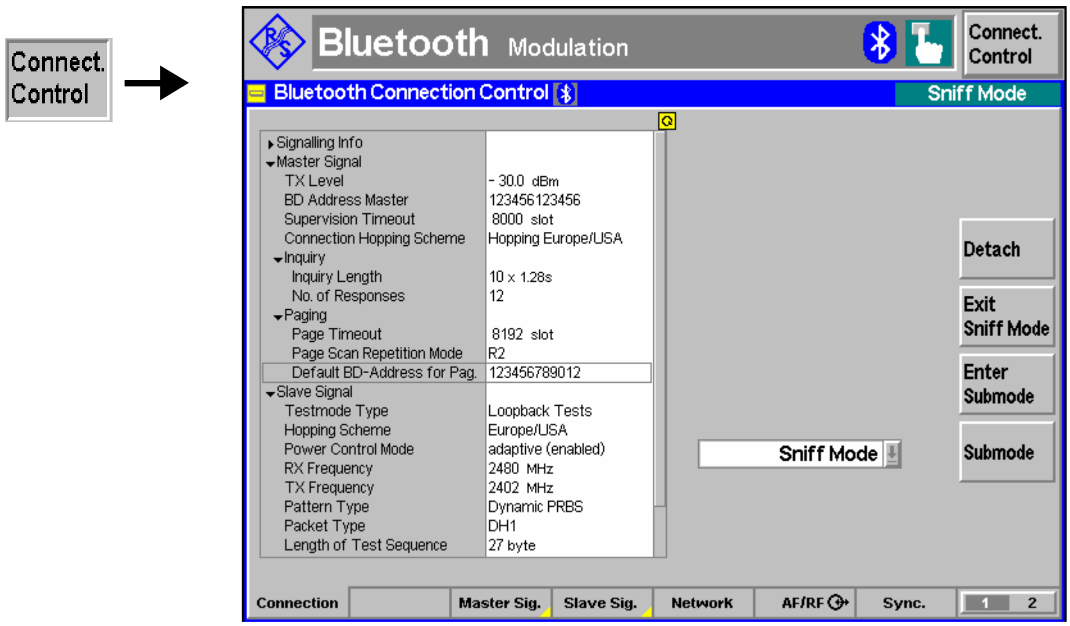


Fig. 4-91 Connection Control – Connection (Sniff)

The info table in the left half of the menu and the *Power* softkey is described in section *Connection Control: Standby State* on page 4.40. The *Detach, Enter Submode* and *Submode* softkeys are described in section *Connection Control in Connected State* on p. 4.137.

Exit Sniff Mode

The *Exit Sniff Mode* softkey releases the *Sniff* mode at the DUT.

The DUT returns to the active state. The R&S® CBT returns to the *Connected* signalling state; see *Fig. 4-40* on p. 4.39.

Remote control `PROCedure:SIGNalling:ACTion SSNiff`

Connection Control in Hold State

The *Connection (Hold)* tab provides information on

- A selection of signalling parameters of the DUT *(Signalling Info)*
- The master and slave signal parameters
- It contains softkeys that lead to another signalling state (see *Fig. 4-40*):
- Release connection to DUT (*Detach* -> state *Standby)*

The *Connection (Hold)* tab is opened if the *Hold* mode is activated while the R&S® CBT is in the *Connected* state or in the *Sniff, Park* or *Audio* substates. It is replaced by the *Connection (Standby)* tab when the connection is lost or deliberately released *(Detach* softkey); see *Fig. 4-40*.

Note: *If the connection is lost during operation (e.g. because of a low signal level), a warning will appear. At the same time, bit 2 is set in the STATus:OPERation register. Prior to further operation, confirm the reception of the message by pressing the* ENTER *key.*

In the **Hold** state the R&S® CBT prevents the DUT from participating in the connection during a given length *(Hold Interval)*. The *Hold Interval* can be set in the *Network* tab before the *Hold* state is reached; see page 4.162. In the hold mode, a Bluetooth transceiver neither receives nor transmits information. The *Hold* is automatically terminated after the *Hold Interval* (–> *Connected* state) but can also be released explicitly *Detach –> Standby)*.

The main application of the *Hold* state is to test the power consumption of the DUT. This must be done locally at the DUT.

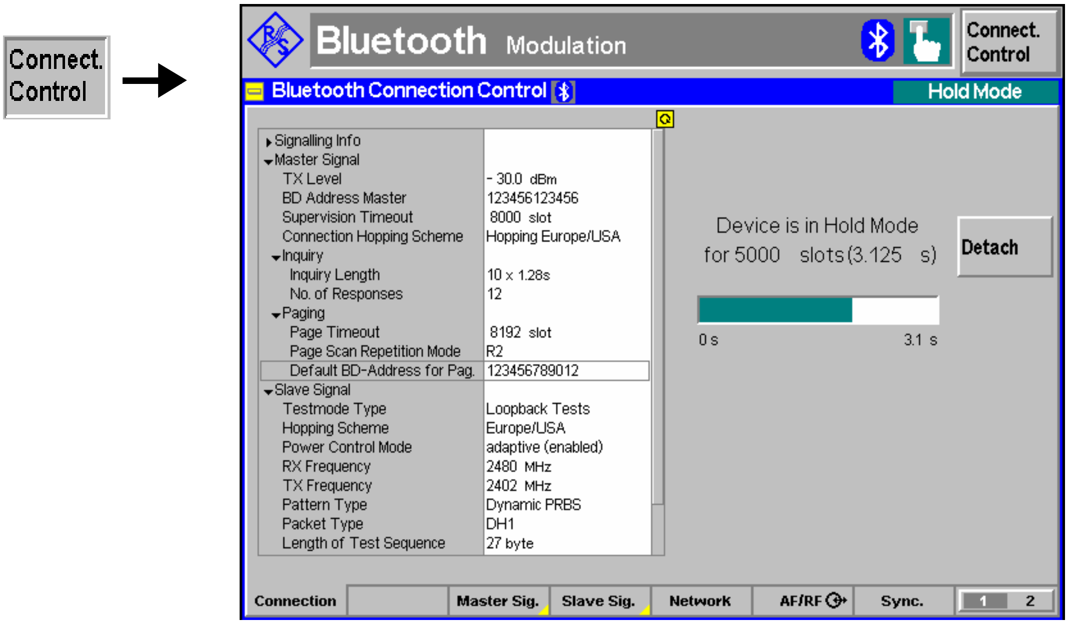


Fig. 4-92 Connection Control – Connection (Hold)

The info table in the left half of the menu and the *Power* softkey is described in section *Connection Control: Standby State* on page 4.40. The *Detach* softkey is described in section *Connection Control in Connected State* on p. 4.137.

Connection Control in Park State

The *Connection (Park)* tab provides information on

- A selection of signalling parameters of the DUT *(Signalling Info)*
- The master and slave signal parameters
- It contains softkeys that lead to another signalling state (see *Fig. 4-40*):
- Activate a different submode *(Enter Submode -> Submode* state)
- Release the Park state (Unpark -> Connected state)
- Release connection to DUT (Detach -> state Standby)

The *Connection (Park)* tab is opened if the *Park* mode is activated while the R&S® CBT is in the *Connected* state or in the *Test Mode, Sniff* or *Audio* substates. It is replaced by the *Connection*

(Standby) tab when the connection is lost or deliberately released *(Detach* softkey). It is replaced by the *Connection (Connected)* tab if the *Park* mode of the DUT is deactivated *(Unpark* softkey). It is replaced by the *Connection (Audio), Connection (Hold), Connection (Sniff)* or *Connection (Test Mode)* tab if one of the corresponding submodes is activated (*Enter Submode* softkey); see *Fig. 4-40*.

Note: *If the connection is lost during operation (e.g. because of a low signal level), a warning will appear. At the same time, bit 2 is set in the STATus:OPERation register. Prior to further operation, confirm the reception of the message by pressing the* ENTER *key.*

In the **Park** state the DUT gives up ist Active Member Address and no longer participates in the connection but still re-synchronizes to the channel by waking up at the beacon instants separated by periodic intervals *(Beacon Intervals).* At the beacon instants the R&S® CBT can re-activate *(Unpark)* the DUT. The *Beacon Interval* can be set in the *Network* tab before the *Park* state is reached; see page 4.162. The Park mode must be terminated explicitly by the R&S® CBT; see *Unpark* below.

The main application of the *Park* state is to test the power consumption of the DUT. This must be done locally at the DUT.

Connect. Control →

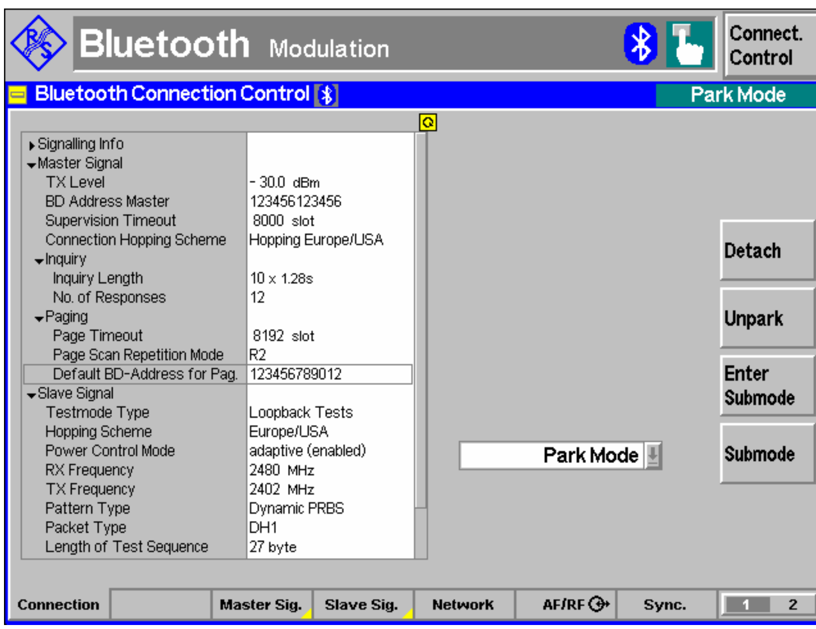


Fig. 4-93 Connection Control – Connection (*Park*)

The info table in the left half of the menu and the *Power* softkey is described in section *Connection Control: Standby State* on page 4.40. The *Detach, Enter Submode* and *Submode* softkeys are described in section *Connection Control in Connected State* on p. 4.137.

Unpark

The *Unpark* softkey releases the *Park* mode at the DUT.

The DUT returns to the active state. The R&S® CBT returns to the *Connected* signalling state; see *Fig. 4-40* on p. 4.39.

Remote control `PROCedure:SIGNalling:ACTion SPARk`

Connection Control in Audio State

The *Connection (Audio)* tab provides information on

- A selection of signalling parameters of the DUT *(Signalling Info)*
- The paging mode
- The master and slave signal parameters
-

It contains softkeys that lead to another signalling state (see Fig. 4-40):

- Activate a different submode (*Enter Submode* -> *Submode* state)
- Release connection to DUT (Detach -> state Standby)

The *Connection (Audio)* tab is opened if the *Audio* mode is activated while the R&S® CBT is in the *Connected* state or in the *Test Mode, Park* or *Sniff* substates. It is replaced by the *Connection (Standby)* tab when the connection is lost or deliberately released *(Detach* softkey). It is replaced by the *Connection (Connected)* tab if the *Audio* mode of the DUT is deactivated *(Exit Audio Mode* softkey). It is replaced by the *Connection (Sniff), Connection (Hold), Connection (Park)* or *Connection (Test Mode)* tab if one of the corresponding submodes is activated (*Enter Submode* softkey); see Fig. 4-40.

Note: *If the connection is lost during operation (e.g. because of a low signal level), a warning will appear. At the same time, bit 2 is set in the STATus:OPERation register. Prior to further operation, confirm the reception of the message by pressing the* ENTER *key.*

In the **Audio** state the R&S® CBT establishes an SCO (Synchronous Connection-Oriented) link on top of the existing baseband ACL (Asynchronous Connection-Less) link. On this link the R&S® CBT can receive audio data from the DUT, transmit audio data to the DUT or loop back audio data received from the DUT. Possible test scenarios are described in section *Audio Test Scenarios* on p. 4.134. The parameters of the Audio mode can be set in the *Network* tab before the *Audio* state is reached; see page 4.162. The Audio mode must be terminated explicitly from the R&S® CBT; see *Exit Audio Mode* below.

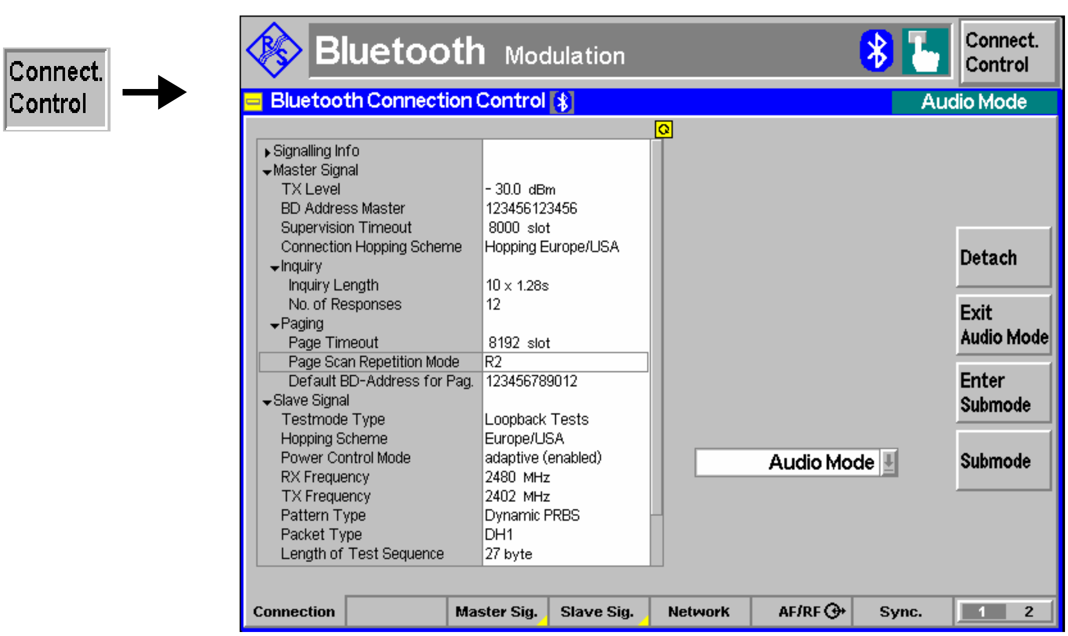


Fig. 4-94 Connection Control – Connection (Audio)

The info table in the left half of the menu and the *Power* softkey is described in section *Connection Control: Standby State* on page 4.40. The *Detach, Enter Submode* and *Submode* softkeys are described in section *Connection Control in Connected State* on p. 4.137.

Exit Audio Mode

The *Exit Audio Mode* softkey releases the *Audio* mode at the DUT.

The DUT returns to the active state. The R&S® CBT returns to the *Connected* signalling state; see *Fig. 4-40* on p. 4.39.

Remote control `PROCedure:SIGNalling:ACTion SAUDio`

Signal of the R&S CBT (Connection Control – Master Sig.)

The *Master Sig.* tab of the *Connection Control* popup menu configures the RF signal generated by the R&S® CBT including the *Dirty Transmitter* parameters and sets various parameters to define how an inquiry is made and a connection is set up. The R&S® CBT provides a panel oriented version of the *Master Sig.* tab and a table oriented version with extended functionality. The *Master Sig.* hotkey toggles between the two versions if it is pressed repeatedly.

Note: *The* Master Sig. *tab is always available, however, some parameters may not be available for editing in some signalling states. For reference see the* Sig. State *field in the command tables in Chapter 6.*

Panel Oriented Version

The panel oriented version of the *Master Sig.* tab provides softkeys to define the following settings for the R&S® CBT acting as a Bluetooth master:

- The master BD_address (BD Address CBT)
- The connection hopping scheme while not in test mode *(Hopping Scheme)*
- The RF output signal level while signalling *(TX Level)*
- The timeout parameters for an inquiry *(Inquiry Length, Number of Responses)*
- The Supervision Timeout

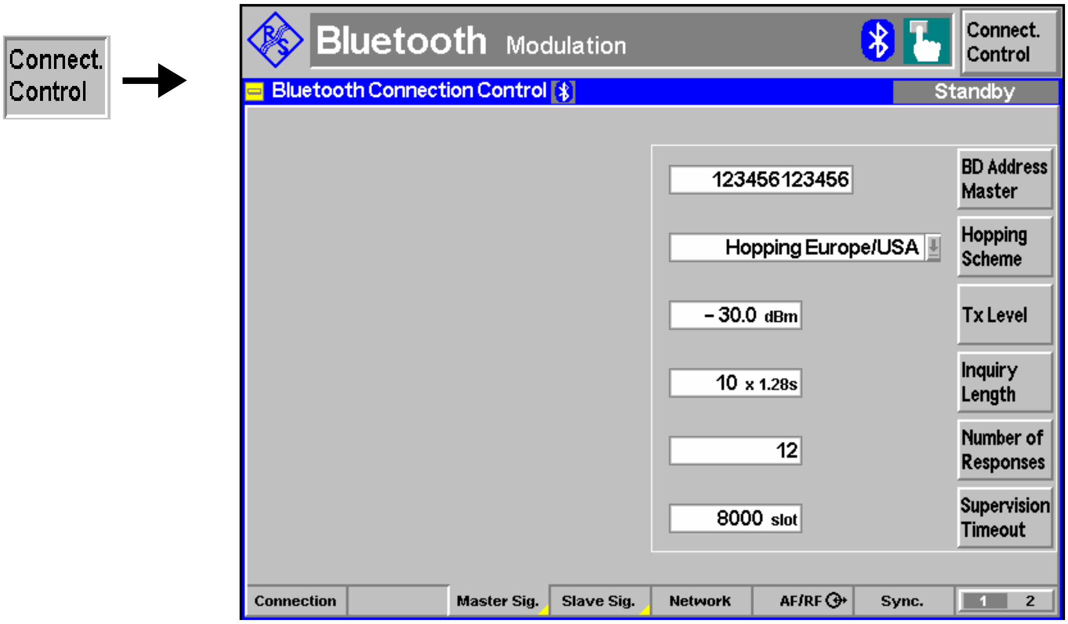


Fig. 4-95 Connection Control – Master Sig. (panel)

For a detailed description of the parameters see section *Table Oriented Version* below.

Table Oriented Version

The table oriented version of the *Master Sig.* tab provides softkeys to define the following settings for the R&S® CBT acting as a Bluetooth master:

- The RF output signal level while signalling *(TX Level)*

- Timing of the Power-up ramp (*Power-up Time before Bit 0*)
- The master BD_address *(BD Address* CBT*)*
- The Supervision Timeout
- The hopping scheme and the frequencies used to inquire and set up the connection *(Connection Hopping Scheme, RX Frequency, TX Frequency)*
- The timeout parameters for an inquiry *(Inquiry)*
- Parameters to define how the R&S® CBT will attempt to page to a DUT *(Paging)*
- Parameters to modify and impair the master signal *(Dirty Transmitter)*

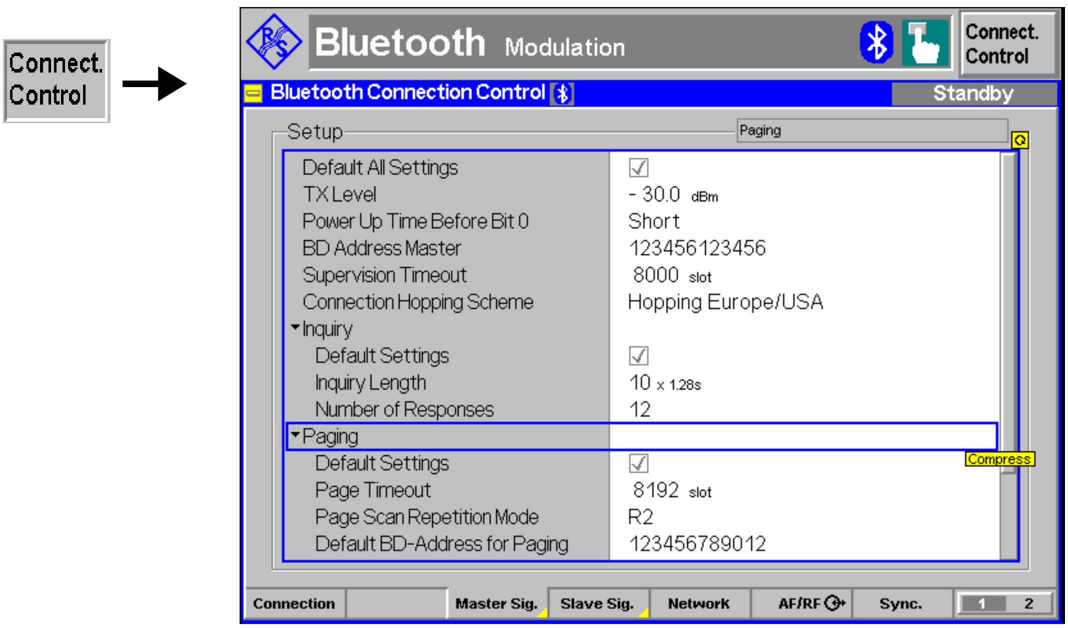


Fig. 4-96 Connection Control – Master Sig. (table)

Default Settings The *Default All Settings* switch assigns default values to all settings in the *Master Sig.* tab (the default values are quoted in the command description in chapter 6 of this manual). Additional *Default Settings* switches are provided for the individual sections in the *Setup* table.

Remote control
`DEFault:MSIGnal ON | OFF`

TX Level Transmit level for the R&S® CBT while signalling. This level is different from the level used during the BER tests.

Remote control
`CONFigure:MSIGnal:TXLevel <Level>`

Power-up Time before Bit Zero The time interval between the start of the power ramp and the time of bit zero (t_{P0}) can be set to either *Long* or *Short.* Note that setting a *Short* time corresponds to 3 µs, which is the value quoted in the Bluetooth RF test specification.

```
Remote control
PROCedure:SIGNalling:PTBZero <Time>
```

BD Address CBT BD_address of the R&S® CBT. This address is used for connection phases. The value is a 12 digit hex value, see *Fig. 4-90* on page 4.141.

Remote control
`CONFigure:MSIGnal:BDADdress <String>`

Supervision Timeout Number of slots of non-communication between the R&S® CBT and the DUT that can occur before the two devices detach from each other. A supervision timeout is set to ensure link control in case that the connection temporarily breaks down.

Remote control
`CONFigure:MSIGnal:SVTout <Slots>`

Connection Hopping Scheme Hopping scheme used for the inquiry, paging and connection to test mode phases. For a definition and a list of hopping schemes see *Hopping Scheme* softkey on page 4.159.

Note: RX/TX single freq. *cannot be used as a connection hopping scheme.*

Remote control
`CONFigure:MSIGnal:HSCHeme <Scheme>`

Inquiry The *Inquiry* section sets timeout parameters for an inquiry.

Inquiry Length Sets the maximum amount of time specified before an inquiry is halted.

Number of Responses Maximum number of responses from Bluetooth devices before the inquiry is halted.

Remote control
`CONFigure:MSIGnal:INQuiry:ILENgth <Timeout>`
`CONFigure:MSIGnal:INQuiry:NOResponses <Responses>`

Paging *Paging* parameters are used to configure how the R&S® CBT will attempt to page to a device under test, i.e. time-outs used, paging modes and a default BD_address of the DUT.

Page Timeout The *Page Timeout* is the maximum time the R&S® CBT will wait for the DUT to respond before the connection attempt will be considered to have failed. The parameter is set as a number of timeslots.

Page Scan Repetition Mode Paging mode that determines the interval between the beginnings of two consecutive page scans while the R&S® CBT attempts a connection and synchronization to the DUT. The possible page scan repetition modes are *R0, R1, R2*. The page scan repetition mode has an impact on the speed of a connection.

Note: *During an inquiry the R&S® CBT reads the allowed page scan repetition mode from the DUT. This value always overrides the initial setting, ensuring that the following connection is set up at optimal speed.*

Connections without previous inquiry can still be very fast, provided that the Page Scan Repetition Mode in the MMI matches the DUT's setting and the DUT's page scan is configured optimal.

Default BD_Address for P. Sets the address of a default device to attempt a connection to. The value is a 12 digit hex value.

Read Signalling Info If this parameter is set to *Off,* the R&S® CBT will not issue commands to read supported features or other signalling information from the DUT. Usually these commands are sent to the DUT to find out about its properties and to fill in some of the signalling information in the *Signalling Info* tree (see section *Connection Control in Test Mode (Test Mode)* on p. 4.139.), namely *Device Name*, *Version* and *Supported Features* (the *Class of Device* and *Paging* are filled in when a device was found during inquiry).

Disabling the signalling info has 2 consequences:

- The connection is made quicker, since there are less LMP packets exchanged between master and slave when connecting
- The R&S® CBT assumes that the LMP version of the DUT is ≥ 1.1. This information is relevant for test mode settings.

Remote control

```
CONFigure:MSIGnal:PAGing:TOUT <Timeout>
CONFigure:MSIGnal:PAGing:PSRMode <Mode>
CONFigure:MSIGnal:PAGing:TARGet <Address>
CONFigure:MSIGnal:PAGing:RSINfo <Enable>
```

The following two parameters are used to test and control the authentication procedure between the R&S® CBT and the DUT.

Authentication Required Specifies how the R&S® CBT will attempt to set up a connection to the Bluetooth DUT:

On The R&S® CBT requires authentication with the specified PIN code. The connection can be established if the DUT responds with the correct code; it will fail if the DUT does not support authentication, or if it responds with the wrong code.

Off The R&S® CBT does not require authentication. If the DUT requires authentication, it must use the specified PIN. Otherwise the connection can be set up without authentication.

Note: The DUT may use either a fixed PIN or a manually entered PIN. If the PIN is manually entered, the Page Timeout *must be sufficiently long to ensure that the R&S® CBT will not stop attempting a connection before the entry is complete.*

Remote control

```
CONFigure:DUT:AUTHentic:ENABle ON | OFF
[SENSe:]DUT:AUTHentic?   (Query only)
```

Pin Code Specifies the PIN code to be used for authentication. This parameter is relevant even if authentication by the R&S® CBT is disabled; see above.

The PIN code is a 48 bit value, to be entered as a hexadecimal number with 1 to 12 digits.

Remote control

```
CONFigure:DUT:PINCode <Code>
```

Store Link Keys Specifies whether the R&S CBT stores the link keys which a DUT sends to it during the authentication (pairing) process. The benefit is that a subsequent connection to the same DUT should be quicker. Besides, some Bluetooth devices expect the link key to be stored.

Remote control
`CONFigure:DUT:STORe:LINK:KEYS`

Dirty Transmitter The *Dirty Transmitter* section contains parameters to impair the master signal in order to test the connection under 'dirty transmitter' conditions and measure the impact on the receiver quality (bit error rate tests).

Basic Rate Packets

Receiver sensitivity tests using a non-ideal transmitter are described in the Bluetooth RF test specification. For tests on Basic Rate packets the tester (CBT) continuously transmits single-slot (DH1) or multi-slot packets (DH3, DH5) with a PRBS 9 payload. The packets are sent to the DUT which operates in loopback test mode. The frequency and modulation index of the master signal and the symbol timing of the packets are periodically modified.

The test specification defines the ten sets of *Carrier Frequency Offset, Modulation Index,* and *Symbol Timing Error* values reported in Table 4-10 below. The parameter sets are used in the order 1, 2, 3, … 10, 1, 2, … and changed every 20 ms. The parameters have the following meaning:

- The *Carrier Frequency Offset* is a (constant) deviation of the actual frequency of the master signal from the nominal Bluetooth channel frequency
- The *Modulation Index* is the ratio between the actual frequency deviation of the CBT and a frequency deviation of 500 kHz:

  *Mod. Index * 500 kHz = Freq. deviation of master signal*

  A modulation index of 0.32 corresponds to the nominal Bluetooth frequency deviation of 160 kHz.
- The *Symbol Timing Error* is the timing error of master packet transmission relative to the ideal slot timing of 625 μs.

In addition to the dirty transmitter parameters in Table 4-10, the test specification defines a packet-dependent drift (i.e. a time-dependent carrier frequency offset) to periodically change the carrier frequency.

EDR Packets (option R&S CBT-B55/K55)

For tests on Enhanced Data Rate (EDR) packets the CBT continuously transmits π/4-DQPSK (2-DHx) or 8DPSK (3-DHx) packets with a PRBS 9 payload. The packets are sent to the DUT which operates in loopback test mode. The frequency of the master signal and the symbol timing of the packets are periodically modified.

The test specification defines the three sets of *Carrier Frequency Offset* and *Symbol Timing Error* values reported in Table 4-11 below. The parameter sets are used in the order 1, 2, 3, 1, 2, … and changed every 20 packets. In addition to the parameters in Table 4-11 the test specification defines a periodic drift that changes the carrier frequency.

Table 4-10 Dirty transmitter parameters according to the Bluetooth test specification (Basic Rate)

Parameter Set	Carrier Frequency Offset / kHz	Modulation Index	Symbol Timing Error / ppm
1	75	0.28	–20
2	14	0.30	–20
3	–2	0.29	+20
4	1	0.32	+20
5	39	0.33	+20
6	0	0.34	–20
7	–42	0.29	–20

Parameter Set	Carrier Frequency Offset / kHz	Modulation Index	Symbol Timing Error / ppm
8	74	0.31	–20
9	–19	0.28	–20
10	–75	0.35	+20

Table 4-11 Dirty transmitter parameters according to the Bluetooth test specification (EDR)

Parameter Set	Carrier Frequency Offset / kHz	Symbol Timing Error / ppm
1	0	0
2	+65	+20
3	–65	–20

The R&S CBT provides the following dirty transmitter settings

Dirty Transmitter Scope Qualifies whether the dirty transmitter settings are active all the time (setting *Global)* or only while a *Receiver Quality* measurement is running.

Remote control
`CONFigure:MSIGnal:DTX:SCOPe <Scope>`

Dirty Tx Selects one of the following schemes to configure the dirty transmitter:

Off No dirty transmitter, undistorted RF carrier

Spec. Table Dirty transmitter settings according to the Bluetooth test specification (see background information and Table 4-10 above). The dirty transmitter settings are listed in the *Spec Table* section. It is possible to disable the specified drift.

User Def. Table Dirty transmitter settings analogous to the Bluetooth test specification but with user defined parameters. The parameters can be changed in the *User Def. Table* section.

Single Values Single set of dirty transmitter parameters; no periodic change of the *Carrier Frequency Offset, Modulation Index,* and *Symbol Timing Error* occurs. The parameters can be set in the *Single Values section.*

Remote control
`CONFigure:MSIGnal:DTX OFF | STAB | UTAB | SING`

Spec Table The dirty transmitter parameters listed in this section correspond to the Bluetooth test specification for Basic Rate and EDR packets (see Table 4-10 and Table 4-11 above). The parameters take effect if *Dirty Tx* is set to *Spec. Table.* The values are fixed, the time-dependent frequency drift is always on. The Basic Rate drift parameters are adjusted to the *Packet Type* selected for loopback tests (DH1, DH3 or DH5, see p. 4.161).

User Def. Table The dirty transmitter parameters in this section are analogous to the *Spec Table* values. They take effect if *Dirty Tx* is set to *User Def. Table.* It is possible to change all values and to enable or disable the *Drift*. The drift itself is generated according to Bluetooth test specifications.

Remote control
```
CONFigure:MSIGnal:UTDTx[:SET<nr>]:MINDex <Index>
CONFigure:MSIGnal:UTDTx[:SET<nr>]:FOFFset <Offset>
CONFigure:MSIGnal:UTDTx[:SET<nr>]:STERror <Error>
CONFigure:MSIGnal:UTDTx:FDRift ON | OFF
```

```
CONFigure:MSIGnal:EUTDtx[:SET<nr>]:FOFFset <Offset>
CONFigure:MSIGnal:EUTDtx[:SET<nr>]:STERror <Error>
CONFigure:MSIGnal:EUTDtx:FDRift ON | OFF
```

Single Values Single set of dirty transmitter parameters to be applied without periodic change. The parameters take effect if *Dirty Tx* is set to *Single Values.* It is possible to change all values and to enable or disable the *Drift*. The drift itself is generated according to Bluetooth test specifications.

Remote control

```
CONFigure:MSIGnal:SDTX:MINDex <Index>
CONFigure:MSIGnal:SDTX:FOFFset <Offset>
CONFigure:MSIGnal:SDTX:STERror <Error>
CONFigure:MSIGnal:SDTX:FDRift ON | OFF
CONFigure:MSIGnal:ESDTx:FOFFset <Offset>
CONFigure:MSIGnal:ESDTx:STERror <Error>
CONFigure:MSIGnal:ESDTx:FDRift ON | OFF
```

Behavior of the DUT (Connection Control – Slave Sig.)

The *Slave Sig.* tab of the *Connection Control* popup menu controls the behavior of the DUT (acting as a Bluetooth slave) while it is in its test mode. The R&S® CBT provides a panel oriented version of the *Slave Sig.* tab and a table oriented version with extended functionality. The *Slave Sig.* hotkey toggles between the two versions if it is pressed repeatedly.

Note 1: ***Signalling states***

The Slave Sig. *tab is always available, however, some parameters may not be available for editing in some signalling states. For reference see the* Sig. State *field in the command tables in Chapter 6.*

Note 2: ***Automatic Measurement Preconfiguration***

The conditions for various test purposes in the Bluetooth test specification differ from the default settings in the Connection Control menu. With a firmware version V4.37 and higher, the R&® CBT suspends some Connection Control settings while a particular measurement application is active and sets the parameter in accordance with the requirements of the test specification. The following table gives an overview.

Application	Parameter	Connection Control setting	Application-specific setting
Modulation – Encoding	Slave Sig. – Testmode Type	Loopback Tests	TX Tests
Spectrum – ACP	Slave Sig. – Hopping Scheme	Europe/USA	RX/TX single freq.
Spectrum – Frequency Range	Slave Sig. – Hopping Scheme	Europe/USA	RX/TX single freq.

The Connection Control settings are resumed when a different application is started.

Panel Oriented Version

The panel oriented version of the *Slave Sig.* tab provides softkeys to define the following settings for the RF signal that the DUT transmits in its test mode:

- The basic test mode settings *(Testmode Type)*
- The data pattern transmitted by the DUT in the current testmode type (Pattern Type)
- The packet type transmitted by the DUT in the current testmode type (Packet Type)
- The length of the payload in the current testmode type (Length of Test Seq.)
- Whitening of the ACL packets that the DUT tansmits in loopback mode
- A sequence of Bluetooth channels to be used for the measurements (Hopping Scheme)
- Channel number and frequency of the signals to be transmitted and received by the DUT in the current testmode type (TX Frequency, RX Frequency)

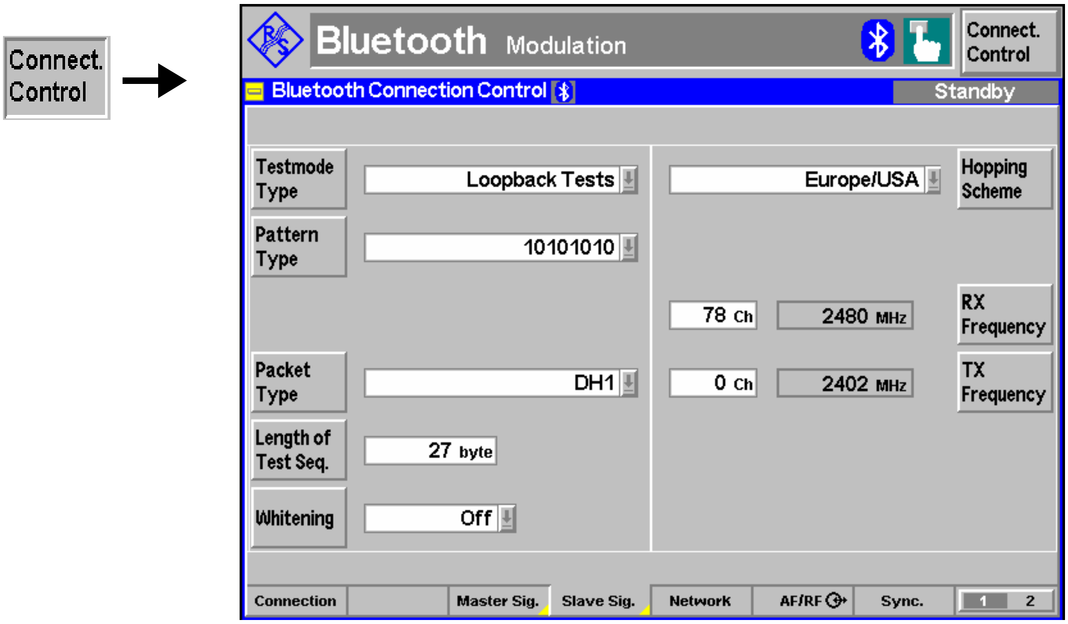


Fig. 4-97 Connection Control – Slave Sig. (panel)

For a detailed description of the parameters see section *Table Oriented Version* below.

Table Oriented Version

The table oriented version of the *Slave Sig.* tab provides the following settings for the RF signal that the DUT transmits in its test mode:

- The basic test mode settings *(Testmode Type)*
- A sequence of Bluetooth channels to be used for the measurements (Hopping Scheme)
- The transmitter output power control (Power Control Mode)
- The parameters for TX Tests and for Loopback Tests

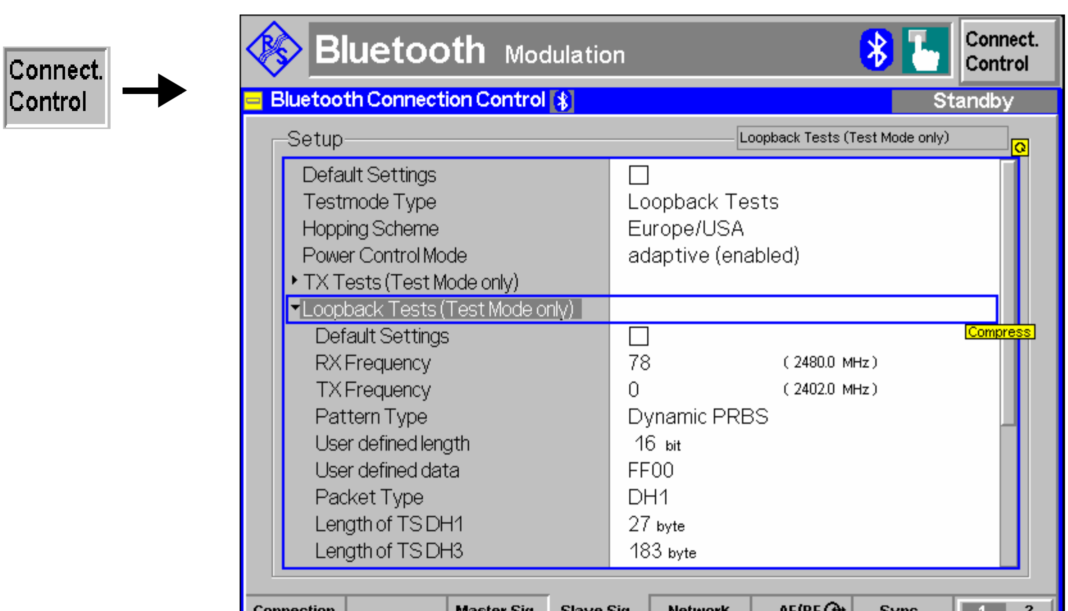


Fig. 4-98 Connection Control – Slave Sig. (table)

Default Settings

The *Default Settings* switch assigns default values to all settings in the *Slave Sig.* tab (the default values are quoted in the command description in chapter 6 of this manual). Further *Default Settings* switches are provided for the *TX Tests* and *Loopback Tests* sections.

Remote control
`DEFault:SSIGnal ON | OFF` etc.

Testmode Type

The *Testmode Type* parameter defines the basic type of test scenario. The following testmode types are provided:

TX Tests	Transmitter test mode
Loopback Tests	Closed loopback mode

Note that some measurements require certain testmode types, e.g. a *Loopback* testmode type is automatically activated when a *Receiver Quality* measurement is switched on. The two testmode types are described below in more detail.

Remote control

```
CONFigure:SSIGnal:TMODe:TMTYpe <Type>
PROCedure:SSIGnal:TMODe:TMTYpe <Type>
```

In a **transmitter test**, the R&S® CBT controls the timing of the piconet, transmitting poll packets at the beginning of its master TX slots. The DUT (acting as a Bluetooth slave) starts test packet transmission in the following slave TX slot where it transmits a definite bit pattern in the payload that is periodically repeated. A test packet may extend over one or several consecutive timeslots. This implies that the period between two consecutive poll packets from the tester *(Poll Period)* is also variable (see Fig. 4-99 below).

Transmitter tests with various bit patterns can be configured. Moreover, the *Poll Period*, the *Packet Type* for test packets and the *Length of the test sequence* can be set; see *TX Tests* section below.

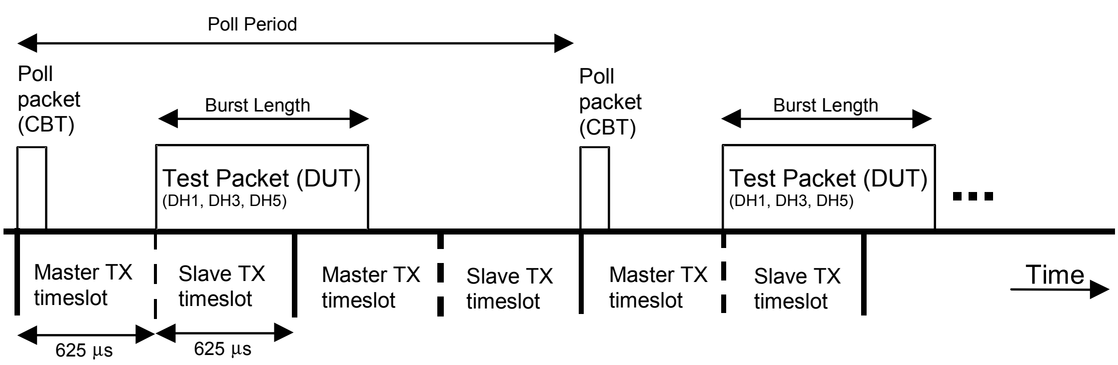


Fig. 4-99 Timing for transmitter tests

In a **loopback test**, the R&S® CBT transmits normal baseband packets. The DUT (acting as a Bluetooth slave) decodes the received packets and sends back the payload using the same packet type. The return packet is sent back either in the slave TX timeslot directly following the transmission of the R&S® CBT or with a delay of one slave and one master timeslot. For *Receiver Quality* tests the correct Loopback Delay setting for the connected DUT has to be used, otherwise the measurement will not work correctly; see p. 4.132.

The R&S® CBT provides a selection of bit patterns *(Pattern Type)* to be used for loopback tests. The data may or may not be whitened (scrambled with a particular bit sequence). Moreover, the *Packet Type* for test packets and the *Length of the test sequence* can be set; see *Loopback Tests* section below.

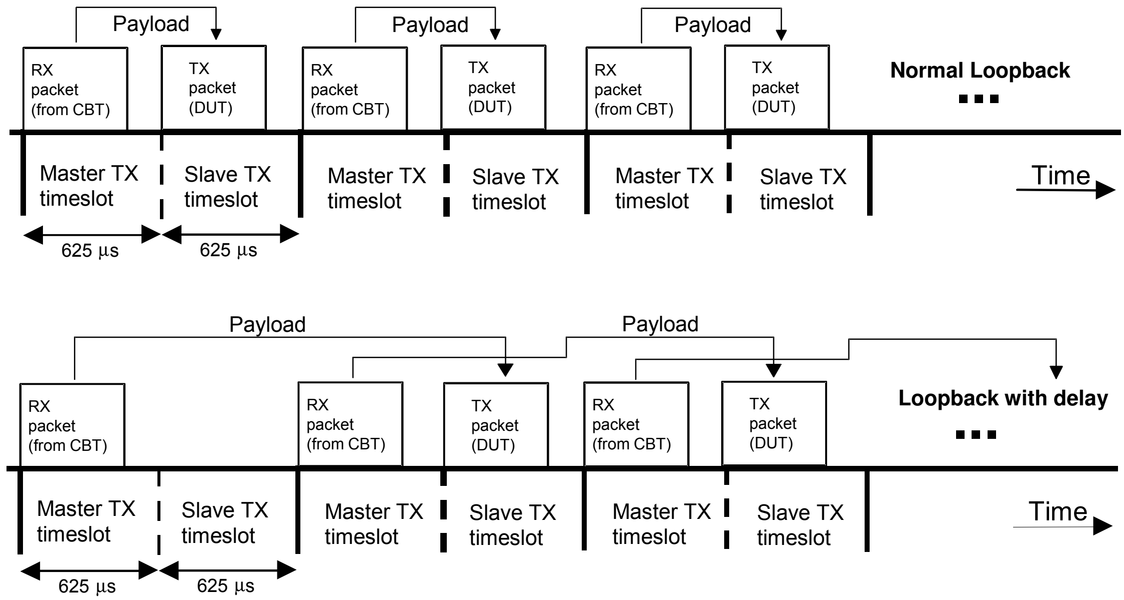


Fig. 4-100 Timing for loopback tests

Hopping Scheme

The *Hopping Scheme* parameter selects a sequence of *Bluetooth* channels to be used for the measurements. The following hopping schemes are provided:

RX/TX single freq. — The DUT transmits at a constant TX frequency and receives a signal at a constant RX frequency from the R&S® CBT.

Note: *For* transmitter tests*, the Bluetooth specification requires the same RX and TX frequency if no hopping is enabled. The frequency is set with a single* RX/TX Frequency *parameter. For* loopback tests*, it is possible to use different RX and TX frequencies which can be set by means of two different parameters.*

Europe/USA — The R&S® CBT uses Europe's and USA's hopping scheme

France — The R&S® CBT uses France's hopping scheme

Reduced Hopping — The R&S® CBT uses the reduced hopping scheme, see below

Note: *The reduced hopping scheme is not supported by all Bluetooth devices.*

Remote control

```
CONFigure:SSIGnal:TMODe:HSCHeme <Scheme>
PROCedure:SSIGnal:TMODe:HSCHeme <Scheme>
```

Frequency hopping is used in *Bluetooth* networks mainly as a spread spectrum technique and to reduce interference. The RF channel is changed in a pseudo-random way after each timeslot (i. e. after each 625 µs, corresponding to a rate of approx 1600 hops per second), so that the whole available frequency spectrum can be used. A hopping sequence defines the order the RF channels. This hopping sequence is determined by the Bluetooth device address of the master and must be used by all Bluetooth devices in the piconet. The timing is based on the clock of the Bluetooth master.

The following channels and frequency ranges are available in the different countries:

Europe/USA	2400 MHz	to	2483.5 MHz,	Channel_k: f_k = 2402+k MHz, k = 0 to 78
France	2446.5 MHz	to	2483.5 MHz,	Channel_k: f_k = 2454+k MHz, k = 0 to 22

The **reduced hopping sequence** was defined to support quick testing over the whole frequency range, including the 79 channels of the Europe/USA scheme and the schemes of the other countries. It consists of the channel sequence 0, 23, 46, 69, 93 where the frequency/channel assignment is according to f_k = 2402+k MHz, k = 0 to 93. The five channels are periodically repeated.

Power Control Mode

The *Power Control Mode* parameter specifies the transmit power control mode of the DUT. The following modes are provided:

Fixed (disabled) — Power control functionality of the DUT disabled. The DUT transmits at a fixed power level and does not accept power up/down commands (see *Power Up hotkey* on p. 4.55). This mode can be used to force the DUT to transmit at fixed power while a transmitter test is performed.

Adaptive (enabled) — Power control functionality of the DUT enabled. This mode must be active to test power control; see *Power Up hotkey* on p. 4.55.

Note: *The power control mode is valid in the test mode only. In the* Connected *state, the DUT accepts power control commands irrespective of the power control mode setting.*

Remote control

```
CONFigure:SSIGnal:PCTR FIXed | ADAPtive
PROCedure:SSIGnal:PCTR FIXed | ADAPtive
```

TX Tests

Sets the parameters for transmitter tests; see explanation on page 4.158. The following transmitter test parameters can be set:

RX/TX Freq. — Sets the receiver and transmitter frequency of the DUT for transmitter testmode types where both frequencies must be identical. Independent receiver and transmitter frequencies can be used in loopback test mode; see below.

Pattern Type — Bit pattern that the DUT is to transmit in test mode. The selected patterns 01010101, 11110000, 11111111 or 00000000 are periodically repeated. In the *Static PRBS* setting, a definite PRBS-9 sequence is used for each transmission, i.e. the DUT transmits a series of identical packets.

Packet Type — This function determines what type of packet is to be transmitted by the DUT during test mode. The following data packet types are supported:

- *DH1* — Data – High rate packet carrying up to 27 information bytes plus a 16-bit CRC code. A DH1 packet covers up to 1 timeslot.
- *DH3* — Data – High rate packet carrying up to 183 information bytes plus a 16-bit CRC code. A DH3 packet covers up to 3 timeslots.
- *DH5* — Data – High rate packet carrying up to 339 information bytes plus a 16-bit CRC code. A DH5 packet covers up to 5 timeslots.

With option R&S CBT-K55 the R&S CBT provides the additional Enhanced Data Rate (EDR) packet types *2-DH1, 2-DH3, 2-DH5, 3-DH1, 3-DH3,* and *3-DH5.* These packet types are described in section *Generator Modulation Panel* on p. 4.29.

The packet type setting has an impact on the poll period; see below.

Length of Test Sequence This function defines the length of the payload for the transmitted packet in bytes. The ranges for the lengths depend on the packet type selected:

DH1 packet *Length ≤ 27 bytes*
DH3 packet *Length ≤ 183 bytes*
DH5 packet *Length ≤ 339 bytes*

For EDR packet types only (requires software option CBT-K55)

2-DH1 0 to 54

2-DH3 0 to 367

2-DH5 0 to 679

3-DH1 0 to 83

3-DH3 0 to 552

3-DH5 0 to 1021

Poll Period This function defines how often a poll packet from the R&S® CBT occurs The parameter represents an even number of slots, i.e. 2, 4, 6,... slots. The poll period is automatically changed to 2, 4, or 6 when a x-DH1, x-DH3, or x-DH5 packet type is selected (x = 1, 2, 3). To prevent simultaneous master/slave transmission, the minimum poll period for an x-DHn packet type (n = 1, 3, 5) is set to n + 1.

Remote control
```
CONFigure:SSIGnal:TMODe:TXTests...
PROCedure:SSIGnal:TMODe:TXTests...
```

Loopback Tests Sets the parameters for loopback tests; see explanation on page 4.158. The following loopback test parameters can be set:

RX Frequency Sets the receiver frequency of the DUT for loopback test modes.

TX Frequency Sets the transmitter frequency of the DUT for loopback test modes.

Pattern Type This function defines the data sequence to be modulated on the RF signal used in loopback test mode. The selected patterns 01010101, 11110000, 11111111 or 00000000 are periodically repeated. Further options are:
Dynamic PRBS (pseudo random sequence PRBS-9)
Static PRBS (pseudo random sequence PRBS-9)
User-defined (see next two settings)

A static pseudo random sequence means that the PRBS sequence generation re-starts at the beginning of each packet. The same bit sequence is used in every packet payload so the DUT transmits a series of identical packets. A dynamic pseudo random sequence means that the PRBS sequence is continued so that a different bit sequence is used in each packet payload.

The next two options are available only if a user-defined *Pattern Type* is selected:

User defined Length Length of the user-defined bit sequence before it is repeated. The value of this function may be set from 3 to 64 bits.

User defined Data Bit stream to be used for the user-defined data. The bit stream is repeated until the complete payload is filled, removing any extra bits from the end of the stream. The data is represented as a hex value. The length of the function depends upon the function *User defined length*. The user-defined data can be up to 64 bits long, therefore a maximum of 16 hex characters shall be entered. The data is entered least significant bit last, i.e. to the right.

Packet Type — This function determines what type of packet is to be transmitted by the DUT during test mode. The supported packets are *DH1, DH3, DH5* (see paragraph on *TX Tests* above).

Length of Test Sequence — This function defines the length of the payload for the transmitted packet in bytes. The ranges for the lengths depend on the packet type selected; see paragraph on *TX Tests* above.

Whitening — Closed loopback mode with whitening switched *On* or *Off*. Whitening means that the DUT transmits ACL (Asynchronous connection-less link) packets that are scrambled with a particular data sequence (whitening word).

Remote control
`CONFigure:SSIGnal:TMODe:LBTests...`
`PROCedure:SSIGnal:TMODe:LBTests...`

Network Parameters (Connection Control – Network)

The *Network* tab sets parameters to control the DUT while it is in the *Audio, Sniff, Park* and *Hold* submode or in *Test* mode.

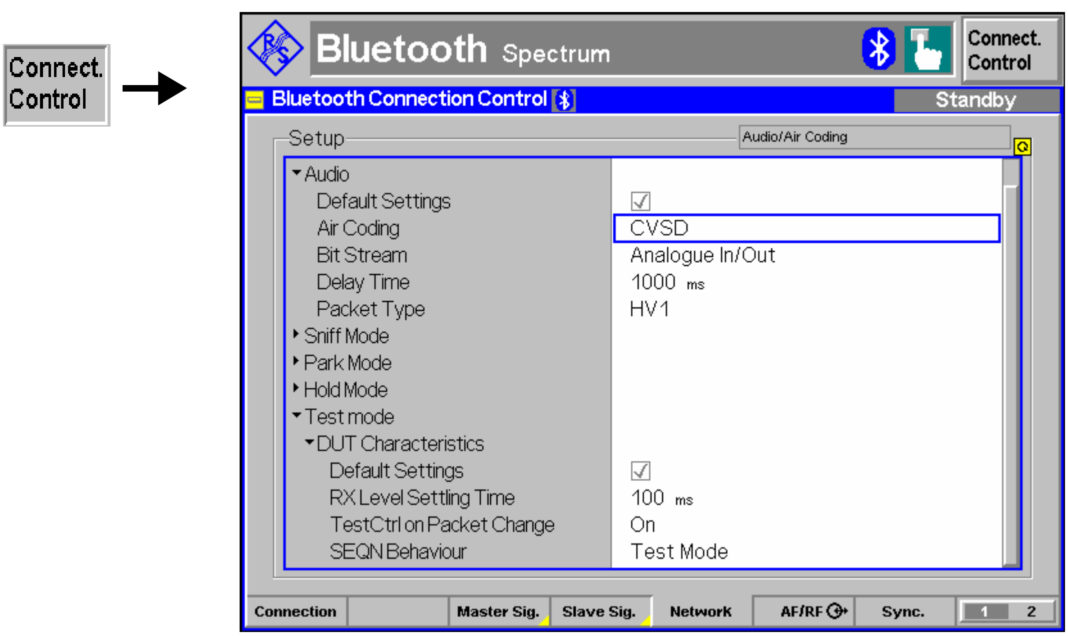


Fig. 4-101 Connection Control – Network (table)

Default Settings — The *Default Settings* switches assign default values to all settings in the *Audio, Sniff Mode, Hold Mode* and *Park Mode* sections of the *Network* tab, respectively (the default values are quoted in the command description in chapter 6 of this manual).

Remote control
`DEFault:NETWork:... ON | OFF` etc.

Audio — The *Audio* section sets the parameters for audio measurements, to be performed in the *Audio* submode (see section *Connection Control in Audio State* on p. 4.147.):

Air Coding — Voice coding format used on the air interface (i.e. in uplink as well as in downlink direction). In the *Audio* state, the R&S® CBT establishes an SCO link to the DUT with either *CVSD* (Continuous Variable Slope Delta modulation), *µ-law log* PCM (Pulse Coded Modulation) or *A-law log* PCM air coding.

Bit Stream — Routing of the SCO bits in the R&S® CBT. To perform receive audio or transmit audio tests (test scenarios 1 and 2 in section *Audio Test Scenarios* on p. 4.134.) one of the two options *Analog In/Out* or *Analog In/Out (Low)* must be selected.

Analog In/Out
The AF IN / OUT or SPEECH CODEC IN / OUT BNC connectors (depending on the the instrument model) are connected to the Bluetooth speech codec. The analog input level for a full scale digital signal is approx. 1.4 V(peak). The analog output level for a full scale digital signal is approx. 1.0 V(peak); see *Encoder Cal* and *Decoder Cal* below.

Analog In/Out (Low)
Similar to *Analog In/Out* but for lower analog input levels: The analog input level for a full scale digital signal is approx. 0.1 V(peak). The analog output level for a full scale digital signal is approx. 1.0 V(peak).

Echo
The R&S® CBT loops back the data received from the DUT after the *Delay Time* set below (audio test scenario 3)..

Decoder Cal
The internal speech codec of the R&S CBT provides a 1 kHz sinewave signal at its analog output, corresponding to a full scale digital signal. The analog signal is routed to the front panel connector labeled AF OUT or SPEECH CODEC OUT (depending on the the instrument model) and can be used for external calibration of the analog output path; see background information below.

Encoder Cal
The speech codec converts the analog signal from the input connector AF IN or SPEECH CODEC IN (depending on the the instrument model) into a digital signal and loops it back to the analog output. This signal is used for external calibration of the analog input path; see background information below.

Delay Time — For test scenario no. 3 *(Bit Stream = Echo)*, the time to elapse before the R&S® CBT loops back data received from the DUT. A longer delay time can be useful for manual audio tests using a headset connected to the DUT.

Packet Type — Type of SCO packet initially transmitted in the *Audio* state (i.e. in uplink as well as in downlink direction): HV1, HV2 or HV3 where HV stands for High quality Voice. The three packet types differ in the number of information bytes, the error protection, and the amount of speech data (length of speech) transported; see Bluetooth baseband specification. Once in the audio state, the DUT may change the packet type from this initial setting.

Note: *The* Air Coding, Delay Time *and* Packet Type *settings are unavailable while the R&S CBT is in Audio submode. The settings must be changed outside the submode.*

Remote control

```
CONFigure:NETWork:AUDio:AIRCoding CVSD | ULAW | ALAW
CONFigure:NETWork:AUDio:BITStream
      AIO | AIOL |ECHO | DCAL | ECAL
CONFigure:NETWork:AUDio:DELTime <DelayTime>
CONFigure:NETWork:AUDio:PTYPe HV1 | HV2 | HV3
```

The purpose of a **decoder calibration** is to determine the correlation between analog output amplitudes (in V(peak)) and the amplitude of the digital signal that the speech decoder receives over the Bluetooth link. To perform a decoder calibration, select *Bit Stream: Decoder Cal* and measure the 1kHz output signal at the AF OUT or SPEECH CODEC OUT connector (depending on the the instrument model) using external equipment (e.g. a second R&S CBT). The expected analog output amplitude is approx. 1.0 V(peak); it corresponds to a full scale (FS) digital input signal of the decoder. This pins down the entire scale of digital input amplitudes, because the relation between analog and digital amplitudes is linear.

The purpose of an **encoder calibration** is to determine the correlation between analog input amplitudes (in V(peak)) and the amplitude of the digital signal that the speech encoder transmits over the Bluetooth link. To perform an encoder calibration, proceed as follows:

1. Perform a decoder calibration as described above, note down the analog output amplitude.
2. Select *Bit Stream: Encoder Cal* and supply the AF IN or SPEECH CODEC IN connector (depending on the the instrument model) with a 1 kHz audio input signal using external equipment (e.g. a second R&S CBT).
3. Measure the looped-back 1 kHz signal at the analog output connector.
4. Adjust the analog input amplitude until the amplitude of the looped-back signal is equal to the output amplitude determined in the first step.

The expected analog input level is approx. 1.4 V(peak); it corresponds to a full scale (FS) digital output signal of the encoder. This pins down the entire scale of digital output amplitudes, because the relation between analog and digital amplitudes is linear.

Sniff

The *Sniff* section sets the parameters for the *Sniff* submode (see section *Connection Control in Sniff State* on p. 4.143. and Bluetooth baseband specification):

Sniff Interval Even number of slots between two consecutive so-called *sniff slots* where the DUT listens to the master signal and the R&S® CBT can start transmission. The sniff interval is an even number of slots because the master is allowed to start transmission in every second slot only.

Sniff Attempts Minimum number of consecutive receive slots within each sniff interval (starting with a sniff slot) where the DUT listens to the master signal. *Sniff Attempts* must be > 0. The DUT may listen even longer if the R&S® CBT sends packets with matching Active Member Address (AM_ADDR) and if the *Sniff Timeout* is >0.

Sniff Timeout Minimum number of consecutive receive slots where the DUT keeps listening to the master signal after receiving a packet with a matching AM_ADDR. For *Sniff Timeout = 0*, the DUT listens at *Sniff Attempts* consecutive sniff slots, irrespective of the AM_ADDR received. For *Sniff Timeout > 0*, the DUT continues listening as long as it receives only packets with matching AM_ADDR.

The *Sniff* mode timing for a single packet with matching AM_ADDR is shown in Fig. 4-102 below.

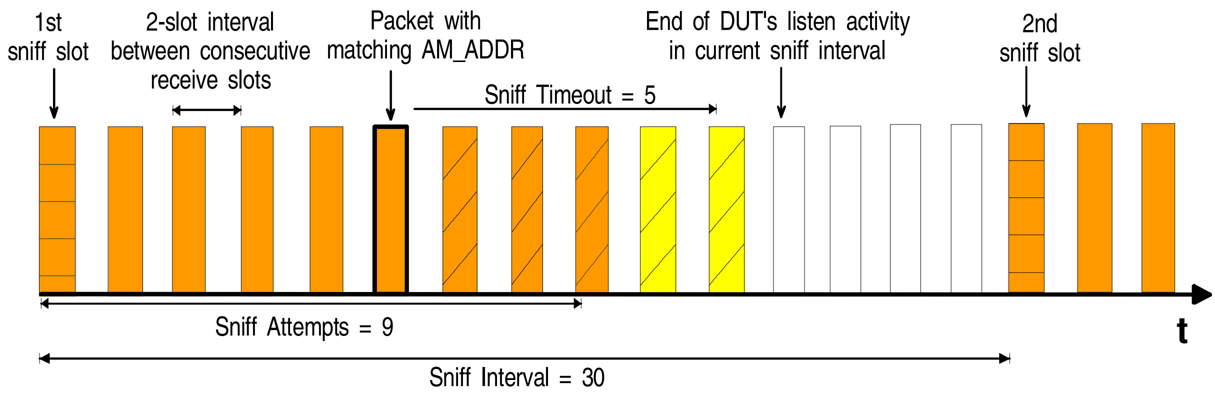


Fig. 4-102 Sniff mode parameters

Remote control
```
CONFigure:NETWork:SNIFf:INTerval.<Slots>
CONFigure:NETWork:SNIFf:ATTempt <Attempts>
CONFigure:NETWork:SNIFf:TOUT <Timeout>
```

Hold The *Hold* section sets the parameters for the *Hold* submode (see section *Connection Control in Hold State* on p. 4.144. and Bluetooth baseband specification):

Hold Interval Integer number of slots during which support of ACL packets is suspended. During the *Hold Interval* the DUT keeps its active member address (AM_ADDR). After the *Hold Interval,* the DUT wakes up and synchronizes to the master signal, and the R&S® CBT returns to the *Connected* signalling state.

Remote control
```
CONFigure:NETWork:HOLD:INTerval <Slots>
```

Park The *Park* section sets the parameters for the *Park* submode (see section *Connection Control in Park State* on p. 4.145.) and Bluetooth baseband specification):

Beacon Interval Integer number of slots between two consecutive beacon instants. In *Park* mode the DUT gives up its active member address (AM_ADDR). At the periodic beacon instants after each *Beacon Interval,* the DUT wakes up and re-synchronizes to the master signal, so the R&S® CBT can *Unpark* the DUT and return to the *Connected* signalling state.

Remote control
```
CONFigure:NETWork:PARK:BINTerval <Slots>
```

Test Mode – DUT Characteristics The parameters in the *Test Mode – DUT Characteristics* section configure the behavior of the R&S® CBT in test mode for specific DUT characteristics. The test mode settings should be checked in case of problems during test mode operation.

RX Level Settling Time

Sets a delay time between the activation of a new measurement and the start of data acquisition. This can be relevant if the new measurement involves a drastic change of the receive level at the DUT (i.e. the R&S® CBT's master signal level), especially if a *RX Quality* test at low level is started after a TX test. The setting takes effect in loopback test mode only.

- A sufficient settling time generally ensures that no side effects from the level change impair the *RX Quality* test.
- Small values of the settling time improve the total measurement time. Some DUT's don't require any settling time, so the parameter can be set to zero.

Remote control
`CONFigure:NETWork:TESt:RLSettling <Time>`

TestCtrl on Packet Change

Qualifies whether a new *Test Control Command* is set after a change of the packet type (DH1, DH3, DH5). The setting takes effect in loopback test mode only.

- Activating the test control command ensures that the DUT recognizes a packet change.
- Most DUTs don't need the test control command to recognize the packet type, so the parameter can be set to *Off*.

Remote control
`CONFigure:NETWork:TESt:TCPChange <Enable>`

SEQN Behavior

Defines the sequential numbering scheme of the packets.

Test Mode	The SEQN bit is toggled after each packet, which may be *ACNnowledged* or *NACKnowledged*.
Normal	The SEQN bit is toggled after each *ACKnowledged* packet only. This behavior is in accordance with Bluetooth specifications.

The parameter can be used to check and compare the behavior of the DUT in both modes.

Remote control
`CONFigure:NETWork:TESt:SNBehaviour <Mode>`

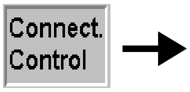
AF/RF Connectors (Connection Control – AF/RF)

The *AF/RF* tab selects the connectors for RF and AF signals. This includes the setting of:

- An external attenuation at the connectors *(Ext. Att. Output, Ext. Att. Input)*
- The audio signal routing and the state of all audio connectors of the R&S CBT

If the *Audio Option* (option R&S CBT-B41) is not fitted, the internal speech codec is connected to the front panel connectors labeled AF IN / AF OUT or SPEECH CODEC IN / OUT (depending on the instrument model), see chapter 8. Only *Analog Mono Audio* connector configuration is possible.

Note: *The* Connector Config *settings are unavailable while the R&S CBT is in Audio submode or in one of the Audio Profile submodes (option R&S CBT-K54). The settings must be changed outside these submodes.*



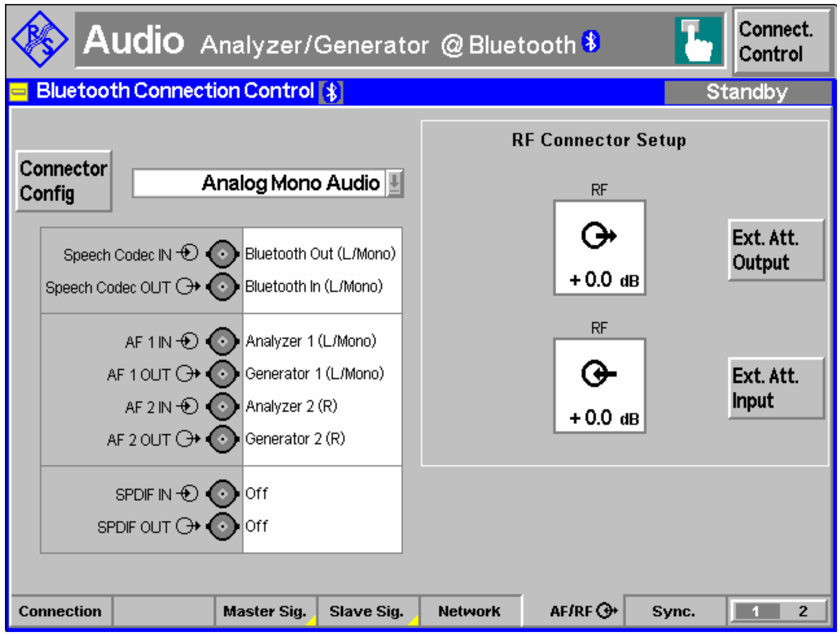


Fig. 4-103 Connection Control – AF/RF connectors

With the exception of the *Connector Config* settings, all functions of this menu are described in the *RF Non Signalling – RF Connectors (Connection Control – RF)* section above in this chapter.

Connector Config

Selects a predefined audio test scenario. The corresponding signal routing and the state of all digital and analog audio connectors of the R&S CBT is shown in the panels below the softkey. For detailed information refer to section *Audio Test Scenarios* below in this chapter.

Remote control
`CONFigure:AFRFsync:CCONfig`

Reference Frequency (Connection Control – *Sync.*)

The *Sync.* tab of the *Connection Control* popup menu determines the reference signal for synchronization. The settings are analogous to the ones in function group *RF Non Signalling;* see section *Reference Frequency (Connection Control – Sync.)*.

Trigger (Group Configuration – Trigger)

The *Trigger* tab is part of the second group of tabs in the *Connection Control* menu. It is accessible after pressing the *1 / 2* toggle hotkey once. Pressing *1 / 2* again switches back to the first group of tabs described above.

The *Trigger* tab defines the trigger condition for the measurement.

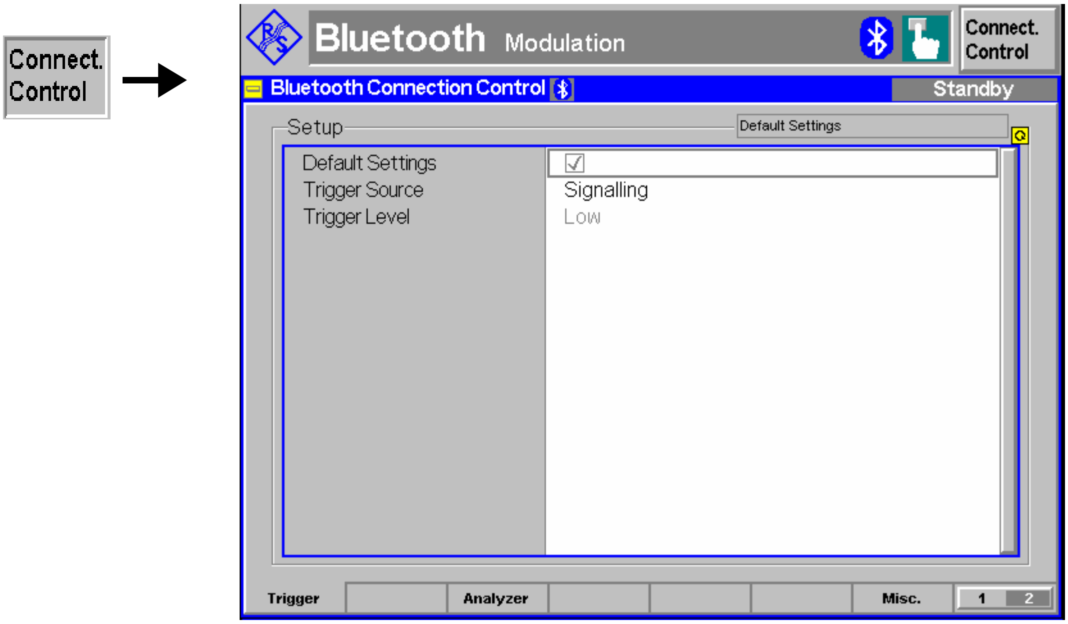


Fig. 4-104 Group Configuration – Trigger

Default The *Default* checkbox assigns the default setting to all parameters of the tab *Trigger*.

Remote control `CONFigure:TRIGger:DEFault ON | OFF`

Trigger The *Trigger* parameter determines how the measurement is to be triggered:

Signalling Trigger signal provided by the signalling unit of the instrument. The trigger signal is also output on pin 2 (second from the right on the top row) of the AUX3 connector on the front panel. This signal is

- *High* (about +4 V) during Bluetooth slots when the R&S® CBT is transmitting; the rising edge corresponds to bit zero of the packet.
- *Low* (about 0 V) during Bluetooth slots when the R&S® CBT is receiving; the falling edge corresponds to bit zero of the packet.

This is also true for the Bluetooth Non-Signalling generator mode.

Power Trigger on the power (rising edge) of the incoming burst, broad-band trigger

For the *RF Power* parameters the signal to be measured must be a burst signal. To measure the *Packet Timing* in a *Power* measurement, the *Signalling* trigger must be used.

Remote control `TRIGger[:SEQuence]:SOURce SIGNalling | POWer`

Level The *Trigger Level* parameter determines the trigger threshold if the measurement is triggered by the *RF Power*.

The trigger threshold is the RF input signal level beyond which the trigger condition is satisfied and a measurement is initiated. With *Signalling* trigger the *Trigger Level* parameter is disabled.

Low	Low trigger threshold, equal to approx. the *RF Max. Level* – 40 dB
High	High trigger threshold, equal to approx. the *RF Max. Level* – 20 dB

Remote control `TRIGger[:SEQuence]:THReshold:POWer LOW | HIGH`

Input Path (Connection Control – Analyzer)

The *Analyzer* tab is part of the second group of tabs in the *Connection Control* menu. It is accessible after pressing the *1 / 2* toggle hotkey once. Pressing *1 / 2* again switches back to the first group of tabs described above.

The *Analyzer* tab adjusts the RF input path to the expected input power *(RF Max. Level).* The settings are analogous to the ones in function group *RF Non Signalling;* see section *Analyzer Settings (Connection Control – Analyzer)*.

In *Bluetooth Signalling* mode, the R&S CBT can determine the maximum RF input level automatically (autoranging).

RF Mode Configures the RF analyzer for manual or automatic input path setting.

Manual	Manual entry of maximum input level via *RF Max. Level*
Auto	Automatic setting according to the peak power of received bursts (autoranging). The autoranging procedure uses the manual level as an initial value. It only operates while a Bluetooth connection is present, or during inquiry and paging.

Autoranging does not operate while the R&S CBT is in the *Standby* state, when the ACP measurement is in the *Run* state, or when the frequency range measurement is in the *Run* state.

Remote control
`[SENSe:]LEVel:MODE <Mode>`

Display Control (Connection Control – Misc)

The *Misc* tab is part of the second group of tabs in the *Connection Control* menu. It is accessible after pressing the *1 / 2* toggle hotkey once. Pressing *1 / 2* again switches back to the first group of tabs described above.

The *Misc* tab defines whether the *Connection Control* popup menu is automatically opened or closed *(Connect. Control Guidance)*.

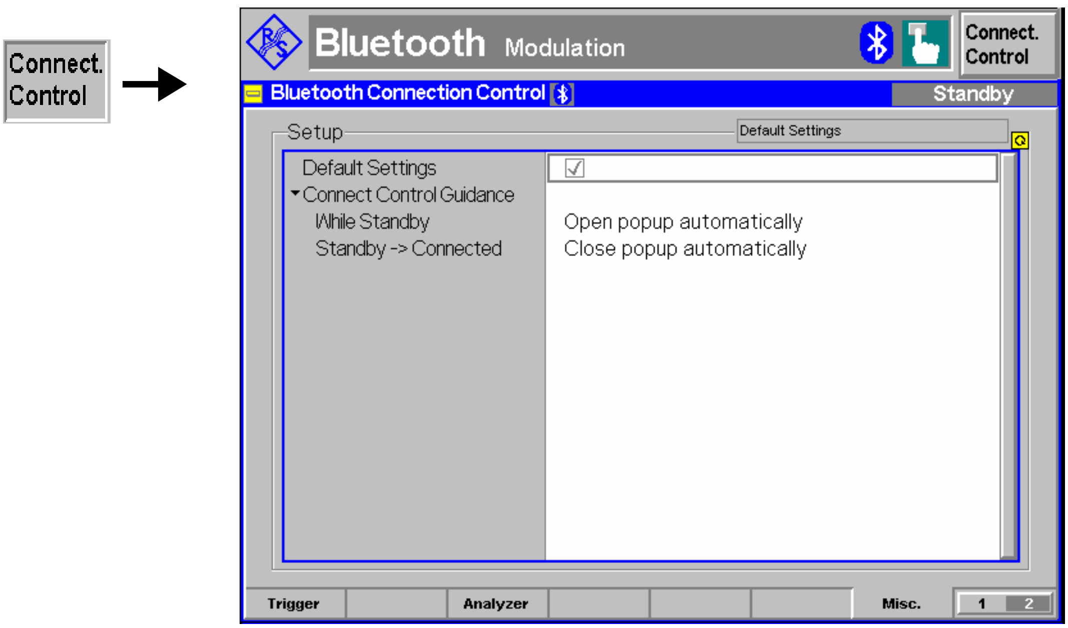


Fig. 4-106 Connection Control – Misc

Default Settings The *Default All Settings* switch sets all parameters of the *Misc* tab to their default values (see command description in chapter 6).

Remote control No command; screen configuration only.

Connect. Control Guidance Defines whether the *Connection Control* popup menu is automatically opened or closed:

While Standby In the *Open popup automatically* mode, the *Connection Control* menu is automatically opened each time the Bluetooth function group is accessed in *Signalling* test mode, each time a measurement menu is opened while the DUT is not connected and each time the connection with the DUT is lost. Otherwise the menu must be opened manually.

Standby –> connected
In the *Close popup automatically* mode, the *Connection Control* menu is automatically closed as soon as the R&S® CBT reaches the "*Connected", "Connected (Test Mode)" or "Connected (Audio)"* state. Otherwise the menu must be closed manually.

Remote control No command; screen configuration only.

RF Measurements (RF)

This section describes the measurement and configuration menus of function group *RF*. It is organized as follows:

- Configuration of the RF output signal, RF analyzer settings and general power measurements *(Analyzer/Generator).*
- General configurations *(Connection Control).*

The most important menus of the *RF* function group are shown in an overview at the end of Chapter 3 in the present R&S® CBT manual.

Analyzer/Generator Menu

The main menu *Analyzer/Generator* configures the RF generator and analyzer and displays the power of the received RF signal.

- The measurement control softkey *Analyzer Power* controls the measurement, indicates its status *(RUN | HLT | OFF)* and opens the configuration menu *Analyzer/Generator Configuration*. The hotkeys associated with the measurement control softkey define the scope of the *Analyzer/Generator* measurement.
- The other softkeys on the right side are combined with various hotkeys (e.g. the hotkeys *Frequency* and *RBW* belong to the softkey *Analyzer Settings).* The softkey/hotkey combinations provide test settings and switch over between different measurements.

Analyzer Power

Analyzer Power is an application in the *Analyzer/Generator* menu. The measurement yields the average power of an RF input signal over a sweep; see section *Measurement Results* on p. 4.174.

A wide range of measurement filters with different bandwidths is available. The accuracy of the *Analyzer Power* measurement is enhanced if the center frequency of the analyzer matches the frequency of the measured signal. The characteristics of the *Analyzer Power* measurement makes it particularly suitable for the analysis of CW signals where no measurement curves are needed.

Power Meter Freq. Sel.

Power Meter Freq. Sel. is the second application in the *Analyzer/Generator* menu. The measurement yields the average, minimum and maximum power of an RF input signal over a sweep plus a statistical evaluation over several consecutive sweeps; see section *Measurement Results* on p. 4.174.

A wide range of measurement filters is available. The measurement is always frequency selective; no wideband filter is provided. The measurement time depends on the filter bandwidth but never exceeds the order of magnitude of 100 ms for a single sweep. The frequency of the RF signal is also measured, provided that is close enough to the selected measurement frequency.

The characteristics of the *Power Meter Freq. Sel* measurement makes it particularly suitable for the analysis of CW signals where no measurement curves are needed.

The main menu *Analyzer/Generator* is opened from the main menu *Menu Select* (with associated key at front of instrument).

Menu Select

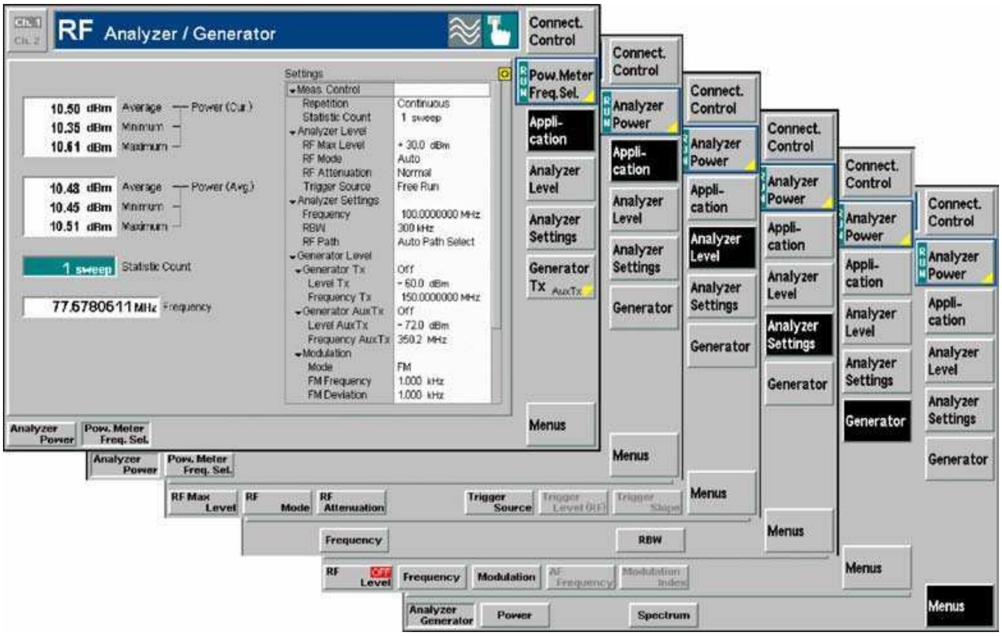


Fig. 4-20 Measurement menu Analyzer / Generator

Test Settings

The settings for the *Analyzer/Generator* menu are accessible via softkey/hotkey combinations. If a softkey (located in the softkey bar on the right side of the menu) is selected and an associated hotkey (displayed across the bottom of the menu) is pressed, a popup window indicating the current setting and enabling an entry will appear.

Example:

Analyzer Settings

The *Analyzer Settings* softkey displays a hotkey bar including the hotkey labeled *Frequency*.

Frequency

The *Frequency* hotkey opens the input window *Frequency*.

Frequency
100 MHz

Input windows indicate the current parameter value (in this case: the current RF input frequency) or a list of the possible settings. Parameters are changed by

- Overwriting/incrementing numerical values (for numerical parameters)
- Selecting from the list of parameters (for select parameters)

Each *Analyzer/Generator* application is controlled by means of the measurement control softkey below the *Connect. Control* softkey and the associated hotkeys.

Analyzer Power

The *Analyzer Power* softkey controls the measurement application and indicates its state *(RUN | HLT | OFF)*. This state can be changed after softkey selection (pressing once) by means of the *ON/OFF* key or the *CONT/HALT* key. The state can be set independently for all three applications.

Remote control

```
INITiate:RFANalyzer            INITiate:NPOWer
ABORt:RFANalyzer               ABORt:NPOWer
STOP:RFANalyzer                STOP:NPOWer
CONTinue:RFANalyzer            CONTinue:NPOWer
FETCh:RFANalyzer:STATus?       FETCh:NPOWer:STATus?
```

Measurement configuration

Pressing the *Analyzer Power* softkey twice opens the popup menu *Analyzer/Generator Configuration* (see page 4.175).

Besides the *Repetition* hotkey defining the scope of the measurement is associated with the *Analyzer Power* softkey. The corresponding setting is specific to the *Analyzer/Generator* menu and also provided in the *Control* tab of the *Analyzer/Generator Configuration* menu; see section *Analyzer/Generator Configuration* on p. 4.175.

Application

The *Application* softkey selects the measurement application. The measurement control softkey (second softkey below *Connect. Control)* indicates the current application. Some of the hotkeys associated with the different softkeys, the *Setup* table, and the results in the *Analyzer/Generator* menu also vary as a function of the application. Details about the measurements and the results are explained in section Measurement Results on p. 4.174.

Analyzer Power

The *Analyzer Power* hotkey selects the measurement of the peak power using a filter with variable bandwidth or a wideband filter. In this application no statistical evaluation of the results is provided.

Remote control
The *Analyzer Power* application corresponds to the `RFANalyzer` subsystem.

Pow. Meter Freq. Sel.

The *Pow. Meter Freq. Sel.* hotkey selects the measurement of the peak and average power using a wide selection of narrow-band (and therefore frequency selective) filters. In this application a statistical evaluation of the results is provided.

Remote control
The *Pow. Meter Freq. Sel.* application corresponds to the `NPOWer` subsystem.

Analyzer Level

The *Analyzer Level* softkey controls the level in the RF input signal path and provides the trigger settings for the current measurement.

The input level and trigger settings are also provided in the *Connection Control* menu. They are described in more detail in sections *Analyzer Settings (Connection Control – Analyzer)* on p. 4.177 on page 4.177 and *Trigger (Connection Control – Trigger)* on p. 4.183.

Analyzer Settings

The *Analyzer Settings* softkey determines the center frequency of the RF analyzer and the resolution bandwidth of the measurement filter. The settings are also provided in the *Control* tab of the *Analyzer/Generator Configuration* menu; see section *Analyzer/Generator Configuration* on p. 4.175.

Generator
Tx Aux Tx

The *Generator* softkey configures the RF signals generated. The generator settings are also provided in the *Connection Control* menu. They are described in more detail in section *Generator Settings (Connection Control – Generator)* on p. 4.178.

The *RF Level* hotkey is also used to switch the RF generator on and off.

Settings table

The *Settings* table in the right half of the *Analyzer/Generator* menu gives an overview of the measurement settings belonging to the current application. It changes when a different application is selected. The rotary knob scrolls and expands the *Settings* table.

Measurement Results

The results displayed in the *Analyzer/Generator* menu are obtained at a definite frequency and resolution bandwidth; see *Analyzer Settings* softkey on p. 4.173.

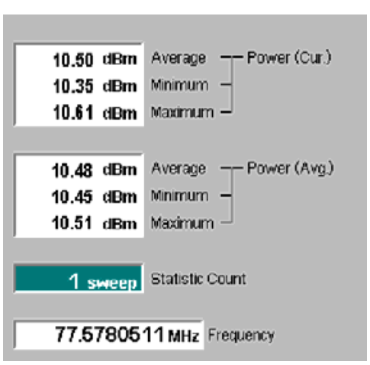
Analyzer Level:

The result for the *Analyzer Level* application appears in a single output field.

The indicated *Power* is the power of the RF input signal measured at the selected frequency and RBW and averaged over a basic evaluation period/sweep of 4096 samples. The result is updated after each sweep.

Remote control
`FETCh[:SCALar]:RFANalyzer:POWer?`

Pow. Meter Freq. Sel.:



The results for the frequency selective power meter *(Pow. Meter Freq. Sel.)* application are displayed in several groups of output fields. All results are obtained at the selected frequency and RBW. The statistical evaluation is based on a basic evaluation period/sweep of 4096 samples and on the statistics cycle *(Statistic Count)* defined in the configuration menu (see section *Analyzer/Generator Configuration* on p. 4.175; for a general description of statistical evaluations in the R&S® CBT refer to Chapter 3, section *General Settings)*.

Power (Curr.) Average, minimum and maximum power of the RF input signal in the current sweep

Power (Avg.) Average, minimum and maximum of the *Power (Curr.)* values: The *Maximum (Minimum)* value is the largest (smallest) power ever measured in the current measurement. *Average* is the average over all *Average – Power (Curr.)* values in the current measurement, obtained according to the averaging rules described in Chapter 3, section *General Settings.*

Statistic Count Number of sweeps per statistics cycle. The colored bar indicates the relative measurement progress in the statistics cycle

Frequency Frequency of the RF input signal. The frequency can be measured with an accuracy of 0.1 Hz.

Remote control
`READ[:SCALar]:NPOWer?`

```
FETCh[:SCALar]:NPOWer?
```

Analyzer/Generator Configuration

The popup menu *Analyzer/Generator Configuration* configures the RF analyzer measurements. It is opened by pressing the *Analyzer Power* measurement control softkey in the Analyzer/Generator menu twice.

In the *Control* tab of the *Analyzer/Generator Configuration* menu both power measurement applications of the *Analyzer/Generator* menu can be configured independently. The tab defines:

- The center *Frequency* of the RF analyzer
- The Repetition mode
- The *Statistic Count* for the measurement (for the *Power Meter Freq. Sel.* measurement only)
- The *Resolution Bandwidth* of the measurement filter

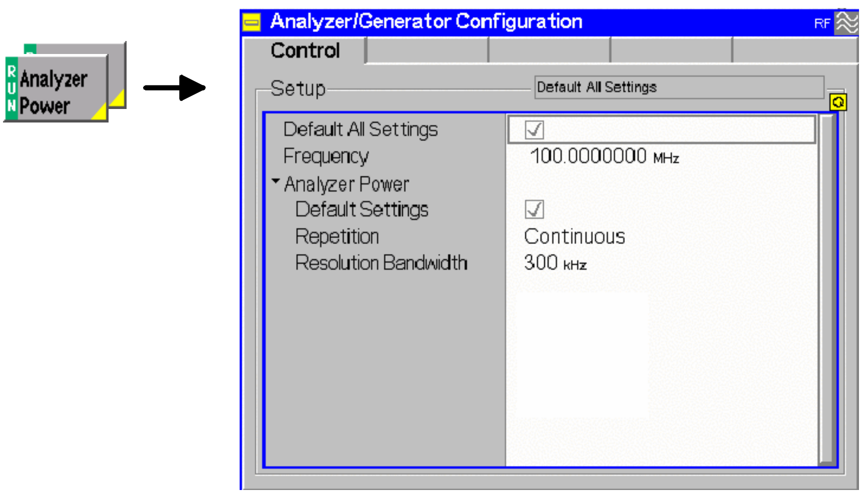


Fig. 4-21 Analyzer/Generator Configuration – Control

Default Settings The *Default All Settings* switch assigns default values to all settings in the *Control* tab (the default values are quoted in the command description in chapter 6 of this manual). In addition, a default switch for the *Analyzer Power* settings is provided.

Remote control
–

Frequency *Frequency* defines the center frequency of the RF analyzer. This setting is valid for both *Analyzer/Generator* measurement applications.

Remote control
`[SENSe:]RFANalyzer:FREQuency <Frequency>`

Resolution Bandwidth *Resolution Bandwidth* defines the resolution bandwidth of the analyzer. The nominal resolution bandwidth is the 3-dB bandwidth of the measurement filter. A list of Gaussian filters with discrete bandwidths between 10 Hz and 1 MHz is provided. The frequencies in the list are given by 1×10^n Hz, 2×10^n Hz, 3×10^n Hz, 5×10^n Hz where n=1 to 5. In addition the value 1 MHz is available.

Remote control
```
[SENSe:]RFANalyzer:BWIDth[:RESolution] <Bandwidth>
[SENSe:]NPOWer:BWIDth[:RESolution] <Bandwidth>
```

Repetition

Repetition determines the repetition mode (see Chapter 3). Repetition modes for the applications *Analyzer Power* and *Power Meter Freq. Sel.* can be set independently.

Single Shot — Single-shot measurement: the measurement is stopped after one sweep comprising 4096 samples. A stopped measurement is indicated by the status display *HLT* in the *Power* softkey.

Continuous — Continuous measurement: The R&S® CBT measures continuously until the measurement is explicitly stopped via the measurement control softkey in the graphical measurement menu (see *Analyzer Power* softkey on p. 4.173). The measurement results are valid after one sweep; however, the measurement is continued, and the output is continuously updated. An ongoing measurement is indicated by the status display *RUN* in the *Power* softkey.

Single shot should always be selected if only a single measurement result is required under fixed conditions. The continuous measurement is suitable for monitoring the evolution of a measured quantity in time, for example for adjustments.

Note: *In remote mode, the counting measurement (counting mode) is available as a further repetition mode with a defined number of measurement cycles to be performed, see chapter 6 of this manual.*

Remote control
```
CONFigure:RFANalyzer:CONTrol:REPetition
      CONTinuous | SINGleshot | 1 ... 10000,NONE,<Stepmode>
CONFigure:NPOWer:CONTrol:REPetition
      CONTinuous | SINGleshot | 1 ... 10000,NONE,<Stepmode>
```

Statistic Count

Statistic Count defines how many sweeps are combined to form one statistics cycle. Each sweep consists of 4096 samples. This setting is available for the *Power Meter Freq. Sel.* application; for *Analyzer Power* measurements the *Statistic Count* is always equal to one.

1 to 1000 sweeps — Number of sweeps per statistics cycle

The settings *1* and *OFF* (press *ON/OFF* key) are equivalent. A statistics cycle determines the duration of single-shot measurements *(*see Chapter 3, section *General Settings*).

Remote control
```
CONFigure:NPOWer:CONTrol:STATistics  1 ... 1000 | NONE
```

Connection Control

The popup menu *Connection Control* contains several tabs to configure the inputs and outputs of the R&S® CBT and the respective signals in the *RF* function group and the trigger settings.

The menu group is activated via the softkey *Connect. Control* to the right of the header of each measurement menu. The individual tabs *(Analyzer, Generator, RF* ⊙→*, Sync., Trigger,)* can be accessed via the hotkey bar at the lower edge of the screen.

Analyzer Settings (Connection Control – Analyzer)

The *Analyzer* tab adjusts the RF input path to the expected input power *(RF Max. Level)*.

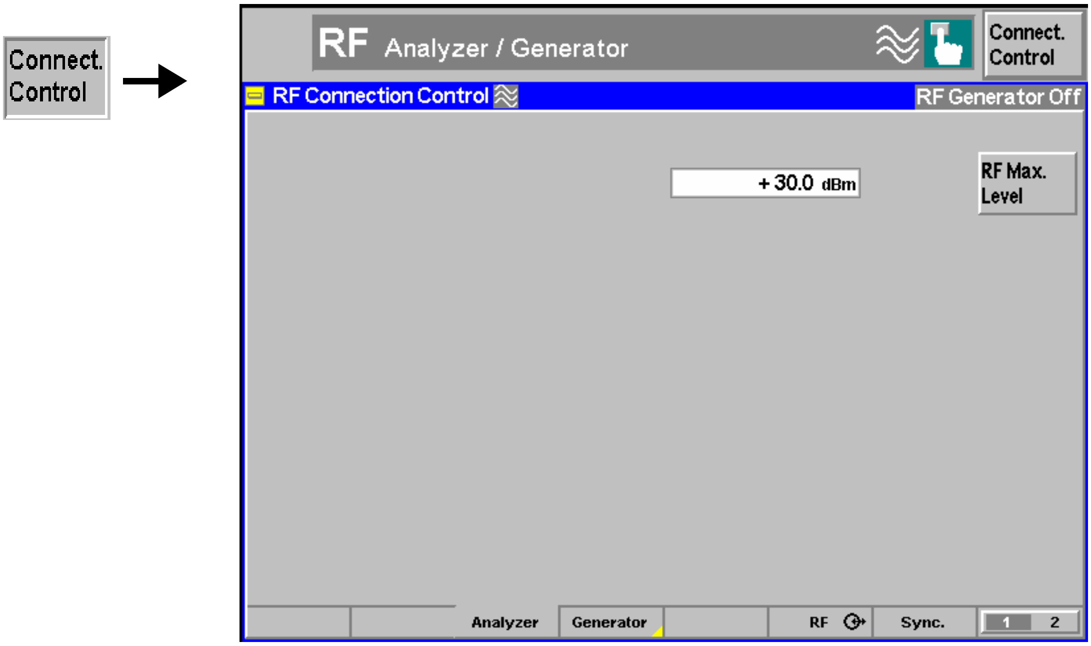


Fig. 4-22 Connection Control – RF analyzer settings

RF Max. Level

RF Max. Level determines the maximum permissible input level (overload level).

The value range depends on the selected RF input (see section *Generator Settings (Connection Control – Generator)* on page 4.178):

External attenuation

If an external input attenuation is reported to the instrument (see section *RF Connectors (Connection Control – RF)* on page 4.181), all levels measured are referenced to the output of the DUT and therefore shifted with respect to the actual level at the input connectors of the R&S® CBT. The level ranges for the input connectors are shifted as well.

Input levels exceeding the *RF Max. Level* can not be measured; the corresponding measurement result fields indicate invalid results "– – –".

Error messages

If the value determined for *RF Max. Level* is too high or too low, a window with the error message *"<Max_Level> is out of range. <permissible max. value> is limit."* and three fields will appear:

Accept	The permissible max. value is accepted as RF Max. Level
Re-edit	RF Max. Level is entered once again

Cancel The last valid input value is maintained

When switching over to another input, the current value of *RF Max. Level* is automatically adapted, if required:

- Towards lower values to the maximum permissible value of the new input,
- Towards upper values to the minimum value of the new input.

Remote control

```
[SENSe:]LEVel:MAXimum <Level>
```

Generator Settings (Connection Control – Generator)

The *Generator* tab configures the RF generator, in particular by defining the output level *(RF Level)*, the *Frequency* and *Frequency Hopping*. The R&S® CBT provides a softkey-oriented version of the *Generator* tab and a table-oriented version with extended functionality. The *Generator* hotkey toggles between the two versions if it is pressed repeatedly.

Softkey-Oriented Version

The *Generator* tab controls and configures the RF generator by defining:

- Level and frequency settings *(RF Level, Frequency, Frequency Offset)*
- Selection of an amplitude *Modulation*

All settings of this menu are also provided in the softkey-oriented version of the *Generator* tab; see section *Table Oriented Version* on p. 4.179.

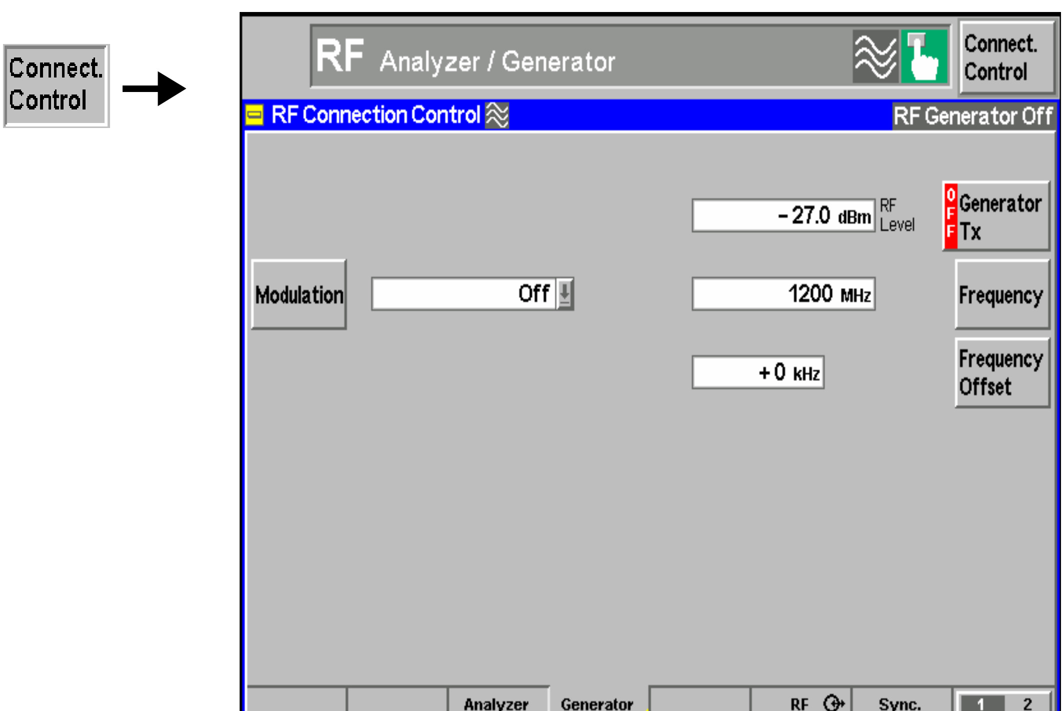


Fig. 4-24 Connection Control – RF generator settings (softkey)

Table Oriented Version

The table-oriented version of the *Generator* tab defines the *Level, Frequency, Frequency Offset* and *Modulation* of the RF output signal.

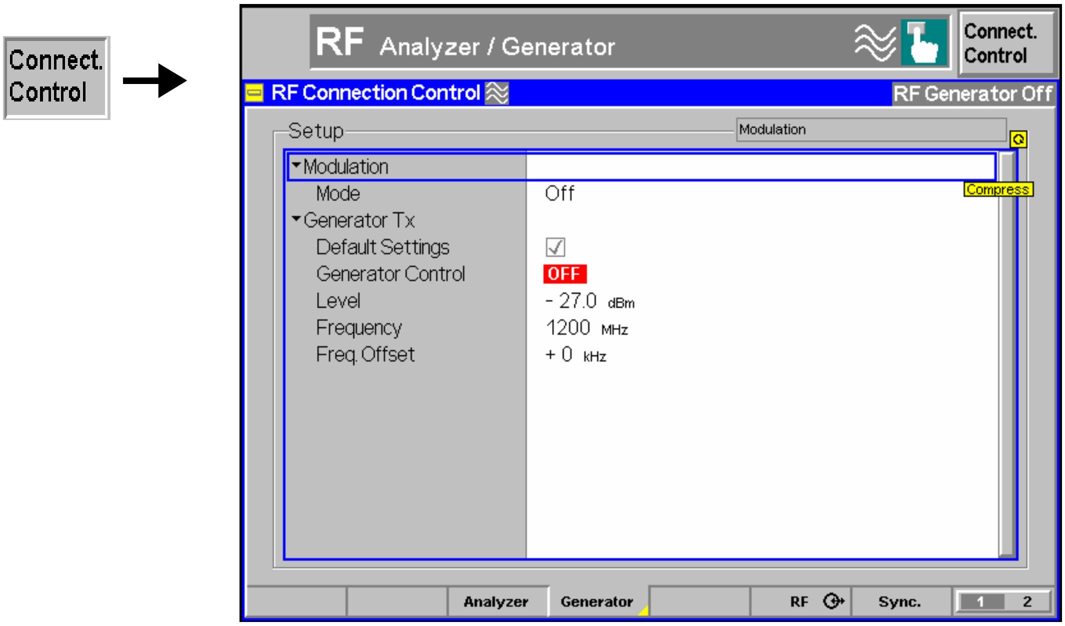


Fig. 4-25 Connection Control – RF generator settings (table)

Default Settings

Default Settings assigns default values to all *Generator Tx* settings (the default values are quoted in the command description in chapter 6 of this manual).

Remote Control
```
DEFault:RFGenerator
```

Modulation – Mode

Modulation – Mode selects the modulation scheme of the RF signal.

Off	Unmodulated (CW) RF carrier signal
Test	RF carrier is modulated with a 11110000 pattern so that it corresponds to a continuous, FM modulated Bluetooth signal. The pattern is periodically repeated.

Remote control
```
SOURce:RFGenerator:MODulation OFF | TEST
```

Generator Control

Generator Control controls the RF generator and indicates its operating state *(ON | OFF)*.

Remote Control
```
INITiate:RFGenerator[:TX]
ABORt:RFGenerator[:TX]
FETCh:RFGenerator[:TX]:STATus?
```

(RF) Level

(RF) Level defines the total level of the generated RF signals in dBm.

External attenuation

If an external gain or attenuation is used and reported to the instrument (see softkey *Ext. Att. Output* in the menu *RF* on page 4.181) the RF generator level is adjusted to maintain the commanded power after the attenuation or gain. As a consequence, all levels indicated are referenced to the input of the DUT and no longer correspond to the actual level at the output connectors of the R&S® CBT. The default value for the generator power is also shifted provided that the generator can output the required power, compensating for the external attenuation or gain. Otherwise it is adapted to the level closest to the shifted default value.

Error messages

If the entered generator level is too high or too low, a window with the error message *"<Max_Level> is out of range. <permissible max. value> is limit."* and three fields will appear:

Accept	The permissible max. value is accepted as RF Level,
Re-edit	RF Level is entered once again,
Cancel	The last valid input value is maintained.

When switching over to another output, the current value of RF Level is automatically adapted, if required:

- Towards lower values to the maximum permissible value of the new output,
- Towards upper values to the minimum value of the new output.

Remote control
```
SOURce:RFGenerator[:TX]:LEVel <Level>
```

Frequency

Frequency defines the frequency of the generated RF signal.

Remote control
```
SOURce:RFGenerator[:TX]:FREQuency <Frequency>
```

Frequency Offset

Frequency offset defines the frequency of the generated RF signals.

Remote control
```
SOURce:RFGenerator:FOFFset <Offset>
```

RF Connectors (Connection Control – RF)

The tab *RF* ⊙→ sets an external attenuation for RF output and input signals *(Ext. Att. Output, Ext. Att. Input).*

Connect. Control →

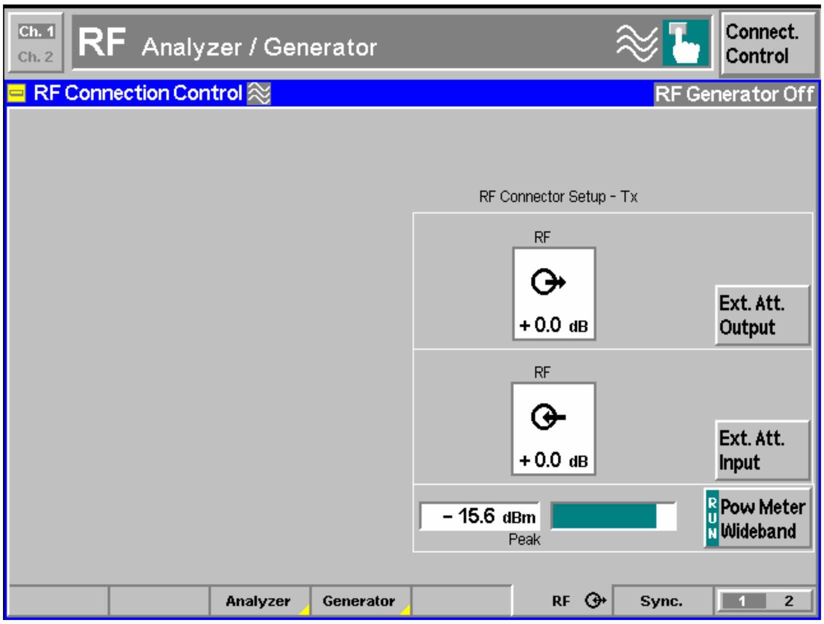


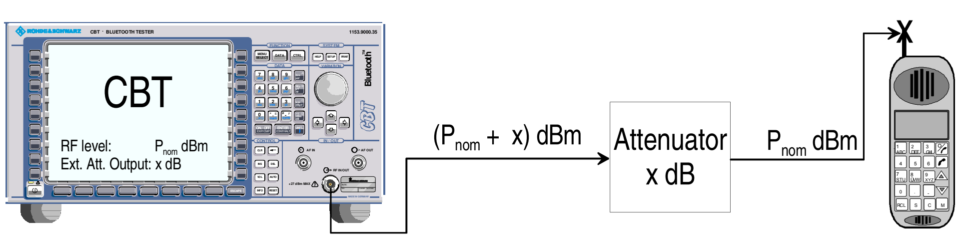
Fig. 4-26 Connection Control – RF connectors

Ext. Att. Output

The softkey *Ext. Att. Output* defines an external attenuation (or gain, if the value is negative) at the RF output.

Input of an external attenuation is suitable if, e.g., a path attenuation (cable) is included in the test setup, which is to be compensated for by an increased signal level.

If an external attenuation is defined, the output signal level is referenced to the input of the DUT, the displayed generator level is therefore shifted with respect to the actual level at the output connector of the R&S® CBT. The default value for the generator power and the level ranges for the RF outputs are also shifted provided that the generator can output the required power, compensating for the external attenuation or gain. Otherwise it is adapted to the level closest to the shifted default value.



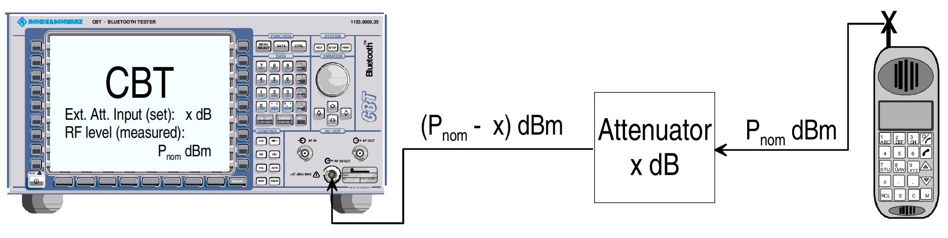
Remote control
`SOURce:CORRection:LOSS[:MAGNitude] <Loss>`

Ext. Att. Input

The softkey *Ext. Att. Input* enters the value of the external attenuation (or gain) at the RF input.

Input of an external attenuation is required if, for example, external attenuator pads are used for protection of the sensitive RF input of the R&S® CBT or if a path attenuation is included in the test setup.

If an external input attenuation is reported to the instrument, all levels measured are referenced to the output of the DUT and therefore shifted with respect to the actual level at the input connectors of the R&S® CBT. The level ranges for the input connectors are shifted as well.



Remote control
`[SENSe:]CORRection:LOSS[:MAGNitude]`

Reference Frequency (Connection Control – Sync.)

The *Sync.* tab determines the reference signals for synchronization.

Connect. Control →

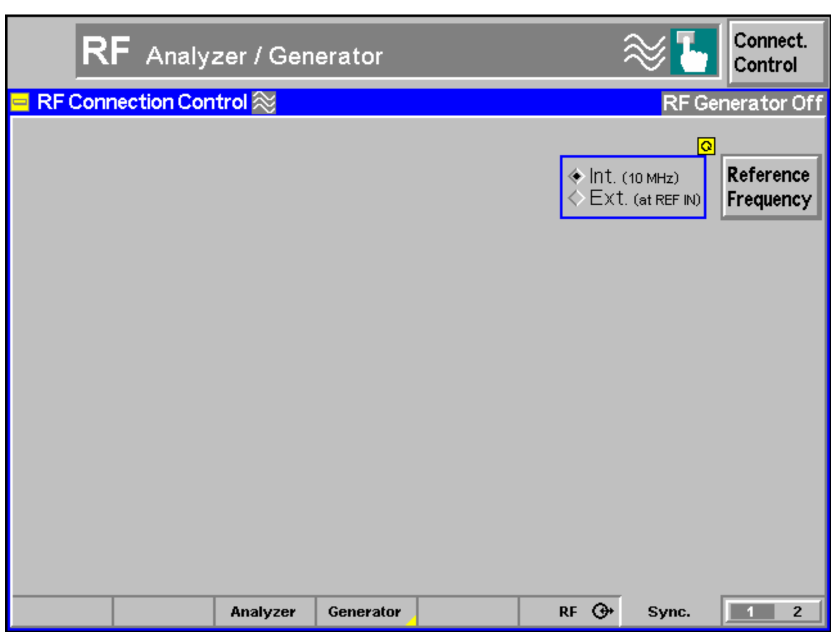


Fig. 4-27 Connection Control – Synchronization

Reference Frequency

The *Reference Frequency* softkey determines the source of the reference signal. The associated field allows to select between two alternatives:

Int. (10 MHz) Internal synchronization by means of a 10 MHz reference frequency (TCXO).

Ext. (at REF IN) Synchronization to external reference signal to be fed in via input REF IN. The external reference signal can be used for synchronization of the R&S® CBT to another instrument. Its frequency must also be 10 MHz nominal.

The reference signal used is also routed to output *REF OUT 1* so that it can be fed to other instruments as well.

Note: *The instrument periodically displays a warning if no synchronization could be achieved e.g. because of missing or faulty input signal with external synchronization selected. At the same time, bit no. 6 (RFNL, Reference Frequency Not Locked) is set in the STATus:OPERation:CMU:SUM1:CMU1 sub-register associated with the R&S® CBT base system and the query `[SENSe:]SYNChronize :FREQuency:REFerence:LOCKed?` returns the value `ON`.*

In the case of external synchronization with squarewave signals (TTL) ensure correct signal matching to avoid reflections. Otherwise, resulting overshoots may cause trigger problems at theR&S® CBT input. A possible remedy is to use a lowpass filter or an attenuator pad directly at the R&S® CBT input.

This configuration is valid in all R&S® CBT function groups.

Caution: *The reference frequency is set to Int. (10 MHz) whenever the base system is reset. After switching back to Ext. (at REF IN) it is necessary to allow for a setting time (~1 s) before the R&S® CBT can synchronize to the external reference frequency. The delay is avoided by a partial reset of all function groups with the exception of the base system.*

Remote control
The commands for the reference frequency are part of the R&S® `CBT` base system:

```
CONFigure:SYNChronize:FREQuency:REFerence:MODE
      INTernal | EXTernal
[SENSe:]SYNChronize:FREQuency:REFerence:LOCKed?
```

Trigger (Connection Control – Trigger)

The *Trigger* tab is part of the second group of tabs in the *Connection Control* menu. It is accessible after pressing the *1 / 2* toggle hotkey once. Pressing *1 / 2* again switches back to the first group of tabs described above.

The *Trigger* tab defines the trigger condition for the measurement.

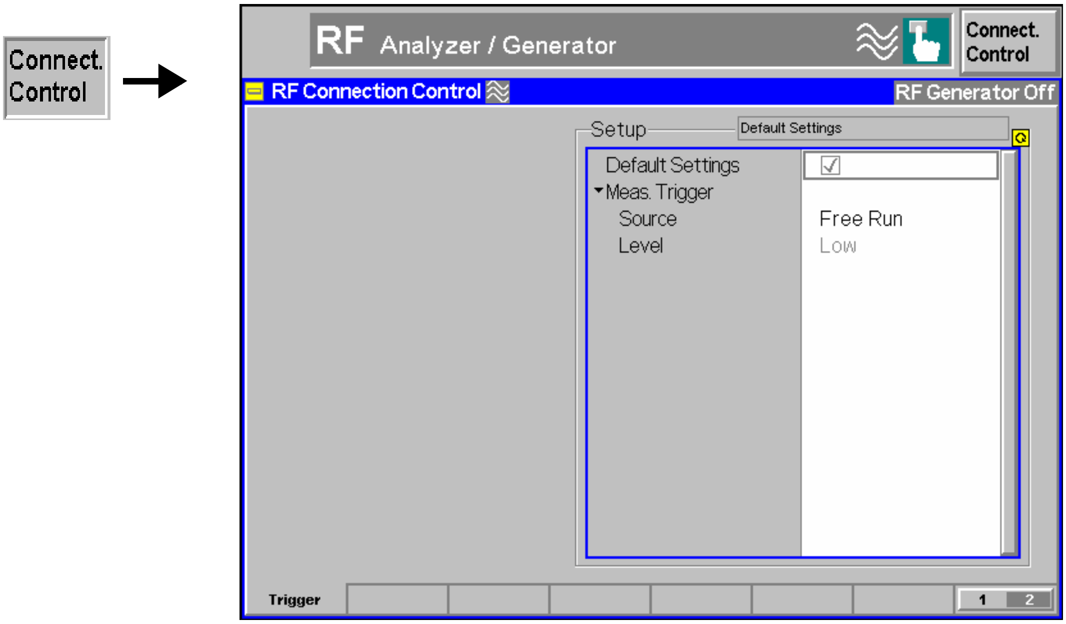


Fig. 4-28 Connection Control – Trigger

Default Settings The *Default Settings* checkbox assigns the default setting to all functions in the *Trigger* tab (the default values are quoted in the command description in chapter 6 of this manual).

Remote control `TRIGger[:SEQuence]:DEFault ON | OFF`

Meas. Trigger – Source

Source selects the source for the trigger event:

Free Run Free-run mode, the measurement is carried out continuously, it is not related to the input signal

Power The measurement is triggered by the level of the measured RF signal

Remote control
`TRIGger[:SEQuence]:SOURce IMMediate | POWer`

Level

The *Level* section defines the trigger thresholds if the measurement is triggered by the *RF Power* (see *Source* function above). Both thresholds are defined relative to the maximum input level set in the *Analyzer* tab (see *RF Max. Level* softkey on p. 4.177). The *Level* settings have no influence on *Free Run* or *External* trigger measurements.

The ***RF Power*** trigger threshold is the RF input signal level beyond which the trigger condition is satisfied and a measurement is initiated.

Low Low trigger threshold, equal to approx. the *RF Max. Level* – 40 dB

High High trigger threshold, equal to approx. the *RF Max. Level* – 20 dB

Remote control
`TRIGger[:SEQuence]:THReshold:POWer LOW | HIGH`

Options and Extensions

The function groups described in this section require the installation of hardware options; for a complete list of deliverable options refer to the data sheet.

Audio Option (R&S CBT-B41)

The *Audio Option* R&S CBT-B41 provides an additional *Audio* function group comprising the functions for generating and measuring audio signals. It can be accessed either from the *Menu Select* menu (standalone audio measurements) or by switching over from the *Bluetooth* measurement menus. In the latter case, the audio circuit of a Bluetooth DUT can be tested without releasing a connection or changing the signalling state of the R&S CBT.

Standalone *audio* measurements are performed with default connector settings, the audio signals being applied to the connectors *AF 1 IN / AF 2 IN* (input) and *AF 1 OUT / AF 2 OUT* (output) on the front panel of the instrument (see chapter 1 of the operating manual). If *Audio* is used in the context of the network tests *(Signalling* test mode), the *AF/RF* tab of the associated *Connect. Control* menu allows to select the input source of the R&S CBT speech encoder and the output destination of its speech decoder.

The audio function group provides the following independent measurements:

- In a single-tone audio measurement *(Analyzer/Generator* menu), the R&S CBT generates an audio signal at constant level and frequency and analyzes a single-tone audio input signal.
- In a multitone measurement, the R&S CBT generates a composite audio signal consisting of up to 20 distinct test tones and analyzes an audio input signal containing the same tones.
- In the total harmonic distortion (THD) measurement, the R&S CBT provides a single-frequency audio test signal with adjustable power and very low harmonic distortion and measures the AF power at the generator frequency (1st harmonic labeled d1) and at the 2nd, 3rd … 9th harmonics.

Two independent audio circuits are provided for each measurement. The *Stereo* applications for the *Multitone* and *THD* measurements are combinations of the primary and secondary circuit applications.

Analyzer/Generator Menu

The main menu *Analyzer/Generator* defines the DC or sinusoidal AC signals generated by the two audio generators and displays the voltage of the two measured audio signals.

- The measurement control softkey *Analyzer 1,* which changes to *Analyzer 2,* depending on the audio measurement application selected) controls the measurement, indicates its status *(RUN | HLT | OFF)* and opens the configuration menu *Audio Configuration*. The hotkeys associated with the measurement control softkey define the scope of the *Audio* measurement.
- The other softkeys to the right of the test diagram are combined with various hotkeys (e.g. the hotkeys *AF Max. Level* and *AF Mode* belong to the softkey *Analyzer Level).* The softkey/hotkey combinations provide test settings and switch over between different measurements.

The *Analyzer/Generator* menu is opened from the main menu *Menu Select* (with associated key at front of instrument) or via the *Audio* hotkey which is available in all *Bluetooth* measurement menus. Compared to the standalone case, the network audio option offers an extended functionality (see Fig. 4-29 below):

- The *Connect. Control* softkey from the previous (calling) network function group is also available in *Audio.*
- A symbol indicating the network test mode (e.g. *@ Bluetooth)* is displayed in the menu header.

- A hotkey switching back to the network function group shows at the bottom of the menu.

The actual *Audio* functionality is identical in the standalone and network modes.

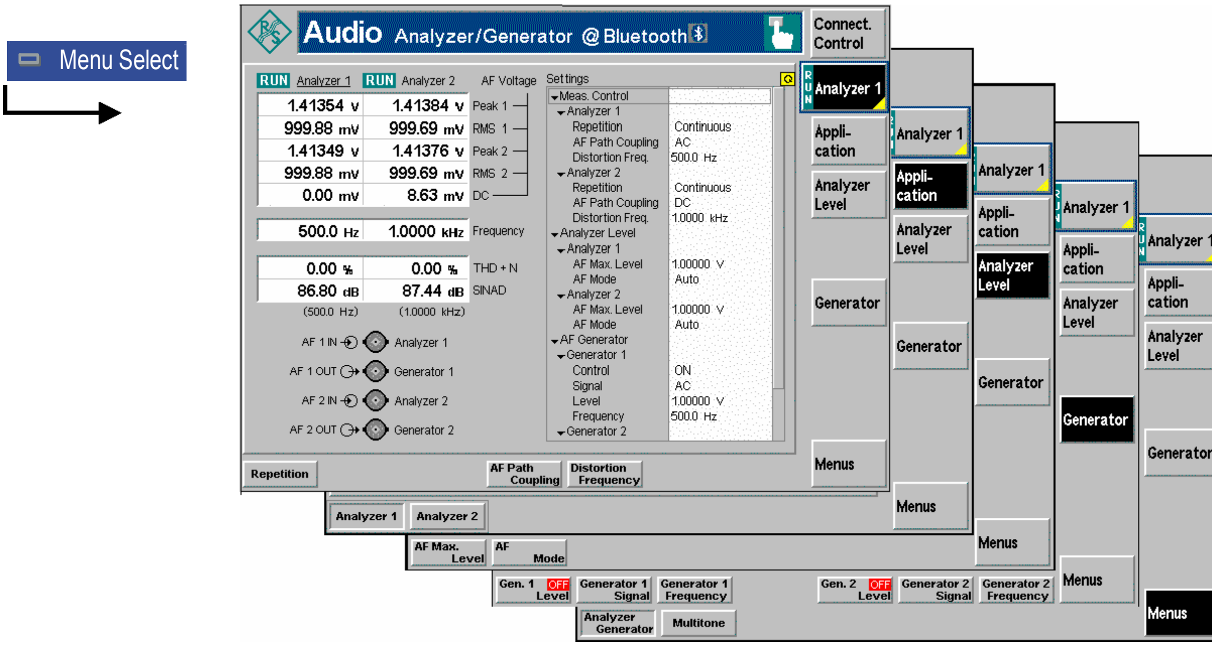


Fig. 4-29 Measurement menu Analyzer/Generator (Audio)

Test Settings

The basic settings for the *Audio* measurement are directly accessible from the measurement menu via softkey/hotkey combinations.

Many of the basic settings are also accessible from the *Analyzer Configuration* popup menu. They are explained in more detail in section *Measurement Configurations (Analyzer Configuration*) on p. 4.191.

Analyzer 1

The *Analyzer 1/2* softkey (which changes to Analyzer 2, depending on the application selected) controls the audio measurement (RUN / HLT / OFF) and indicates its status. This status can be changed after softkey selection (pressing once) by means of the ON/OFF key or the CONT/HALT key. The status can be set independently for all Audio applications.

Remote control

```
INITiate:AFANalyzer:<Applic>
STOP:AFANalyzer:<Applic>
ABORt:AFANalyzer:<Applic>
CONTinue:AFANalyzer:<Applic>

FETCh:AFANalyzer:<Applic>:STATus?
      <Applic> = [PRIMary] | SECondary
```

Measurement configuration

Pressing the *Analyzer* softkey twice opens the popup menu *Analyzer Configuration*; see p. 4.191. Besides, the measurement control softkey provides hotkeys to define the path coupling and a possible distortion frequency. All these settings are described in more detail in section *Measurement Control (Analyzer Configuration – Control)* on p. 4.191.

Appli-cation

The Application softkey selects the audio measurement application.

The results of both applications *Analyzer 1* and *Analyzer 2* are indicated in the corresponding columns of the output tables; see section *Measurement Results* on p. 4.189. The *Settings* table shows the measurement configurations for both applications. On the other hand, all softkeys and hotkeys in the measurement menu belong to the current application.

Analyzer 1

Analyzer 1 selects the primary audio circuit where the audio signals are applied to the connectors AF 1 OUT (output, AF generator signal) and AF 1 IN (input) on the R&S CBT front panel.

Remote control:
The *Analyzer 1* application is selected by the keyword `[:PRIMary]` in the 3rd level of the analyzer commands, e.g. `INITiate:AFANalyzer[:PRIMary]`.

Analyzer 2

Analyzer 2 selects the secondary audio circuit where the audio signals are applied to the connectors AF 2 OUT (output, AF generator signal) and AF 2 IN (input) on the R&S CBT front panel.

Remote control:
The *Analyzer 2* application is selected by the keyword `:SECondary` in the 3rd level of the analyzer commands, e.g. `INITiate:AFANalyzer:SECondary`.

Analyzer Level

The *Analyzer Level* softkey controls the level in the AF input signal path.

AF Max. Level

The *AF Max. Level* hotkey sets the maximum expected AF input level. Levels exceeding this value cannot be measured.

For analog analyzers, the level is entered in mV. Digital analyzer levels are controlled using full scale (FS) units, 1 FS corresponding to maximum analyzer level. The R&S CBT automatically uses an analog or digital analyzer, depending on the selected audio test scenario (see section *Audio Test Scenarios* on p. 4.222).

Remote control

```
[SENSe:]AFLEVel<Applic>:MAXimum <Level>
[SENSe:]AFLEVel<Applic>:FSCale:MAXimum <Level>
      <Applic> = [:PRIMary] | :SECondary
```

Error messages

If the value set for *Manual Level* is too high or too low, a window with the error message *"<Max_Level> is out of range. <permissible max. value> is limit."* and three fields will appear:

Accept	The permissible max. value is accepted as maximum input level.
Re-edit	The *Manual Level* is entered once again.
Cancel	The last valid input value is maintained.

AF Mode

The *AF Mode* hotkey determines how the input level is defined.

Manual Manual input of maximum input level via *Manual Level* (in mV).

Auto Automatic setting of maximum input level *(autoranging)* according to average power of applied AF signal (plus an appropriate overload margin).

Note1: *A maximum input level can be entered even if automatic level setting (autoranging) is selected. It serves as a start value for the autoranging algorithm and is important to ensure safe switchover to manual setting.*

Note2: *The AF Max. Level and AF Mode settings supersede the corresponding settings in the Multitone menu (Analyzer 1/2); see hotkeys AF Max. Level on p. 4.198 and AF Mode on p. 4.198.*

Remote control
```
[SENSE:]AFLevel<Applic>:MODE  MANual | AUTomatic
      <Applic> = [:PRIMary] | :SECondary
```

Generator

The *Generator* softkey controls the audio generator and defines the properties of the generated DC or sinusoidal AC signal. The three hotkeys for the primary and secondary audio circuit *(Gen. 1/Gen. 2)* are analogous.

The generator settings are also provided in the *Analyzer Configuration* menu; see section

Generator Settings (Analyzer Configuration – Generator) on p. 4.192.

Bluetooth

The hotkey switches back to the previous GSM function group.

This hotkey is available if the *Analyzer/Generator* menu is opened from a GSM function group. The hotkey is labeled with the calling function group and test mode, which is also displayed in the menu header.

Remote control
All function groups for network tests are referenced by their secondary addresses; see Chapter 5 of the operating manual.

Measurement Results

The test settings of the *Audio* measurement and the results are displayed in the tables in the center of the menu.

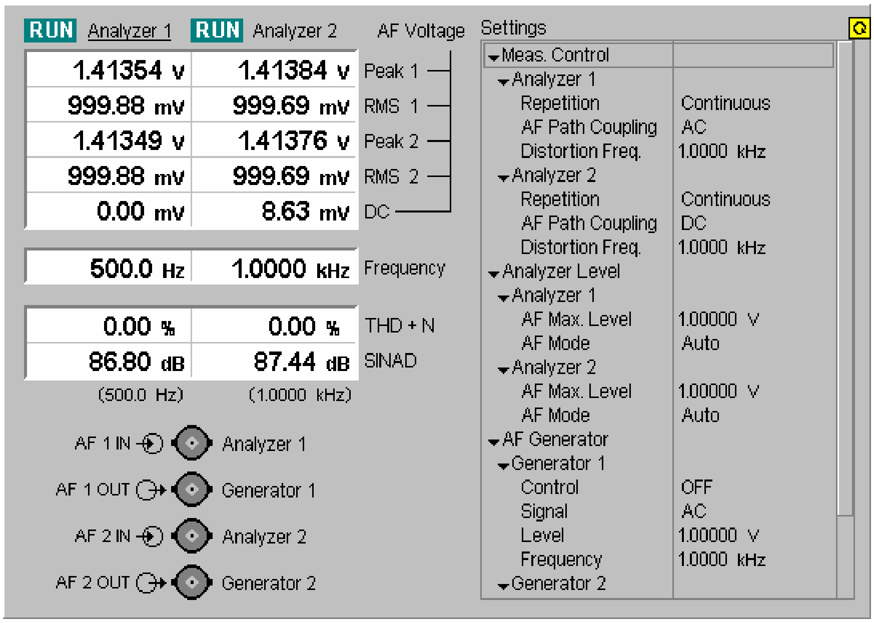


Fig. 4-30 Display of test settings and measurement results (Audio)

Results

The table and output fields in the left half of the table show the results for both audio circuits (applications *Analyzer 1* and *Analyzer 2).* If an analyzer is switched off (see measurement control softkey *Analyzer 1* on p. 4.186), *OFF* is indicated above the corresponding output column and the output fields show invalid results ("---").

The values in the *AF Voltage* table represent the measured voltages of the AF signals:

Peak 1/2 Peak value of the AC component of the measured AF signal in V. The numbers 1 and 2 denote two different input paths for AF signals with different filter configuration; see Fig. 4-33 on p. 4.193.

RMS 1/2	Effective (RMS-averaged) value of the AC component of the measured AF signal in V.
DC	DC component of the measured AF signal in V
Frequency	Frequency of the measured AC signal
THD + N	Ratio of the measured AF signal voltage with a notched-out reference frequency to the complete measured AF signal in percent. The reference frequency of the distortion measurement set in the *Control* tab of the configuration menu (see p. 4.191) is indicated in brackets below the output field. If the reference frequency is equal to the fundamental frequency of the AF signal, the *THD + N* value corresponds to the *Total Harmonic Distortion and Noise*. To avoid suppression of the first harmonic, the bandwidth of the notch filter is automatically adjusted to be smaller than the reference frequency.
SINAD	Signal-to-Noise-and-Distortion ratio calculated from the THN+D value as follows:

$$\mathrm{SINAD(in\ dB)} = 20 \times \log\left(\frac{1}{(\mathrm{THN + D(in\ \%)/100})}\right)$$

Example: A THN+D factor of 1% results in a SINAD of 40 dB.

Remote control
```
READ[:SCALar]:AFANalyzer:<Applic>[:RESult]?
FETCh[:SCALar]:AFANalyzer:<Applic>[:RESult]?
```

AF Connector Overview

The figure below the result table shows the destination of the input signals fed in via AF 1 IN and AF 2 IN and the signal sources for the two audio output connectors AF 1 OUT and AF 2 OUT.

- For standalone audio measurements and network tests in *Non Signalling* mode the routing of input and output audio signals is fixed: The connectors AF 1 IN and AF 1 OUT are used as input and output for the primary audio circuit (Analyzer 1, Generator 1). AF 2 IN and AF 2 OUT are used as input and output for the secondary audio circuit (Analyzer 2, Generator 2).
- If network tests are performed in *Signalling* mode, the routing of input and output audio signals is a function of the *Speech Decoder* output destination. For more information refer to the description of the *AF/RC Connector* tab in the *Bluetooth* section of this manual.

Settings

The *Settings* table gives an overview of the configuration of the current measurements. This includes the settings made via the softkeys and hotkeys of the *Audio* menu.

Remote control
Settings are read out using the query corresponding to the setting command (setting command with appended question mark). See section *Test Settings* on p. 4.186.

Measurement Configurations (Analyzer Configuration)

The popup menu *Analyzer Configuration* contains three tabs to determine the parameters of the *Audio* measurement. It is opened by pressing the softkey *Analyzer* in the measurement menu *Analyzer/Generator* twice. It is possible to change between the tabs by pressing the associated hotkeys.

The popup menu *Analyzer Configuration* is activated by pressing the measurement control softkey at the top right in the graphical measurement menu *Power* twice. It is possible to change between the tabs by pressing the associated hotkeys.

Measurement Control (Analyzer Configuration – Control)

The *Control* tab determines:

- The *Repetition* mode,
- The *AF Path Coupling* of the audio measurement.
- The reference frequency of the distortion measurement *(Distortion Frequency)*.

The settings can be defined independently for the applications *Analyzer 1* and *Analyzer 2*.

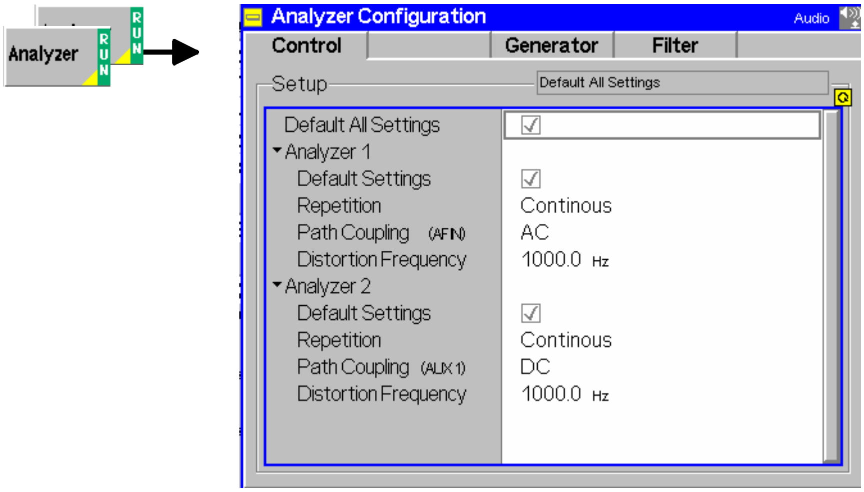


Fig. 4-31 Analyzer Configuration – Control

Default Settings The *Default* switch assigns default values to all settings in the *Control* tab (the default values are quoted in the command description). In addition, default switches for the individual applications are provided.

Remote Control
–

Repetition The *Repetition* field determines the repetition mode, see Chapter 3 of the operating manual. In *Audio,* one statistics cycle is terminated when the system has settled and a valid result is available.

Remote control
```
CONFigure:AFANalyzer:<Applic>:CONTrol:REPetition
       CONTinuous | SINGleshot | 1 ... 10000,NONE,<Stepmode>
```

Path Coupling

Path Coupling sets the input path for measurement of the AC or AC and DC component of the AF signal:

AC DC component of the measured AF signal (including a possible DC offset of the input amplifier) blocked. This ensures accurate measurement of the AC component. The DC component, however, can not be measured; the DC Voltage output field in the Analyzer/Generator menu indicates "---".

DC Measurement of the complete AF input signal (DC plus AC components).

Note: *The path coupling has an impact on the allowed filter settings; see section Input Path Configuration (Analyzer Configuration – Filter) on p. 4.192.*

Remote control
CONFigure:AFANalyzer:<Applic>:CONTrol:COUPling AC | DC

Distortion Frequency

Distortion Frequency defines the reference frequency of the distortion measurement. If the reference frequency is set to the fundamental frequency of the AF signal, the *Distortion* value corresponds to the Total Harmonic Distortion and Noise.

Remote control
CONFigure:AFANalyzer:<Applic>:CONTrol:DIStortion:FREQuency

Generator Settings (Analyzer Configuration – Generator)

The *Generator* tab defines the properties of the generated AF signals. The settings can be defined independently for the two AF generators.

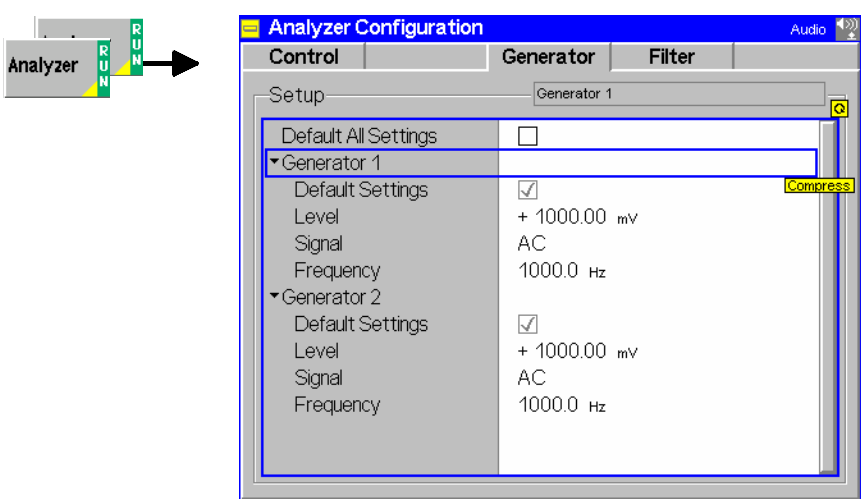


Fig. 4-32 Analyzer Configuration – Generator

Default Settings

The *Default Settings* switch assigns default values to all settings in the *Generator* tab (the default values are quoted in the command description in chapter 6). In addition, default switches for the two independent generators are provided.

Remote Control
–

Level

Level defines the generator level. The meaning of the entered level depends on the generator signal type (see *Signal* below):

- If the generated signal is an AC signal, *Level* denotes the effective (RMS averaged) voltage.
- If the generated signal is an DC signal, *Level* denotes the constant DC voltage.

For analog generators, the level is entered in mV. Digital generator levels are controlled using full scale (FS) units, 1 FS corresponding to maximum generator level. The R&S CBT automatically uses an analog or digital generator, depending on the selected audio test scenario (see section *Audio Test Scenarios* on p. 4.222).

Remote control

```
SOURce:AFGenerator:<Applic>:LEVel <Level>
SOURce:AFGenerator:<Applic>:FSCale:LEVel <Level>
```

Signal

Signal qualifies whether the generated audio signal is a DC or an AC signal.

Remote control

```
SOURce:AFGenerator:<Applic>:SMODe DC | AC
```

Frequency

Frequency sets the frequency of the generated AF audio signal in Hz. The hotkey is disabled if the generated signal is a DC signal.

Remote control

```
SOURce:AFGenerator:<Applic>:FREQuency <Frequency>
```

Input Path Configuration (Analyzer Configuration – Filter)

The *Filter* tab configures the different filter stages for the AF analyzer. The input path for measuring the AC component of the AF signal is as shown below:

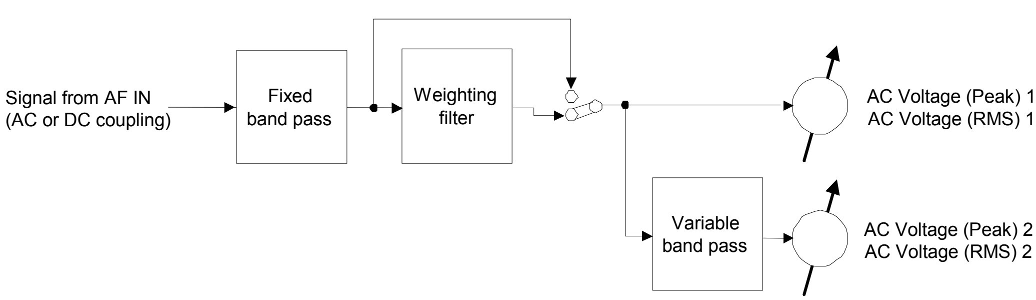


Fig. 4-33 AF analyzer input path configuration

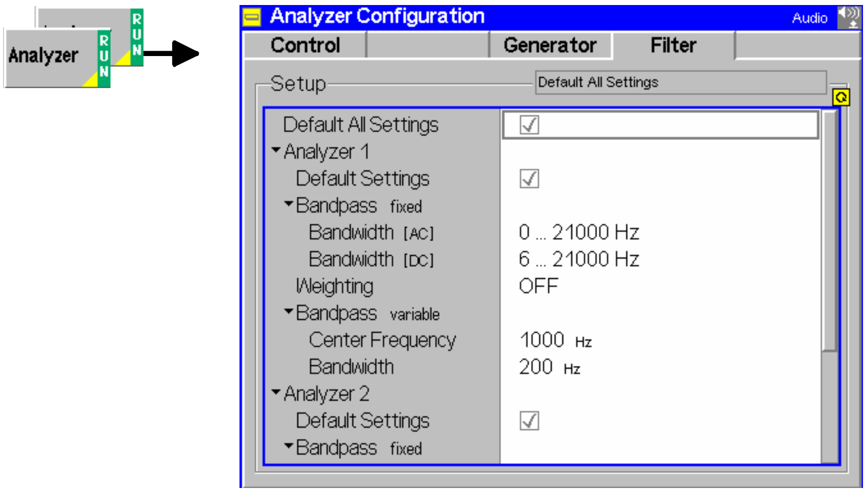


Fig. 4-34 Analyzer Configuration – Filter

Default Settings The *Default Settings* switch assigns default values to all settings in the *Filter* tab (the default values are quoted in the command description in chapter 6).

Remote Control
–

Bandpass The *Bandpass* section sets the bandwidth of the fixed band pass (see *Fig. 4-33 above*).

Bandwidth (AC Coup.)	Bandwidth to be used if the AF path coupling is set to AC (see *Path Coupling* on page 4.192)
Bandwidth (DC Coup.)	Bandwidth to be used if the AF path coupling is set to DC

The R&S CBT provides a broad selection of bandwidths with lower cutoff frequencies between 0 Hz and 300 Hz and upper cutoff frequencies between 250 Hz and 21 kHz (see command description in chapter 6).

Note: *If the AF Path Coupling is set to DC, the audio analyzer receives the complete AF input signal including a possible DC component. To avoid measurement inaccuracies, band pass filters with a lower cutoff ≥ 6 Hz are available only.*

Remote control
```
CONFigure:AFANalyzer:<Applic>:FILTer:BPASs:ACCoupling
CONFigure:AFANalyzer:<Applic>:FILTer:BPASs:DCCoupling
```

Weighting The *Weighting* section selects a weighting filter to be switched into the AF signal path after the fixed band pass (see *Fig. 4-33 above*).

Off	No weighting filter
C-Message	Swith on C-message weighted filter
CCITT	Swith on CCITT weighting filter
A	Switch on A-weighted filter

The A-weighted filter deemphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise. Thus, noise levels stated in terms of dBA reflect the response of the human ear by filtering out some of the noise in the low- and high-frequency ranges that the ear does not detect well. The A-weighted scale commonly is used in local ordinances and standards.

Remote control
`CONFigure:AFANalyzer:<Applic>:FILTer:WEIGhting`

Bandpass (variable)

The *Bandpass (variable)* section sets the center frequency and the bandwidth of the variable band pass.

Note: *The variable band pass settings affect the results for AC Voltage (Peak) 2 and AC Voltage (RMS) 2 only (see Fig. 4-33 above). These quantities are available in remote control but not displayed in the Analyzer/Generator menu.*

Remote control
```
CONFigure:AFANalyzer:<Applic>:FILTer:VBPass:CFRequency
CONFigure:AFANalyzer:<Applic>:FILTer:VBPass:BWIDth
```

Multitone Measurement

The graphical measurement menu *Multitone* shows the results of the multitone audio measurement.

To perform an *Multitone* measurement, the R&S CBT generates a composite audio signal that represents the superposition of up to 20 individual fixed-frequency tones with configurable frequency and level. An audio signal containing the same tones can be analyzed in a single measurement and displayed in a bar chart.

The *Multitone* measurement is thus a fast method to determine the level of up to 20 different tones at known frequencies and to perform a limit check for all results. Possible applications are also frequency response and intermodulation measurements.

The *Multitone* measurement menu is opened via the main menu *Menu Select* (with the associated key at the front of the instrument) or from the *Analyzer/Generator* menu using the *Multitone* hotkey. It provides three independent applications which can be started and stopped using the *AF Chan. One, AF Chan. Two,* or *Stereo* measurement control softkeys:

- In the *AF Chan. One* application, the AF generator signal is routed to the AF 1 OUT connector; the received audio signal is measured at *AF 1 IN*.
- In the *AF Chan. Two* application, the AF generator signal is routed to the *AF 2 OUT* connector; the received audio signal is measured at *AF 2 IN*.
- The *Stereo* application is a combination of the previous two applications, where the R&S generates and analyzes two independent multitone audio signals.

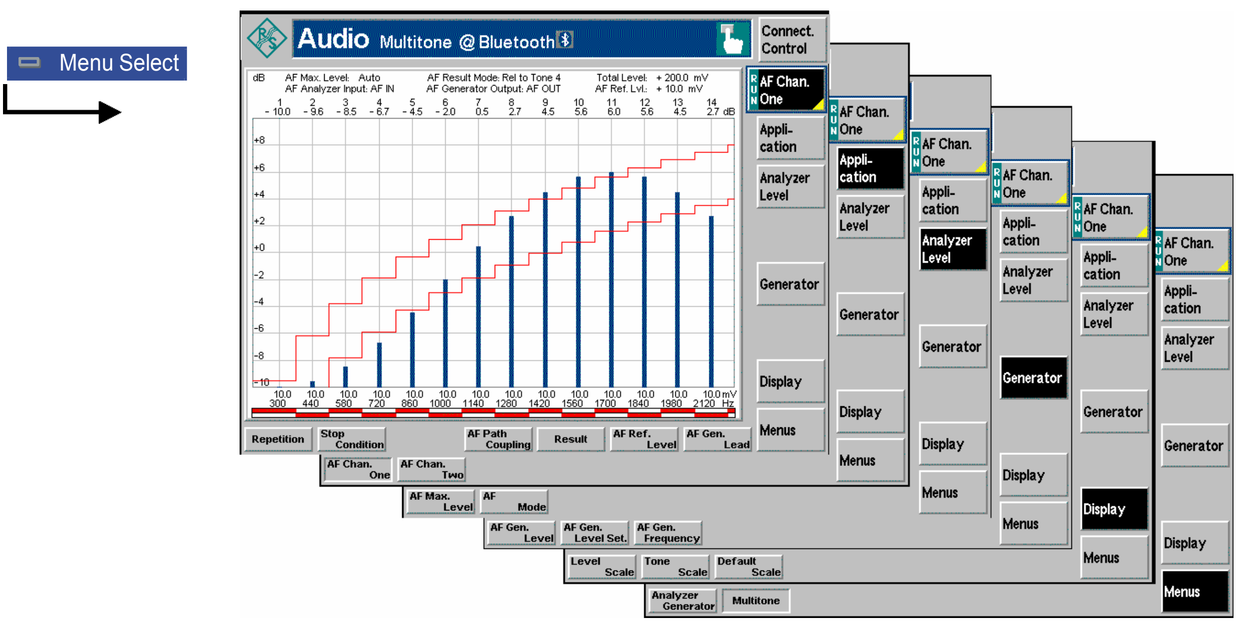


Fig. 4-35 Measurement menu Multitone

Test Settings

The *Multitone* measurement can be configured by means of the softkeys and hotkeys in the graphical measurement menu.

AF Chan. One

The *AF Chan. One* softkey controls the *Multitone* measurement and indicates its status *(RUN | HLT | OFF)*. This status can be changed after softkey selection (pressing once) by means of the *ON/OFF* key or the *CONT/HALT* key.

AF Chan. One changes to *AF Chan. Two* or *Stereo* if the corresponding applications are selected.

Remote control
`INITiate:MULTitone:AFxChannel; ABORt:MULTitone:AFxChannel;`
`STOP:MULTitone:AFxChannel; CONTINUE:MULTitone:AFxChannel`
`FETCh:MULTitone:AFxChannel:STATus? (x = 1,2)`

Measurement configuration

Pressing the *AF Chan. One* softkey twice opens the popup menus *Multitone Configuration* (see page 4.202). Besides, a number of hotkeys defining the scope of the measurement and further settings are associated with the *AF Chan. One* softkey. All settings are also provided in the *Control* tab of the *Multitone Configuration* menu; see section *Measurement Control (Multitone Configuration – Control)* on page 4.202.

Application

The *Application* softkey activates one of the applications of the *Multitone* measurement. The two applications represent two independent audio circuits. Both circuits are identical except for the input and output connectors. Configurations such as the input path *(Analyzer Level)* can be set independently. Changing the application will also change the measurement control softkey *AF Chan. One / AF Chan. Two.*

AF Chan. One

The *AF Chan. One* hotkey selects the *Multitone* measurement on channel one. This means that the audio signals are applied to the connectors AF 1 IN (R&S CBT input) and AF 1 OUT (R&S CBT output) on the front panel.

Remote control
Audio channel no. one is identified by the third-level keyword `AF1Channel`.

AF Chan. Two

The *AF Chan. Two* hotkey selects the *Multitone* measurement on channel two. This means that the audio signals are applied to the connectors AF 2 IN (R&S CBT input) and AF 2 OUT (R&S CBT output) on the R&S CBT front panel.

Remote control
Audio channel no. two is identified by the third-level keyword `AF2Channel`.

Stereo

If the *Stereo* application is active, the multitone analysis is performed twice at the *AF Chan. One* and *AF Chan. Two* frequencies.

With the exception of the *Repetition Mode* and the *Stop Condition,* the *AF Chan One* and *AF Chan Two* settings are also valid for the *Stereo* application.

Remote control
The *Stereo* application is controlled with an independent set of `…MULTitone:STEReo…` commands. Many of the `…MULTitone:STEReo…` commands use a duplicated parameter set for simultaneous configuration of the two audio circuits. With the exception of the *Repetition Mode* and the *Stop Condition,* the *Stereo* settings overwrite the *AF Chan One* and *AF Chan Two* settings and vice versa.

Analyzer Level

The *Analyzer Level* softkey controls the level in the AF input signal path for both applications of the *Multitone* measurement.

AF Max. Level

The *AF Max. Level* hotkey sets the maximum expected input level in mV. Two independent values can be set for the two applications AF Chan. One *(Analyzer 1)* and AF Chan. Two *(Analyzer 2)*. The setting is applied if the *AF Mode* (see softkey below) is set to *Manual*.

Note: *The AF Max. Level setting supersedes the corresponding level set in the Control tab of the Analyzer Configuration menu; see section* *Measurement Control (Analyzer Configuration – Control) on p. 4.191.*

For analog analyzers, the level is entered in mV. Digital analyzer levels are controlled using full scale (FS) units, 1 FS corresponding to maximum analyzer level. The R&S CBT automatically uses an analog or digital analyzer, depending on the selected audio test scenario (see section *Audio Test Scenarios* on p. 4.222).

```
[SENSe:]AFLEVel<Applic>:MAXimum <Level>
[SENSe:]AFLEVel<Applic>:FSCale:MAXimum <Level>
      <Applic> = [:PRIMary] | :SECondary
```

AF Mode

The *AF Mode* hotkey determines how the input level is defined.

Manual	Manual input via *AF Max. Level* hotkey
Auto	Automatic setting according to the average power of the applied AF signal.

Two independent values can be set for the two applications AF Chan. One *(Analyzer 1)* and AF Chan. Two *(Analyzer 2)*.

Note: *The AF Mode setting supersedes the corresponding setting in the Control tab of the Analyzer Configuration menu; see section* *Measurement Control (Analyzer Configuration – Control) on p. 4.191.*

Remote control

```
[SENSE:]AFLevel<Applic>:MODE  MANual | AUTomatic
      <Applic> = [:PRIMary] | :SECondary
```

Generator Level

The *Generator Level* softkey defines the level of the AF multitone signal.

The generator level settings are described in more detail in section *Test Tones (Multitone Configuration – Tone Def.)* on page 4.205.

Display

The *Display* softkey scales or shifts the graphical display.

Level Scale

The *Level Scale* hotkey defines the level scale of the *Multitone* test diagram (ordinate scale). The level scale merely represents a display configuration that doesn't have any impact on the measurement or on the input signal path.

The level scale is calculated from a maximum value *(Max.)* and a *Span:*

- The *Max* value defines the upper edge of the diagram.
- The difference *Max – Span* defines the lower edge of the diagram.
- The number of horizontal grid lines (corresponding to 10, 15, or 16 cells) and the ordinate labeling is adapted to the range.

Remote control
no remote control command; screen configuration only

Tone Scale

The *Tone Scale* hotkey selects the display range (abscissa scale) of the test diagram. The range comprises 14 test tones which must be in consecutive order. This condition leaves the following options:

Tone 1 to 14 Display all results between tone 1 and tone 14

...

Tone 7 to 20 Display all results between tone 7 and tone 20

If a tone is within the selected range but disabled in the *Tone Def.* tab of the configuration menu (see section *Test Tones (Multitone Configuration – Tone Def.)* on page 4.205.), the corresponding result is not indicated, i.e. the bar is omitted and a gap occurs in the test diagram.

Remote control
no remote control command; screen configuration only

Default Scale

The *Default Scale* hotkey cancels all display configurations made and activates the default settings.

Remote control
no remote control command; screen configuration only

Menus

The *Menus* softkey displays the hotkey bar for switching over to the other measurement menus.

Measurement Results

The *Multitone* measurement menu displays the individual levels at up to 14 out of 20 different test tones, corresponding to 20 (not necessarily distinct) audio input frequencies. The results and the test settings are indicated in two parameter lines and the actual test diagram (bar graph) with its axis labels.

The measurement menus for the *AF Chan One* and *AF Chan Two* applications are analogous. If the *Stereo* application is active, the multitone analysis is performed twice at the *AF Chan. One* and *AF Chan. Two* frequencies. The two measurements are handled separately; the measurement diagram contains two bar graphs. The limit check is performed independently for the two sets of results.

Parameter lines

Test tone no. and frequency response

Bar graph with upper and lower limit lines

Test tone voltage and frequency

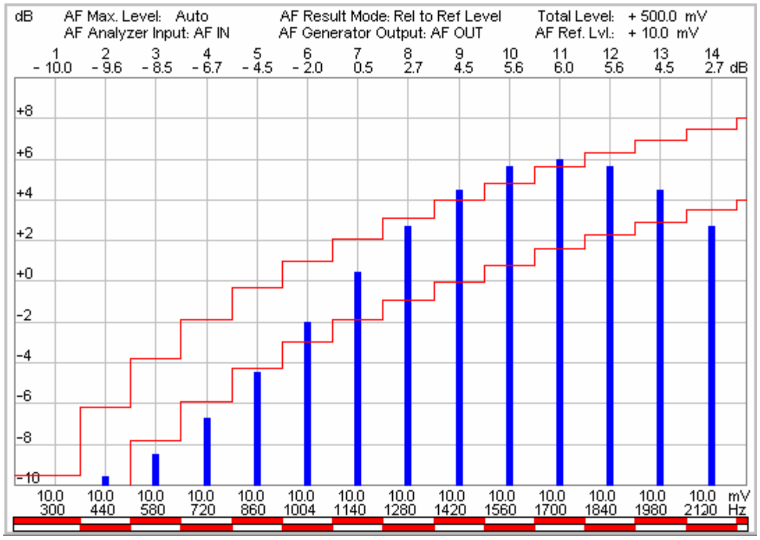


Fig. 4-36 Display of measurement results (Multitone)

Parameter lines The first parameter line contains the following settings and results:

AF Max. Level	Maximum AF input level in mV as set by means of the *AF Max. Level* softkey described on p. 4.198.
AF Result Mode	Reference value for all levels as set in the configuration menu (see section *Measurement Control (Multitone Configuration – Control)* on p. 4.202)
Total Level	Sum of the individual levels of all test tones measured in mV.

The second parameter line contains the following settings:

AF Analyzer Input	Input connector used for the Multitone measurement. In the AF Chan. One application, AF IN is used.
AF Generator Output	Output connector used for the Multitone measurement. In the AF Chan. One application, AF OUT is used.
AF Ref. Lvl	0-dB line in the test diagram as set in the configuration menu (see section *Measurement Control (Multitone Configuration – Control)* on p. 4.202).

Remote control
The settings are read out using the query corresponding to the setting command (setting command with appended question mark).

Bar graph The bar graph shows the AF level in dB at a maximum of 14 out of 20 different audio frequencies corresponding to a continuous range of test tones configured in the *Tone Def.* tab of the configuration menu (see p. 4.205). If a test tone is disabled in the configuration menu, the corresponding bar is omitted.

Frequency axis (abscissa) The range of test tones (no. 1 to 14, 2 to 15 etc.) to be viewed can be selected via the *Display – Tone Scale* hotkey (see p. 4.199). The bars representing the level of the different tones are equidistantly distributed over the whole diagram width. This optimizes the readability of the diagram but implies that the abscissa scale is not necessarily linear. Therefore, the frequency and voltage of every single test tone is displayed below the frequency axis.

Frequency response axis (ordinate) The ordinate can be arbitrarily scaled by setting a maximum and minimum value (both in dB). With a fixed ordinate, the adjustable 0 dB reference line (see *Level Scale* hotkey on p. 4.198) allows to shift the whole diagram vertically.

Remote control
`READ:ARRay:MULTitone:<Application>?` etc.
`READ[:SCALar]:MULTitone:<Application>:TONE<nr>?` etc.
`(<Application> = AF1Channel | AF2Channel | STEReo)`

Limit Check

The upper and lower limit lines for each test point defined in the *Limit Lines* tab of the configuration menu (see p. 4.204) correspond to the two red step functions in the diagram. If the result at a particular test point exceeds the upper limit (falls below the lower limit), the corresponding section of the upper (lower) bar across the bottom of the diagram turns red.

Remote control
```
CALCulate:ARRay:MULTitone:<Application>:MATChing:LIMit?
CALCulate[:SCALar]:MULTitone:<Application>:TONE<nr>:MATChing:
      LIMit?
CALCulate[:SCALar]:MULTitone:<Application>:MATChing:LIMit?
      (<Application> = AF1Channel | AF2Channel | STEReo)
```

Measurement Configurations (Multitone Configuration)

The popup menu *Multitone Configuration* contains four tabs which determine the parameters of the *Multitone* measurement including the error tolerances.

The popup menu *Multitone Configuration* is activated by pressing the main softkey (labeled *AF Chan. One* or *AF Chan. Two*, depending of the application selected) in the measurement menu *Multitone* twice. It is possible to change between the tabs by pressing the associated hotkeys.

Measurement Control (Multitone Configuration – Control)

The *Control* tab controls the *Multitone* measurement by determining

- The Repetition mode
- The *Stop Condition* for the measurement
- The AC or DC input *Path Coupling*
- A settling time for the AF generator *(AF Generator Lead)*
- The 0-dB line in the graphical diagram *(AF Ref. Level)*
- Reference value for all levels in the graphical diagram *(Result)*

Besides, it configures the measurement diagram by adding or removing the *Grid*. All parameters can be set independently for the two AF channels 1 and 2.

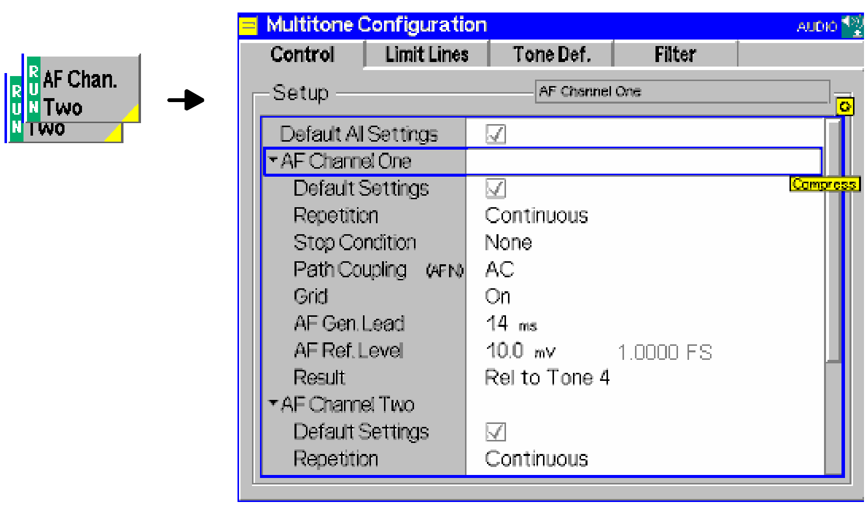


Fig. 4-37 Multitone Configuration – Control

Default Settings The *Default* switch assigns default values to all settings in the *Control* tab (the default values are quoted in the command description in chapter 6). Two additional default switches reset all *AF Channel One* or all *AF Channel Two* settings, respectively.

Remote Control: –

Repetition

Repetition determines the repetition mode, see Chapter 3 of this manual. In *Audio,* one statistics cycle is terminated when the system has settled and a valid result is available.

Remote control

```
CONFigure:MULTitone:<Application>:CONTrol:REPetition
      CONTinuous | SINGleshot | 1 ... 10000,NONE,<Stepmode>
      (<Application> = AF1Channel | AF2Channel | STEReo)
```

Stop Condition

Stop Condition defines a stop condition for the measurement:

None	Continue measurement even if tolerance is exceeded
On Limit Failure	Stop measurement if tolerance is exceeded

Remote control

```
CONFigure:MULTitone:<Application>:CONTrol:REPetition
        CONTinuous | SINGleshot | 1 ... 10000,NONE,<Stepmode>
           (<Application> = AF1Channel | AF2Channel | STEReo)
```

AF Path Coupling

*AF Path Coupling*sets the input path for measurement of the AC or AC and DC component of the AF signal:

AC	DC component of the measured AF signal (including a possible DC offset of the input amplifier) blocked. This ensures accurate measurement of the AC component. The DC component, however, can not be measured; the DC Voltage output field in the Analyzer/Generator menu indicates "---".
DC	Measurement of the complete AF input signal (DC plus AC components).

Note: *The AF path coupling has an impact on the allowed filter settings; see section* *Input Path Configuration (Multitone Configuration – Filter) on p. 4.207.*

Remote control

```
CONFigure:MULTitone:<Application>:COUPling  AC | DC
      (<Application> = AF1Channel | AF2Channel | STEReo)
```

AF Generator Lead

AF Generator Lead defines a settling time for the measurement to be applied after a change of the generator settings. A small value accelerates the measurement but may impair its accuracy.

Remote control

```
CONFigure:MULTitone:<Application>:AFGLead <Time>
      (<Application> = AF1Channel | AF2Channel | STEReo)
```

AF Ref. Level

AF Ref. Level defines an audio reference level. The reference level defines the 0 dB line of the test diagram provided that *Relative to Ref. Lev.* is selected as *Result* (see below). For analog generators, the level is entered in mV. Digital generator levels are controlled using full scale (FS) units, 1 FS corresponding to maximum generator level. The R&S CBT automatically uses an analog or digital generator, depending on the selected audio test scenario (see section *Audio Test Scenarios* on p. 4.222).

Remote control

```
CONFigure:MULTitone:<Application>:RLEVel <Voltage>
CONFigure:MULTitone:<Application>:FSCale:RLEVel
      (<Application> = AF1Channel | AF2Channel | STEReo)
```

Result The *Result* function defines the reference value for all measurement results. This corresponds to the 0 dB reference line in the diagram.

Relative to Ref. Lev. All results are referenced to the AF Ref. Level; see above

Relative to Tone 1 All results are referenced to the measurement result at tone 1 (if available)

...

Relative to Tone 20 All results are referenced to the measurement result at tone 20 (if available)

The measurement is taken at up to 20 audio frequencies (tone 1 to 20) which can be defined and switched on or off in the *Tone Def.* tab of the configuration menu (see page 4.205).

Remote control
```
CONFigure:MULTitone:<Application>:RMODe  RLEV | TON<nr>
      (<Application> = AF1Channel | AF2Channel | STEReo)
```

Limit Lines (Multitone Configuration – Limit Lines)

The *Limit Lines* tab defines upper and lower limits for the audio level at all test tones and enables or disables the limit check. All parameters can be set independently for the two AF channels 1 and 2.

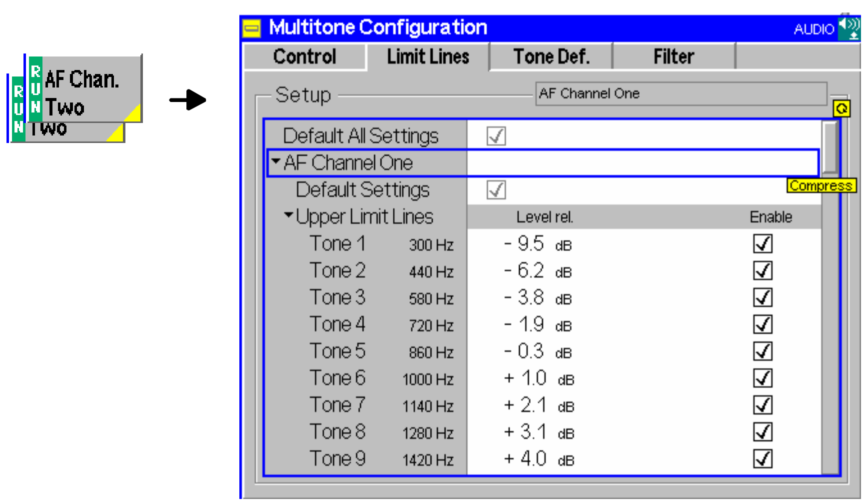


Fig. 4-38 Multitone Configuration – Limit Lines

Default Settings The *Default All Settings* switch assigns default values to all fields in the *Limit Lines* tab (the default values are quoted in the command description in chapter 6 of this manual). Two additional default switches reset all *AF Channel One* or all *AF Channel Two* settings, respectively.

Remote control
```
DEFault:MULTitone:LIMit:LINE  ON | OFF
DEFault:MULTitone:<Application>:LIMit:LINE  ON | OFF
      (<Application> = AF1Channel | AF2Channel | STEReo)
```

Upper Limit Line/ Lower Limit Line

Upper and lower limit lines for all 20 test points can be defined separately in the two table sections *Upper Limit Line* and *Lower Limit Line.*

The tone nos. and the corresponding frequencies are indicated in the two left columns of the table as defined in the *Tone Def.* tab (see p. 4.205). For each tone, the upper and lower limit can be entered as a single value in dB. The corresponding *Enable* checkbox switches the limit line in the test diagram and the limit check on (if checked) or off.

Remote control

```
CONFigure:MULTitone:<Application>:LIMit:LINE:ASYMmetric:UPPer
      <Limit_1>, <Enable_1>...
CONFigure:MULTitone:<Application>:TONE<nr>:LIMit:LINE
         :ASYMmetric:UPPer <Limit>, <Enable>
CONFigure:MULTitone:<Application>:LIMit:LINE:ASYMmetric:LOWer
         <Limit_1>, <Enable_1>...
CONFigure:MULTitone:<Application>:TONE<nr>:LIMit:LINE
         :ASYMmetric:LOWer <Limit>, <Enable>
         (<Application> = AF1Channel | AF2Channel | STEReo)
```

Test Tones (Multitone Configuration – Tone Def.)

The *Tone Def.* tab configures the audio test signal generated by the R&S CBT. This signal is composed of up to 20 test tones with different frequencies and levels. All parameters can be set independently for the two AF channels 1 and 2.

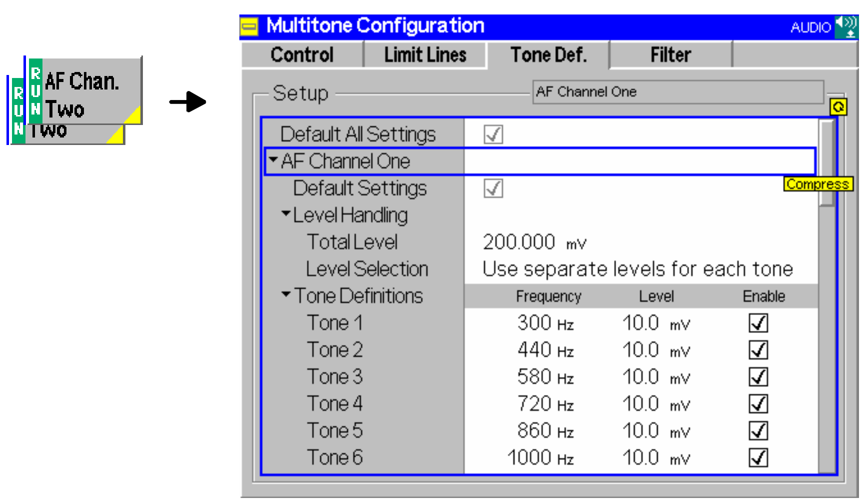


Fig. 4-39 Multitone Configuration – Tone Def.

Default Settings

The *Default All Settings* switch assigns default values to all fields in the *Tone Def.* tab (the default values are quoted in the command description in chapter 6 of this manual). Two additional default switches reset all *AF Channel One* or all *AF Channel Two* settings, respectively.

Remote control

```
DEFault:MULTitone:FILTer  ON | OFF
DEFault:MULTitone:<Application>:FILTer  ON | OFF
      (<Application> = AF1Channel | AF2Channel | STEReo)
```

Level Handling: Total Level

Total Level defines the sum of the individual voltages of all enabled tones. The meaning of the total level depends on the *Level Selection* setting (see below):

- If *Level Selection* is set to *Use Separate Levels,* a separate AF level can be assigned to each of the 20 test tones.
- If *Level Selection* is set to *Use Total Level,* a single sum level is defined for the whole multitone signal. This level is evenly distributed among all enabled test tones.

For analog generators, the levels are entered in mV. Digital generator levels are controlled using full scale (FS) units, 1 FS corresponding to maximum generator level. The R&S CBT automatically uses an analog or digital generator, depending on the selected audio test scenario (see section *Audio Test Scenarios* on p. 4.222).

The *Total Level* entered must not exceed the maximum level of the AF generator quoted in the data sheet.

Remote control
```
CONFigure:MULTitone:<Application>:TDEFinition:TLEVel
CONFigure:MULTitone:<Application>:FSCale:TDEFinition:TLEVel
          (<Application> = AF1Channel | AF2Channel | STEReo)
```

Level Selection

The *Level Selection* table section defines how the voltage of each of the test tones is determined:

Use separate levels for each tone
A separate AF level (in mV) can be assigned to each of the 20 test tones. The *Total Level* is ignored. It can still be edited for future measurements where the *Level Selection* parameter is set to *Manual*.

Use Total Level
A single sum level (also in mV) is defined for the whole multitone signal. This level is evenly distributed among all enabled test tones. This means that the level of each enabled test tone is set to *Total Level / n* where n is the number of enabled test tones (n = 1 to 20). If a test tone is disabled, the total level is maintained and the share of the remaining test tones in the total level increases.

Remote control
```
CONFigure:MULTitone:<Application>:TDEFinition:MODE
          SEParate | TLEVel
          (<Application> = AF1Channel | AF2Channel | STEReo)
```

Tone Definitions The *Tone Definitions* table assigns an audio *Frequency* (in Hz) and *Level* (RMS voltage in mV) to each of the 20 test tones.

The frequencies must be multiples of 1 Hz. It is possible, however, to define several tones at the same frequency, or to number the tones in arbitrary order: The x-axis is scaled by the **number** of the test tones, not by their frequency. The RMS voltages of different tones may coincide and can vary within the range quoted in the remote control command description in chapter 6 of this manual. The sum of all test tones must not exceed the maximum level of the AF generator quoted in the data sheet.

For analog generators, the levels are entered in mV. Digital generator levels are controlled using full scale (FS) units, 1 FS corresponding to maximum generator level. The R&S CBT automatically uses an analog or digital generator, depending on the selected audio test scenario (see section *Audio Test Scenarios* on p. 4.222).

Note: *The voltages of all test tones enabled can be set manually or automatically, depending on the setting of the* Level Selection *parameter described above.*

The *AF Gen.* checkbox switches the tone in the audio signal and the corresponding bar in the test diagram on (if checked) or off.

Remote control
```
CONFigure:MULTitone:<Application>:TDEFinition
CONFigure:MULTitone:AF1CHannel:FSCale:TDEFinition
         <Freq_1>,<Level_1>,<Enable_1>,...
CONFigure:MULTitone:<Application>:TDEFinition:TONE<nr>
CONFigure:MULTitone:AF1CHannel:FSCale:TDEFinition:TONE<nr>
         <Freq>,<Level>,<Enable>,...
         (<Application> = AF1Channel | AF2Channel | STEReo)
```

Input Path Configuration (Multitone Configuration – Filter)

The *Filter* tab configures the receive path of the R&S CBT for the *Multitone* measurement (see Fig. 4-40 below). All parameters can be set independently for the two AF channels 1 and 2.

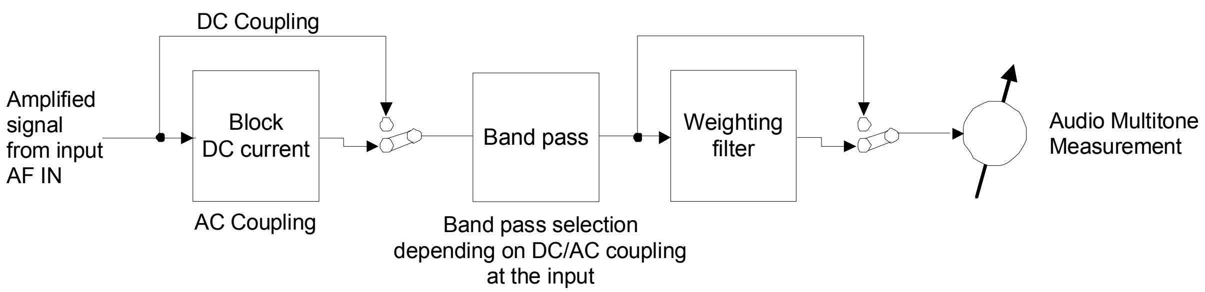


Fig. 4-40 Signal path for Multitone measurements

The audio receive path of the R&S CBT may contain the following filter stages:

AF Path Coupling	Capacitor stage to block the DC component of the AF input signal including a possible DC offset of the input amplifier. With DC coupling, the complete AF input signal is measured.
Weighting	Weighting filter according to CCITT or C-message weighted filter.
Band Pass	Audio band pass filter with selectable bandwidth to limit the input frequencies to a definite audio band and eliminate unwanted signal components. The allowed bandwidth depends on the *AF Path Coupling.*

The audio results are generated at the end of the audio receive path, after the audio signal has passed all filter stages that are switched on.

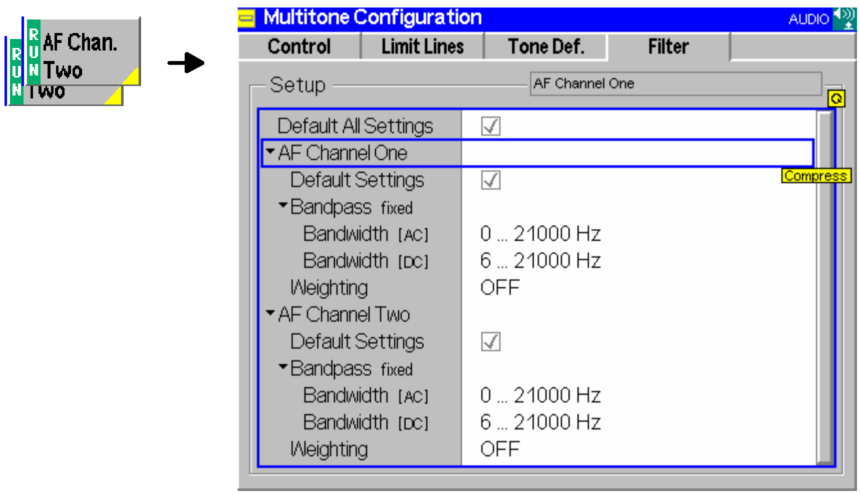


Fig. 4-41 Multitone Configuration – Filter

Default All Settings

The *Default All Settings* switch assigns default values to all fields in the *Filter* tab (the default values are quoted in the command description in chapter 6). Two additional default switches reset all *AF Channel One* or all *AF Channel Two* settings, respectively.

Remote control
```
DEFault:MULTitone:FILTer ON | OFF
DEFault:MULTitone:<Application>:FILTer ON | OFF
       (<Application> = AF1Channel | AF2Channel | STEReo)
```

AF Channel One

The table section *AF Channel One* defines the input path for the *Multitone* measurement. The following settings are provided:

Band pass	Selection of the bandwidth of the R&S CBT's audio band pass. A separate band pass can be selected for AC coupling and DC coupling.
Weighting	Use of an A-weighted filter, a C-message weighted filter *(C-Message)*, a *CCITT* weighting filter or none of these filters *(OFF)*.

The R&S CBT provides a broad selection of bandwidths with lower cutoff frequencies between 0 Hz and 300 Hz and upper cutoff frequencies between 250 Hz and 21 kHz (see command description in chapter 6).

Note: *If the AF Path Coupling is set to DC (see section Measurement Control (Multitone Configuration – Control) on page 4.202), the audio analyzer receives the complete AF input signal including a possible DC component. To avoid measurement inaccuracies, a band pass with a lower cutoff ≥ 6 Hz must be used.*

Remote control

```
CONFigure:MULTitone:<Application>:FILTer:BPASs:DCCoupling
                <Bandwidth>
CONFigure:MULTitone:<Application>:FILTer:BPASs:ACCoupling
                <Bandwidth>
CONFigure:MULTitone:<Application>:FILTer:BPASs:WEIGhting
        CME | CCI | OFF
        (<Application> = AF1Channel | AF2Channel | STEReo)
```

Total Harmonic Distortion (THD)

The Total Harmonic Distortion *(THD)* application provides a single-frequency audio test signal with adjustable power and very low harmonic distortion and measures the AF power at the generator frequency (1^{st} harmonic labeled d1) and at the 2^{nd}, 3^{rd} … 9^{th} harmonics. These results yield the Total Harmonic Distortion, defined as the ratio of the summed up power of the 2^{nd}, 3^{rd} … 9^{th} harmonics to the power of all harmonics including the fundamental signal.

The THD is obtained in a frequency-selective measurement at the harmonic frequencies. The measurement is accessed from the *Menu Select* menu. It provides three independent applications which can be started and stopped using the *AF Chan. One, AF Chan. Two,* or *Stereo* measurement control softkeys:

- In the AF Chan. One application, the AF generator signal is routed to the AF 1 OUT connector; the received audio signal is measured at AF 1 IN.
- In the AF Chan. Two application, the AF generator signal is routed to the AF 2 OUT connector; the received audio signal is measured at AF 2 IN.
- The Stereo application is a combination of the previous two applications, where the R&S generates and analyzes two audio signals at equal or different frequencies.

In the standard test setup for the *AF Chan. One* or *AF Chan. Two* applications, the AF generator signal is fed to the input of a DUT, and the R&S CBT measures the harmonic distortion caused by the DUT's nonlinear behavior. When using an external test signal for this type of THD measurements, ensure that it is sufficiently free from distortion.

The *Stereo* application is primarily suited for THD tests on Bluetooth devices with a stereo audio output, e.g. for the *Earphone / Speaker* test.

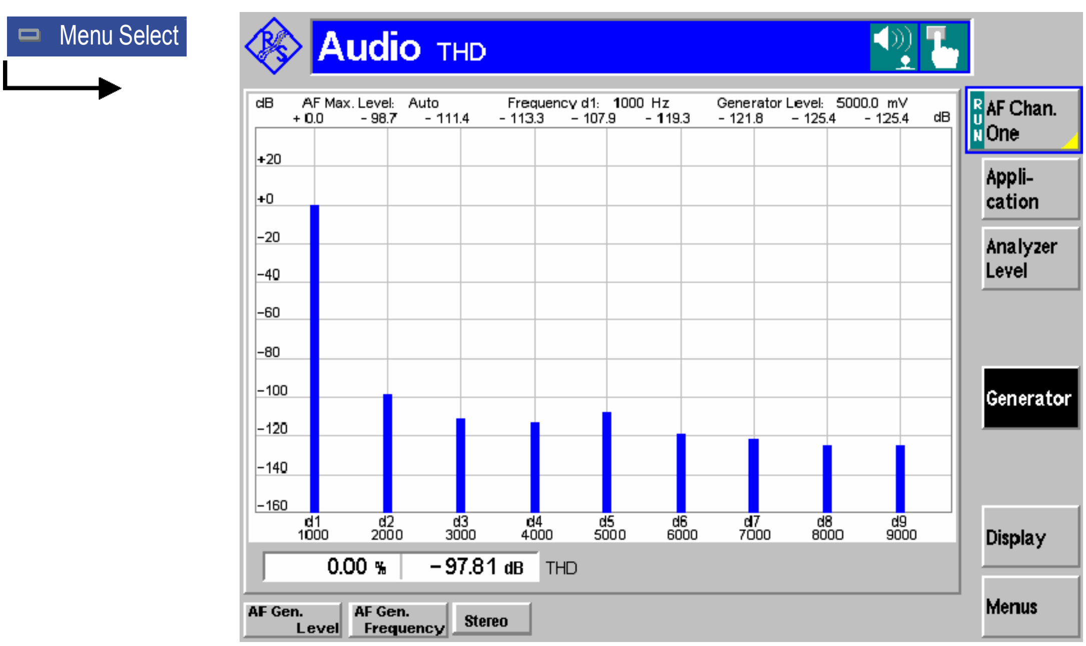


Fig. 42 Display of results (Audio – THD)

Test Settings

The softkeys and associated hotkeys provide the most important test settings. They are analogous to the other *Audio* measurements; see section *Test Settings* on p. 4.186. The *THD Configuration* menu is described on p. 4.211.

Measurement Results

The diagram in the *Audio – THD* menu shows the levels of the 1^{st} harmonic d1 and of the harmonics d2 … d9 in dB. The 1^{st} harmonic provides the 0-dB level reference. By definition, the frequency of the n^{th} harmonic is equal to n times the d1 frequency. The diagram scale can be changed using the *Display – Level Scale* hotkey.

Below the diagram, the THD is displayed as a percentage and as a dB-value. The percentage value is calculated from the ratio of the summed up power of the 2nd, 3rd … 9th harmonics to the power of all harmonics including the fundamental signal:

$$THD[\%] = \sqrt{\frac{U^2{}_{d2} + U^2{}_{d3} + ... + U^2{}_{d9}}{U^2{}_{d1} + U^2{}_{d2} + U^2{}_{d3} + ... + U^2{}_{d9}}} \cdot 100\ \%$$

The dB result is calculated according to:

$$THD[dB] = 20 \cdot \log(THD\,[\%]\,)$$

The THD value never exceeds 100 % or 0 dB; its value is always smaller than the Total Harmonic Distortion and Noise *(THD + N)* provided in the audio *Analyzer/Generator* measurement. Harmonics at frequencies above 21 kHz are not evaluated and do not contribute to the THD. Moreover it is possible to exclude one or more harmonics from the THD calculation; see *Measurement Control (THD Configuration – Control)* on p. 4.211.

Stereo application

If the *Stereo* application is active, the THD analysis is performed twice at the *AF Chan. One* and *AF Chan. Two* frequencies. The two measurements are handled separately so that the formulas above hold for each measurement. The measurement diagram contains two bar graphs and two pairs of THD results.

Remote control

`READ[:SCALar]:THD:AF1Channel:THD?`
`FETCh[:SCALar]:THD:AF1Channel:THD?`
`READ:ARRay:THD:AF1Channel?`
`FETCh:ARRay:THD:AF1Channel?` (similar for AF2Channel and Stereo)

Measurement Configurations

The popup menu *THD Configuration* contains two tabs which determine the parameters of the *THD* measurement.

The popup menu *THD Configuration* is activated by pressing the main softkey (labeled *AF Chan. One* or *AF Chan. Two* or *Stereo*, depending of the application selected) in the measurement menu *THD* twice. It is possible to change between the tabs by pressing the associated hotkeys.

Measurement Control (THD Configuration – Control)

The *Control* tab of the configuration menu provide statistical settings and controls the generated and measured signals.

The two applications *AF Chan. One* or *AF Chan. Two* provide two completely independent sets of measurement settings.

Note: *With the exception of the* Repetition Mode, *the* AF Chan One *and* AF Chan Two *settings are also valid for the* Stereo *application. In remote control, the* Stereo *application provides additional commands for simultaneous configuration of the* AF Chan One *and* AF Chan Two *settings.*

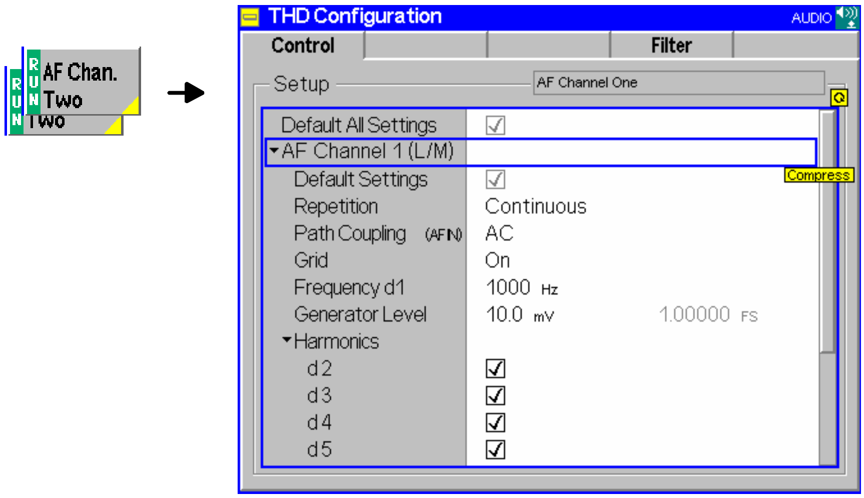


Fig. 43 THD Configuration – Control

AF Channel 1

Repetition — Single shot or continuous THD measurement. In *Audio*, one statistics cycle is terminated when the system has settled and valid results are available.

Path Coupling — Sets the input path for measurement of the AC or AC and DC component of the AF signal. If *AC* is set, the DC component of the measured AF signal (including a possible DC offset of the input amplifier) is blocked. This ensures an accurate measurement of the AC component. The DC component, however, cannot be measured and has no impact on the THD results. If *DC* is set, the complete AF input signal (DC plus AC components) is measured.

Note: The AF path coupling has an impact on the allowed filter settings; see section *Input Path Configuration (Multitone Configuration – Filter)* on p. 4.207.

Grid — Displays or removes the grid in the diagram

Frequency d1 — Frequency of the audio generator and of the first harmonics d1

Generator Level — RMS level of the generated first harmonic. For analog generators, the level is entered in mV. Digital generator levels are controlled using full scale (FS) units, 1 FS corresponding to maximum generator level. The R&S CBT automatically uses an analog or digital generator, depending on the selected audio test scenario (see section *Audio Test Scenarios* on p. 4.222).

Harmonics — List of harmonics d2 to d9. Unchecked harmonics are measured and displayed in the diagram, however, they are not included in the calculation of the THD. Harmonics at frequencies above 21 kHz are not measured.

Remote control

```
CONFigure:THD:AF1Channel:CONTrol:REPetition
CONFigure:THD:AF1Channel:COUPling AC | DC
CONFigure:THD:AF1Channel:TDEFinition
CONFigure:THD:AF1Channel:HARMonics<nr>
```

(similar for `AF2Channel` and `STEReo`)

Input Path Configuration (THD Configuration – Filter)

The *Filter* tab configures the receive path of the R&S CBT for the *THD* measurement. All parameters can be set independently for the two AF channels 1 and 2. The settings are also valid for the *Stereo* application.

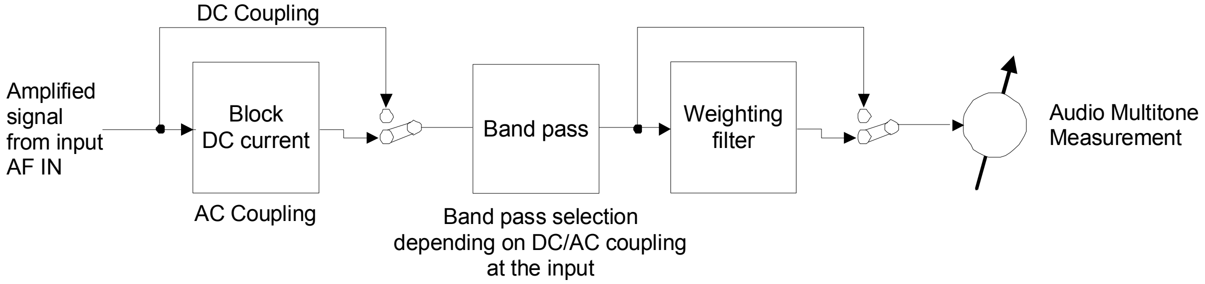


Fig. 44 Signal path for THD measurements

The audio receive path of the R&S CBT may contain the following filter stages:

AF Path Coupling	Capacitor stage to block the DC component of the AF input signal including a possible DC offset of the input amplifier. With DC coupling, the complete AF input signal is measured.
Weighting	Weighting filter according to CCITT or C-message weighted filter.
Band Pass	Audio band pass filter with selectable bandwidth to limit the input frequencies to a definite audio band and eliminate unwanted signal components. The allowed bandwidth depends on the *AF Path Coupling.*

The audio results are generated at the end of the audio receive path, after the audio signal has passed all filter stages that are switched on.

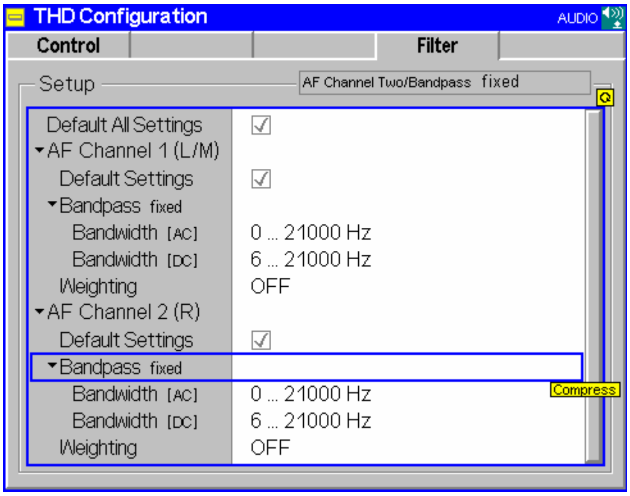


Fig. 45 THD Configuration – Filter

Default All Settings

The *Default All Settings* switch assigns default values to all fields in the *Filter* tab (the default values are quoted in the command description in chapter 6). Two additional default switches reset all *AF Channel One* or all *AF Channel Two* settings, respectively.

Remote control
```
DEFault:THD:FILTer ON | OFF
DEFault:THD:AFxChannel:FILTer ON | OFF (x = 1,2)
```

AF Channel One The table section *AF Channel One* defines the input path for the *THD* measurement. The following settings are provided:

Band pass	Selection of the bandwidth of the R&S CBT's audio band pass. A separate band pass can be selected for AC coupling and DC coupling.
Weighting	Use of an A-weighted filter, a C-message weighted filter *(C-Message)*, a *CCITT* weighting filter or none of these filters *(OFF)*.

The R&S CBT provides a broad selection of bandwidths with lower cutoff frequencies between 0 Hz and 300 Hz and upper cutoff frequencies between 250 Hz and 21 kHz (see command description in chapter 6).

Note: *If the AF Path Coupling is set to DC (see section Measurement Control (Multitone Configuration – Control) on page 4.202), the audio analyzer receives the complete AF input signal including a possible DC component. To avoid measurement inaccuracies, a band pass with a lower cutoff ≥ 6 Hz must be used.*

Remote control

```
CONFigure:THD:AFxChannel:FILTer:BPASs:DCCoupling
                <Bandwidth>
CONFigure:THD:AFxChannel:FILTer:BPASs:ACCoupling
                <Bandwidth>
CONFigure:THD:AFxChannel:FILTer:BPASs:WEIGhting
                CME | CCI | OFF  (x = 1,2)
```

The *Stereo* application is configured using the `AFxChannel` commands.

Audio Profiles (Option R&S CBT-K54)

A profile defines the requirements for Bluetooth devices to support a particular use case. Compliance with the profile specification ensures interoperability between different Bluetooth devices. With option R&S CBT-K54, the R&S CBT provides the following profiles:

- **Headset** (HS) profile. This profile is used by headsets, sometimes also by personal computers, cellular phones etc. Equipment using the headset profile is wirelessly connected to another Bluetooth device, e.g. a cellular phone. The phone plays the role of a bidirectional audio gateway, whereas the headset acts as the gateway's remote audio input and output.
- **Hands-Free** (HF) profile. This profile is used by hands-free units that are commonly used together with cellular phones. A typical example is a car's embedded hands-free unit that is wirelessly connected to a cellular phone. Again, the cellular phone plays the role of an audio gateway, with the hands-free unit acting as the gateway's remote audio input and output. The CBT supports the hands-free profile version V1.5.

The R&S CBT can test Bluetooth devices acting as headset/hands-free units or as audio gateways. The role of the R&S CBT and the DUT is implicitly defined together with the profile selection.

Connecting a DUT for audio profile tests

The audio profiles extend the list of available submodes in the *Connection* tab of the *Connection Control* menu. This means that the audio profile modes can be activated like any other submode of the *Connected* signalling state (see Bluetooth signalling state machine on p. 4.51 of the R&S CBT operating manual).

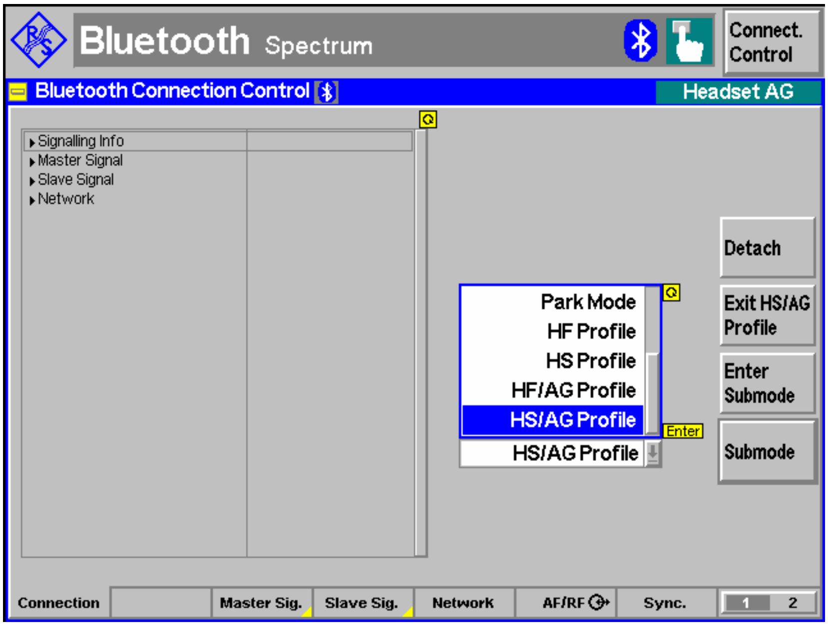


Fig. 4-53 Audio profile modes

Preparatives

Prior to connection, the Bluetooth DUT must be paired with the tester. On the R&S CBT, this involves an inquiry and detection of the DUT's Bluetooth device address. Moreover, most DUTs require a correct PIN code from the R&S CBT in order to set up the connection or enter the selected audio profile submode.

1. Establish an RF connection between the RF connector *RF IN/OUT* of the R&S CBT and the DUT, switch on both devices.
2. Ensure that the R&S R&S CBT is in *Standby* signalling state and that the pairing mode at the DUT is enabled.
3. Press *Connection Control – Connect – Inquire* and wait until the R&S CBT has stored the DUT's Bluetooth address.

4. Press *Master Sig. – Paging – PIN Code* and enter the PIN code of the device, if necessary (many devices use the default PIN „0000“).

Note: *Some devices also require authentication to be turned on (Authentication Required: On).*

5. Return to the *Connection* tab, press *Connect,* and wait until the R&S CBT has entered the *Connected* state. If necessary, reopen the *Connection Control* menu.

Submode selection

6. Press *Submode* and select an appropriate audio profile mode. If your DUT is a headset/hands-free unit, select the *HS Profile* or *HF Profile*, respectively. The R&S CBT will mimic the corresponding audio gateway. If your DUT is a phone (or another device acting as an audio gateway), select *HS/AG Profile* or *HF/AG Profile.* The R&S CBT will mimic the corresponding handset or hands-free device.

Note: *If you connect to a cellular phone you might be prompted to enter an appropriate PIN. You can lengthen the time you have to enter the PIN by increasing the page timeout value, e.g. to a value around 30,000 slots (Connection Control – Master Sig. – Paging – Page Timeout).*

Performing audio tests

Audio tests in the audio profile submodes can be performed as described in section *Audio Measurements* on p. 4.129 of the R&S CBT operating manual, with a speaker and a microphone connected to the analog output and input connectors *SPEECH CODEC OUT / IN* of the R&S CBT.

If the audio option R&S CBT-B41 is available in addition, it is possible to provide a controlled audio signal for the DUT and route the audio signals from the DUT to the audio analyzer; see section *Audio Option* in this chapter.

Note: *A Bluetooth device that complies with one of the audio profiles does not necessarily have to support the low-level Audio submode.*

Remote Control

The audio profiles extend the following remote control commands (see chapter 6 of this manual):

```
PROCedure:SIGNalling:ACTion
[SENSe:]SIGNalling:XSTate?
[SENSe:]SIGNalling:STATe?
```

A2DP (Sink) Profile (Option R&S CBT-K52)

A profile defines the requirements for Bluetooth® devices to support a particular use case. Compliance with the profile specification ensures interoperability between different Bluetooth devices. With option R&S CBT-K52, the R&S CBT provides the following additional profile:

- **Advanced Audio Distribution Profile (A2DP)**. This profile is used by headphones or speakers. A typical use case is the streaming of high-quality audio content (e.g. music) from a stereo music player. The audio content is distributed in mono or stereo on ACL channels using a compressed format for efficient use of the bandwidth. A2DP is different from the Bluetooth® audio profiles (e.g. the *Headset (HS)* and *Hands-Free (HF)* profiles that the R&S CBT supports with option R&S CBT-K54) that distribute voice on SCO channels.

The role of the R&S CBT and the DUT is implicitly defined together with the profile selection. The R&S CBT always acts as audio source, transmitting audio data over the Bluetooth (RF) link, while the DUT acts as an audio sink.

Connecting a DUT for A2DP tests

The A2DP (Sink) audio profile extends the list of available submodes in the *Connection* tab of the *Connection Control* menu. This means that it can be activated like any other submode of the *Connected* signalling state (see Bluetooth signalling state machine on p. 4.51 of the R&S CBT operating manual).

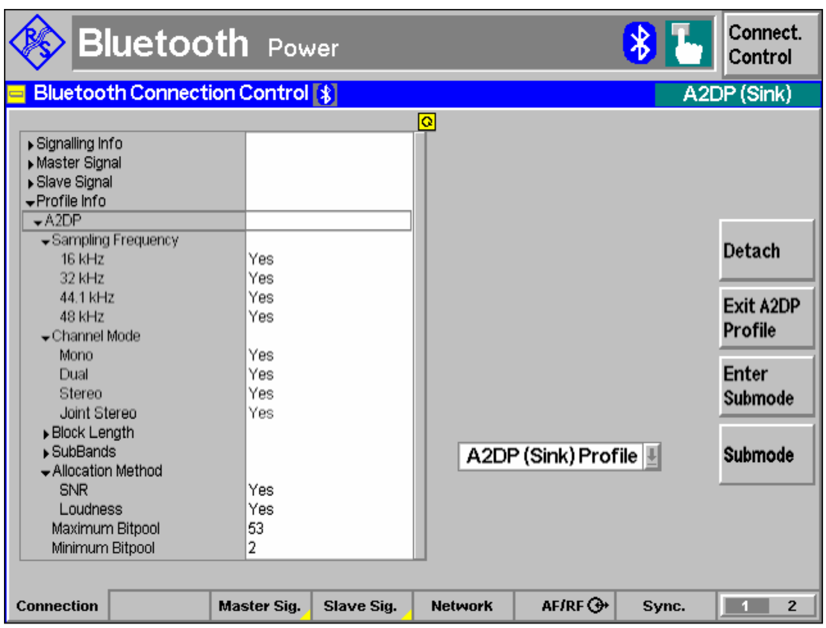


Fig. 46 A2DP (Sink) profile mode

Preparatives

Prior to connection, the Bluetooth DUT must be paired with the tester. On the R&S CBT, this involves an inquiry and detection of the DUT's Bluetooth device address. Moreover, most DUTs require a correct PIN code from the R&S CBT in order to set up the connection or enter the selected audio profile submode.

1. Establish an RF connection between the RF connector *RF IN/OUT* of the R&S CBT and the DUT, switch on both devices.
2. Ensure that the R&S R&S CBT is in *Standby* signalling state and that the pairing mode at the DUT is enabled.
3. Press *Connection Control – Connect – Inquire* and wait until the R&S CBT has stored the DUT's Bluetooth address.
4. Press *Master Sig. – Paging – PIN Code* and enter the PIN code of the device, if necessary (many devices use the default PIN „0000").

Note: *Some devices also require authentication to be turned on (Authentication Required: On).*

5. Return to the *Connection* tab, press *Connect,* and wait until the R&S CBT has entered the *Connected* state. If necessary, reopen the *Connection Control* menu.

Submode selection

6. Press *Submode* and select *A2DP (Sink)*. The R&S CBT will mimic an audio source in accordance with the A2DP profile specification.

Note: *If you connect to a cellular phone you might be prompted to enter an appropriate PIN. You can lengthen the time you have to enter the PIN by increasing the page timeout value, e.g. to a value around 30,000 slots (Connection Control – Master Sig. – Paging – Page Timeout).*

Performing A2DP audio tests

Audio tests in the *A2DP (Sink)* submode can be performed as described in section *Audio Test Scenarios on p.* 4.222. For many use cases, it is advantageous to install the audio option R&S CBT-B41 in addition. The audio option provides a controlled audio signal for the DUT and can route the audio signals from the DUT to the audio analyzer; see section *Audio Option* in this chapter.

Note: *A Bluetooth device that complies with one of the audio profiles does not necessarily have to support the low-level Audio submode.*

Remote Control

The A2DP profile extends the following remote control commands:

`PROCedure:SIGNalling:ACTion SINK | SSINk`

(enter/exit *A2DP (Sink) Profile* submode)

`[SENSe:]SIGNalling:XSTate?`

(Query signalling state. The response `SINK` indicates that the *A2DP (Sink) Profile* submode is active)

A2DP (Sink) Profile Submode Settings

The *Audio – A2DP* settings control the coding of audio data that the Bluetooth® DUT receives and decodes in *A2DP (Sink) Profile* submode. The information is signaled to the Bluetooth DUT which acts as an audio sink. The R&S CBT supports Sub-Band Coding (SBC), which is mandatory for the A2DP profile. All profile settings are accessible from the *Network* tab of the *Connection Control* menu.

The SBC specifications are part of the Bluetooth® specification. For detailed reference refer to appendix B of the “Advanced Audio Distribution Profile Specification”.

Note: *The SBC settings that the connected Bluetooth® DUT supports are displayed in the* Connection Control – Connection *tab while the R&S CBT is in* A2DP (Sink) Profile *submode (see section* *Display of Profile Info on p.* 4.221*). According to the specification, an audio sink must support all available SBC settings.*

The Audio – SCO *settings in the* Network *tab configure the* Audio *submode. They are identical with the* Audio *settings described in the R&S CBT operating manual.*

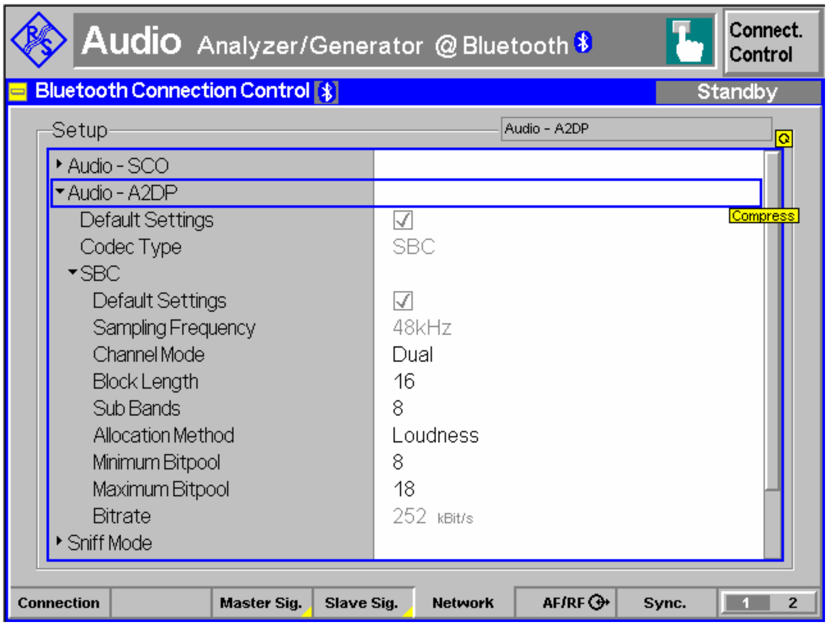


Fig. 47 Connection Control – Network: Audio – A2DP settings

Audio – A2DP The *Audio – A2DP* settings configure the audio Sub-Band Coding (SBC) codec settings. The codec type is displayed for information. The parameters are identical with the “Codec Specific Information Elements” described in the “Advanced Audio Distribution Profile Specification”.

Sampling Frequency The fixed audio sampling frequency of 48 kHz is displayed for information.

Channel Mode The mode in which the audio samples are encoded.

MONO single channel encoding

DUAL two independent channel encoding (each channel is encoded independently, in simple terms 2 * MONO channel mode)

STEREO two channel encoding (encoding uses the audio data in both left and right channels)

JOINT STEREO two channel encoding (encoding uses the audio data in both left and right channels), encoding is done on L+R and L-R audio samples

Block Length Number of blocks of audio samples that are encoded in a single SBC frame. The following relations hold:

Number of audio sampling instants encoded in a single SBC Frame = Number of sub bands * Block Length

Number of audio samples encoded in a single SBC Frame = Number of sub bands * Block Length * Number of Channels

(Number of Channels = 1 for MONO and 2 for DUAL/STEREO/JSTEREO channel mode)

Sub Bands The number of sub bands the audio spectrum is subdivided into for analysis and encoding.

Allocation Method The method which defines the algorithm used to calculate the number of bits allocated to represent each sub band sample.

Minimum Bitpool / Maximum Bitpool For MONO/DUAL modes, the bitpool is the number of bits used to represent one block of audio sample data for one channel. For STEREO/JOINT STEREO modes, this is the number of bits used to represent one block of audio samples (both left and right channels). The following relations hold:

Number of audio sampling instants for one block = Number of subbands

Number of audio samples in one block = Number of subbands * Number of channels

(Number of channels = 1 for MONO and 2 for DUAL/STEREO/JSTEREO)

The CBT uses the maximum bitpool value to encode the audio stream.

Bitrate The bit rate is calculated from the previous SBC settings and indicated for information. The value turns red if it exceeds the allowed maximum value; see section *Bit Rate Calculation and Restrictions* on p. 4.220.

Remote control

```
CONFigure:NETWork:AUDio:A2DP:CTYPe?
CONFigure:NETWork:AUDio:A2DP:SBC:SFRequency?
CONFigure:NETWork:AUDio:A2DP:SBC:CMODe
CONFigure:NETWork:AUDio:A2DP:SBC:BLENgth
CONFigure:NETWork:AUDio:A2DP:SBC:SBANds
CONFigure:NETWork:AUDio:A2DP:SBC:AMEThod
CONFigure:NETWork:AUDio:A2DP:SBC:BITPool:MINimum
CONFigure:NETWork:AUDio:A2DP:SBC:BITPool:MAXimum
```

Bit Rate Calculation and Restrictions

The bit rate in kbps for the transferred audio data is calculated as described in section 12.9 of the Bluetooth® “Advanced Audio Distribution Profile Specification”:

$$< Bitrate >= 8 \times \frac{< Frame\ Length > \times < Sampling\ Frequency >}{< Sub\ Bands > \times < Block\ Length >}\ .$$

The relationship between the bitrate, the no. of sub bands, and the block length is nonlinear because the frame length also depends on the sub bands and the block length. The calculation of the frame length in bytes depends on the channel modes. For MONO channel mode it is obtained as

$$\begin{aligned}< Frame\ Length\ MONO >= 4 + \frac{< Sub\ Bands >}{2} + \\ + ceiling\left(\frac{< Block\ Length > \times < Maximum\ Bitpool >}{8}\right)\end{aligned}\ .$$

For DUAL channel the frame length is

$$\begin{aligned}< Frame\ Length\ DUAL >= 4 + < Sub\ Bands > + \\ + ceiling\left(\frac{< Block\ Length > \times < Maximum\ Bitpool >}{4}\right)\end{aligned}$$

For STEREO channel mode, the frame length is

$$< Frame\ Length\ STEREO >= 4 + < Sub\ Bands > + \\ + ceiling\left(\frac{< Block\ Length > \times < Maximum\ Bitpool >}{8}\right)$$

<Frame Length> = 4 + <Sub Bands> .

For JOINT STEREO channel mode, the frame length is

$$< Frame\ Length\ JOINT\ STEREO >= 4 + < Sub\ Bands > + \\ + ceiling\left(\frac{< Sub\ Bands > + < Block\ Length > \times < Maximum\ Bitpool >}{8}\right)$$

According to the "Advanced Audio Distribution Profile Specification", the maximum bit rate for the audio decoder of a Bluetooth® DUT acting as an audio sink is 320 kBit/s for MONO, and 512 kBit/s for the two-channel modes. If a combination of SBC settings results in a higher bit rate, the value is displayed with red color, and the R&S CBT will not be able to enter the *A2DP (Sink) Profile* submode.

Display of Profile Info

While in *A2DP (Sink) Profile* submode, the R&S CBT displays the "Codec Specific Information Elements" that the connected Bluetooth® DUT supports. The information appears in the *Profile Info* section of the *Connection Control – Connection* tab; it corresponds to the SCB codec settings described in section *A2DP (Sink) Profile Submode Settings* on p. 4.218. An audio sink must support sampling frequencies of 44.1 KHz and 48 kHz and all displayed *Channel Mode*, *Block Length*, *Sub Band,* and *Allocation Method* values.

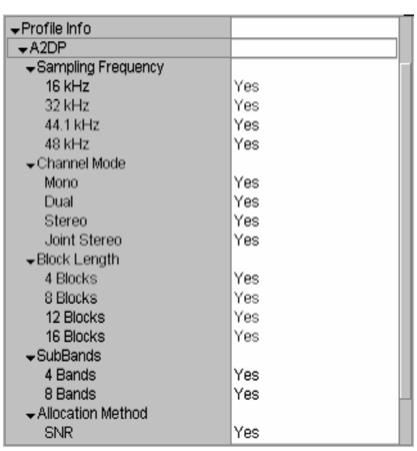


Fig. 48 Display of profile information

Remote control `[SENSe:]PROFile:A2DP:…?`

Audio Test Scenarios

The signal routing and the state of all digital and analog audio connectors of the R&S CBT is shown in the *AF/RF In/Out* menu. There is no need to change the signal routing for each connector individually. Instead of that, a set of predefined connector configurations *(Connector Config)* route all signals according to the needs of a typical test scenario.

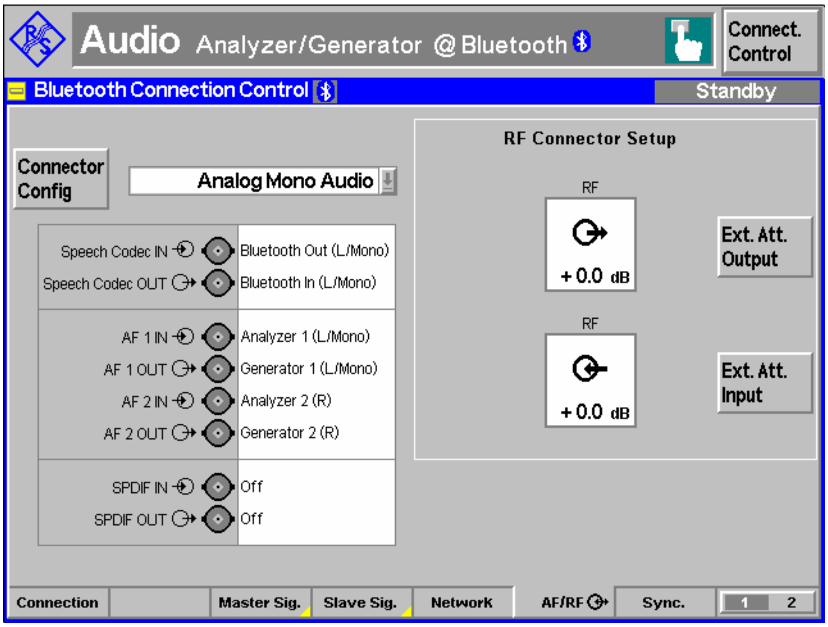
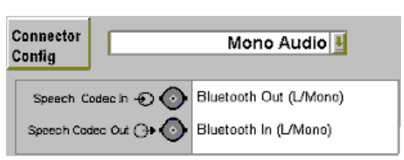


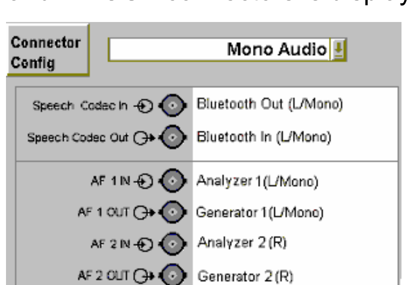
Fig. 49 Connection Control – AF/RF In/Out

Connector List The audio connectors in the connector overview in the left half of the dialog depend on the installed R&S CBT hardware options:

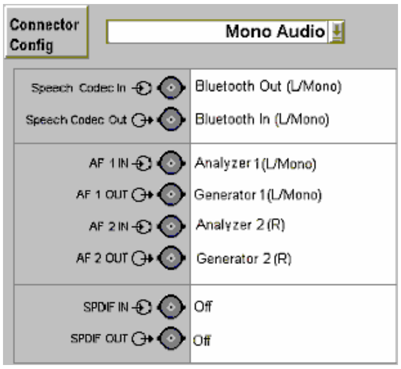
- If none of the options R&S CT-B41 and R&S CBT-B42 is installed, the speech codec settings are displayed only. Only *Analog Mono Audio* connector configuration is possible.



- With option R&S CBT-B41, *Audio Measurement Unit,* the group of AF IN and AF OUT connectors is displayed in addition.



- With option R&S CBT-B42, *Digital Audio Interface,* the SPDIF IN and SPDIF OUT connectors are displayed in addition. These connectors can be used for audio testing with external digital equipment. Note that installation of option R&S CBT-B42 also requires option R&S CBT-B41.



Mono and stereo channel types

In stereo configurations, connector pairs such as AF 1 IN and AF 2 IN or AF 1 OUT and AF 2 OUT are often used for the Left (L) and Right (R) channels. If the audio link is single channel (mono) only, then it is transported through the Left audio channel within the CBT. The Right audio channel will not have any data in this scenario.

Generator and analyzer types

The selected connector configuration has an impact on the generator and analyzer types in the *Audio* measurement group. The following table gives an overview. For more information refer to the detailed description of the test scenarios below.

Note: *Some of the analog generator or analyzer settings may be redundant for digital generators or analyzers and vice versa. Redundant parameters are grayed in the menus of the* Audio *measurement group.*

Table 1 Digital/analog analyzers and generators for different connector configurations

Connector Configuration	**Generator**	**Analyzer**
Analog Mono Audio	Analog	Analog
Analog Stereo Audio	Analog (but not used)	Analog (but not used)
Digital Stereo Audio	Analog	Analog
Microphone Test	Analog	Digital
Earphone / Speaker Test	Digital	Analog
Audio Link Test	Digital	Digital

Restrictions

The R&S CBT supports SCO and A2DP test signals in the downlink. SCO signals are always mono signals, the A2DP profile uses mono or stereo channel modes.

In the uplink, the R&S CBT supports mono SCO signals but no A2DP signals. This restricts the test functionality for some of the connector configurations; refer to the detailed description below.

Remote control `CONFigure:AFRFsync:CCONfig`

Schematic Description of Connector Configurations

In the following sections, the signal flow for the different test scenarios is shown in schematics of the same type.

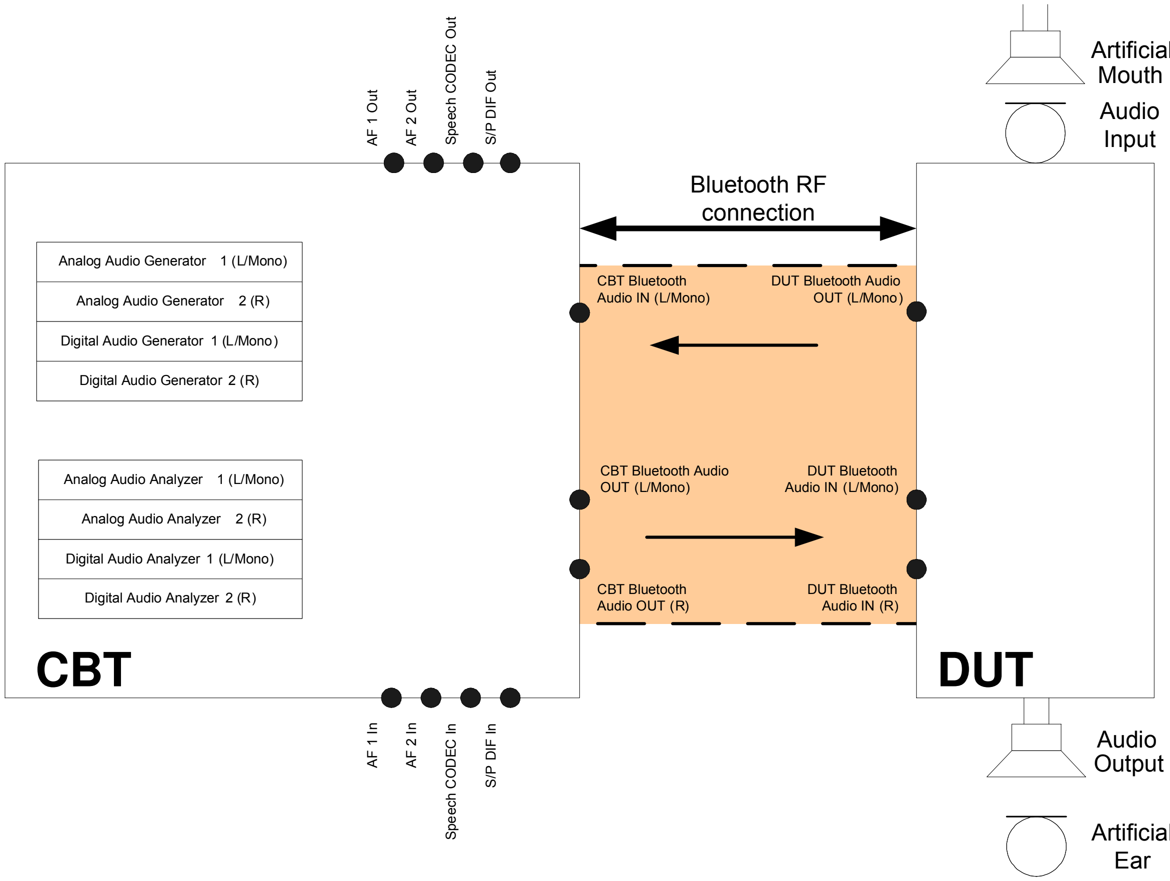


Fig. 50 Schematic description of connector configurations

The schematics show three basic functional blocks and ports for audio test scenarios (from left to right):

- Bluetooth tester R&S CBT with different audio analyzer and generator types and audio connectors.
- Bluetooth RF link between the RF connector RF IN/OUT of the R&S CBT and the RF input/output of the DUT (shaded area). The “Bluetooth audio” inputs and outputs are logical. Physically, they are all encompassed by the single RF link.
- The Bluetooth DUT with audio inputs and outputs.

Analog Mono Audio

With this connector configuration, an externally generated analog mono audio test signal is fed to the speech coder input SPEECH CODEC IN on the front panel of the R&S CBT. The signal is modulated onto the Bluetooth RF carrier and transmitted to the DUT. The DUT returns the audio data using the Bluetooth RF carrier. The received audio signal is demodulated and fed to the analog output connector SPEECH CODEC OUT.

If option R&S CBT-B41 is installed, the analog audio generator and analyzer are also available as shown below. With the depicted configuration of the AF IN / OUT connectors, it is possible to perform additional measurements on analog signals (audio or otherwise) which do not require the presence of a Bluetooth link.

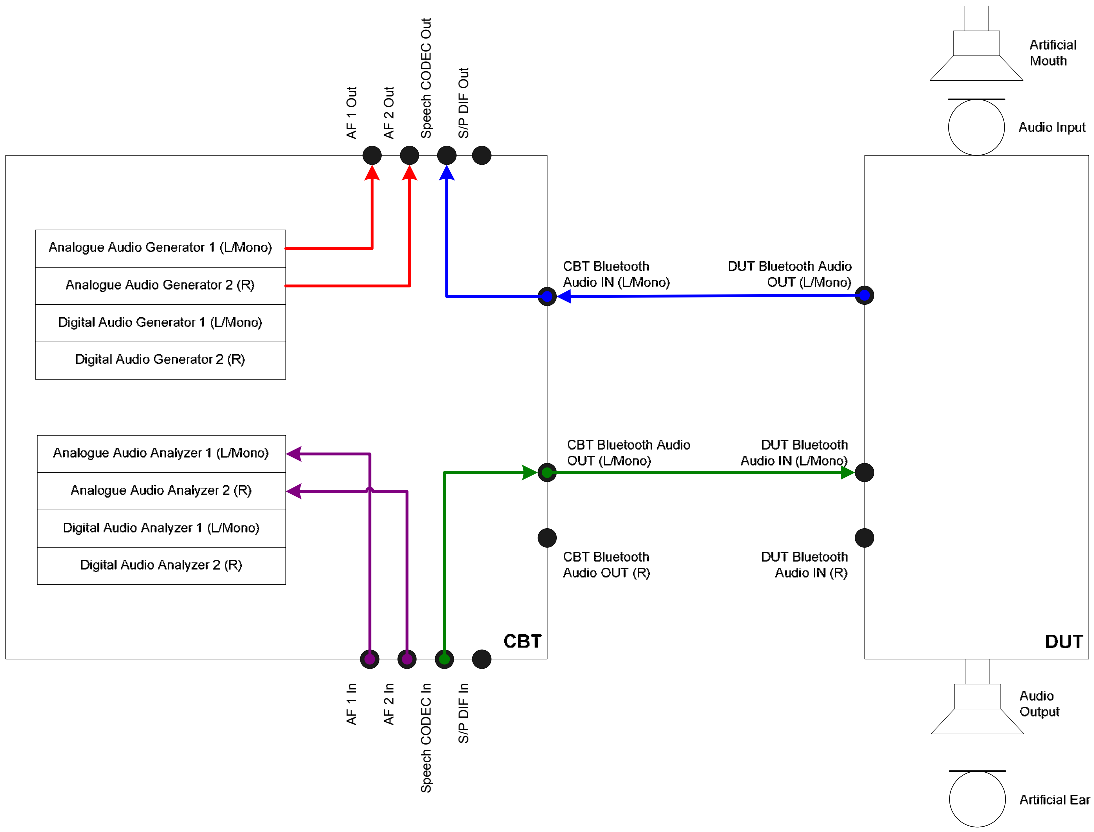


Fig. 51 Signal flow for “Audio Mono Audio”

Test purpose This test can be used for simple audio tests for SCO links using additional external microphones and speakers (receive audio, transmit audio, echo tests); refer to the description of the Bluetooth *Audio Test Scenarios* in the operating manual.

Audio channel modes Single channel audio (mono SCO). Only the left channels of the audio paths are used.

Required options No option required
Recommended: R&S CBT-B41, Audio Measurement Unit (for additional measurements)

Recommended measurements Audio *Analyzer / Generator* measurement, for additional measurements on analog signals.

Analog Stereo Audio

With this connector configuration, an externally generated analog audio test signal is fed to the analog input connectors AF 1 IN and AF 2 IN on the front panel of the R&S CBT. The signal is modulated onto the Bluetooth RF carrier and transmitted to the DUT. With SCO connection, the DUT sends audio data to the CBT using the Bluetooth RF carrier. The received audio signal is demodulated and fed to the analog output connectors AF 1 OUT and AF 2 OUT on the front panel. The analysis is done using external test equipment.

The analog audio generator and analyzer are not available as shown below.

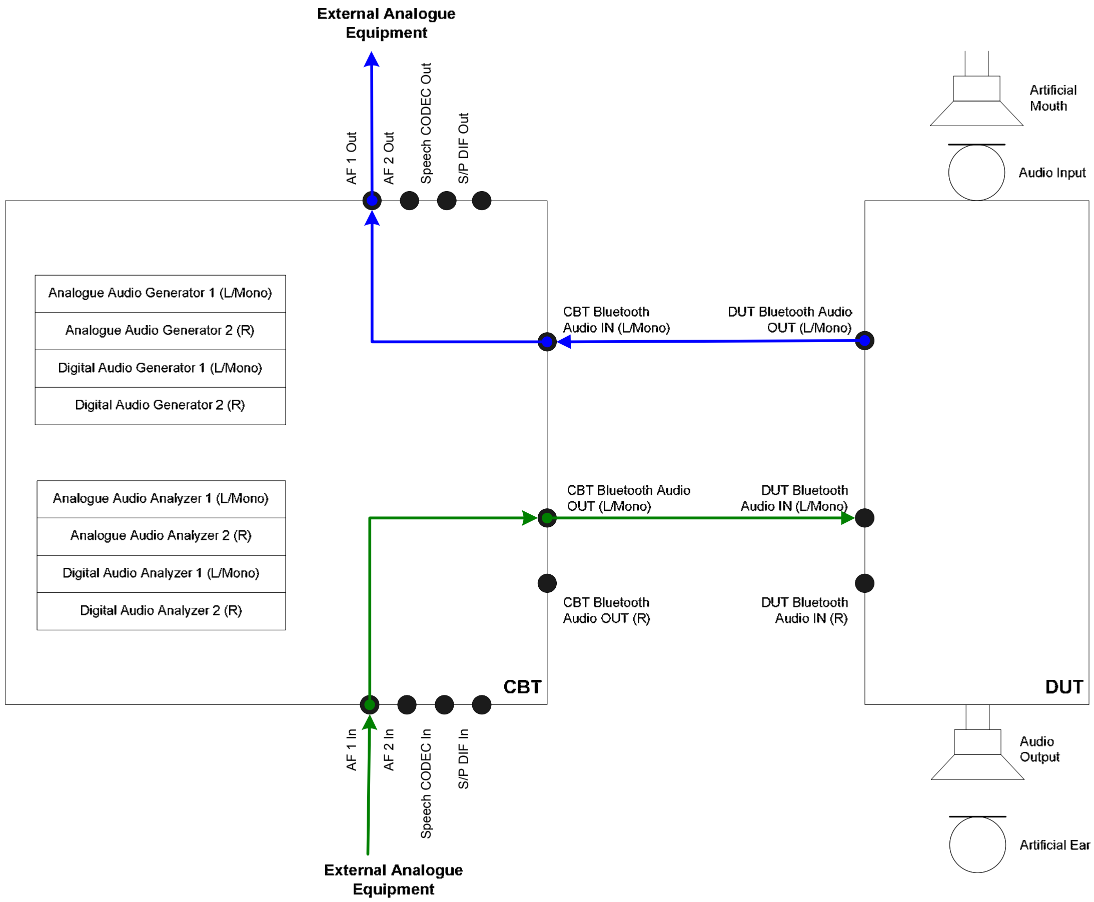


Fig. 52 Signal flow for “Analog Stereo Audio” – SCO connection

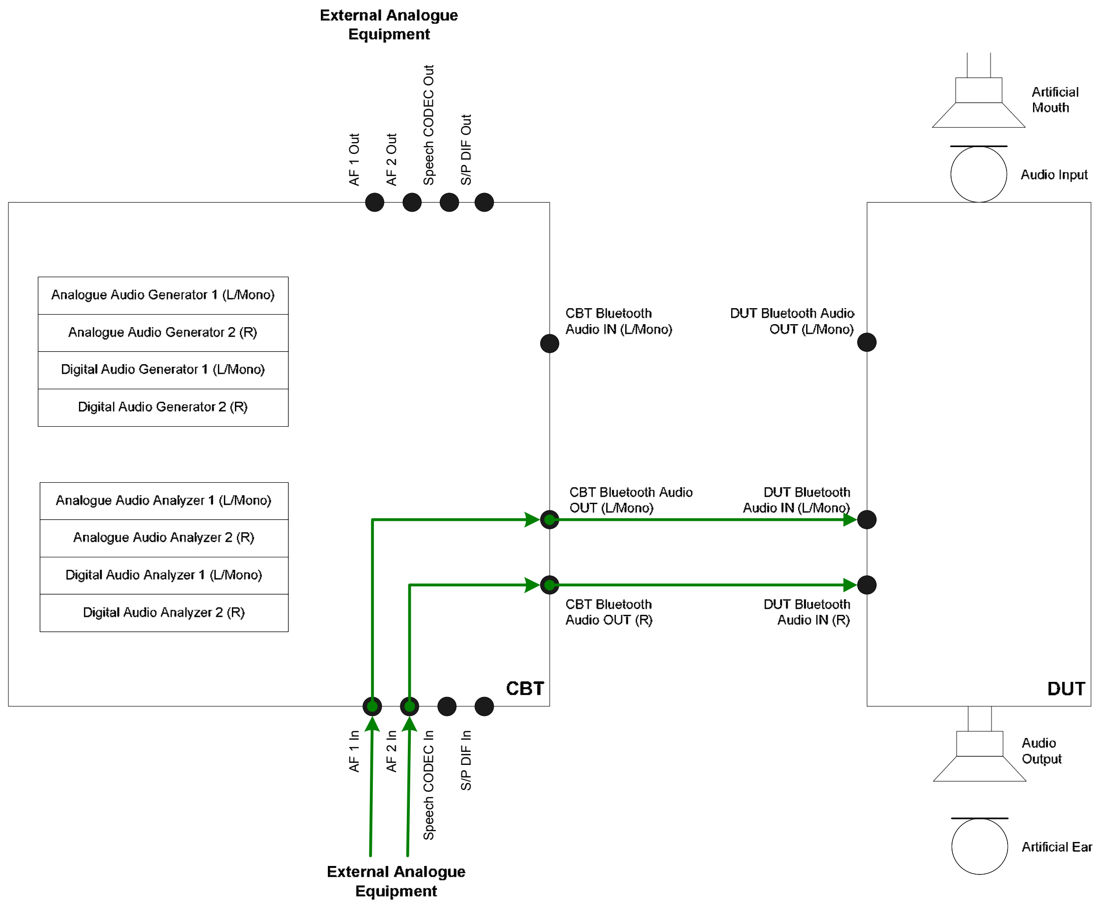


Fig. 53 Signal flow for “Analog Stereo Audio” – A2DP connection

Test purpose

This test is used to measure the audio signals using external analog AF test equipment.

Audio channel modes

Note: *In the present firmware version, single channel audio use cases (mono SCO links only) or downlink mono or stereo A2DP use cases are supported. The R&S CBT Bluetooth IN (R) signal cannot be evaluated.*

Required options

R&S CBT-B41, Audio Measurement Unit

Recommended measurements

The digital or analog audio generators and analyzers are not used in this test scenario.

Digital Stereo Audio

With this connector configuration, an externally generated digital audio test signal is fed to the digital input connector SP DIF IN on the rear panel of the R&S CBT. The signal is modulated onto the Bluetooth RF carrier and transmitted to the DUT. The DUT returns the audio data using the Bluetooth RF carrier. The received audio signal is demodulated and fed to the digital output connector SP DIF OUT on the rear panel. The analysis is made using external test equipment.

The analog audio generator and analyzer are also available as shown below. With the depicted configuration of the AF IN / OUT connectors, it is possible to perform additional measurements on analog signals (audio or otherwise) which do not require the presence of a Bluetooth link.

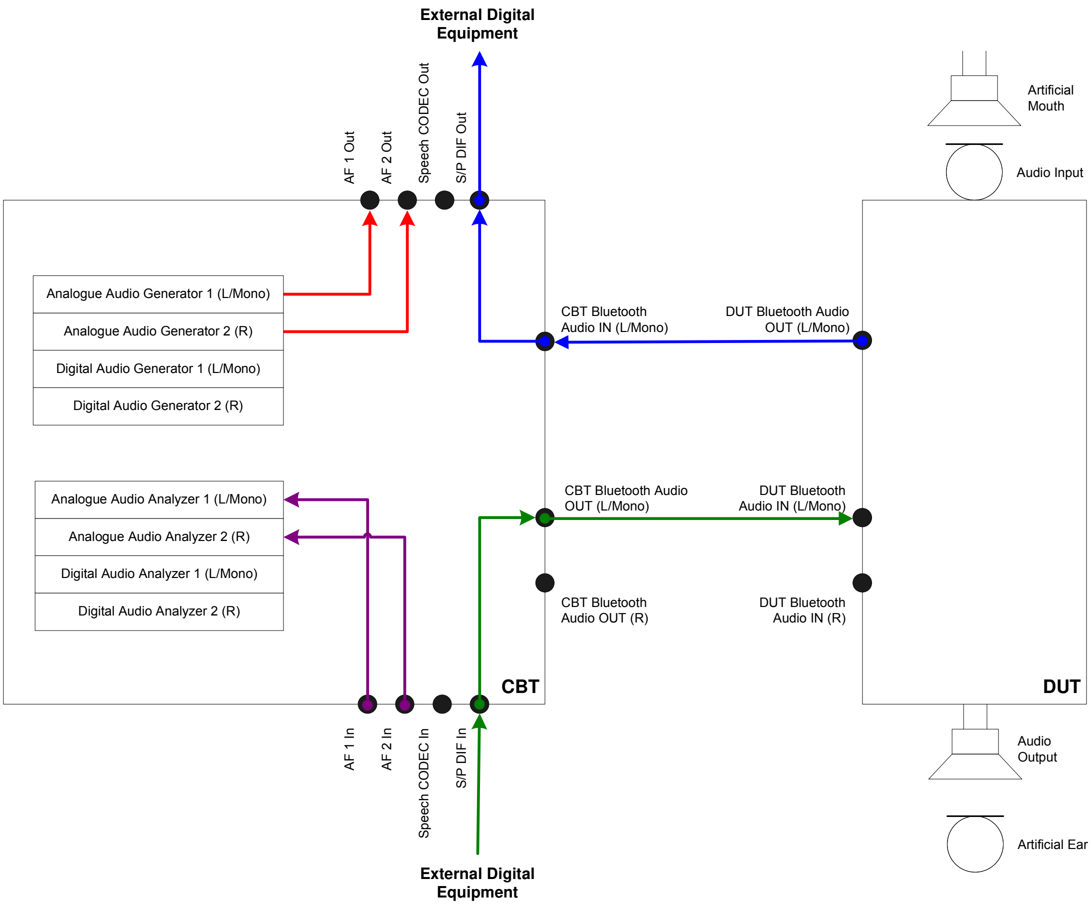


Fig. 54 Signal flow for “Digital Stereo Audio” – SCO connection

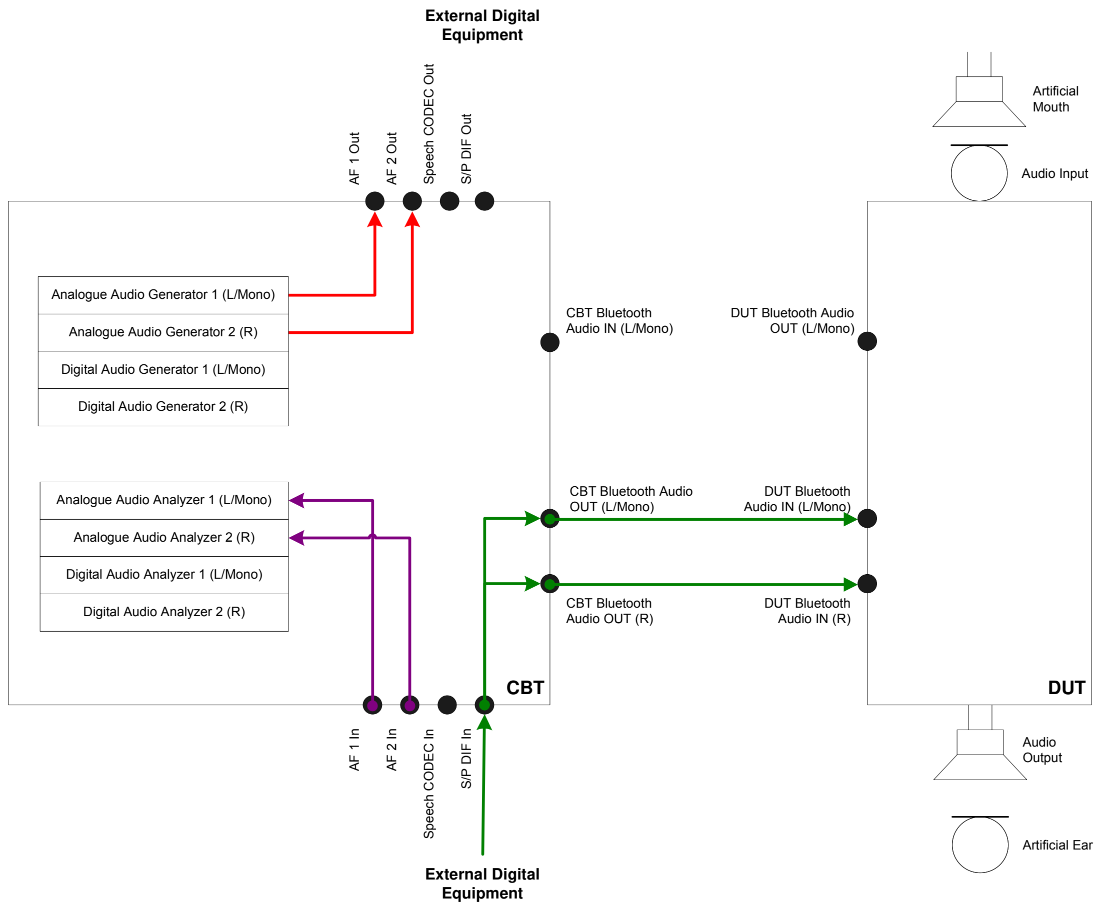


Fig. 55 Signal flow for “Digital Stereo Audio” – A2DP connection

Test purpose This test is used to measure the audio signals using external digital AF test equipment.

Audio channel modes ***Note:*** *In the present firmware version, single channel audio use cases (mono SCO links only) or downlink mono or stereo A2DP use cases are supported. The R&S CBT Bluetooth IN (R) signal cannot be evaluated.*

Required options R&S CBT-B41, *Audio Measurement Unit*
R&S CBT-B42, *Digital Audio Interface*

Recommended measurements Audio *Analyzer / Generator* measurement, for additional measurements on analog signals.

Microphone Test

With this connector configuration, the audio signal from the internal analog audio generator is tapped at the audio output connectors AF 1 OUT and AF 2 OUT and directly fed to the audio input of the DUT. The DUT returns the audio data using the Bluetooth RF carrier. The received audio signal is demodulated and analyzed using the digital audio analyzer of the R&S CBT. The received audio data from the

DUT are terminated in the R&S CBT; no audio output signal is available. The downlink Bluetooth signal (R&S CBT → DUT) is not relevant.

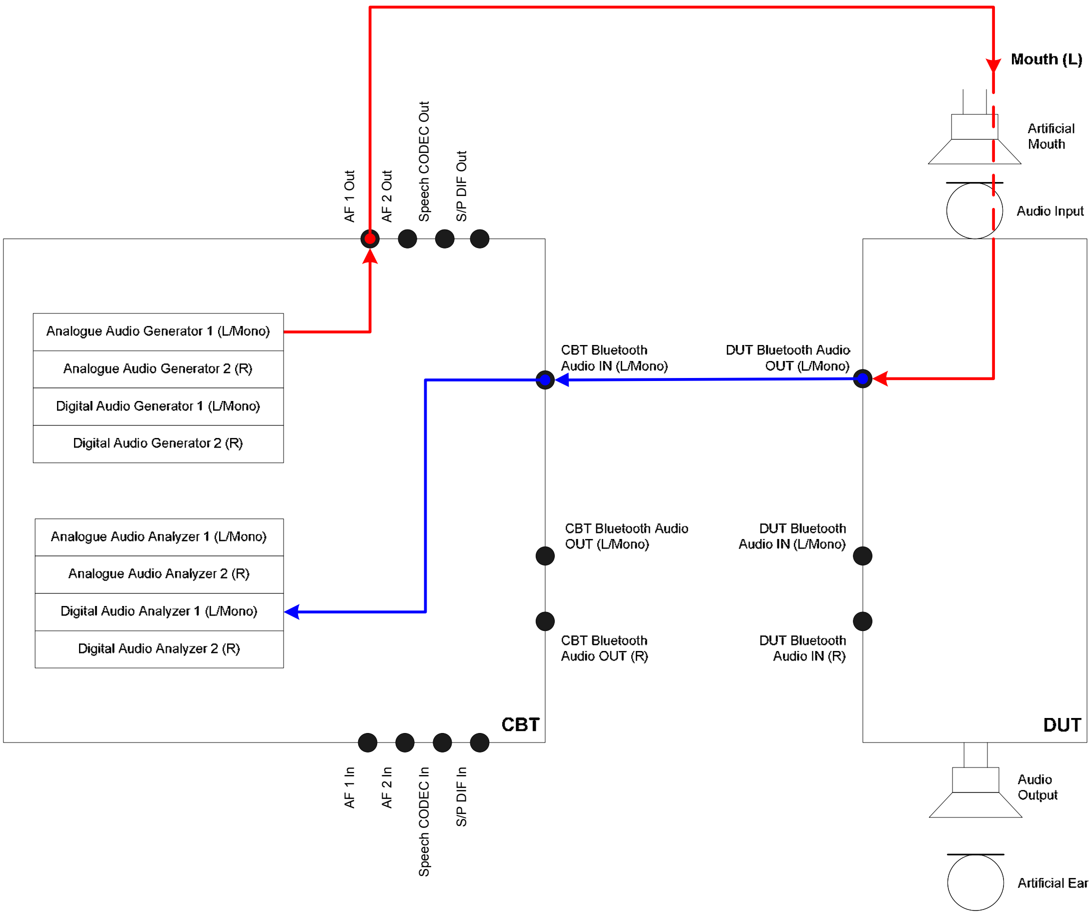


Fig. 56 Signal flow for “Microphone Test”

Test purpose

Typically, this test is used to measure the audio signal distortion in the uplink (DUT → R&S CBT).

Audio channel modes

Note: *In the present firmware version, single channel audio use cases (mono SCO links only) are supported. The R&S CBT Bluetooth IN (R) signal cannot be evaluated.*

Required options

R&S CBT-B41, Audio Measurement Unit

Recommended measurements

Total Harmonic Distortion and/or *Multitone* measurement; see sections *Total Harmonic Distortion (THD)* on p. 4.210 and *Multitone Measurement* on p. 4.196.

Earphone / Speaker Test

With this connector configuration, the audio signal from the internal digital audio generator is modulated onto the Bluetooth RF carrier and transmitted to the DUT. The analog audio output signal of the DUT is fed to AF 1 in and AF 2 IN and analyzed using the analog audio analyzer of the R&S CBT. The received audio data from the DUT are terminated in the R&S CBT; no audio output signal is available. The uplink Bluetooth signal (DUT → R&S CBT) is not relevant.

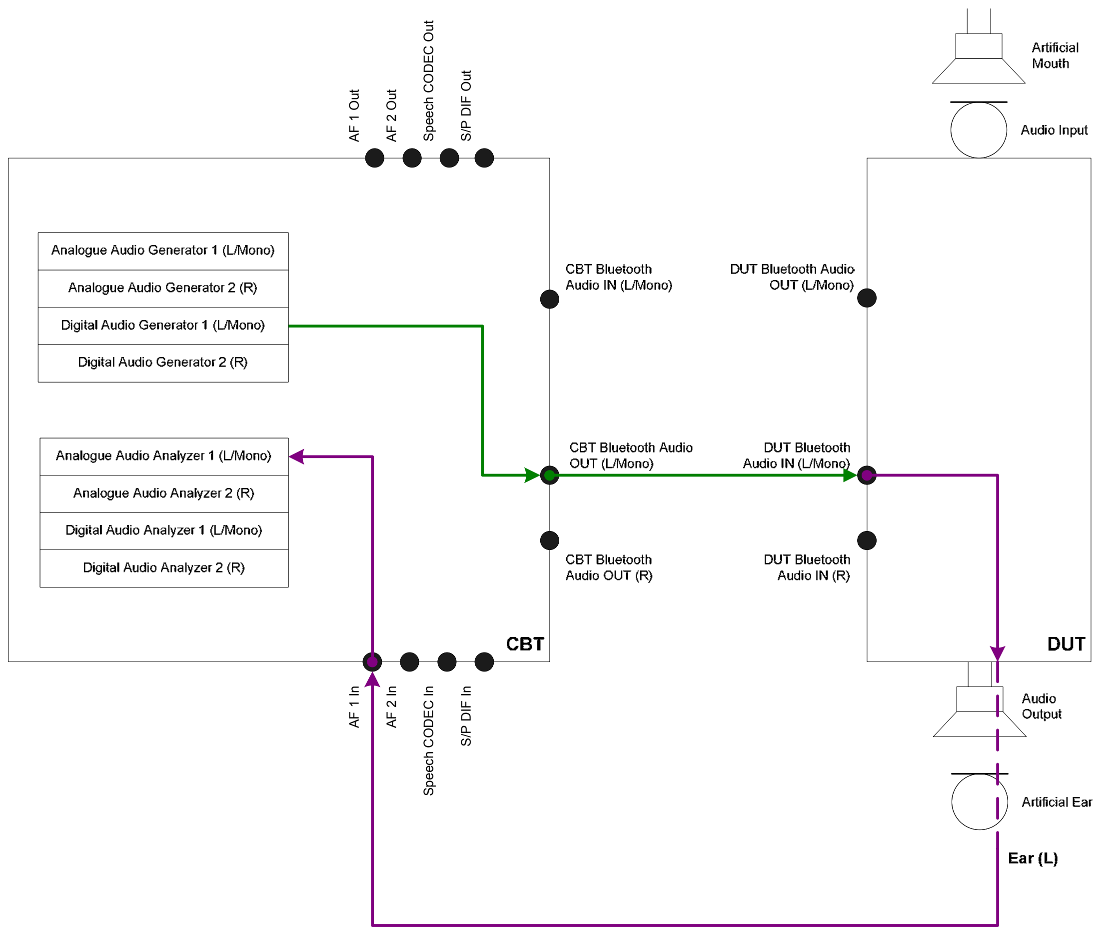


Fig. 57 Signal flow for “Earphone / Speaker Test” – SCO or mono A2DP connection

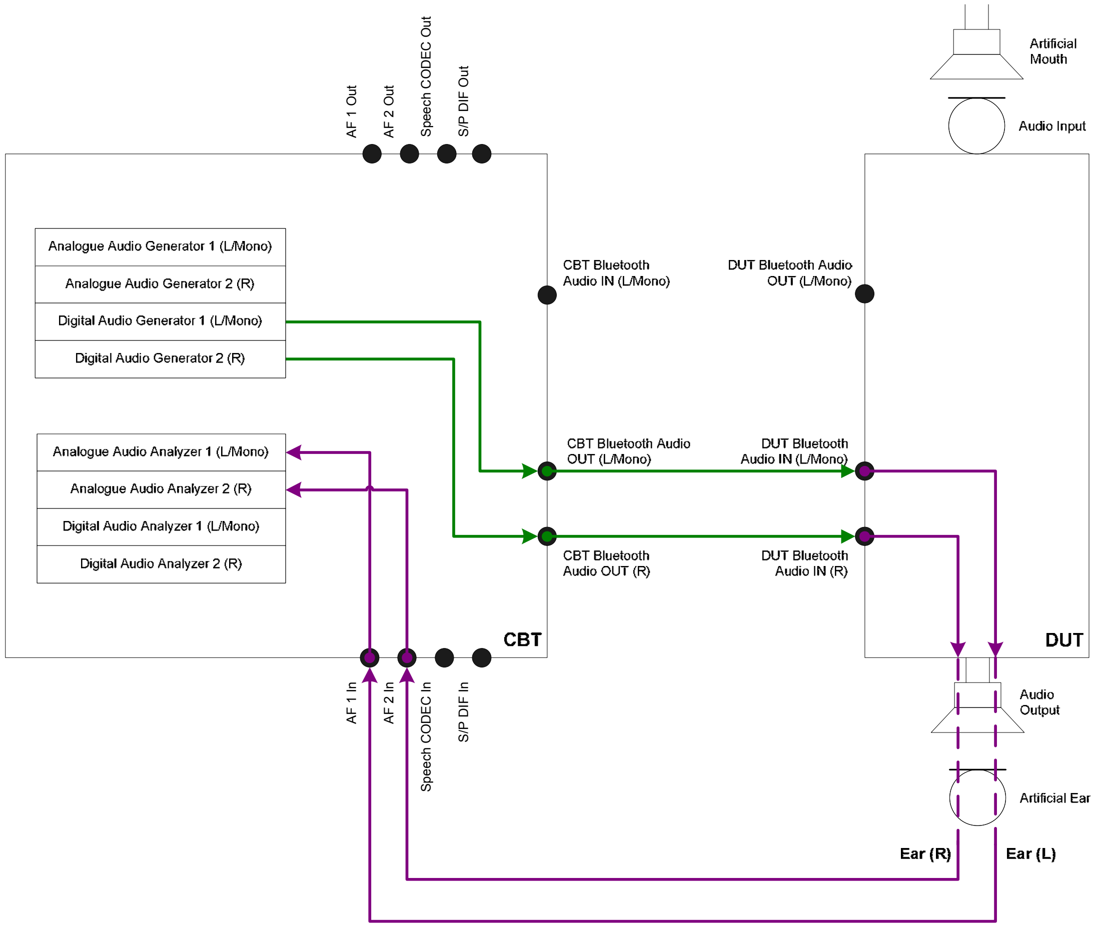


Fig. 58 Signal flow for “Earphone / Speaker Test” – A2DP stereo connection

Test purpose Typically, this test is used to measure the audio signal distortion in the downlink (R&S CBT → DUT).

Audio channel modes Stereo or mono. For single channel audio (mono SCO or mono A2DP) links, only the left channels of the audio paths are used.

Required options R&S CBT-B41, *Audio Measurement Unit*
R&S CBT-K52, *A2DP / SBC (Stereo Profile and Codec)*, required for stereo links.

Recommended measurements *Total Harmonic Distortion* and/or *Multitone* measurement; see sections *Total Harmonic Distortion (THD)* on p. 4.210 and *Multitone Measurement* on p. 4.196.

Audio Link Test

With this connector configuration, the audio signal from the internal digital audio generator is modulated onto the Bluetooth RF carrier and transmitted to the DUT. If a SCO connection is set up, the DUT can return the audio data using the Bluetooth RF carrier. The received audio signal is demodulated and analyzed using the digital audio analyzer of the R&S CBT. Neither the audio inputs nor the audio outputs of the R&S CBT and the DUT are used.

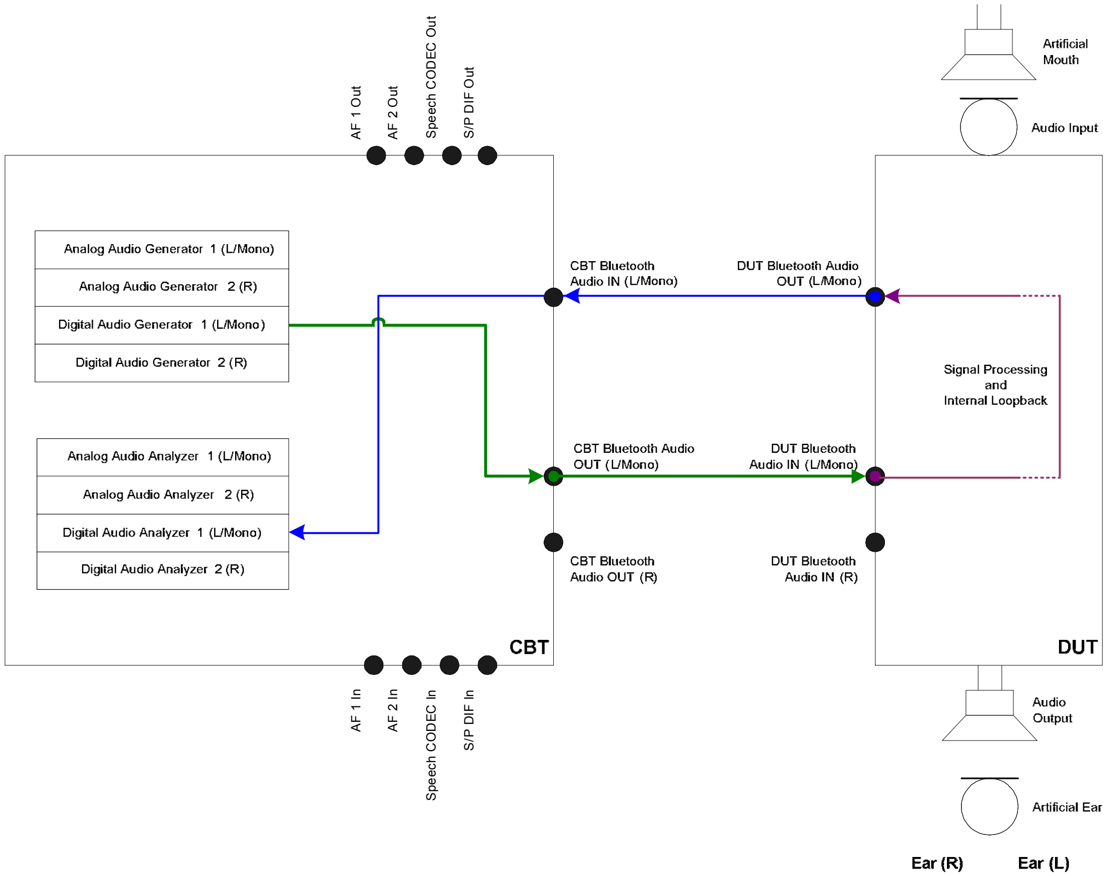


Fig. 59 Signal flow for "Audio Link Test"

Test purpose

Typically, this test is performed with a DUT that processes the received audio signal and loops it back using the Bluetooth link. The R&S CBT measures the audio quality of the looped back signal.

Example of signal processing in the DUT: Decode the audio data, transfer it to the internal GSM / CDMA …subsystem and back to the Bluetooth subsystem.

Audio channel modes

Mono SCO links, for A2DP see note below. Only the left channels of the audio paths are used.

Required options

No option required. Recommended: R&S CBT-B41, Audio Measurement Unit (for additional measurements).

Recommended measurements

Audio *Analyzer / Generator* measurement (with option R&S CBT-B41) .

Note: *With a A2DP connection, the R&S CBT transmits a mono or stereo signal on the downlink, however, the Bluetooth sink cannot loop back the received data. The situation is similar to the "Earphone / Speaker Test" shown in Fig. 58 on p. 4.232 except that the audio analyzers of the R&S CBT are not available for the analysis of the analog audio output signal of the DUT.*

Contents

5 Remote Control – Basics

This chapter provides:

- Instructions on how to set up the R&S® CBT for remote control operation.
- A general introduction to remote control of programmable instruments. This includes the description of the command structure and syntax according to the SCPI standard, the description of command execution and of the status registers.
- A comprehensive description of the R&S® CBT's remote control concept.

In Chapter 6, all remote control functions of the base system and of function groups *RF* and are described in detail. The commands for each function group and their parameters are listed according to their function and in alphabetical order in the command lists at the end of Chapter 6.

Program examples for the R&S® CBT can be found in Chapter 7.

Introduction

The instrument is equipped with a GPIB bus interface according to standard IEC 625.1/IEEE 488.1. The connectors are located at the rear of the instrument and permit a connection to a controller for remote control.

This section assumes basic knowledge of GPIB bus programming and operation of the controller. A description of the interface commands can be found in the relevant manuals.

Not all of the commands supported by the instrument are taken from the SCPI standard (Standard Commands for Programmable Instruments), however, their syntax follows SCPI rules. The SCPI standard is based on standard IEEE 488.2 and aims at the standardization of device-specific commands, error handling and the status registers.

The requirements that the SCPI standard places on command syntax, error handling and configuration of the status registers are explained in detail in the following sections. Tables provide a fast overview of the bit assignment in the status registers. The tables are supplemented by a comprehensive description of the status registers.

Note: *In contrast to instruments with manual control, which are designed for maximum possible operating convenience, the priority of remote control is the "predictability" of the device status. This means that when incompatible settings are attempted, the command is ignored and the device status remains unchanged, i.e. other settings are not automatically adapted. Therefore, GPIB bus control programs should always define an initial device status (e.g. with the command *RST) and then implement the required settings.*

Operation via Remote Control

As with any device, the R&S® CBT must be assigned a unique primary address in the range 0 to 30. In addition it uses extended addressing, i.e. a secondary address must be assigned to the individual function groups. Primary and secondary addresses can be defined in the *Remote* index card of the *Setup* menu (see Chapter 4) or via remote control.

Switchover to Remote Control (Model R&S® CBT)

On power-up, the instrument is always in the manual operating state and can be operated via the front panel controls. The instrument is switched to remote control in the following cases:

With active GPIB bus	as soon as the Remote Enable (REN) GPIB line is asserted by the controller.
With active RS-232 interface	as soon as the instrument receives any characters via the interface.

Operation via the front panel is disabled. The instrument remains in the remote state until it is reset to the manual state via the front panel or via GPIB bus (see section *Return to Manual Operation*).

Note: ***Local to remote transition and signalling states***

Switching from manual operation to remote control does usually not affect the device settings. However, if the R&S® CBT operates in a Non Signalling *test mode, all generators are switched off. In a* Signalling *mode, the current connection or call is dropped and the R&S® CBT returns to its default signalling state.*

To change this behavior and preserve the generator and signalling states in a local to remote transition, the command `SYSTem:GTRMode:COMPatible OFF` *can be used; see Chapter 6.*

Note: ***Accelerating the Shut Down Process***

When operating the instrument in remote control mode, it is recommended to disable the nonvolatile RAM, see command `SYSTem:NONVolatile:DISable` *in Chapter 6. This will accelerate the shut down process; see Chapter 1, section* Switching off the Instrument.

Setting the Device Address

The GPIB address (primary address) of the instrument is factory-set to 20. It can be changed manually via the *Primary Address* softkey in the *Setup - Remote* menu (model R&S® CBT) or via GPIB bus. For remote control, addresses 0 through 30 are permissible.

In addition to the primary address, up to 30 secondary addresses can be assigned to the individual function groups and test modes. This concept of extended addressing allows the same remote commands to be used in several function groups and modes. Secondary address 0 is reserved for the R&S® CBT base system. The other secondary addresses are set via the *Second. Address* softkey in the *Setup - Remote* menu or via remote control.

Note: *In the Setup – Remote menu, secondary addresses between 1 and 29 can be assigned. When using the National Instruments driver, add 96 to the secondary address. For example, specify a secondary address of 96 to access secondary address 0 on the instrument.*

Changing the addresses manually (model R&S® CBT):

The R&S CBT uses the secondary addresses 1, 2 and 3 for function groups *RF Non Signalling, Bluetooth Non Signalling* and *Bluetooth Signalling,* respectively. This default assignment can be changed e.g. to re-use remote control scripts developed for an R&S CMU.

1. Call *Setup - Remote* menu.
2. Press *Primary Address* softkey. Enter desired address in the input field.
3. Press *Second. Address* softkey. Use the rollkey to select the list line with the desired address (numbers 1 to 29). Press ENTER to edit the line. From the popup window select the desired function group (use the rollkey to change between the entries in the popup window). Confirm your selection and close the popup window using the ENTER key.
4. Press the *ESCAPE* key to close the *Setup – Remote* menu.

Via GPIB bus interface:

- Use the `SYSTem:REMote:ADDRess:PRIMary <Addr_1>` command to define the GPIB bus address of the R&S® CBT.
- Use the `SYSTem:REMote:ADDRess:SECondary <Addr_2>,"<Fgroup>"` (*<Fgroup> = RF_NSig, Bluetooth_NSig, Bluetooth_Sign* for function groups *RF Non Signalling, Bluetooth Non Signalling, Bluetooth Signalling)* command to assign distinct secondary addresses to all function groups needed. The secondary address is transferred with each command (physical/hardware addressing, see program example in Chapter 7). Alternatively, software switchover with a command preceded by a secondary address and a semicolon is possible:

  `<Addr_2>;<Command>` (logical addressing of secondary address; use semicolon)

Via RS-232 interface:

- Use the `SYSTem:REMote:ADDRess:PRIMary <Addr_1>` command to define the GPIB bus address of the R&S® CBT.
- Use the `SYSTem:REMote:ADDRess:SECondary <Addr_2>,"<Fgroup>"` command to assign distinct secondary addresses to all function groups needed.
- Use the `*SEC <Addr_2>` command for a software switchover from one secondary address to another. Alternatively place `<Addr_2>;` in front of the command:

  `*SEC <Addr_2>` followed by `<Command>` is equivalent to `<Addr_2>;<Command>`, provided that secondary address `<Addr_2>` has been appropriately defined.

Indications during Remote Control

Note: ***Remote display for model R&S® CBT*** **32**

The remote screen of a R&S® CBT 32 can be displayed on an external monitor and configured using the remote control commands reported in this section. The remote report is a useful debugging tool. While it is displayed, the measurements are slowed down.

In the REMOTE state no menus but only the header *Remote* is indicated.

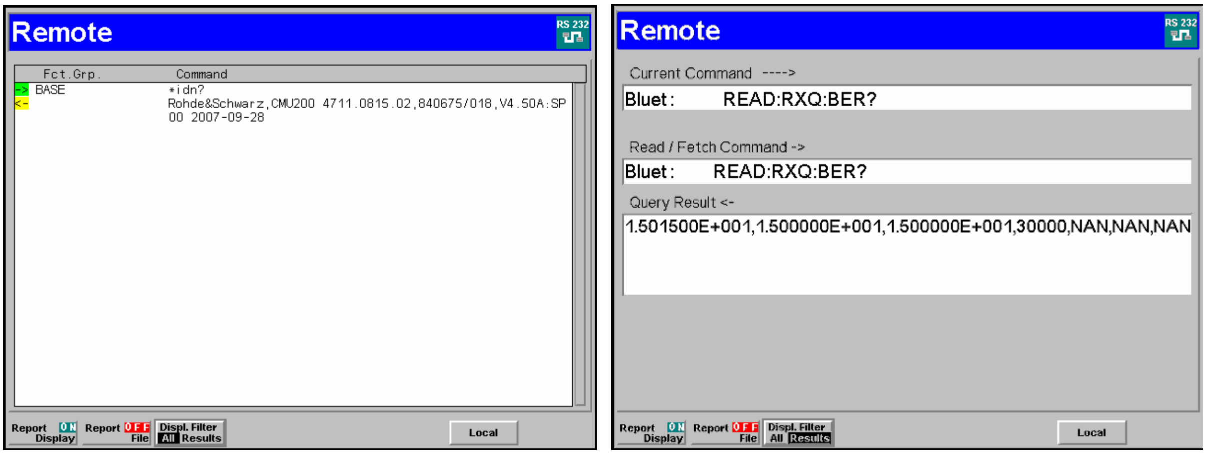


Fig. 5-1 Remote screen

Report Display

The *Report Display* hotkey can be activated (state *ON,* press the *ON/OFF* key*)* to display the input and output strings of the remote-control interface on the *Remote* screen. The remote display consists of three columns:

<Input/output> Colored symbols for input (–>) to the R&S® CBT, output (<–) or error messages (E).

Fct. Grp. Name of the addressed function group; see description of command `SYSTem:REMote:ADDRess:SECondary` in Chapter 6.

Command Input command string, response/output string of the R&S® CBT or error message.

This parameter can also be set in the *Setup – Remote* menu; see chapter 4 or in the *Remote Service Tool;* see chapter 1.

Remote control
`TRACe:REMote:MODE:DISPlay ON | OFF`

Displ. Filter All Results

The *Display Filter* hotkey selects the appearance of the remote screen and the displayed information:

All The remote screen shows all remote control commands that are exchanged between the controller program and the R&S® CBT (see example on the left-hand side of Fig. 5-1 above).

Results The commands are filtered: The remote screen only shows the current command (with a switched icon to distinguish several repeated commands) and the last `READ…?` or `FETCh…?` query sent to the R&S CMU, together with the received results. Compared to *Report Mode: All,* the font size is enlarged, and the secondary address string is abbreviated to 5 characters (e.g. *WCDMA* for *WCDMAUEFDD_NSig).* (see example on the right-hand side of Fig. 5-1 above). This report mode is suited for a rough observation of the command sequence, with an emphasis of the received results.

Remote control
`TRACe:REMote:MODE:DISPlay:FILTer ON | OFF`

Report File

The *Report File* hotkey can be activated (state *ON,* press the *ON/OFF* key*)* to write the input and output strings of the remote-control interface to a file named Remote.trc in the root directory of the internal hard disk *(INTERNAL* directory in the *Data* menu or directory C:\temp). The two softkeys *Report Display* and *Report File* may be active *(ON)* at the same time.

This parameter can also be set in the *Setup – Remote* menu; see chapter 4 or in the *Remote Service Tool;* see chapter 1.

Remote control
`TRACe:REMote:MODE:FILE ON | OFF`

Local

The *Local* hotkey switches back to manual control. The current measurement and generator states and the current signalling state (if a *Signalling* test mode is active) are preserved; see also section *Return to Manual Operation below*.

Remote control
`GTL` interface message, included in the NI command `IBLOC (device%)`
(addressed command; see Chapter 8)

Equivalent R&S® CBT-specific command, also for operation via serial interface:
`*GTL`

Return to Manual Operation (Model R&S® CBT)

Return to manual operation can be initiated via the front panel or the GPIB bus.

Manually:

➢ Press any key on the front panel or press the *Local* hotkey in the *Remote* screen. The current measurement and generator states and the current signalling state (if a *Signalling* test mode is active) are preserved.

Note:

– *Before returning to manual control, command processing must be completed. If this is not the case, the* R&S® CBT *switches back to remote control immediately.*

– *Returning to manual control by pressing any front panel key can be disabled by the GPIB Local Lockout Message (LLO; see Chapter 8, Table* Universal Commands*), which is also included in the NI commands SetRWLS (Set Remote With Lockout State) or SendLLO. This prevents unintentional switch-over, i.e. return to manual control is possible via the GPIB bus only. The* R&S® CBT*-specific command `*LLO TRUE` is equivalent to LLO.*

– *Returning to manual control via the front panel keys can be enabled again by deactivating the REN control line of the GPIB bus (see Chapter 8). The* R&S® CBT*-specific command `*LLO FALSe` also enables return to manual control.*

Via GPIB bus:

...
`CALL IBLOC(device%)` Set instrument to manual operation
...

Equivalent R&S® CBT-specific command, also for serial interface: `*GTL`

Target Menu

On switching over from remote to manual control, the R&S® CBT preserves the current measurement and generator states and the current signalling state (if the *Bluetooth Signalling* test mode is active). The instrument tries to open the menu that the user is likely to prefer, i.e. the measurement menu of the current, running measurement. If several measurements are running in parallel, the instrument applies the following selection rules to resolve the ambiguity and determine a preferred menu:

- The preferred menu must belong to a measurement that is in the *RUN* or *HLT* state (see section *Measurement Control Commands and States* on p. 5.31 ff.). *RDY* measurements and suppressed measurements are discarded.
- Measurement menus of the main application have the priority over configuration menus (e.g. for signalling and generators).
- Out of several running measurements of the same hierarchy level, the last one that was initiated (`INITiate:…` or `READ:…?`) is preferred.

If no measurement is in the *RUN* or *HLT* state, the last measurement that was aborted (`ABORt:…`) is preferred.

Setting the Transmission Parameters (RS-232 Interface)

To ensure a correct data transmission, the transfer parameters of the instrument and the controller must be identical. The number of data and stop bits, the parity, baud rate and the handshake mode can be set in the *Setup - Comm.* menu (model R&S® CBT):

- Open *Setup - Comm.* menu.
- Use the cursor keys and the rollkey to select and change desired parameters.
- Terminate the input using the *[ENTER]* key.

Alternatively, the COM parameters can be set via remote control: `SYSTem:COMMunicate:SERial1…`

GPIB Bus Messages

The messages transferred via the data lines of the GPIB bus (see Chapter 8) can be either i**nterface messages or device messages.**

Interface Message

Interface messages are transferred on the data lines of the GPIB bus, the ATN control line being active. They are used for communication between controller and instrument and can only be sent by a computer which has the function of an GPIB bus controller.

Interface commands can be further subdivided into

- **universal commands**
- **addressed commands**

Universal commands act on all devices connected to the GPIB bus without previous addressing, addressed commands only act on devices previously addressed as listeners. The interface messages relevant to the instrument are listed in Chapter 8, section *Interface Messages*.

Device Messages (Commands and Device Responses)

Device messages are transferred via the data lines of the GPIB bus, the "ATN" control line not being active. The ASCII character set is used. A distinction is made according to the direction in which device messages are transferred:

Commands are messages the controller sends to the instrument. They operate the device functions and request information. The commands are subdivided according to two criteria:

1. According to the effect they have on the instrument:

   Setting commands cause instrument settings such as a reset of the instrument or setting the output level to some value.

   Queries cause data to be provided for output on the GPIB bus, e.g. for identification of the device or polling the active input.

2. According to their definition in standard IEEE 488.2:

   Common Commands have a function and syntax that is exactly defined in standard IEEE 488.2. Typical tasks are the management of the standardized status registers, reset and selftest.

   Device-specific Commands are functions that depend on the features of the instrument such as frequency setting. A majority of these commands has also been standardized by the SCPI committee.

Device responses are messages the instrument sends to the controller after a query. They can contain measurement results, instrument settings and information on the instrument status (cf. section 3.5.4).

Structure and syntax of the device messages are described in the next section. In Chapter 6 all commands are listed and explained in detail.

SCPI Command Structure and Syntax

SCPI commands consist of a so-called header and, in most cases, one or more parameters. The header and the parameters are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). The headers may consist of several key words. Queries are formed by directly appending a question mark to the header.

Common Commands

Common (=device-independent) commands consist of a header preceded by an asterisk "*" and possibly one or more parameters.

Examples:

`*RST` RESET, resets the instrument.

`*ESE 253` EVENT STATUS ENABLE, sets the bits of the event status enable registers.

`*ESR?` EVENT STATUS QUERY, queries the contents of the event status register.

Device-specific commands

Hierarchy: Device-specific commands are of hierarchical structure (see Fig. 5-2). The different levels are represented by combined headers. Headers of the highest level (root level) have only one key word. This key word denotes a complete command system.

Example:

`SOURce` This key word denotes the command system `SOURce`.

For commands of lower levels, the complete path has to be specified, starting on the left with the highest level, the individual key words being separated by a colon ":".

Example:

`SOURce:RFGenerator:TX:FREQuency 1MHZ`

This command is located on the fourth level of the SOURce system. It switches on frequency hopping for the RF generator.

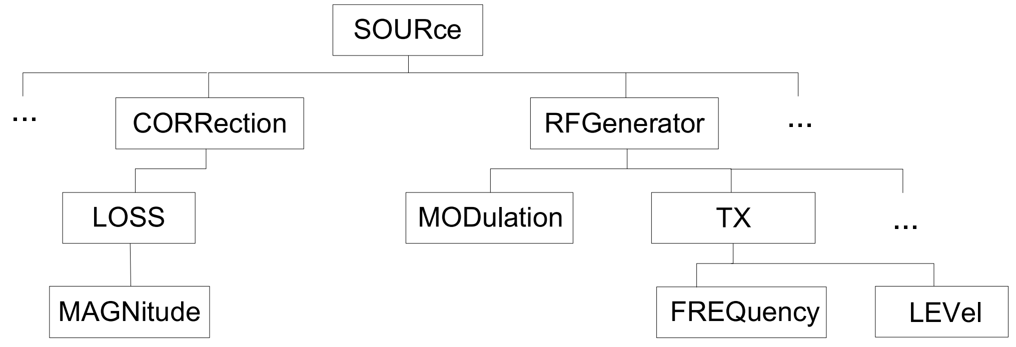


Fig. 5-2 Example for the tree structure of the SCPI command systems; the `SOURce` system

Multiple key words

Some key words occur on several levels within one command system. Their effect depends on the structure of the command, i. e. on the position in the command header they are inserted in.

Example: `SOURce:RFGenerator:TX:FREQuency 1GHZ`

This command contains the key word `SOURce` in the first command level. It defines the frequency of the RF generator signal.

`TRIGger:SOURce EXTern`

This command contains the key word `SOURce` in the second command level. It defines the trigger source “external trigger”.

Optional key words:

Some command systems permit certain key words to be optionally inserted into the header or omitted. These key words are marked by square brackets in this manual. The full command length must be recognized by the instrument for reasons of compatibility with the SCPI standard. Some commands are considerably shortened by omitting optional key words.

Example: `TRIGger[:SEQuence]:SOURce EXTern`

This command defines the trigger source “external trigger”. The following command has the same effect:

`TRIGger:SOURce EXTern`

Note: *An optional key word must not be omitted if its effect is additionally specified by a numeric suffix.*

Long and short form:

The key words feature a long form and a short form. Either the short form or the long form can be entered; other abbreviations are not permitted.

Example:

```
TRIGger:SOURce EXTern
TRIG:SOUR EXT
```

Note: *The short form is marked by upper-case letters, the long form corresponds to the complete word. Upper-case and lower-case notation only serves to distinguish the two forms in the manual, the instrument itself does not distinguish upper-case and lower-case letters.*

Parameters:

Parameters must be separated from the header by a "white space". If several parameters are specified in a command, they are separated by a comma ",". For a description of the types of parameter, refer to section *Parameters* on page 5.11.

Example:

```
CONFigure:WPOWer:CONTrol:REPetition
        SINGleshot,SONerror, NONE
```

This command sets parameters to define the statistics of a power measurement.

Numeric suffix:

If a device features several functions or features of the same kind, e.g. several inputs, the desired function can be selected by a suffix added to the command. Entries without suffix are interpreted as entries with the suffix 1.

Example: `STATus:OPERation:CMU:SUM<nr>[:EVENt]?`

This command queries and deletes the contents of the EVENt part of the `STATus:OPERation:CMU:SUM<nr>` register. There are two sum registers numbered 1 and 2, respectively (<nr> = 1,2).

Structure of a Command Line

A command line may consist of one or several commands. It is terminated by a <New Line>, a <New Line> with EOI or an EOI together with the last data byte. Visual BASIC automatically produces an EOI together with the last data byte.

Several commands in a command line must be separated by a semicolon ";". If the next command belongs to a different command system, the semicolon is followed by a colon.

Example: `CALL IBWRT(device%, "TRIGger:SOURce EXTern;:FETch:WPOWer:STATus?")`

This command line contains two commands. The first command belongs to the `TRIGger` system and defines the trigger source (external trigger). The second command belongs to the `FETCh` system and returns the status of the power measurement.

If the successive commands belong to the same system, having one or several levels in common, the command line can be abbreviated. To this end, the second command after the semicolon starts with the level that lies below the common levels (see also Fig. 5.1). The colon following the semicolon must be omitted in this case.

Example: `CALL IBWRT(device%, "TRIG:SOUR EXT;:TRIG:THR LOW")`

This command line is represented in its full length and contains two commands separated from each other by the semicolon. Both commands are part of the `TRIGger` command system, i.e. they have one level in common.
When abbreviating the command line, the second command begins with the level below `TRIG`. The colon after the semicolon is omitted.

The abbreviated form of the command line reads as follows:

`CALL IBWRT(device%, "TRIG:SOUR EXT;THR LOW")`

However, a new command line always begins with the complete path.

Example:
```
CALL IBWRT(device%, "TRIG:SOUR EXT ")
CALL IBWRT(device%, "TRIG:THR LOW ")
```

Responses to Queries

A query is defined for each setting command unless explicitly specified otherwise. It is formed by adding a question mark to the associated setting command. According to SCPI, the responses to queries are partly subject to stricter rules than in standard IEEE 488.2.

1. The requested parameter is transmitted without header.
   Example: `TRIGger:THReshold?` Response: `LOW`
2. Maximum values, minimum values and all further quantities, which are requested via a special text parameter are returned as numerical values.
   Example: `CONFigure:WPOWer:CONTrol:REPetition? MAX` Response: `10000`
3. Numerical values are output without their unit. The default unit for each command is reported in the command description on Chapter 6.
   Example: `SOURce:RFGenerator:FREQuency?` Response: `1E9` for 1 GHz
4. Boolean values are returned as 0 (for OFF) and 1 (for ON).
   Example: `SOURce:DM:CLOCk:STATe?` Response: `1`
5. Text (character data) is returned in short form (see also next section).
   Example: `FETCh:WPOWer:STATus?` Response: `ERR`

Parameters

Most commands require a parameter to be specified. The parameters must be separated from the header by a "white space". Permissible parameters are numerical values, Boolean parameters, text, character strings and block data. The type of parameter required for the respective command and the permissible range of values are specified in the command description.

Numerical values

Numerical values can be entered in any form, i.e. with sign, decimal point and exponent. Values exceeding the resolution of the instrument are rounded up or down. The mantissa may comprise up to 255 characters, the values must be in the value range –9.9E37 to 9.9E37. The exponent is introduced by an "E" or "e". Entry of the exponent alone is not allowed. In the case of physical quantities, the unit can be entered. Permissible unit prefixes are G (giga), MA (mega), MOHM and MHZ are also permissible), K (kilo), M (milli), U (micro) and N (nano). If the unit is missing, the fundamental unit is used.

Example: `SOUR:RFG:FREQ 1.5GHz` is equivalent to `SOUR:RFG:FREQ 1.5E9`

Special numerical values

The texts MINimum, MAXimum, DEFault, UP and DOWN are interpreted as special numerical values.

In the case of a query, the associated numerical value is provided.

Example: Setting command: `CONF:WPOW:CONT:REP MAXimum, NONE, NONE`
Query: `CONF:WPOW:CONT:REP?`
Response: `10000, NONE, NONE`

MIN/MAX — MINimum and MAXimum denote the minimum and maximum value.

DEF — DEFault denotes the preset value. This value is set by the *RST command.

INF/NINF — INFinity, Negative INFinity (NINF) represent the numerical values -9.9E37 or 9.9E37, respectively. INF and NINF are only sent as device responses.

NAN — Not a Number (NAN) represents the value 9.91E37. NAN is only sent as device response. This value is not defined. Possible causes are division by zero, subtraction or addition of infinite and the representation of missing values.

Boolean Parameters

Boolean parameters represent two states. The ON state (logically true) is represented by ON or a numerical value different from 0. The OFF state (logically untrue) is represented by OFF or the numerical value 0. A query responds with 0 or 1.

Example: Setting command: `SOURce:DM:CLOCk:STATe ON`
Query: `SOURce:DM:CLOCk:STATe?`
Response: `1`

Text

Text parameters observe the syntax rules for key words, i.e. they can be entered using a short or long form. Like any parameter, they have to be separated from the header by a white space. In the case of a query, the short form of the text is provided.

Example: Setting command: `TRIGger:SOURce EXTern`
Query: `TRIGger:SOURce?` Response: `EXT`

Strings

Strings must always be entered within quotation marks (' or ").

Example: `:SYST:REM:ADDR:SEC 1,"Bluetooth_NSig"` or
`:SYST:REM:ADDR:SEC 1,’Bluetooth_Nsig’`

Block data

Block data are a transmission format which is suitable for the transmission of large amounts of data. A command using a block data parameter with definite length has the following structure:

Example: `:HEADer:HEADer #45168xxxxxxxx`

The hash symbol # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmission of these data bytes all End or other control signs are ignored until all bytes are transmitted.

A #0 combination introduces a data block of indefinite length. The use of the indefinite format requires a NL^END message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

Overview of Syntax Elements

: The colon separates the key words of a command. In a command line the separating semicolon marks the uppermost command level.

; The semicolon separates two commands of a command line. It does not alter the path.

, The comma separates several parameters of a command.

? The question mark forms a query.

* The asterisk marks a common command.

" Quotation marks introduce a string and terminate it.

The hash sign # introduces binary, octal, hexadecimal and block data.

Binary:	#B10110
Octal:	#O7612
Hexadecimal:	#HF3A7
Block:	#21312

A "white space" (ASCII-Code 0 to 9, 11 to 32 decimal, e.g. blank) separates header and parameter.

Instrument Model and Command Processing

The block diagram in figure *Fig. 5-3* shows how GPIB bus commands are serviced in the instrument. The individual components work independently and simultaneously. They communicate with each other by means of so-called "messages".

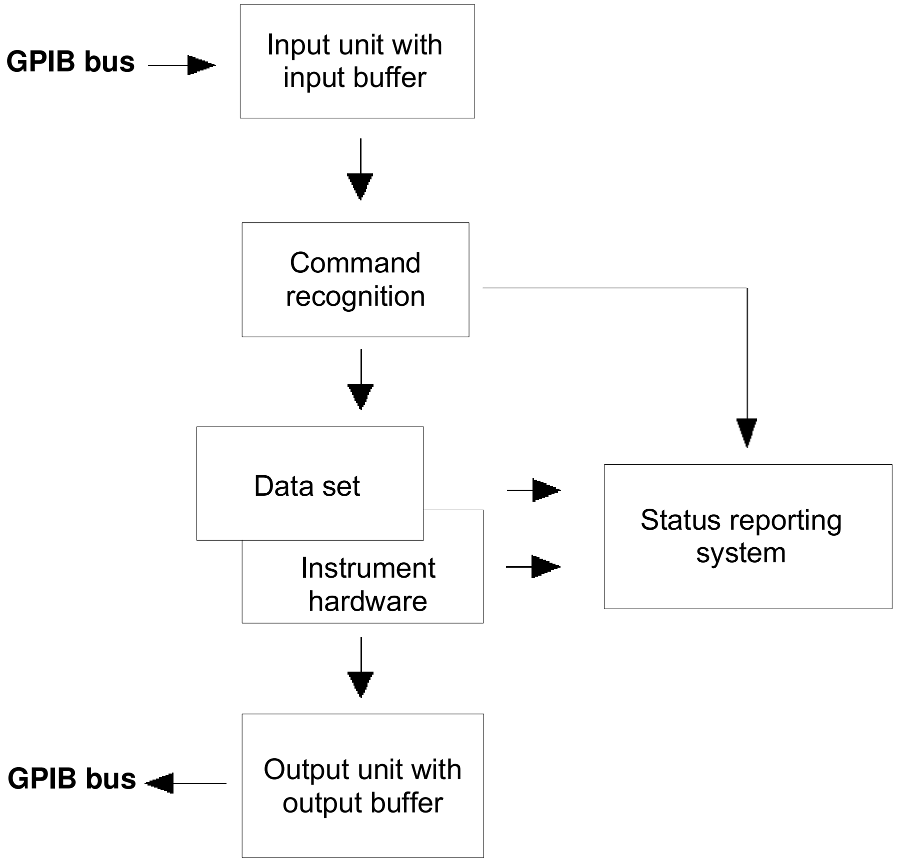


Fig. 5-3 Instrument model in the case of remote control via GPIB bus

Input Unit

The input unit receives commands character by character from the GPIB bus and collects them in the input buffer. The input unit sends a message to the command recognition as soon as the input buffer is full or as soon as it receives a delimiter, <PROGRAM MESSAGE TERMINATOR>, as defined in IEEE 488.2, or the interface message DCL.

If the input buffer is full, the GPIB bus traffic is stopped and the data received up to then is processed. Subsequently the GPIB bus traffic is continued. If, however, the buffer is not yet full when receiving the delimiter, the input unit can already receive the next command during command recognition and execution. The receipt of a DCL clears the input buffer and immediately initiates a message to the command recognition.

Command Recognition

The command recognition stage analyzes the data received from the input unit. It proceeds in the order in which it receives the data. Only a DCL is serviced with priority, e.g. a GET (Group Execute Trigger) is only executed after the commands received before. Each recognized command is immediately transferred to the data set but not executed immediately.

The command recognition detects syntax errors in the commands and transfers them to the status reporting system. The rest of a command line after a syntax error is ignored.

If the command recognition detects a delimiter or a DCL, it also requests the data set to perform the necessary instrument hardware settings. Subsequently it is immediately prepared to process further commands. This means that new commands can already be serviced while the hardware is still being set ("overlapping execution").

Data Set and Instrument Hardware

The expression "instrument hardware" denotes the part of the instrument fulfilling the actual instrument function - signal generation, measurement etc. The controller is not included. The data set is a detailed software reproduction of the instrument hardware.

GPIB bus setting commands lead to an alteration in the data set. The data set management enters the new values (e.g. frequency) into the data set, however, it only passes them on to the hardware when requested by the command recognition. As this is only ever effected at the end of a command line, the order of the setting commands in the command line is not relevant.

The commands are only checked for their compatibility among each other and with the instrument hardware immediately before they are transmitted to the instrument hardware. If the detection is made that execution is not possible, an "execution error" is signalled to the status reporting system. All alterations of the data set are canceled, the instrument hardware is not reset. Due to the delayed checking and hardware setting, however, impermissible instrument states can be set for a short period of time within one command line without this leading to an error message (example: simultaneous activation of FM and PM). At the end of the command line, however, a permissible instrument state must have been reached again.

Before passing on the data to the hardware, the settling bit in the `STATus:OPERation` register is set (cf. section *STATus:OPERation Register*). The hardware executes the settings and resets the bit again as soon as the new state has settled. This fact can be used to synchronize command servicing.

GPIB bus queries induce the data set management to send the desired data to the output unit.

Status Reporting System

The status reporting system collects information on the instrument state and makes it available to the output unit on request. The exact structure and function are described in section *Status Reporting System* on page 5.16.

Output Unit

The output unit collects the information requested by the controller, which it receives from the data set management. It processes it according to the SCPI rules and makes it available in the output buffer. If the information requested is longer, it is made available "in portions" without this being recognized by the controller.

If the instrument is addressed as a talker without the output buffer containing data or awaiting data from the data set management, the output unit sends the error message "Query UNTERMINATED" to the status reporting system. No data are sent on the GPIB bus, the controller waits until it has reached its time limit. This behavior is specified by SCPI.

Command Sequence and Command Synchronization

What was said above makes clear that overlapping execution is possible in principle for all commands. Equally, setting commands within one command line are not absolutely serviced in the order in which they have been received.

In order to make sure that commands are actually carried out in a certain order, each command must be sent in a separate command line, that is to say, with a separate IBWRT()-call.
In order to prevent an overlapping execution of commands, one of commands *OPC, *OPC? or *WAI must be used. All three commands cause a certain action only to be carried out after the hardware has been set and has settled. By suitable programming, the controller can be forced to wait for the respective action to occur (cf. *Table 5-1*).

Table 5-1 Synchronization with *OPC, *OPC? and *WAI

Command	**Action after the hardware has settled**	**Programming the controller**
*OPC	Setting the operation-complete bit in the ESR	- Setting bit 0 in the ESE - Setting bit 5 in the SRE - Waiting for service request (SRQ)
*OPC?	Writing a "1" into the output buffer	Addressing the instrument as a talker
*WAI	Executing the next command Note: The GPIB bus handshake is not stopped	Sending the next command

Status Reporting System

The status reporting system (cf. Fig. 5-5) stores all information on the present operating state of the instrument, and on errors which have occurred. This information is stored in the status registers and in the error queue. The status registers and the error queue can be queried via GPIB bus.

The information is of a hierarchical structure. The register status byte (STB) defined in IEEE 488.2 and its associated mask register service request enable (SRE) form the uppermost level. The STB receives its information from the standard event status register (ESR) which is also defined in IEEE 488.2 with the associated mask register standard event status enable (ESE) and registers `STATus:OPERation` and `STATus:QUEStionable` which are defined by SCPI and contain detailed information on the instrument.

The IST flag ("Individual STatus") and the parallel poll enable register (PPE) allocated to it are also part of the status reporting system. The IST flag, like the SRQ, combines the entire instrument status in a single bit. The PPE fulfills an analog function for the IST flag as the SRE for the service request.

The output buffer contains the messages the instrument returns to the controller. It is not part of the status reporting system but determines the value of the MAV bit in the STB and thus is represented in *Fig. 5-5*.

Structure of an SCPI Status Register

Each standard SCPI register consists of 5 parts which each have a width of 16 bits and have different functions (cf. *Fig. 5-4*). The individual bits are independent of each other, i.e. each hardware status is assigned a bit number which is valid for all five parts. Bit 15 (the most significant bit) is set to zero for all parts. Thus the contents of the register parts can be processed by the controller as positive integer.

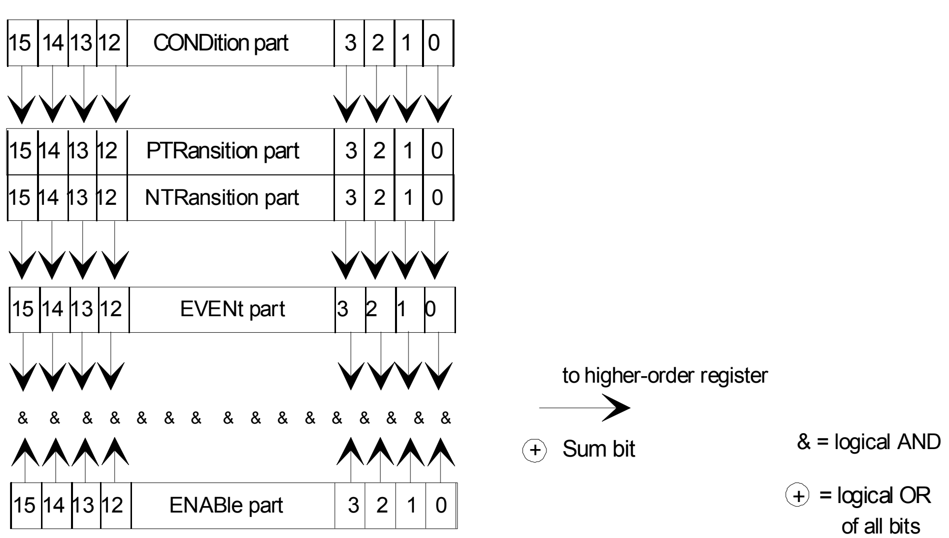


Fig. 5-4 The status register model

CONDition part The CONDition part is permanently overwritten by the hardware or the sum bit of the next lower register. Its contents always reflect the current instrument status. This register part can only be read, but not overwritten or cleared. Reading the CONDition register is nondestructive.

PTRansition part The Positive-TRansition part acts as a transition filter. When a bit of the CONDition part is changed from 0 to 1, the associated PTR bit decides whether the EVENt bit is set to 1.
PTR bit =1: the EVENt bit is set.
PTR bit =0: the EVENt bit is not set.
This status register part can be overwritten and read at will. Reading the PTRansition register is nondestructive.

NTRansition part The Negative-TRansition part also acts as a transition filter. When a bit of the CONDition part is changed from 1 to 0, the associated NTR bit decides whether the EVENt bit is set to 1.
NTR bit =1: the EVENt bit is set.
NTR bit =0: the EVENt bit is not set.
This part can be overwritten and read at will. Reading the PTRansition register is nondestructive.

With these two transition register parts the user can define which state transition of the condition part (none, 0 to 1, 1 to 0 or both) is stored in the EVENt part.

EVENt part The EVENt part indicates whether an event has occurred since the last reading, it is the "memory" of the condition part. It only indicates events passed on by the transition filters. It is permanently updated by the instrument. This part can only be read by the user. Reading the register clears it. This part is often equated with the entire register.

The R&S® CBT implementation of the EVENt parts of all status registers differs from the SCPI specification: The bits in the EVENt part are directly set by the instrument as soon as the instrument state changes so that the setting condition becomes true. The CONDition, PTRansition, and NTRansition register parts are not needed. The EVENt part is cleared upon reading.

ENABle part The ENABle part determines whether the associated EVENt bit contributes to the sum bit (cf. below). Each bit of the EVENt part is ANDed with the associated ENABle bit (symbol '&'). The results of all logical operations of this part are passed on to the sum bit via an OR function (symbol '+').
ENAB bit =0: the associated EVENt bit does not contribute to the sum bit
ENAB bit =1: if the associated EVENT bit is "1", the sum bit is set to "1" as well.
This part can be written into and read by the user at will. Its contents is not affected by reading.

Sum bit As indicated above, the sum bit is obtained from the EVENt and ENABle part for each register. The result is then entered into a bit of the CONDition part of the higher-order register.
The instrument automatically generates the sum bit for each register. Thus an event, e.g. a PLL that has not locked, can lead to a service request throughout all levels of the hierarchy.

Note: *The service request enable register SRE defined in IEEE 488.2 can be taken as ENABle part of the STB if the STB is structured according to SCPI. By analogy, the ESE can be taken as the ENABle part of the ESR.*

Overview of the Status Registers

Fig. 5-5 shows the status registers used in the R&S® CBT. The STATus:QUEStionable register is not used. In addition to the standard STATus:OPERation register, the R&S® CBT offers 30 independent STATus:OPERation:CMU:SUM1|2:CMU<nr> sub-registers (<nr>=1 ... 15).

Cascading registers

The hierarchical structure of the STATus:OPERation register was designed with the aim of reporting and specifying the events generated during different measurements independently. Each sub-register receives entries from a particular combination of a function group and signalling mode (e.g. *RF Non Signalling, Bluetooth Signalling* etc.). The function groups and modes are identified by means of their secondary address, an integer number between 0 and 29. Secondary address 0 is reserved for the R&S® CBT base system. The remaining secondary addresses can be arbitrarily assigned or queried via the SYSTem:REMote:ADDRess:SECondary command (see Chapter 6). The assignment between sub-registers and secondary addresses is as follows:

Sub-register	Secondary Address	Sub-register	Secondary Address
STAT:OPER:CMU:SUM1:CMU1	0 (reserved for CBT base system)	STAT:OPER:CMU:SUM2:CMU1	15
...	...	...	...
STAT:OPER:CMU:SUM1:CMU15	14	STAT:OPER:CMU:SUM2:CMU15	29

Contents of the sub-registers

The higher-level STATus:OPERation registers summarize the sub-registers as shown in Fig. 5-5. E.g., if the corresponding ENABle bit is set, any EVENt reported in one of the STATus:OPERation:CMU:SUM1|2:CMU<nr> sub-registers sets the sum bit of the STATus:OPERation:CMU:SUM1|2 register to 1.

This means that the STATus:OPERation register indicates whether any event occurred, the lower-level STATus:OPERation:CMU:SUM1|2 registers indicate the function group and signalling mode in which the event occurred, the lowest-level STATus:OPERation:CMU:SUM1|2 registers indicate the nature of the individual events.

The meaning of the bits in function group *RF Non Signalling* is given below (see section *STATus:OPERation* Register on p. 5.22 ff.). For other function groups refer to the relevant manuals.

Accessing the sub-registers

Every single status register can be configured and queried individually by means of the commands of the STATus:OPERation subsystem (see Chapter 6).

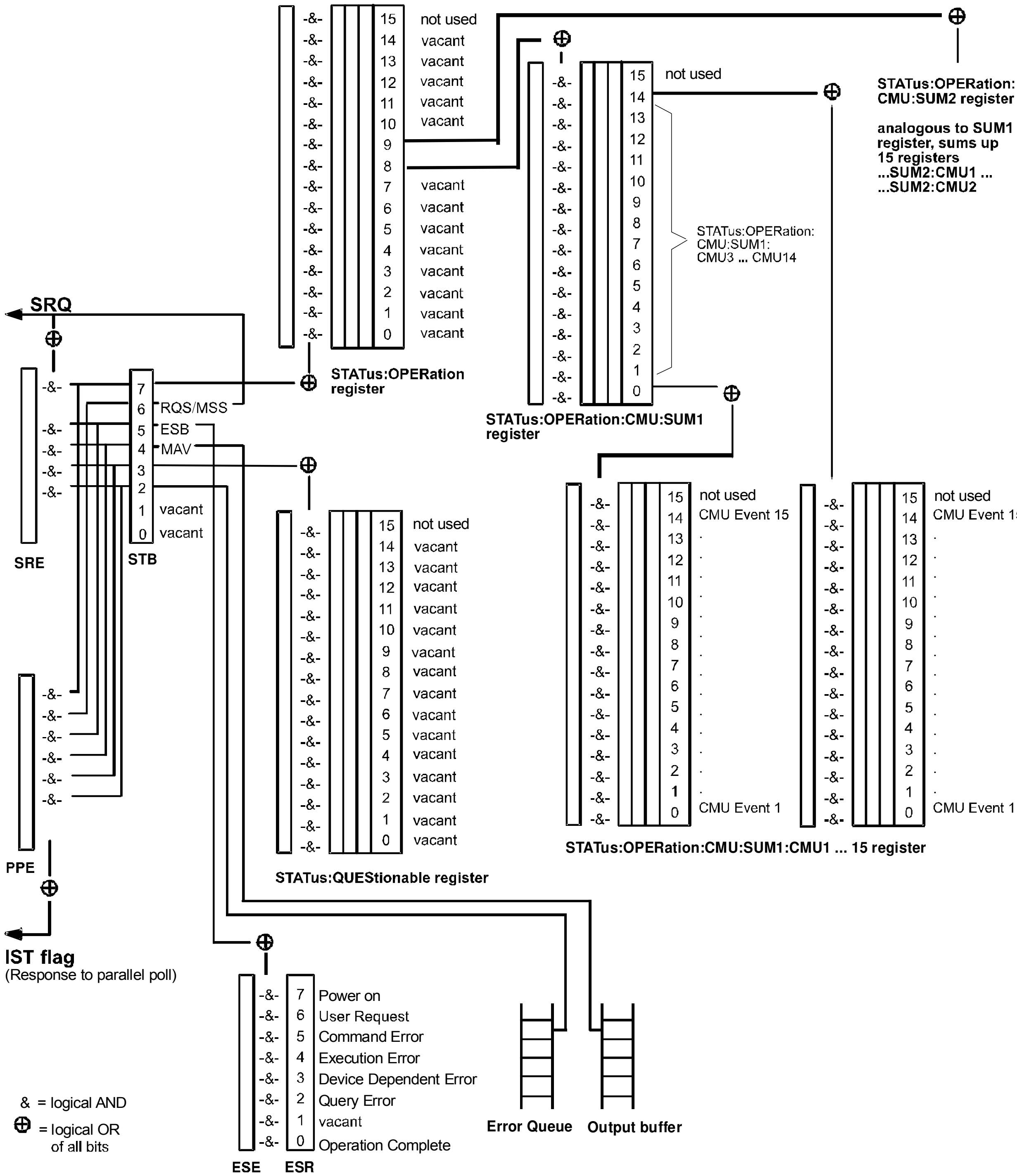


Fig. 5-5 The status registers

Status Byte (STB) and Service Request Enable Register (SRE)

The STB is already defined in IEEE 488.2. It provides a rough overview of the instrument status by collecting the pieces of information of the lower registers. It can thus be compared with the CONDition part of an SCPI register and assumes the highest level within the SCPI hierarchy. A special feature is that bit 6 acts as the sum bit of the remaining bits of the status byte.

The status byte is read out using the command "*STB?" or a serial poll.

The STB is linked to the SRE. The latter corresponds to the ENABle part of the SCPI registers in its function. Each bit of the STB is assigned a bit in the SRE. Bit 6 of the SRE is ignored. If a bit is set in the SRE and the associated bit in the STB changes from 0 to 1, a Service Request (SRQ) is generated on the GPIB bus, which triggers an interrupt in the controller if this is appropriately configured and can be further processed there.
The SRE can be set using command "*SRE" and read using "*SRE?".

Table 5-2 Meaning of the bits used in the status byte

Bit no.	Meaning
2	**Error Queue not empty** This bit is set when an entry is made in the error queue. If this bit is enabled by the SRE, each entry of the error queue generates a Service Request. Thus an error can be recognized and specified in greater detail by polling the error queue. The poll provides an informative error message. This procedure is to be recommended since it considerably reduces the problems involved with GPIB bus control.
3	**QUEStionable status sum bit** This bit is set if an EVENt bit is set in the QUEStionable status register and the associated ENABle bit is set to 1. A set bit indicates a questionable instrument status, which can be specified in greater detail by polling the QUEStionable status register.
4	**MAV-Bit** (Message AVailable) This bit is set if a message is available in the output buffer which can be read. This bit can be used to enable data to be automatically read from the instrument to the controller (cf. annex D, program examples).
5	**ESB bit** Sum bit of the event status register. It is set if one of the bits in the event status register is set and enabled in the event status enable register. Setting of this bit indicates a serious error which can be specified in greater detail by polling the event status register.
6	**MSS-Bit** (Master Status Summary bit) This bit is set if the instrument triggers a service request. This is the case if one of the other bits of this register is set together with its mask bit in the service request enable register SRE.
7	**OPERation status register sum bit** This bit is set if an EVENt bit is set in the OPERation status register and the associated ENABle bit is set to 1. A set bit indicates that the instrument is just performing an action. The type of action can be queried by polling the OPERation status register.

IST Flag and Parallel Poll Enable Register (PPE)

By analogy with the SRQ, the IST flag combines the entire status information in a single bit. It can be queried by means of a parallel poll (cf. Section *Parallel Poll* on page 5.26) or using the command "`*IST?`".

The parallel poll enable register (PPE) determines which bits of the STB contribute to the IST flag. The bits of the STB are ANDed with the corresponding bits of the PPE, with bit 6 being used as well in contrast to the SRE. The IST flag results from the ORing of all results. The PPE can be set using commands "*PRE" and read using command "`*PRE?`".

Event Status Register (ESR) and Event Status Enable Register (ESE)

The ESR is defined in IEEE 488.2. It can be compared with the EVENt part of an SCPI register. The event status register can be read out using command "`*ESR?`".
The ESE is the associated ENABle part. It can be set using the command "`*ESE`" and read using the command "`*ESE?`".

Table 5-3 Meaning of the bits used in the event status register

Bit No.	Meaning
0	**Operation Complete** This bit is set on receipt of the command *OPC exactly when all previous commands have been executed.
2	**Query Error** This bit is set if either the controller wants to read data from the instrument without having sent a query, or if it does not fetch requested data and sends new instructions to the instrument instead. The cause is often a query which is faulty and hence cannot be executed.
3	**Device-dependent Error** This bit is set if a device-dependent error occurs. An error message with a number between -300 and -399 or a positive error number, which denotes the error in greater detail, is entered into the error queue (cf. annex B, Error Messages).
4	**Execution Error** This bit is set if a received command is syntactically correct but cannot be performed for other reasons. An error message with a number between -200 and -300, which denotes the error in greater detail, is entered into the error queue (cf. annex B, Error Messages).
5	**Command Error** This bit is set if a command which is undefined or syntactically incorrect is received. An error message with a number between -100 and -200, which denotes the error in greater detail, is entered into the error queue (cf. annex B, Error Messages).
6	**User Request** This bit is not used in the R&S® CBT.
7	**Power On** (supply voltage on) This bit is set on switching on the instrument.

STATus:OPERation Register

The R&S® CBT offers 30 independent `STATus:OPERation:CMU:SUM1|2:CMU<nr>` sub-registers (<nr>=1 ... 15) which are implemented in a hierarchical form. The bits of the 30 `STATus:OPERation` registers are set only after the registers are assigned to a function group and measurement mode (see p. 5.18).

In the EVENt part, the `STATus:OPERation` register contains information on which actions the instrument has executed since the last readout. All five parts of the registers can be read using one of the commands of the subsystem `STATus:OPERation:CMU:SUM1|2:CMU<nr>:...` . Moreover, the EVENt part can be enabled and read by means of the `STATus:OPERation:SYMBolic...` commands, see section *Symbolic Status Event Register Evaluation* on page 5.26 ff.

The bit assignment for the R&S® CBT base system which is always assigned to the `...SUM1:CMU1` sub-register (secondary address 0) is as follows:

Table 5-4 Meaning of the bits used in the `STATus:OPERation:CMU:SUM1:CMU1` sub-register assigned to the R&S® CBT base system

Bit-No.	Meaning	Symbol in `STATus:OPERation:SYMBolic...`
4	**Measurement Result is Invalid** This bit is set if a measurement caused invalid results, e.g. because of no input signal was available (see also application example below and section *Retrieving Measurement Results* on p. 5.39 ff.).	**MINV**
6	**Reference Frequency Not Locked** This bit is set if synchronization to the reference frequency failed (e.g. because of a missing or faulty external reference frequency). The R&S® CBT checks the synchronization approx. once per second and updates the RFNL bit. Alternatively, the synchronization can be queried via `[SENSe:]SYNChronize:FREQuency:REFerence:LOCKed?` (see Chapter 6).	**RFNL**

For function group *RF Non Signalling,* the bit assignment is as follows:

Table 5-5 Meaning of the bits used in the `STATus:OPERation:CMU:SUM1|2:CMU<nr>` sub-register assigned to *RF Non Signalling*

Bit-No.	Meaning	Symbol in `STATus:OPERation:SYMBolic...`
0	**Overload** This bit is set if the currently used input connector is overloaded.	**IOV**
4	**Measurement Result is Invalid** This bit is set if a measurement caused invalid results, e.g. because no input signal was available (see also application example below and section *Retrieving Measurement Results* on p. 5.39 ff.).	**MINV**
11	**RF Input Overdriven** This bit is set if the RF input level at the RF output connector is larger than the specified *RF Max. Level* plus an appropriate margin.	**RFIO**

Bit-No.	Meaning	Symbol in `STATus:OPERation:SYMBolic...`
12	**RF Input Underdriven** This bit is set while the RF input level at the RF output connector falls below the measurement range controlled by the specified *RF Max. Level.*	**RFIU**

Bluetooth mobile tests comprise the two signalling modes *Non Signalling* and *Signalling* so that 2 different secondary addresses are used. In *Non Signalling* mode, no bits are assigned.

In the status register for the *Signalling* mode the bit assignment is as follows:

Table 5-6 Meaning of the bits used in the **`STATus:OPERation:CMU:SUM1|2:CMU<nr>`** sub-registers assigned to *Bluetooth Signalling*

Bit-No.	Meaning	Symbol in `STAT:OPER:SYMB...`
1	**DUT disconnected** This bit is set when the connection to the DUT is released.	**DUTD**
2	**Connection lost** This bit is set if the R&S CBT had to leave the signalling state "Connected" (e.g. because of a connection timeout).	**CONL**
3	**Inquiry done and at least one DUT found** This bit is set after a successful inquiry.	**INQD**
12	**Test mode parameters rejected by DUT** This bit is set if test mode parameters on the R&S CBT are changed and the DUT does not acknowledge that.	**TMPR**
13	**Test mode not enabled on DUT** This bit is set if a connection is attempted to a DUT on which the test mode is not locally enabled.	**TMNE**
14	**Sub-mode not supported by DUT** This bit is set if the R&S CBT attempts to place the DUT into a sub-mode (Hold, Sniff, Park, Audio, ...) that is not supported by the DUT.	**SMNS**

Application example (see also description of Winbatch tool in Chapter 7): The following command sequence shows how an event “Measurement Result is Invalid” is registered in the status reporting system and illustrates some of the tools that the R&S® CBT provides to monitor the instrument status.

...

`CBTBASE: *CLS`	Clear status reporting system.
`CBTBASE: TRACE:REMOTE:MODE:SRQ ON`	Include service requests sent by the R&S® CBT in the remote control report.
`CBTBASE: TRACE:REMOTE:MODE:DISPLAY ON`	Display remote report on screen.
`CBTBASE: *SRE 128`	Enable service request.
`CBTRFNS: STAT:OPER:SYMB:ENAB MINV`	Enable event reporting for bit no. 4, MINV, in a different function group (RF Non Signalling).

`CBTRFNS: READ:RFAN:NPOW?`	Initiate a single-shot RF analyzer power measurement using default settings and return results. In case of invalid measurement results (e.g. because no input signal is applied to the input connector of the R&S® CBT), a read symbol "S" for service request should appear on the screen.
`CBTBASE: STAT:OPER:EVEN:SADD?`	Check which function group reported an event. The query returns the RF function group.
`CBTRFNS: STAT:OPER:SYMB?`	Query events reported by the RF function group: Bit MINV must be set

STATus:QUEStionable-Register

This register contains information on questionable instrument states. They can occur, e.g. if the instrument is operated outside its specified range. It can be queried using one of the commands "`:STATus:QUEStionable:CONDition?`" or "`:STATus:QUEStionable[:EVENt]?`".

The R&S® CBT does not use this register.

Application of the Status Reporting System

In order to effectively use the status reporting system, the information contained there must be transmitted to the controller and further processed. There are several methods, which are outlined in the following.

Service Request

The instrument can send a service request (SRQ) to the controller. Usually this service request initiates an interrupt at the controller, to which the control program can react appropriately. As evident from Fig. 5-5, an SRQ is always initiated if one or several of bits 2, 3, 4, 5 or 7 of the status byte are set and enabled in the SRE. Each of these bits combines the information of a further register, the error queue or the output buffer. The ENABle parts of the status registers can be set so that arbitrary bits in an arbitrary status register initiate an SRQ. In order to use the possibilities of the service request effectively, all bits should be set to "1" in the enable registers SRE and ESE.

Examples (cf. Fig. 5-5):

Use command "`*OPC`" to generate an SRQ

- Set bit 0 in the ESE (Operation Complete)
- Set bit 5 in the SRE (ESB)

After its settings have been completed, the instrument generates an SRQ.

Indication of an event (e.g. overloading of used input connector) by means of an SRQ with the controller:

- Set bit 7 in the SRE (sum bit of the `STATus:OPERation` register)

The following steps depend on the secondary address (0 ≤ <SecAddr> ≤ 29) assigned to the function group and signalling mode used.

0 ≤ <SecAddr> ≤ 14

- Set bit 8 in the `STATus:OPERation:ENABle` register.
- Set bit <SecAddr>-1 in the `STATus:OPERation:CMU:SUM1:ENABle` register
- Set bit 0 in the `STATus:OPERation:CMU:SUM1:CMU<SecAddr>:ENABle` register.

15 ≤ <SecAddr> ≤ 29

- Set bit 9 in the `STATus:OPERation:ENABle` register.
- Set bit <SecAddr>-16 in the `STATus:OPERation:CMU:SUM2:ENABle` register
- Set bit 0 in the `STATus:OPERation:CMU:SUM2:CMU<SecAddr>:ENABle` register.

When the event assigned to bit no. 0 of the `STATus:OPERation:CMU:SUM1|2:CMU<SecAddr>` register occurs (e.g. when the input connector is overloaded in function group *RF Non Signalling)* the instrument generates a SRQ.

The same procedure can be applied to find out which event caused an SRQ:

- `STB?`
- Query `STAT:OPER:EVENT?`
- Query `STAT:OPER:CMU:SUM1|2:EVENT?` (function group, signalling mode)
- Query `STAT:OPER:CMU:SUM1|2:CMU1...15:EVENT?` (measurement)

The SRQ is the only possibility for the instrument to become active on its own. Each controller program should set the instrument such that a service request is initiated in the case of malfunction. The program should react appropriately to the service request.

Symbolic Status Event Register Evaluation

The examples for status register handling given in section *Service Request* on p. 5.25 are based on a step-by-step evaluation of the `STATus:OPERation` register and its sub-registers. As a convenient alternative to this approach, the R&S® CBT provides commands for symbolic status event register evaluation. These commands are global (i.e. available in all function groups) and described in detail in Chapter 6. They organize and simplify the following actions:

`STATus:OPERation:EVENt:SADDress?`	Return the next secondary address and associated function group where an event was reported.
`STATus:OPERation:SYMBolic:ENABle <Event_1>[,<Event_2>,...<Event_15>]`	Enable the events of the parameter list up to the status byte, i.e. set the corresponding bits in the `STATus:OPERation:ENABle` register and in the sub-registers `STATus:OPERation:CMU:SUM1|2:ENABle` and `STATus:OPERation:CMU:SUM1|2:CMU <SecAddr>:ENABle`, so that the events are reported in the status byte. <SecAddr> denotes the current secondary address, see also example in section *Service Request* on p. 5.25.
`STATus:OPERation:SYMBolic[:EVENt]?`	Return all events reported in the current function group. The event symbols listed with the bit assignment of the `STATus:OPERation...` registers; for an example see *Table 5-5* on page 5.22.

An example program for symbolic status register evaluation is included in chapter 7 of this manual.

Serial Poll

In a serial poll, just as upon the command "`*STB?`", the status byte of an instrument is queried. However, the query is made via interface messages and is thus clearly faster. The serial-poll method has already been defined in IEEE 488.1 and used to be the only standard possibility for different instruments to poll the status byte. The method also works for instruments which do not adhere to SCPI or IEEE 488.2.

The quick-BASIC command for executing a serial poll is "`IBRSP()`". The serial poll is mainly used to obtain a fast overview of the state of several instruments connected to the GPIB bus.

Parallel Poll

In a parallel poll, the controller uses a single command to request up to eight instruments to transmit one bit of information each on the data lines, i.e., to set the data line allocated to each instrument to a logical "0" or "1". In addition to the SRE register, which determines the conditions under which an SRQ is generated, there is a parallel poll enable register (PPE). This register is ANDed with the STB bit by bit, considering bit 6 as well. The results are ORed, the result is possibly inverted and then sent as a response to the parallel poll of the controller. The result can also be queried without parallel poll by means of the command "`*IST?`".

The instrument first has to be set for the parallel poll using the quick-BASIC command "`IBPPC()`". This command allocates a data line to the instrument and determines whether the response is to be inverted. The parallel poll itself is executed using "`IBRPP()`".

The parallel poll method is mainly used to find out quickly which one of the instruments connected to the GPIB bus has sent a service request. To this effect, SRE and PPE must be set to the same value.

Query by Means of Commands

Each part of any status register can be read by means of queries. The individual commands are listed in Chapter 6. The returned value is always a number that represents the bit pattern of the register queried. This number is evaluated by the controller program.

Queries are usually used after an SRQ in order to obtain more detailed information on the cause of the SRQ.

Error Queue Query

Each error state in the instrument leads to an entry in the error queue. The entries of the error queue are detailed plain-text error messages that can be looked at in the ERROR menu via manual control or queried via the GPIB bus using command `"SYSTem:ERRor?"`. Each call of `"SYSTem:ERRor?"` provides one entry from the error queue. If no error messages are stored there any more, the instrument responds with `0, "No error"`.

The error queue should be queried after every SRQ in the controller program as the entries describe the cause of an error more precisely than the status registers. Especially in the test phase of a controller program the error queue should be queried regularly since faulty commands from the controller to the instrument are recorded there as well.

Reset Values of the Status Reporting Systems

Table 5-7 comprises the different commands and events causing the status reporting system to be reset. None of the commands, except for `*RST` and `SYSTem:PRESet` influences the functional instrument settings. In particular, DCL does not change the instrument settings.

Table 5-7 Resetting instrument functions

Event	Switching on supply voltage		DCL,SDC (Device Clear, Selected Device Clear)	*RST or SYSTem:PRESet	STATus:PRESet	*CLS
	Power-On-Status-Clear					
Effect	0	1				
Clear STB,ESR	—	yes	—	—	—	yes
Clear SRE,ESE	—	yes	—	—	—	—
Clear PPE	—	yes	—	—	—	—
Clear EVENt parts of the registers	—	yes	—	—	—	yes
Clear ENABle parts of all OPERation-and QUEStionable registers, Fill ENABle parts of all other registers with "1".	—	yes	—	—	yes	—
Fill PTRansition parts with „1" Clear NTRansition parts	—	yes	—	—	yes	—
Clear error queue	yes	yes	—	—	—	yes
Clear output buffer	yes	yes	yes	1)	1)	1)
Clear command processing and input buffer	yes	yes	yes	—	—	—

1) Every command being the first in a command line, i.e. immediately following a <PROGRAM MESSAGE TERMINATOR> clears the output buffer.

Measurement Control

The R&S® CBT offers a variety of measurements which are arranged in function groups and measurement groups. All measurements are controlled according to the same basic concepts. The benefit of this structure lies in the close analogy of all function groups. Commands belonging to different measurements have the same structure and syntax.

The following sections are devoted to the principles of measurement control:

- A measurement group can be split up into different subgroups by means of *applications* (optional, i.e. not available for every measurement group).
- Four different measurement states are defined; they can be accessed with a set of measurement control commands.
- The end of the measurement (or of a particular measurement stage) can be indicated by means of *the event reporting system.*
- Statistical settings comprising the repetition mode, statistic count (optional), stop condition (optional), and display mode (optional) control how the measurement is performed. The possible measurement states depend on the repetition mode.
- For many measurements it is possible to specify limits and perform a limit check.
- The current status and the results of the measurement can be queried in a systematic way.

Some measurements do not require the full scheme.

Measurement Groups and Applications

Applications are different measurements belonging to the same measurement group. Each application is assigned its own set of configuration parameters. With few exceptions (e.g. some tolerance values), all parameters assigned to the applications are independent from each other. Thus, applications effectively split up a measurement group into various independent subgroups which can be configured individually and serviced in parallel.

The benefit of this feature is that the results of an application will not become invalid when another application in the same measurement group is started.

Applications are generally identified by the third-level keyword in a command while the measurement group is identified by the second-level keyword.

Function group *RF (Non Signalling)* contains the following measurement groups and applications:

Table 5-8 RF measurement groups and applications

Measurement	**Description**
`RFANalyzer`	Average RF power over a sweep, measured with different filters.

Bluetooth measurements can be performed in *Signalling* mode only. The measurement groups and applications listed in the following table are defined.

Table 5-9 Bluetooth measurement groups and applications

Measurement	Description
POWer:TIME	Measurement of the power of the transmitter output power of the Bluetooth DUT as a function of time with evaluation of the nominal power, peak power, leakage power and packet timing plus a power control check. A statistical evaluation and limit check are performed for the measured quantities (except the power control check).
POWer:RELative	Measurement of the transmitter output power of the Bluetooth DUT as a function of time, evaluated separately for the *GFSK* and *DPSK* portions of EDR packets, and with a calculation of Relative Power (P_{DPSK} - P_{GFSK}) and the guard time. A statistical evaluation and limit check are done for the measured quantities. This application is only available after installation of the EDR options (R&S CBT-B55/K55).
MODulation:DEViation	Measurement of the frequency deviation over the whole Bluetooth Basic Rate packet, or over the GFSK portion of an EDR packet, with calculation of the frequency accuracy, the frequency drift, and the maximum drift rate. A statistical evaluation and limit check are performed for all modulation results.
MODulation:DPSKeying	Measurement of the frequency stability and modulation accuracy (DEVM) over the DPSK portion of EDR packets, along with a conformance check for symbols satisfying a threshold condition for DEVM. A statistical evaluation and limit check are done for all modulation results. This application is only available after installation of the EDR options (R&S CBT-B55/K55).
MODulation:ENCoding	Measurement of the Bit Error Rate and the percentage of packets that the R&S CBT received with zero bit errors while the Bluetooth EUT operates in *TX Tests* mode. This application is only available after installation of the EDR options (R&S CBT-B55/K55).
MODulation:IQANalyzer	Display of the constellation points (or vector diagrams) for the DPSK modulated portion of the EDR bursts. This application is only available after installation of the EDR options (R&S CBT-B55/K55).
MODulation:PDIFference	Calculation of the normalized phase difference of each symbol relative to the preceding symbol. This application is only available after installation of the EDR options (R&S CBT-B55/K55).
SPECtrum:ACPower	Measurement of the output RF spectrum emissions in the frequency domain. The measurement yield the Adjacent Channel Power (ACP) in 3 upper and 3 lower adjacent channels.
SPECtrum:BWIDth	Measurement of the width of the frequency band around the peak of the emissionwhere the transmit power drops by less than 20 dB.
SPECtrum:FRANge	Calculation of the lower and upper limit frequencies where the signal power crosses a specified power threshold.
RXQuality:BER RXQuality:SBER	Measurement of the bit error rate and the packet error rate at variable receiver input level of the DUT (application BER*)* or a search for the receiver input level corresponding to a particular bit error rate (application SBER). A broad range of parameters configure the *Receiver Quality* measurements; up to five different configurations can be stored in separate (and pre-configured) *Test Setups* identified with the keyword TSETup<nr> where <nr> = 1, ..., 5. With the EDR options (R&S CBT-B55/K55) the R&S CBT also supports Receiver Quality tests on EDR packets.

The measuremens in *Table 5-8* are complemented by groups of commands used to retrieve results that are automatically provided by the mobile station (e.g. the signalling information `SINFo` reported by the DUT). These command groups do not represent real measurements; they consist of queries only. For an overview, see the list of remote control commands at the end of chapter 6.

The following measurement groups and applications are defined in the *Audio* function group (with option R&S® CBT-B41):

Table 5-11 Audio measurement groups and applications

Measurement	**Description**
`AFANalyzer`	DC and AC voltage and Total Harmonic Distortion and Noise of a single-tone audio signal.
`MULTitone`	Analysis of a composite audio signal consisting of up to 20 individual fixed-frequency tones with configurable frequency and level including limit check.
`THD`	Analysis of the AF power at the generator frequency (1st harmonic labeled d1) and at the 2^{nd}, 3^{rd} …9^{th} harmonics and calculation of the Total Harmonic Distortion.

Measurement Control Commands and States

Measurement control commands are used to switch over between the following four measurement states:

OFF measurement is switched off, no results available (after `STOP`)

RUN measurement is running

STOP measurement has been stopped, valid results are preserved

STEP measurement has been interrupted after a statistics cycle (in repetition mode *Continuous* or *Counting* with *Stepping* mode set in addition). The next cycle must be launched with a `CONTinue` command.

The *STOP* state corresponds to the *HLT* state indicated next to the softkeys controlling a measurement in manual operation. A *STEP* state is not defined in manual control.

The three measurement states *OFF, STOP,* and *STEP* can be mapped onto the standard SCPI state *IDLE*, the *RUN* state can be mapped onto the SCPI state *INITiated*. This and the relation between control commands and measurement states is shown in the following diagram:

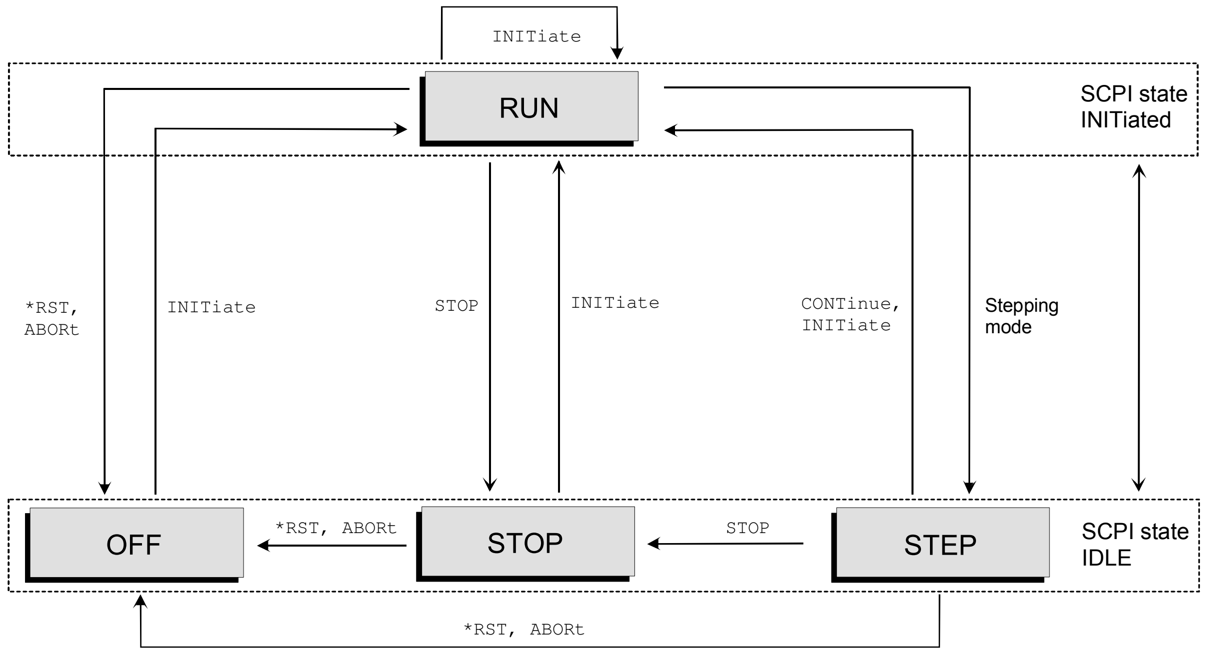


Fig. 5-7 Measurement states and control commands

The measurement control commands are supplemented by the measurement object, i.e.:

INITiate:<meas_obj> Starts a measurement in the repetition mode set via the `CONFigure:<meas_obj>:CONTrol:REPetition` command (single shot, continuous or counting mode, see section *Measurement Statistics* on page 5.37). The command resets the counters for the evaluation period and statistics (the latter is not used in RF measurements) to zero, furthermore, all measurement values are set invalid *(INV).*

As illustrated in *Fig. 5-7*, `INITiate` can be called in any measurement state. If the measurement is already running *(RUN),* `INITiate` aborts `(ABORt)` and restarts a running measurement.

The measurement reserves all necessary hardware resources and switches into the *RUN* state. If the measurement can not be started due to a resource conflict it remains in the *OFF* state, and the measurement status returned by the `FETCh:<meas_obj>:STATus?` is *ERR*. At the same time the SCPI error –213, *Init ignored*, is generated.

Possible resources conflicts

- The RF connector is already allocated by another measurement or signal generator. The other measurement must be switched off first.
- Due to the method used for the analysis, two measurements can not be evaluated at the same time.

Overlapping execution

`INITiate` is implemented as an overlapped command. In contrast to SCPI specifications, the `*OPC` command (see Chapter 6, *Common Commands)* can not be applied together with the `INITiate` command. The *operation complete* bit (bit no. 0 in the event status register, ESR) is set immediately after the command sequence `INIT; *OPC`, i.e. as soon as the measurement is started and not after the end of the first evaluation period.

The command `CONFigure:<meas_obj>:EREPorting <Event>, <Mode>` represents a more flexible tool for generating a service request or setting the *operation complete* bit after the end of a measurement (see section *Event Reporting* on page 5.34).

`READ` command

Instead of `INITiate`, the `READ` command can be used to initiate a (single shot) measurement, see section *Retrieving Measurement Results* on page 5.39.

`ABORt:<meas_obj>`

Aborts the current measurement immediately and switches over to the *OFF* state. All measurement values are set invalid *(INV);* the hardware resources are released for other measurements.

As illustrated in *Fig. 5-7*, `ABORt` can be called in any measurement state.

Sequential execution

`ABORt` is implemented as a sequential command. This means that `ABORt` is not complete until the measurement has released all of its resources and has changed to the *OFF* state.

`STOP:<meas_obj>`

Stops (halts) the measurement as quickly as possible; i.e. after the end of the current evaluation period (or statistics cycle, if cycles comprising several evaluation periods are defined). The measurement changes to the *STOP* state such that all corresponding measurement values are kept unchanged. The hardware resources are retained.

As illustrated in *Fig. 5-7*, `STOP` can be called in the measurement states *RUN* and *STEP*. If called in the *OFF* state the command causes an SCPI error –221, *Settings conflict*.

Sequential execution

`STOP` is implemented as a sequential command. Execution of `STOP` is considered as complete as soon as the measurement state *STOP* is reached.

The `STOP` command causes no events which are set by the event reporting system (see section *Event Reporting* on page 5.34). This means that a service request must be explicitly requested by an `*OPC` command.

`CONTinue:<meas_obj>`

Resumes the measurement for the next measurement evaluation period and changes to the *RUN* state.

As illustrated in *Fig. 5-7*, `CONTinue` can be called in the measurement states *STOP* and *STEP*. If the previous measurement has been terminated (the measurement status returned by the `FETCh:<meas_obj>:STATus?` is *RDY),* `CONTinue` restarts the measurement and resets the counters for the evaluation period and statistics (the latter is not used for RF measurements) to zero.

In the other measurement states the command causes an SCPI error –221, *Settings conflict*.

Overlapping execution — CONTinue is implemented as an overlapping command like INITiate. As a consequence, *OPC can not be used together with CONTinue.

Stepping mode — The stepping mode determines whether a measurement in the *counting* or *continuous* mode (see section *Measurement Statistics* on page 5.37) is interrupted after each evaluation period (or each statistics cycle, if cycles comprising several evaluation periods are defined) or not. This mode is set via the <Stepmode> parameter of the CONFigure:<meas_obj>:CONTrol:REPetition CONTinuous | 1 ... 10000, <StopCondition>, <Stepmode> command:

<Stepmode> = STEP — The measurement is interrupted (⇒ measurement state *STEP)* after each evaluation period, and the event reporting system (see p. 5.34) is invoked. The next measurement cycle must be started with the CONTinue:<meas_object> command.

<Stepmode> = NONE — The measurement runs according to its repetition mode. Event reporting is invoked only when the measurement stops (status = RDY).

Note: *STEP can be set in all repetition modes* (single shot, continuous, counting). *For a single shot measurement, which is always stopped after one evaluation period, the stepping mode has no effect.*

In function group *RF Non Signalling*, <meas_obj> can stand for any of the measurement objects POWer and SPECtrum.

Event Reporting

The event reporting system specifies in which way the R&S® CBT reports that a measurement or a measurement step has been correctly terminated, i.e., that the measurement status *STEP* or *RDY* has been reached. Event reporting is configured for each measurement group individually by means of the command:

CONFigure:<meas_obj>:EREPorting SRQ | SOPC | SRSQ | OFF

The parameters have the following meaning:

SRQ — Service request. A service request is generated (i.e. bit no. 6 (RQS/MSS) of the status byte (STB) is set) whenever the measurement status *STEP* or *RDY* is reached (see section *Service Request* on page 5.25).

SOPC — Single operation complete. The *operation complete* bit (bit no. 0 in the event status register) is set whenever the measurement status *STEP* or *RDY* is reached (see section *Status Reporting System* on page 5.16).

SRSQ — A service request is generated and the *operation complete* bit is set.

OFF — No special action is taken when the measurement status *STEP* or *RDY* is reached.

Note: *No action is taken if the* STOP *state is reached due to an explicit STOP command.*

Symbolic Measurement Ready Evaluation:

If event reporting is enabled (i.e. CONFigure:<meas_obj>:EREPorting is not set to OFF), each measurement that reaches the *STEP* or *RDY* status causes an entry in the *measurement queue*. The measurement queue can be queried by means of the `SYSTem:MQUeue[:COMPlete]<spec>?` commands described in Chapter 6. Two different specifiers are provided:

`<spec> = [:LIST]`	Returns the complete list of all ready measurements and reset all entries in the measurement queue to *NONE*.
`<spec> = :ITEM`	Returns the next ready measurement in the list and reset the corresponding entry in the measurement queue to *NONE*.

Symbolic measurement ready evaluation is in order, e.g. to avoid inconsistencies when a `FETCh...?` command is used to retrieve measurement results (see section *Retrieving Measurement Results* on page 5.39).

Measurement Status

The status of the current measurement can be queried by means of the following command:

FETCh status `FETCh:<meas_obj>:STATus?`

Returns the current status of the measurement. The `FETCh...` command can be used as well to poll the progress of a measurement. The response to the `FETCh...` query has the format `<Status>, <Counting_No>, <Statistic_No>`.

<Status> The first parameter in the response reports on the current status of the measurement. The measurement status returned is closely linked to the four measurement states described in section *Measurement Control Commands and States* on page 5.31 ff.:

OFF	measurement in the *OFF* state after `*RST` or `ABORt`
RUN	measurement in the *RUN* state after `INITiate`, `CONTinue`, or `READ`
STOP	measurement in the *STOP* state after `STOP` (stopped explicitly)
STEP	measurement in the *STEP* state due to `<Stepmode> = STEP`, valid measurement results
RDY	measurement in the *STOP* state because stopped according to the repetition mode and stop condition set.
ERR	measurement in the *OFF* state because it could not be started with `INITiate` or `READ` for lack of resources, e.g. because the RF connectors were already in use by another measurement.

<Counting_No> The second parameter in the response returns the current value of the statistics counter (the number of the current statistics cycle) if the measurement is performed in the *Counting* mode:

0 ... 10000	number of the current statistics cycle
NONE	no counter for statistics cycles used, i.e. a repetition mode other than *Counting* is set.

<Statistic_No> The third parameter in the response returns the number of the current *evaluation period* (e.g. a timeslot in digital network tests) within a statistics cycle. In some measurements this counter is not used (response *NONE*).

Generator Control

The commands used for control of the R&S® CBT's RF signal generator are analogous to the measurement control commands explained on page 5.31. The generator is in one of the following two generator states:

OFF	generator switched off, resources released
RUN	generator running
STOP	generator stopped, resources reserved

The *RUN* state corresponds to the status indication *ON* in the *RF generator* softkey (see section *Analyzer/Generator Menu* in Chapter 4).

The relation between generator commands and generator states is shown in the following diagram:

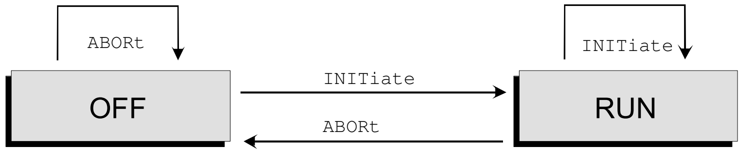


Fig. 5-8 Generator states and control commands

Generator control commands are recognized by the second-level keyword `RFGenerator`. The generator control commands behave as follows:

INITiate: RFGenerator

Starts the generator, reserves all necessary hardware resources and changes to the generator state *RUN.*

As illustrated in *Fig. 5-8*, `INITiate` can be called in any generator state. If the generator is already running *(RUN),* `INITiate` has no effect.

If the generator cannot be started due to a resource conflict it remains in the *OFF* state, and the measurement status returned by the FETCh:<meas_obj>:STATus? is *ERR*. At the same time the SCPI error –213, *Init ignored*, is generated.

Possible resource conflicts: The RF connector is already allocated by another generator. The other generator must be switched off first.

Sequential execution: `INITiate` is implemented as a sequential command. The `*OPC` command (see Chapter 6, *Common Commands)* can be applied together with the `INITiate` command.

ABORt: RFGenerator

Switches the generator off, releases the hardware resources for other generators, and changes to the generator state *OFF.*

As illustrated in *Fig. 5-8*, `ABORt` can be called in any generator state. If the generator is switched off *(OFF),* `ABORt` has no effect.

Sequential execution: `ABORt` is implemented as a sequential command. The command is not terminated until the generator is completely switched off.

Generator Status

The generator status can be queried by means of the `FETCh...?` command:

FETCh command `FETCh:<meas_obj>:STATus?`

Returns the current generator status. The `FETCh...` command can be used to poll the generator status. The `FETCh...` query returns one of the following generator states:

OFF generator is in the *OFF* state (default status after `*RST` or due to `ABORt...` command)

RUN generator running (*RUN* state after `INITiate...` command)

STOP generator stopped (after `STOP...` command)

ERR generator is in the *OFF* state because it could not be started with an `INITiate...` command for lack of resources (e.g. the RF connector is already in use by another generator)

Measurement Statistics

The Bluetooth RF signal is divided into periodic bursts serving as basic evaluation periods for the measurement and for the calculation of statistical results (see also Chapter 3, section *General Settings)*.

Together with the *Statistic Count*, the *Repetition Mode* defines how many evaluation periods are measured if the measurement is not stopped explicitly (measurement control commands `STOP...`, `ABORT...`) or by a limit failure. With remote control the three repetition modes *Single Shot, Continuous* and *Counting* are available (*Counting* is not available in manual control*)*.

In `POWer` and `MODulation` measurements, different traces corresponding to the result in the current evaluation period, the maximum, minimum, or average over a set of evaluation periods (bursts) are determined. These results can be queried independently.

Table 5-12 Statistics in remote control

Setting	Description	Command

Statistic Count	Integer number of evaluation periods forming one statistics cycle. An evaluation period is equal to a burst (`POWer | MODulation`) or a packet (`RXQuality`).
	
	In an RXQuality:SBER measurement, the STATistics parameter denotes the number of packets to be averaged per iteration step (search cycle).
		`CONFigure:<meas_obj>:CONTrol:STATistics` **`1 ... 1000 | NONE`**
		
		`(<meas_obj> = POWer:TIME | WPOWer | MODulation:DEViation | RXQuality:BER:TSETup<nr>)`
		
		`CONFigure:RXQuality:SBER:CONTrol:STATistics` **`1 ... 1000 | NONE,`** `<Search_Value>, <Cycles>`

Repetition mode Single Shot	The measurement is stopped after one statistics cycle.	`CONFigure:<meas_obj>:CONTrol:REPetition` **`SINGleshot`**`, <StopCondition>, <Stepmode>` `(<meas_obj> = POWer:TIME | WPOWer | MODulation:DEViation | RXQuality:BER:TSETup<nr>)`
Continuous	The measurement is continued until stopped explicitly or by a limit failure. Average results are calculated according to the rules given in chapter 3.	`CONFigure:<meas_obj>:CONTrol:REPetition` **`CONTinuous`**`, <StopCondition>, <Stepmode>` `(<meas_obj> = POWer:TIME | WPOWer | MODulation:DEViation | RXQuality:BER:TSETup<nr>)`

Setting	Description	Command
Counting	Repeated single shot measurement with configured statistics cycles.	`CONFigure:<meas_obj>:CONTrol:REPetition` **1 ... 1000**, `<StopCondition>, <Stepmode>` `(<meas_obj> = POWer:TIME | WPOWer | MODulation:DEViation | RXQuality:BER:TSETup<nr>)` A counting measurement with 1 evaluation period is equivalent to a single shot measurement..

Traces	The specifiers `CURRent, MAXimum, MINimum,` and `AVERage` denote the traces for the current evaluation period, the maximum, minimum, extreme value, or average of a set of evaluation periods. They correspond to the *Display Mode* set in the measurement configuration menus.
	In general all four traces are evaluated during the measurement. They are selected via the specifiers used as last keywords in the `READ...` or `FETCh...` queries.
		Measurement results:
		`READ:ARRay:<meas_obj>:<disp>?`
		`READ:SUBarrays:POWer...<disp>?`
		`...`
		Limit matching:
		`CALCULATE:ARRay:<meas_obj>:<disp>: MATChing:LIMit?`
		`....`
		`<disp> = :CURRent | :AVERage | :MAXimum | MINimum`
		`<meas_obj> = POWer:TIME | MODulation:DEViation`

Note: *Some measurement groups (e.g. the* `WPOWer` *measurement in function group RF) use simplified statistical settings where the Statistic Count is always 1. It is still possible to select different repetition modes for these measurements.*

Specifying Limits

Limit checks are provided for most of the Bluetooth measurement applications. The following table gives an overview of the types of limits and possible results of a limit check.

Table 5-14 Limits and limit check

	Description	Command

Scalar limits	Limit values for a single (scalar) measured quantity. Depending on the measured quantity, either an upper limit or upper and lower limits can be defined.	`CONFigure:<meas_obj>:<disp>:LIMit: SCALar:ASYMmetric:<Spec.>:VALue`
		`<disp> = :CURRent | :AVERage | :MAXimum | MINimum`
		`<meas_obj> = POWer:TIME | MODulation:DEViation`
		`<Spec.> = UPPer | LOWer | [:COMBined]` for upper limits, lower limits, or combined upper and lower limits.
		`CONFigure:RXQuality:BER:TSETup<nr>:LIMit:SCALar:ASYMmetric[:COMBined]:VALue`

Limit check	The command on the right side performs the scalar limit check and returns all results within a measurement group.	`CALCulate[:SCALar]:<meas_obj.> :MATChing:LIMit?` `<meas_obj> = POWer:TIME | MODulation:DEViation | BER`

	Description	Command	
	Possible results of the scalar limit check are listed on the right side. Further messages assessing, e.g., the power ramp or the result of the BER test in general, may be issued in particular cases (see detailed command description in chapter 6). For the POWer… and MODulation… meas. objects, the output list contains four sets of results corresponding to the four display modes CURRent | AVERage | MAXimum | MINimum (see section *Measurement Statistics* on page 5.37).	NMAU NMAL INV OK	not matching, underflow not matching, overflow measured value invalid no limit failure

Retrieving Measurement Results

General command structure

The results of a measurement can be retrieved by means of the `FETCh` or `READ` query. All these queries have the same structure:

```
FETCh<type>:<meas_obj>[:RESult]<spec>?
READ<type>:<meas_obj>[:RESult]<spec>?
```

The literals written in angle brackets have the following meaning:

`<type>` Measurement trace `(:ARRay)`, scalar values `([:SCALar])` can be retrieved in the network tests; see the relevant operating manuals.

To limit the number of commands and simplify the program syntax, all scalar results determined in a measurement are generally read out with a single command. They are returned as a list of values separated by commas.

The length of the arrays depends on the measurement group and possibly on the configuration settings; see also *Subarrays* paragraph below.

`<meas_obj>` Measurement group (measurement object): `POWer | SPECtrum` are used in *RF Non Signalling* mode.

`<spec>` `[:CURRent]` current evaluation period, other statistical traces can be retrieved in the network tests.

Subarrays

Arrays generally consist of a large number of values representing the measurement trace over the whole time or frequency range. With the `SUBarrays` commands, the R&S® CBT provides a flexible tool for handling large amounts of data. These commands restrict a measurement to up to 32 subranges where either all measurement results or a single statistical value can be read out.

Subarray configuration

The subarrays are configured with the following commands:

```
CONFigure:SUBarrays:<meas_obj> <Mode>, <Start>, <Samples>
                                     {,<Start>, <Samples>}
```

`<meas_obj>` Measurement group (measurement object). For examples refer to the manuals for the network tests.

`<Mode>` Statistics mode for **all** subranges. The following parameters can be set:

`ALL`	Return all measurement values (the number of values in every subrange is given by the `<Samples>` parameter).
`ARIThmetical`	Return the arithmetical mean value of the results in every subrange.
`MINimum`	Return the minimum of the results in every subrange.
`MAXimum`	Return the maximum of the results in every subrange.
`IVAL`	Return a single measurement value corresponding to the abscissa value <Start>. If <Start> is located between two test points with valid results then the result is calculated from the results at these two adjacent test points by linear interpolation. Ignore the <Samples> parameter.
`PAVG`	Return the arithmetic mean value of the results in every subrange. This mode is appropriate for average power measurements. It may produce misleading results, e.g. for quantities with alternating sign.
`XMINimum`	Return the minimum of the results in every subrange, preceded by the corresponding x-axis value. For n subranges, 2*n values are returned (x1, y1, y2, y2 … xn, yn). If the minimum in a subrange is invalid, two NANs (NAN, NAN) are returned.
`XMAXimum`	Return the minimum of the results in every subrange, preceded by the corresponding x-axis value. See `XMINimum` above.

`<Start>` Start of current range (time or frequency or channel number).

`<Samples>` Number of samples in current range.

The subranges may overlap but must be within the total range of the `<meas_obj>`. Test points outside this range are not measured (result *NAN)* and do not enter into the ARIThmetical, MINimum and MAXimum values.

By default, only one range corresponding to the total measurement range is used and all measurement values are returned.

Subarray results are retrieved by means of `FETCh` or `READ` queries, with `:SUBarrays` inserted as a second-level keyword:

```
FETCh:SUBarrays<type>:<meas_obj>[:RESult]<spec>?
READ:SUBarrays<type>:<meas_obj>[:RESult]<spec>?
```

In the default subarray configuration, these commands are identical with the `FETCh` or `READ` queries described above (i.e. all measurement results are read out).

FETCh command

`FETCh<type>:<meas_obj>[:RESult]<spec>?`

Retrieves the latest valid measurement results.

If the `FETCh` query is used immediately after an `INITialize...` command, the first evaluation period is terminated before the query is executed so that a valid result can be acquired. If called up repeatedly after termination of the first evaluation period, the FETCh query may return the same results several times until they have been updated after the next period.

A FETCh returns the results without interaction with the measurement (unsynchronized query).

Measurement states

According to the definition given above the effect of the FETCh query depends on the measurement status and the history of the measurement:

Status	Valid Results?	Effect of FETCh...?
≠ OFF	Yes	Returns the current results.
OFF	No	Generates an SCPI error –230, *Data corrupt or stale.* This is why FETCh should not be used while the measurement is in the *OFF* state.
RUN	No	Waits until valid results are available and returns these results.
STOP	No	Generates an SCPI error –230, *Data corrupt or stale.* This scenario occurs, e.g. if the measurement is stopped explicitly before the first evaluation period has been terminated.

READ command

READ<type>:<meas_obj>[:RESult]<spec>?

Starts a new measurement, terminates the measurement and returns the results after one single shot. The READ...? query is equivalent to:

```
ABORt...;
INITiate...;
FETCh...?
```

The READ command preserves all configurations (such as event reporting, stop condition, statistics count...). READ initiates a measurement which is terminated after one single shot (⇒ measurement state *STOP*, status *RDY*; if an error occurred, the status is *ERR*). However, it does not affect the repetition mode setting itself.

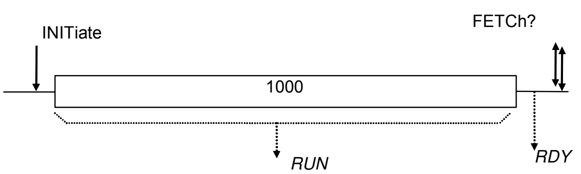
In case of no error (status *RDY*), the measurement can be continued by means of the CONTinue command. It will be performed with the repetition mode set before READ was executed.

Diagrammatic Overview of Measurement Control

The commands used to configure and control the measurements, to query the status of the measurement, and to retrieve the measurement results are closely linked to the settings for the repetition mode and stop condition. The various scenarios are most easily explained by means of a graphical representation of the measurements.

Single Shot Measurements

Stop condition: NONE

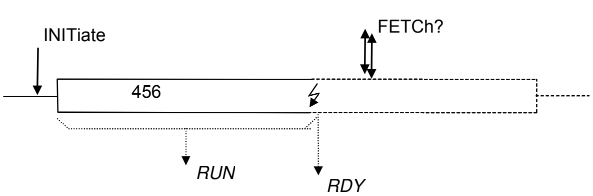


A single shot measurement comprising 1000 evaluation periods with stop condition none is performed. The measurement is started with the `INITiate` command. The results can be queried using the `FETCh...?` (status *RDY)* commands. The measurement is configured via:

```
CONFigure:<meas_obj>:CONTrol <type>,1000
CONFigure:<meas_obj>:CONTrol:REPetition
        SINGleshot,NONE,<Stepmode>
```

The <Stepmode> parameter has no effect.

Stop condition: SONerror



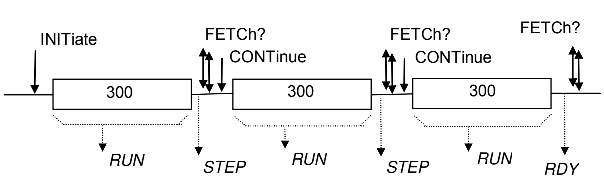
A single shot measurement comprising 1000 evaluation periods with stop condition SONerror is performed. The measurement is started with the `INITiate` command and stopped before the end of the statistics cycle. The results can be queried using the `FETCh` (status *STOP)* commands. The number of bursts measured can be queried using the `FETCh:<meas_obj>:STATus?` command. The measurement is configured via:

```
CONFigure:<meas_obj>:CONTrol <type>,1000
CONFigure:<meas_obj>:CONTrol:REPetition
                      SINGleshot,SONerror
                      <Stepmode>
```

The <Stepmode> parameter has no effect.

Counting Measurements

Stop condition: NONE

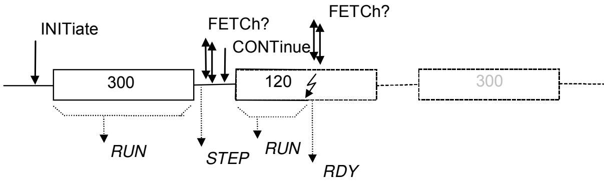


A counting measurement comprising 3 counts of measurements, each about a statistics cycle of 300 evaluation periods, is performed. The measurement is started with the `INITiate` command. The results can be queried using the `FETCh...?` (status *STEP* or *RDY)* commands. The measurement is configured via:

```
CONFigure:<meas_obj>:CONTrol <type>,300
CONFigure:<meas_obj>:CONTrol:REPetition
                      3,NONE,<Stepmode>
```

The STEP status occurs only if the stepping mode is set (`<Stepmode> = STEP`). In this case, the next cycle must be restarted via the `CONTinue` command.

Stop condition: SONerror



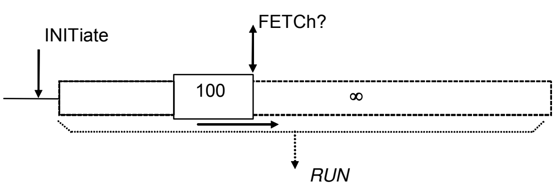
A counting measurement comprising counts of measurements, each about a statistics cycle of 300 evaluation periods, is performed. The measurement is started with the `INITiate` command. The results can be queried using the `FETCh...?` (status *STEP* or *RDY)* commands. The measurement is configured via:

```
CONFigure:<meas_obj>:CONTrol <type>,300
CONFigure:<meas_obj>:CONTrol:REPetition
                    3,SONerror,<Stepmode>
```

The STEP status occurs only if the stepping mode is set (`<Stepmode> = STEP`). In this case, the next cycle must be restarted via the `CONTinue` command.

Continuous Measurements

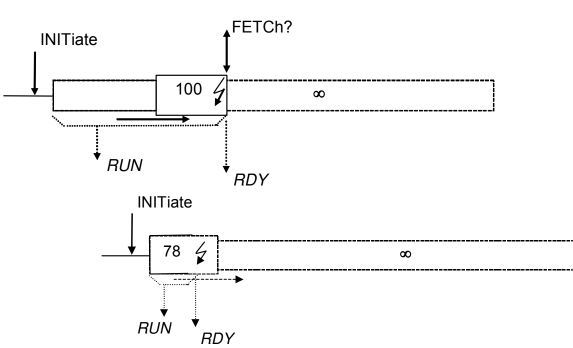
Statistics cycles, stop condition: NONE



A continuous measurement with statistics cycles consisting of 100 bursts each is performed. Average results are calculated according to the rules given in chapter 3. The measurement is started with the `INITiate` command. During the measurement `FETCh...?` may return inconsistent results. The measurement is configured via:

```
CONFigure:<meas_obj>:CONTrol <type> 100
CONFigure:<meas_obj>:CONTrol:REPetition
               CONTinuous,NONE,NONE
```

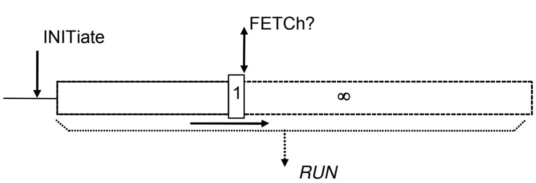
Statistics cycles, stop condition: SONerror



A continuous measurement with statistics cycles consisting of 100 evaluation periods each is performed. The measurement is started with the `INITiate` command. During the measurement `FETCh...?` may return inconsistent results. If the stop condition is met during the first statistics cycle no valid result is available. The measurement is configured via:

```
CONFigure:<meas_obj>:CONTrol <type> 100
CONFigure:<meas_obj>:CONTrol:REPetition
               CONTinuous,SONerror,NONE
```

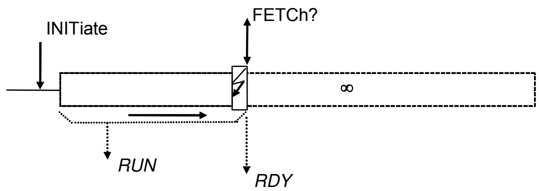
Statistics off, stop condition: NONE



A continuous measurement is performed. No statistics cycles are defined. The measurement is started with the `INITiate` command. During the measurement `FETCh...?` may return inconsistent results. The measurement is configured via:

```
CONFigure:<meas_obj>:CONTrol <type> OFF
CONFigure:<meas_obj>:CONTrol:REPetition
               CONTinuous,NONE,NONE
```

Statistics off, stop condition: SONerror



A continuous measurement is performed. No statistics cycles are defined. The measurement is started with the `INITiate` command. During the measurement `FETCh...?` may return inconsistent results. The measurement is configured via:

```
CONFigure:<meas_obj>:CONTrol <type> OFF
CONFigure:<meas_obj>:CONTrol:REPetition
                    CONTinuous,SONerror,NONE
```

Note: *The* stepping *mode can be set for continuous measurements as well (Parameter `<Step-mode>=STEP`, see section* Counting Measurements *on page 5.42). In this case, the system takes up the STEP status after each statistics cycle. It can be re-launched via the `CONTinue` command.*

Quick Connection Setup

The R&S® CBT provides several features that are primarily intended to simplify and speed up a connection to a Bluetooth device and make measurements faster. A program example is reported in Chapter 7.

Table 5-16 R&S® CBT settings for quick connection and measurements

Setting	Description	Command syntax
Read Signalling Info = Off	Do not request signalling info from the DUT to avoids exchange of unnecessary information	`CONF:MSIG:PAG:RSIN OFF`
Number of Responses = 1	Stop the inquiry after the first response if only one Bluetooth device is connected	`CONF:MSIG:INQ:NOR 1`
– (automatic function)	The R&S® CBT remembers the information acquired during an inquiry. Subsequent inquiries to the same DUT will be faster.	–
Connect Testmode	To perform TX and RX measurements, directly access the test mode, skipping the CONN state	`PROC:SIGN:ACT TEST` `SIGN:XST?`

Overview – Power/Modulation	If no traces are needed, use the combined `POWer:MPR` measurement rather than `POWer:TIME` and `MODulation:DEViation`	`INIT:POW:MPR`
		`FETC:POW:MPR?`
		`ABOR:POW:MPR`

Contents

6 Remote Control – Commands

In the following, all remote-control commands for the *Base* system and the function groups *RF* and *Bluetooth* will be presented in tabular form with their parameters and the ranges of numerical values. The chapter is organized as follows:

- Common commands, commands for the *Base* system and the function groups *RF, Bluetooth Non Signalling and Bluetooth Signalling* are presented separately.
- Within the measurement modes, first the general configuration and then the individual measurement groups are described.

Unless otherwise stated in the command description, all commands may be used for control of the R&S® CBT via GPIB interface or serial (RS-232) interface. An introduction to remote control according to the SCPI standard, the status registers of the R&S® CBT, and the operating concept and measurement control is given in Chapter 5.

Special Terms and Notation

This section describes some particular features in the syntax of the remote control commands. The general description of the SCPI command syntax can be found in section *Structure and Syntax of Device Messages* in Chapter 5.

Description of commands

The commands are arranged in tables; all of them are arranged in the same way. From top to bottom, the table rows contain the following entries:

1. Complete command syntax including the parameter list and a short description of the command,
2. List and description of the parameters with their default values, the units, and unit rings.
3. Detailed description of the command, signalling state required for command execution, required firmware version.

Extensive lists of default values are annexed to the command description.

Order of commands

The commands are arranged according to their function. The general purpose of a command is described by the keyword in the second level. Lower-level keywords define the command in more detail. This means that commands with the same second-level, third-level etc. keywords are generally grouped together in the same sections.

Example: `CONFigure:POWer:FREQuency:CENTer <Frequency>`

Commands with the keyword *POWer* in the second level belong to the power measurement. The keywords in the third and fourth levels indicate that the command defines the center analyzer frequency used in the power measurement.

Measurement object

The term *measurement object* denotes a group of remote control commands relating to the same group of measured quantities. E.g., all commands concerning the measurement of the signal power vs time form a common measurement object.

Combined measurements — To limit the number of remote control command and their parameters, scalar quantities of the same measurement object are always measured together and returned in lists.

Parameters — Many commands are supplemented by a parameter or a list of parameters. Parameters either provide alternative options (setting a or setting b or setting c ..., see special character "|"), or they form a list separated by commas (setting x,y).

<Par_Name> — In the command tables and lists, parameters are generally described by a name (literal) written in angle brackets (<>). This literal merely serves as a parameters description; in an application program it must be replaced by one of the possible settings reported in the detailed parameter description.

Example: `CONFigure:POWer:CONTrol <Mode>,<Statistics>`

with `<Mode>` = `SCALar | ARRay`
`<Statistics>` = `1 to 10000 | NONE`

possible command syntax: `CONF:POW:CONT SCAL,OFF`

NAN — NAN (not a number) is generally used to represent missing data, e.g. if a portion of a trace has not been acquired yet. It is also returned after invalid mathematical operations such as division by zero. As defined in the SCPI standard, NAN is represented as 9.91 E 37.

INV — INV (invalid) is returned if a limit check is performed without defining the appropriate tolerance values.

Upper / lower case — Upper/lower case characters characterize the long and short form of the keywords in a command. The short form consists of all upper-case characters, the long form of all upper case plus all lower case characters. On the R&S® CBT, either the short form or the long form are allowed; mixed forms will generally not be recognized. Either the short form or the long form are permissible. The instrument itself does not distinguish upper case and lower case characters.

Special characters

| — A vertical stroke in the parameter list characterizes alternative parameter settings. Only one of the parameters separated by **|** must be selected.

Example: The following command has two alternative settings:

`TRIGger:SEQuence:DEFault ON | OFF`

[ ] — *Key words* in square brackets can be omitted when composing the command header (see Chapter 5, section "Structure of a Command"). The complete command must be recognized by the instrument for reasons of compatibility with the SCPI standard.
Parameters in square brackets are optional as well. They may be entered in the command or omitted.

{ } — Braces or curly brackets enclose one or more parameters that may be included zero or more times.

<nr> — This symbol stands for a numeric suffix, e.g. an enumeration index for input and output connectors.

Lists of commands

Command: The *Command* column of the table contains all remote control commands arranged according to their function (configurations or measurement objects). Within a section, the commands are listed in alphabetical order.

Parameters: The *Parameter* column lists the parameters of the commands.

Remarks: The *Remarks* column gives additional information about the commands which

- Have no query form *(no query)*
- Have only a query form *(query only)*
- Can be used both as setting commands and as queries (*with query*, this applies to all commands belonging to none of the two preceding categories)

Alphabetical Lists Chapter 6 concludes with alphabetical command lists for both test modes.

Common Commands

The common commands are taken from the IEEE 488.2 (IEC 625-2) standard. These commands have the same effect on different devices. The headers of these commands consist of "*" followed by three letters. Many common commands are related to the status reporting system which is described in detail in Chapter 5.

Table 6-1 Common Commands

Command	Parameters	Remark
***CLS**		no query
***ESE**	0 to 255	
***ESR?**		query only
***GTL**		not IEEE 488.2 confirmed; see p. 6.17 and Chapter 8, *Addressed Commands*
***IDN?**		query only
***IST?**		query only
***LLO**	TRUE | FALSe	not IEEE 488.2 confirmed; see p. 6.19 and Chapter 8, *Universal Commands*
***OPC**		
***PRE**	0 to 255	
***PSC**	0 | 1	
***RST**		no query
***SEC**	0 to 30	not IEEE 488.2 confirmed; see p. 6.12
***SRE**	0 to 255	
***STB?**		query only
***TST?**		query only
***WAI**		

***CLS**
CLEAR STATUS sets the status byte (STB), the standard event register (ESR) and the EVENt-part of the QUEStionable and the OPERation register to zero. The command does not alter the mask and transition parts of the registers. It clears the output buffer.

***ESE** 0 to 255
EVENT STATUS ENABLE sets the event status enable register to the value indicated. The query *ESE? returns the contents of the event status enable register in decimal form.

***ESR?**
STANDARD EVENT STATUS QUERY returns the contents of the event status register in decimal form (0 to 255) and subsequently sets the register to zero.

***IDN?**
IDENTIFICATION QUERY queries the instrument identification.

***IST?**

INDIVIDUAL STATUS QUERY returns the contents of the IST flag in decimal form (0 | 1). The IST-flag is the status bit which is sent during a parallel poll (see chapter 5).

***OPC**

OPERATION COMPLETE sets bit 0 in the event status register when all preceding commands have been executed. This bit can be used to initiate a service request (see chapter 5).

***OPC?**

OPERATION COMPLETE QUERY writes message "1" into the output buffer as soon as all preceding commands have been executed (cf. chapter 5).

***PRE 0 to 255**

PARALLEL POLL REGISTER ENABLE sets parallel poll enable register to the value indicated. Query *PRE? returns the contents of the parallel poll enable register in decimal form.

***PSC 0 | 1**

POWER ON STATUS CLEAR determines whether the contents of the ENABle registers is maintained or reset when the instrument is switched on.

*PSC = 0	causes the contents of the status registers to be maintained. Thus a service request can be triggered on switching on in the case of a corresponding configuration of status registers ESE and SRE.
*PSC ≠ 0	≠resets the registers.

Query *PSC? reads out the contents of the power-on-status-clear flag. The response can be 0 or 1.

***RST**

RESET sets the instrument to a defined default status. The command resets all function groups and test modes, restoring the default values defined for remote control operation. *RST is equivalent to `SYSTem:RESet[:ALL]`. The default settings are indicated in the description of commands.

***SRE 0 to 255**

SERVICE REQUEST ENABLE sets the service request enable register to the value indicated. Bit 6 (MSS mask bit) remains 0. This command determines under which conditions a service request is triggered. The query *SRE? returns the contents of the service request enable register in decimal form. Bit 6 is always 0.

***STB?**

READ STATUS BYTE QUERY reads the contents of the status byte in decimal form.

***TST?**

SELF TEST QUERY triggers selftests of the instrument and outputs an error code in decimal form (the output is zero in the current firmware version).

***WAI**

WAIT-to-CONTINUE prevents servicing of the subsequent commands until all preceding commands have been executed and all signals have settled (see also chapter 5 and *OPC).

Base System Commands

The commands in the R&S® CBT base system are used to query the instrument state, perform general device configurations, set and query the status registers, reset the instrument, manage files and configure the reference frequency.

System Commands

The SYSTem subsystem contains the functions that are not related to instrument performance. The R&S® CBT supports the following SCPI-confirmed SYSTem commands:

SYSTem:ERRor?				Error Queue
Response	Parameter description	Def. value	Default unit	FW vers.
-32768 to +32768 and error string Ex.: -230,"Data corrupt or stale"	Error message	0, "No error"	–	V3.50
Command description				
This command queries the next entry from the error/event queue and deletes it. Positive error numbers are instrument-dependent; negative error numbers are reserved by the SCPI standard, see chapter 9. If the error queue is empty, the error number 0, "No error" is returned.				

SYSTem:VERSion?				SCPI Version
Response	Parameter description	Def. value	Default unit	FW vers.
YYYY.V Ex.: 1999.0	SCPI version of R&S® CBT	–	–	V3.50
Command description				
This command queries the SCPI version number to which the instrument complies. YYYY is the year of SCPI compliance, V is the version number within the year.				

SYSTem:NONVolatile:DISable	Disable Non Volatile RAM
Command description	FW vers.
This command has no query form. It prevents the R&S® CBT from saving measurement settings to the non volatile ram. This improves the system performance but implies that the current settings will not be saved for later sessions. Disabling the non volatile ram is recommended for all instruments that are operated in remote control mode. ***Note:*** *There is no way to cancel the effect of the `SYSTem:NONVolatile:DISable` command within the current session, even if the R&S® CBT is switched to manual control (Local). To re-enable the non volatile ram, the R&S® CBT must be rebooted.*	V3.50

SYSTem:REBoot System Reboot	
Description of command	FW vers.
This command reboots the instrument.	V4.30

SYSTem:REBoot:ERRor *<Enable>*				Reboot on Error
<Enable>	Parameter description	Def. value	Default unit	FW vers.
ON | **OFF**	System error causes an automatic reboot System error requires manual reboot	OFF	–	V5.00
Command description				
This command has no query form. If it is sent with the parameter `ON`, any subsequent non-recoverable system error will cause a shutdown and automatic reboot of the R&S® CBT. The R&S CBT will be able to continue a running remote control script, provided that the controller program allows the instrument to pause for some time. After the reboot, or after a reset of the instrument (`*RST, SYSTem:RESet…, SYSTem:PRESet[:ALL]`), *Reboot on Error* is disabled so that successive system errors will be displayed in red message boxes. `SYSTem:REBoot:ERRor ON` is effective in remote control mode only.				

Status Commands

The STATus subsystem controls the SCPI-defined status reporting structures. The purpose and definition of status registers is given in Chapter 5, section "Status Reporting System". Unless otherwise stated, all the following commands are SCPI-confirmed.

STATus:OPERation[:EVENt]?				Event Part
Response	Parameter description	Def. value[1]	Default unit	FW vers.
0 to 32767	Event part	–	–	V3.50
Command description				
This command queries and deletes the contents of the EVENt part of the STATus:OPERation register.				

STATus:OPERation:ENABle *<Number>*				Enable part
<Number>	Parameter description	Def. value	Default unit	FW vers.
0 to 32767	Enable part	–	–	V3.50
Command description				
This command enters a number to be interpreted as a bit pattern in the ENABle part of the STATus:OPERation register. If a bit is set the corresponding event is reported in the summary bit of the status byte.				

STATus:OPERation:CMU:SUM<nr>[:EVENt]?				Event part
Response	Parameter description	Def. value	Default unit	FW vers.
0 to 32767	Event part	–	–	V3.50
Command description				
This command queries and deletes the contents of the EVENt part of the `STATus:OPERation:CMU:SUM<nr>` register (<nr> = 1,2).				

[1] `*RST` does not supersede the entries in the status registers; for an overview of the reset values of the `STATus`... system refer to section *Reset Values of the Status Reporting Systems* in chapter 5.

STATus:OPERation:CMU:SUM<nr>:ENABle *<Number>*				Enable part
<Number>	Parameter description	Def. value	Default unit	FW vers.
0 to 32767	Enable part	–	–	V3.50
Command description				
This command enters a number to be interpreted as a bit pattern in the ENABle part of the `STATus:OPERation:CMU:SUM<nr>` register (<nr> = 1,2). If a bit is set the corresponding event is reported in the summary bit of the status byte.				

STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>[:EVENt]?				Event part
Response	Parameter description	Def. value	Default unit	FW vers.
0 to 32767	Event part	–	–	V3.50
Command description				
This command queries and deletes the contents of the EVENt part of the `STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>` register (<nr> = 1 to 2; <nr_event> = 1 to 15).				

STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>:ENABle *<Number>*				Enable part
<Number>	Parameter description	Def. value	Default unit	FW vers.
0 to 32767	Enable part	–	–	V3.50
Command description				
This command enters a number to be interpreted as a bit pattern in the ENABle part of the `STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>` register (<nr> = 1 to 2; <nr_event> = 1 to 15). If a bit is set the corresponding event is reported in the summary bit of the status byte.				

STATus:OPERation:CMU:ALL?				Query all operation registers
Response	Parameter description	Def. value	Default unit	FW vers.
0 to 32767, ... , 0 to 32767	Event part of all CBT operation registers	–	–	V3.50
Command description				
This command queries the EVENt parts of all `STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>` registers. The result is returned as a list of 30 integer values separated by commas.				

STATus:OPERation:CMU:CLEar	Clear all operation registers
Command description	FW vers.
This command clears the EVENt parts of all `STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>` registers (<nr> = 1 to 2; <nr_event> = 1 to 15).	V3.50

STATus:QUEStionable[:EVENt]?				Event part
Response	Parameter description	Def. value	Default unit	FW vers.
0 to 32767	Event part	–	–	V3.50
Command description				
This command queries and deletes the contents of the EVENt part of the STATus:QUEStionable register.				

STATus:QUEStionable:ENABle *<Number>*				Enable part
<Number>	Parameter description	Def. value	Default unit	FW vers.
0 to 32767	Enable part	–	–	V3.50
Command description				
This command enters a number to be interpreted as a bit pattern in the ENABle part of the STATus:QUEStionable register. If a bit is set the corresponding event is reported in the summary bit of the status byte.				

STATus:PRESet	Reset status registers
Command description	FW vers.
This command sets the transition filters (PTRansition and NTRansition filters) and the ENABle registers of the STATus:OPERation and the STATus:QUEStionable registers to defined values: • PTRansition is set to 32767 (0x7FFF), i.e. all hardware events are detected and transferred to the EVENt register. • NTRansition is set to 0, i.e. a hardware event that disappears does not cause any change in the EVENt register. The ENABle registers are also set to 0 so that events are not reported in the status byte.	V3.50

Symbolic Status Event Register Evaluation

The following commands are used to retrieve the events reported and the corresponding function groups; see section *Symbolic Status Event Register Evaluation* in Chapter 5.

STATus:OPERation:EVENt:SADDress? — Check event reporting

Response	Parameter description	Def. Value[2]	Default Unit	FW vers.
1 to 30, "Fgrp"	"Next" secondary address Corresponding function group name (or "", if no event was reported)	31 ""	– –	V3.50

Command description

This command is always a query. It checks the `STATus:OPERation:CMU:SUM<nr>:EVENt` sum registers (<nr> = 1 | 2), returns the next secondary address and function group string where an event was reported, and deletes the entry in the `EVENt` register. If applied repeatedly, the command checks the secondary addresses in ascending order (i.e. the events are not queried chronologically).

The command is global; it is available in all function groups. Possible responses are:

1,"RF_NSig" An event was reported in function group *RF* (currently assigned to secondary address 1).

31,"" No (further) event reported.

STATus:OPERation:SYMBolic:ENABle <Event>{,<Event>} — Symbolic status evaluation

Parameter list	Parameter description	Def. Value[3]	Default Unit	FW vers.
<Event>{,<Event>} | NONE	List of symbols for events to be reported No event reported	NONE	–	V3.50

Command description

This command enables event reporting for one or several events in the current function group, i.e. it sets the corresponding bits in the `STATus:OPERation:CMU: SUM<nr>:CMU<nr_event>:ENABle` register (`<nr> = 1 | 2, <nr_event>` denotes the current function group) and in all sum registers up to the status byte. The events and the corresponding symbols for each function group are listed in chapter 5 of the relevant manuals (see section *Status Registers).* The symbols may be entered in arbitrary order.

STATus:OPERation:SYMBolic[:EVENt]? — Symbolic status evaluation

Response	Parameter description	Def. Value[4]	Default Unit	FW vers.
NONE | <Event>{,<Event>}	No event in the current function group List of reported events	NONE	–	V3.50

Command description

This command is always a query. It lists the events reported in the current function group and deletes these events in the `STATus:OPERation:CMU:SUM<nr> :CMU<nr_event>:EVENt` register as well as in all sum registers.

[2] The default values quoted in this command are achieved after a `*CLS` command. `*RST` does not supersede the entries in the status registers; see section *Reset Values of the Status Reporting Systems* in chapter 5.
[3] The default values quoted in this command are achieved after a `STATus:PRESet` command. `*RST` does not supersede the entries in the status registers; see section *Reset Values of the Status Reporting Systems* in chapter 5.
[4] The default values quoted in this command are achieved after a `*CLS` command. `*RST` does not supersede the entries in the status registers; see section *Reset Values of the Status Reporting Systems* in chapter 5.

Setup – Basic Device Settings

The SETup subsystem contains the commands for global configuration of the remote control parameters, the serial interfaces, the options, date and time, the keyboard and beeper. It corresponds to the *Setup* menu opened via the *SETUP* key on the front panel.

Subsystem Remote

The *REMote* subsystem contains the commands for configuration of the remote control parameters. It corresponds to the *Remote* tab in the *Setup* menu opened via the *SETUP* key on the front panel.

SYSTem:REMote:ADDRess:PRIMary *<Addr>*				Primary Address
<Addr>	Parameter description	Def. value	Default unit	FW vers.
0 to 30	Primary address to the GPIB (IEEE) bus	20	–	V3.50
Command description				
This command sets the primary address of the GPIB driver which is used to address the device (R&S® CBT). It is equivalent to `SYSTem:COMMunicate:GPIB[:SELF]:ADDRess` (see below).				

SYSTem:REMote:ADDRess:SECondary *<Addr>,<FGrp>*				Secondary Address
<Addr>,<FGrp>	Parameter description	Def. value	Default unit	FW vers.
1 to 29, „FGrp_name“ | NONe	Secondary address of the function group Name of the function group or NONE if the secondary address is not to be mapped	Configuration-specific	–	V3.50
Command description				

This command assigns the secondary addresses to the remote control modes (function groups) of the GPIB driver (compare next command). If a secondary address is successively assigned to different function groups, the previous assignments are overwritten. The following function group names are used:

FGrp_name	**Function Group**	**FGrp_name**	**Function Group**
BASE	R&S® CBT base system	Bluetooth_NSig	Bluetooth Non Signalling
RF_NSig	RF Non Signalling	Bluetooth_Sig	Bluetooth Signalling

The R&S® CBT base system (function group *BASE)* is always assigned to secondary address 0; the assignment cannot be changed by the `SYSTem:REMote:ADDRess:SECondary` command. A program example illustrating how to adapt the secondary addresses to the requirements of a specific driver can be found in chapter 7.

Example:	Setting:	SYST:REM:ADDR:SEC 2,"Bluetooth_NSig" SYST:REM:ADDR:SEC 1,NONE
	Query: --> Response:	SYST:REM:ADDR:SEC? 2 "Bluetooth_NSig"
	Query: --> Response:	SYST:REM:ADDR:SEC? 1 NONE
	Query: --> Response:	SYST:REM:ADDR:SEC? NONE,"Bluetooth_NSig", ... (30 returned values)

SEC *<Addr>				Secondary Address
<Addr>	Parameter description	Def. value	Default unit	FW vers.
0 to 29	Secondary address	0	–	V3.50
Command description				
This command has no query form. It switches over to the specified secondary address. It is required if the serial interface is used for remote control (software switchover, RS-232 remote interface, see previous command and section *Setting the Device Address* in chapter 5).				

SYSTem:REMote:ADDRess:SECondary:UNMap	Unmap all Secondary Addresses
Command description	
This command has no query form. It clears the mapping between all secondary addresses and function groups (see `SYSTem:REMote:ADDRess:SECondary` or `*SEC`). The R&S® CBT base system (function group *BASE)* is always mapped to secondary address 0; this assignment cannot be cleared. The command is available in versions V3.50 and higher of the R&S® CBT base system.	

SYSTem:REMote:TPManagement *<Enable>*				Task Priority Management
<Enable>	Parameter description	Def. value	Default unit	FW vers.
ON **| OFF**	All measurements are releasable All measurements are persistent	– *)	–	V3.60
Command description				
This command determines the behavior of the R&S® CBT if conflicting measurements are run in parallel. *) A reset does not change the task priority management setting.				

SYSTem:REMote:RDMode *<Enable>*				Remote Debug Mode
<Enable>	Parameter description	Def. value	Default unit	FW vers.
ON **| OFF**	Activate remote debug mode Activate ordinary remote mode	OFF*)	–	V3.60
Command description				
This command enables or disables the remote debug mode. *) The remote debug mode is not changed after *RST but reset when the CBT is re-started.				

SYSTem:REMote:FORMat:NUMeric *<Standard>*				Block Data Format
Standard	Parameter description	Def. value	Def. unit	FW vers.
IEEE754 | **SCPI**	Data is transferred in a definite length block as IEEE floating point numbers of the specified <length>*). Numeric data is transferred as ASCII bytes. The number are separated by commas as specified in IEEE 488.2.	SCPI	–	V4.00
Command description				
This command selects the format for numeric data transferred to and from the analyzer. The format setting is only valid for commands and queries which are explicitly designed for the transfer of binary data, e.g. `READ:BINary:ARRay:IQRecorder:PHASe?` This command has no equivalent in manual control. *) See description of block data format in Chapter 5.				

SYSTem:REMote:FORMat:BORDer *<Byte Order>*				Byte Order
Returned value	Parameter description	Def. value	Def. unit	FW vers.
NORMal **SWAPped**	The least significant bit is transferred first (little endian) The most significant bit is transferred first (big endian)	NORMal	–	V4.00
Command description				
This command controls whether binary data is transferred in normal or swapped byte order. This command has no equivalent in manual control.				

Subsystem Communicate

The *COMMunicate* subsystem contains the commands for configuration of the remote serial interfaces. It corresponds to the *Communicate* tab in the *Setup* menu opened via the *SETUP* key on the front panel. The parameters set in this subsystem are explained in more detail in chapter 8, section *Hardware Interfaces*.

SYSTem:COMMunicate:GPIB[:SELF]:ADDRess *<Addr>*				Primary Address
<Addr>	Parameter description	Def. value	Default unit	FW vers.
0 to 30	Primary address to the GPIB (IEEE) bus	20	–	V3.50
Command description				
This command sets the primary address of the GPIB driver which is used to address the device (R&S® CBT). It is equivalent to `SYSTem:REMote:ADDRess:PRIMary` (see above).				

SYSTem:COMMunicate:SERial1:APPLication?				Application
Response	Parameter description	Def. value	Default unit	FW vers.
TRAN | REM | PRIN	Transfer Remote control Printer control (future extension)	dep. on SCPI connection (port) and printer settings	-	V3.50
Command description				
This command is always a query. It returns the current application (connection) of the serial (RS-232) interface COM 1.				

SYSTem:COMMunicate:SERial1[:RECeive]:BAUD *<Baudrate>*				Baud Rate
<Baudrate>	Parameter description	Def. value	Default unit	FW vers.
110 | 300 | 600 | 1200 | 2400 | 4800 | 9600 | 19200 | 38400 | 57600 | 115200	baud rate	9600	baud	V3.50
Command description				
This command sets the baud rate of the serial interface COM 1. If the COM port is selected as GPIB connector, the default transmission rate is 19200 baud.				

SYSTem:COMMunicate:SERial1>[:RECeive]:BITS *<DataBits>*				Data Bits
<DataBits>	Parameter description	Def. value	Default unit	FW vers.
7 | 8	number of data bits	8	–	V3.50
Command description				
This command sets the number of data bits of the serial interface COM 1. The default value is 7 if the serial interface is used for data transfer (see `SYSTem:COMMunicate:SERial1:APPLication?`). The sum of data bits and stop bits must be equal to 9.				

SYSTem:COMMunicate:SERial1[:RECeive]:STOP *<StopBits>*				Stop bits
<StopBits>	Parameter description	Def. value	Default unit	FW vers.
1 | 2	number of stop bits	1	-	V3.50
Command description				
This command sets the number of stop bits of the serial interface COM 1. The default value is 2 if the serial interface is used for data transfer (see `SYSTem:COMMunicate:SERial1:APPLication?`). The sum of data bits and stop bits must be equal to 9.				

SYSTem:COMMunicate:SERial1[:RECeive]:PARity[:TYPE] *<Parity>*				Parity
<Parity>	Parameter description	Def. value	Default unit	FW vers.
NONE ODD EVEN	no parity odd parity even parity	NONE	–	V3.50
Command description				
This command sets the parity of the serial interface COM 1.				

SYSTem:COMMunicate:SERial1:TRANsmit:PACE *<Pace>*				Transmission Protocol
<Pace>	Parameter description	Def. value	Default unit	FW vers.
XON ACK NONE	Xon/Xoff – protocol Hardware protocol with CTS/RTS lines No protocol set	XON	–	V3.50
Command description				
This command sets the handshake protocol of the serial interface COM 1.				

Subsystem Options

The *Options* subsystem contains the commands for querying information on the instrument and the available options. It corresponds to the *Options* tab in the *Setup* menu opened via the *SETUP* key on the front panel.

SYSTem:OPTions:INFO?			Device Info
Response	Def. value	Default unit	FW vers.
Example: ROHDE&SCHWARZ, CBT , 840675/018, V3.50 2003-01-30	–	–	V3.50
Command description			
This command returns the information on the device comprising the manufacturer, model, serial number and base system firmware version. This command is always a query and is equivalent to the common command `*IDN?`			

SYSTem:OPTions?				Options
Response	Parameter description	Def. value	Def. unit	FW vers.
HWO, "B55","available" | "B55",NAN, …	Identifier for hardware options 1st option, available 2nd option, not available	–	–	V3.50
SWO, "K55",NAN | "K55","enabled" | "K55","3x85.c05 available", …	Identifier for software options 1st option, not available 1st option, enabled 1st option, available but not enabled			
HWE, “CPU(FMR)“, “FMR6“ ...	Identifier for hardware equipment 1st equipment ...			
FWV, „FPGA Digital“,"V1.13", "FPGA RF","V2.09", …	Identifier for firmware versions 1st option, 2nd option, ...			
Command description				
This command returns a list of all options and equipment available in the instrument, equivalent to the list overview in the *Setup – Options* tab. It is always a query. An alternative list of options (following IEEE 488.2 conventions) can be queried via the common command *OPT?				

SYSTem:OPTion:ACTivation *‘<Key code>‘*				Option Enable
‘<Key code>‘	Parameter description	Def. value	Def. unit	FW vers.
‘<string>’	Key code supplied with the option, to be entered as a string	–	–	V4.20
Command description				
This command enables a software option. The type of the option (e.g. R&S CBT-K55) is identified automatically according to the key code. The command is particularly useful for R&S CBT 32 instruments, if no external monitor is available. Once they have been enabled, options and versions can be handled using the Remote Service Tool or VersionManager described in chapter 1.				

Subsystem Time

The *Time* subsystem contains the commands for the current time and date. It corresponds to the *Time* tab in the *Setup* menu opened via the *SETUP* key on the front panel.

SYSTem[:TIME]:TZONe *<Hour>[,<Minute>]*				Time Zone
Parameters	Parameter description	Def. value	Default unit	FW vers.
<Hour> <Minute>	Integer value between –12 and +12 -59 to +59 (optional)	+1 0	–	V3.50
Command description				
This command defines the time zone via the time offset from Greenwich mean time. A time offset of +1 h (default setting) corresponds to Middle European time.				

SYSTem[:TIME]:TIME *<Hour>,<Minute>,<Second>*				Current Time
Parameters	Parameter description	Def. value	Default unit	FW vers.
<Hour>, <Minute>, <Second>	Hours (0 to 23) Minutes (0 to 59) Seconds (0 to 59)	– – –	h min s	V3.50
Command description				
This command sets the internal system time of the R&S® CBT.				

SYSTem[:TIME]:DATE *<Year>,<Month>,<Day>*				Date
Parameters	Parameter description	Def. value	Default unit	FW vers.
<Year>, <Month>, <Day>	Four-digit year (1980 to 2099) Month (1 to 12) Day (1 to 31)	– – –	–	V3.50
Command description				
This command sets the internal system date of the R&S® CBT.				

Subsystem MISC

The *MISC* subsystem sets the acoustic signal and selecting the external keyboard assignment. It corresponds to the *Misc.* tab in the *Setup* menu opened via the *SETUP* key on the front panel.

SYSTem:MISC:KBEep *<Enable>*				Key Beep
<Enable>	Parameter description	Def. value	Default unit	FW vers.
ON | OFF	Key beep on or off	OFF	–	V3.50
Command description				
This command switches the acoustic signal of the R&S® CBT on or off.				

SYSTem:MISC:KEYBoard *<Country>*				Keyboard
<Country>	Parameter description	Def. value	Default unit	FW vers.
US | GR	American keyboard German keyboard	US	–	V3.50
Command description				
This command selects the driver for the external keyboard.				

Subsystem GTRMode (Local to Remote Switchover)

The *GTRMode* subsystem determines the behavior of the R&S® CBT in a local to remote transition. The settings are provided in the *Remote* tab of the *Setup* menu.

SYSTem:GTRMode:COMPatible *<Enable>*				Local to Remote
<Enable>	Parameter description	Def. value	Default unit	FW vers.
ON | OFF	Connection or call dropped on local to remote switchover/ generator switched off Current signalling state or generator state maintained	ON	–	V3.50
Command description				
This command defines the behavior of the R&S® CBT in a local to remote transition. The command is valid for all function groups and test modes, however, its effect depends on the test mode *(Signalling* or *Non Signalling* tests): *Signalling* — In the *ON* setting, the connection or call is dropped and the R&S® CBT returns to its default signalling state (e.g. *SBY* in the *Bluetooth Signalling* function group). In the *OFF* setting, all signalling states are maintained. This makes it possible to switch the instrument to remote control without dropping a call or connection. See also operating manuals for the different network tests. *Non Signalling* — In the *ON* setting, all generators are switched off. In the *OFF* setting, the current operating state of all generators is maintained.				

*GTL	Go to Local
Command description	
This command has no query form. It switches the instrument immediately back to local mode (manual control). The R&S® CBT opens the menu of the current running measurement; see also section *Return to Manual Control* in Chapter 5. This command can be used instead of the addressed command GTL if a serial connection is used.	

Subsystem MQUeue

The *MQUeue* subsystem contains the commands for symbolic measurement ready evaluation. These commands are used to query the contents of the measurement queue. To activate the measurement queue, event reporting must not be switched off; see section *Event Reporting* in Chapter 5.

SYSTem:MQUeue[:COMPlete][:LIST]?		Complete Measurement Queue		
Response	Parameter description	Def. value	Default unit	FW vers.
<FGroup_Mode>, <MeasObject>, ...	Function group and test mode Ready measurement	"NONE", "NONE"	–	V3.50
Command description				
This command is always a query. It returns and deletes the contents of the complete measurement queue. The individual results are returned in chronological order (first in first out). Examples of possible responses are: 'Bluetooth_Sig','POWer','Bluetooth_Sig','MODulation' Power and moodulation measurement ready in function group *Bluetooth Signalling* "NONE", "NONE" No ready measurements reported				

SYSTem:MQUeue[:COMPlete]:ITEM?		Next Entry in Measurement Queue		
Response	Parameter description	Def. value	Default unit	FW vers.
<FGroup_Mode>, <MeasObject>	Function group and test mode Ready measurement	"NONE", "NONE"	–	V3.50
Command description				
This command is always a query. It returns and deletes the oldest ready measurement in the measurement queue.				

Reset of Function Groups

The `PRESet/RESet` subsystem restores the (factory) default values for all instrument settings. It corresponds to the *Reset* menu opened via the *RESET* key on the front panel.

SYSTem:PRESet[:ALL] SYSTem:RESet[:ALL]	Reset all function groups and test modes
Command description	FW vers.
This command sets all parameters of the instrument to default values. The commands differ for instrument settings with distinct default values in manual and remote control (e.g. the repetition mode for many measurements): `SYST:PRES` restores the default values for manual control, leaving the current remote control parameters unchanged. `SYST:RES` restores the default values for remote control leaving the current manual control parameters unchanged. This command is equivalent to `*RST`.	V3.50

SYSTem:RESet:CURRent	Partial Reset
Command description	FW vers.
This command sets all parameters of the current function group and test mode to default values. The command is available in all function groups. In contrast to the *Reset* menu the command restores the default values defined for remote control operation. In cases where remote and manual control use distinct settings (e.g. the repetition mode for many measurements), the manual control settings are left unchanged.	V3.50

Remote Report – Subsystem TRACe

The TRACe subsystem determines whether the remote report is displayed on screen or written to a file. It corresponds to the *Report...* hotkeys on the bottom of the *Remote* screen.

LLO *<Boolean>				Local Lockout
<Boolean>	Parameter description	Def. value	Default unit	FW vers.
FALSe | TRUE	Hitting any front panel key switches to manual control Front panel keys locked	FALSe	–	V3.50
Command description				
This command has no query form. It locks the front panel keys to prevent an inadvertent switchover to manual control. If TRUE is set, the hotkeys to control the remote screen are still active. The parameter FALSe reactivates all front panel keys for switchover to manual control. This command can be used instead of the universal command LLO if a serial connection is used.				

TRACe:REMote:MODE:DISPlay *<Enable>*				Report Display
<Enable>	Parameter description	Def. value	Default unit	FW vers.
ON | OFF	Remote report displayed on screen Remote report not displayed	OFF	–	V3.50
Command description				
This command qualifies whether the remote report is displayed on screen. The remote report is a useful debugging tool. While it is displayed, the measurements are slowed down. If an R&S® CBT 32 is used, the remote report can be displayed on an external monitor.				

TRACe:REMote:MODE:DISPlay:FILTer *<Enable>*				Report Mode
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON **OFF**	Report Mode: Results Report Mode: All (no command filter)	OFF	–	V4.51
Description of command				
This command defines the report mode in the remote control screen.				

TRACe:REMote:MODE:FILE *<Enable>*				Report File
<Enable>	Parameter description	Def. value	Default unit	FW vers.
ON | OFF	Remote report stored Remote report not stored	OFF	–	V3.50
Command description				
This command qualifies whether the remote report is written to a file named Remote.trc in the *INTERNAL* directory of the internal hard disk. While the remote report is written, the measurements are slowed down.				

TRACe:REMote:MODE:ERRor ***<Enable>***		Show/Hide Error Messages		
<Enable>	Parameter description	Def. value	Default unit	FW vers.
ON | OFF	Show or hide error messages	ON	–	V3.50
Command description				
This command qualifies whether error messages (marked by a "E !" symbol on a red square) are included in the remote report.				

TRACe:REMote:MODE:SRQ ***<Enable>***		Show/Hide Service Requests		
<Enable>	Parameter description	Def. value	Default unit	FW vers.
ON | OFF	Show or hide SRQs	OFF	–	V3.50
Command description				
This command qualifies whether a message is written to the remote report whenever the R&S® CBT sends a service request to the controller. The message symbolizes the contents of the status byte (e.g. ERR, OPR, MAV, OPER,...) and is marked by a red "S" symbol.				

TRACe:REMote:MODE:OUTLines ***<Enable>***		Report Lines for Output		
<Enable>	Parameter description	Def. value	Default unit	FW vers.
1 to 4	Maximum number of lines	4	–	V3.50
Command description				
This command defines the maximum number of lines available for each output string in the remote report screen. If the output string of a query (e.g. `READ:ARRay:POWer?` in the RF function group) is longer than the specified number of lines, it is truncated and the last three characters are replaced by "...".				

File Manager – System MMEMory

The `MMEMory` system provides mass storage capabilities for the R&S® CBT. Part of the functionality of this system is included in the *Data* menu.

The mass storage of the CBT is always internal. The parameter *<msus>* (mass storage unit specifier) in the `MMEMory` commands denotes the section on the internal hard disk that is reserved for mass storage (directory c:\temp). The *R&S Remote Service Tool* organizes the data transfer between the CBT and an external PC or laptop; see description in Chapter 1.

The <FileName> parameter is a string. The contents of the string may contain characters for specifying subdirectories, e.g. "\TEMP\TRASH\test.txt" for the file named *test.txt* in the *TEMP\TRASH* subdirectory of the root directory or "TEMP\TRASH\test.txt" for the file named *test.txt* in the *TEMP\TRASH* subdirectory of the current directory, to be queried with `MMEMory:DIRectory [:CURRent]?`. The file name itself may contain the period as a separator for extensions.

Unless otherwise stated, all the following commands are SCPI-confirmed.

MMEMory:INFO? *<FileName> [,<msus>]* View Info

<FileName>	Parameter description	Def. value	Def. unit	
"<8 dig.max>.<3dig.>"	Name of the file to be inquired in DOS (8.3) convention.	–	–	
<msus>	Parameter description	Def. value	Def. unit	
INTernal	Internal memory (hard disk)	INTernal[5]	–	
Returned info	Parameter description	Def. value	Def. unit	FW vers.
<Year>,<Month>,<Day>, <Hour>,<Min>,<Sec>, <Size>, <Version>, "<Comment>"	Date when the file was stored Time when the file was stored File size in byte File version number Comment string stored with the file	– – – " " " "	y, m, d h, min, s byte – –	V3.50

Description of command

This command retrieves information about a file stored on the internal mass memory. The <msus> parameter is not needed.

This command is R&S® CBT-specific. The <Version> and <Comment> output parameters are reserved for future extensions.

MMEMory:COMMent *<Comment>* Comment

<Comment>	Parameter description	Def. value	Def. unit	FW vers.
"<160 characters max.>"	Comment string	" "	–	V3.50

Description of command

This command defines a comment for a R&S® CBT configuration file. The comment is saved to the file generated via `MMEMory:SAVE[:ALL] <FileName>[,<msus>]` or `MMEMory:SAVE:CURRent <FileName>[,<msus>]`. The command is R&S® CBT-specific.

MMEMory:DIRectory[:CURRent]? Current Directory

Returned value	Parameter description	Def. value	Def. unit	FW vers.
INT, "<DirectoryName>"	Internal storage device Name and path of the current directory in DOS convention.	INT[6] "\USERDATA\SAVE"	–	V3.50

Description of command

This command is always a query and returns the current directory name and path. Possible return strings are INT, " " (for the internal root directory) or INT, "\TEMP\TRASH" (for the \TEMP\TRASH subdirectory of the internal root directory). This command is R&S® CBT-specific.

The current directory is set to default when the base system is booted but left unchanged when the base system is reset (`*RST, SYSTem:RESet:CURRent`).

5 See MMEMory:MSIS *[<msus>]* setting.

6 See MMEMory:MSIS *[<msus>]* setting.

MMEMory:CDIRectory *[<DirName>], [<msus>]* Change Directory

<DirName>	Parameter description	Def. value	Def. unit	FW vers.
"<DirectoryName>", INTernal	Name of the directory to be accessed Internal storage device	"\USERDATA\SAVE"	–	V3.50

Description of command

This command has no query form. It sets the directory specified via *<DirName>* as default directory. If this parameter is omitted, the directory is set to the USERDATA\SAVE subdirectory of the `INTernal` root directory.

MMEMory:DELete *<FileName> [,<msus>]* Delete File

Parameters	Parameter description	Def. value	Def. unit	FW vers.
"<FileName>", INTernal	Name of the file to be deleted Storage device of the file to be deleted	– INTernal[6]	– –	V3.50

Description of command

This command has no query form. It removes a single file from the specified mass storage device.

MMEMory:RMDir *<DirName> [,<msus>]* Remove Directory

Parameters	Parameter description	Def. value	Def. unit	FW vers.
"<DirectoryName>", INTernal	Name of the directory to be removed Storage device of the directory	– INTernal[6]	– –	V3.50

Description of command

This command has no query form. It removes a directory with all its contents and subdirectories from the specified mass storage device. The command is R&S® CBT-specific.

MMEMory:MKDir *<DirName> [,<msus>]* Make Directory

Parameters	Parameter description	Def. value	Def. unit	FW vers.
"<DirectoryName>", INTernal	Name of the directory to be created Storage device of the directory	– INTernal[6]	– –	V3.50

Description of command

This command has no query form. It creates a new subdirectory in the current directory. The command is R&S® CBT-specific.

MMEMory:COPY Copy File
<FileSource>, <msus1>, <FileDest>, <msus2> | <FileSource>, <FileDest>

Parameters	Parameter description	Def. value	Def. unit	FW vers.
"<FileSource>", INTernal, "<FileDest>", INTernal	Name of the file to be copied Storage device of the source file Name of the new file Storage device of the new file	– INTernal[6] – INTernal[6]	– – – –	V3.50

Description of command

This command has no query form. It copies the contents of an existing file or directory to a new one.

MMEMory:MOVE <FileSource>, <msus1>, <FileDest>, <msus2> | <FileSource>, <FileDest>				Move File
Parameters	Parameter description	Def. value	Def. unit	FW vers.
"<FileSource>", INTernal, "<FileDest>", INTernal	Name of the file to be renamed Storage device of the source file Name of the new file Storage device of the new file	– INTernal[6] – INTernal[6]	– – – –	V3.50
Description of command				
This command has no query form. It moves an existing file to another file name and mass storage device.				

MMEMory:REName ***<FileSource>, <FileDest> [,<msus>]***				Rename File
Parameters	Parameter description	Def. value	Def. unit	FW vers.
"<FileSource>", INTernal, "<FileDest>", INTernal	Name of the file to be renamed Storage device of the source file Name of the new file Storage device of the new file	– INTernal[6] – INTernal[6]	– – – –	V3.50
Description of command				
This command has no query form. It renames an existing file. This command is R&S® CBT-specific.				

MMEMory:SCAN?				Scan Disk
Rückgabe	Parameter description	Def. value	Def. unit	FW vers.
INT, D , ”<SubdirectoryName1>”, ”<SubdirectoryName2>”, ... , F , ”<FileName1>”, ”<FileName2>”, ... ,	Storage device List of subdirectory names List of file names	–	–	V3.50
Description of command				
This command is always a query and lists the contents of the current directory. Subdirectories and files are listed in alphabetical order. The first entry specifies the mass storage device (internal), entries after ”D” denote the subdirectories, entries after ”F” denote the files. This command is R&S® CBT-specific.				

MMEMory:DATA *<FileName> ,<Data>* Transfer Data

Parameters	Parameter description	Def. value	Def. unit	
"<FileName>", <Data>	Name of the destination file Data to be transferred to the R&S® CBT	– –	– –	
Parameters for query	Parameter description	Def. value	Def. unit	FW vers.
"<FileName>"	Name of the source file	–	–	V3.50

Description of command

This command loads `<data>` from the controller into the file `<FileName>` stored in the current directory of the current R&S® CBT mass storage device. `<data>` is in 488.2 block format. The data may be transferred via GPIB bus or via serial interface.

The query form is `MMEMory:DATA? <FileName>` with the response being the associated `<data>` in block format. In this form the command transfers data from the current R&S® CBT mass storage device to the controller.

Instead of the entire data transferred the remote protocol contains a string indicating the length of the block data in bytes, e.g. `<DEF BLOCK (Length = 19)>`.

MMEMory:SAVE[:ALL] *<FileName> [,<msus>]* Save all configurations

Parameters	Parameter description	Def. value	Def. unit	FW vers.
"<FileName>", INTernal	Name of the config. file to be created Storage device of the config. file	– INTernal	– –	V3.50

Command description

This command saves the configuration of all function groups and test modes to a single configuration file. A "?" in the specified file name will be replaced by current numbers that are automatically incremented, starting with zero. The auto-increment function overwrites an existing file with a "9" in its file name. For instrument settings that may be different in manual and remote control (e.g. the repetition mode for many measurements) the manual setting is saved. This command is R&S® CBT-specific.

MMEMory:SAVE:CURRent *<FileName> [,<msus>]*
Save configurations in current function group and test mode

Parameters	Parameter description	Def. value	Def. unit	FW vers.
"<FileName>", INTernal	Name of the config. file to be created Storage device of the config. file	– INTernal	– –	V3.50

Command description

This command saves the configuration of the current function group and test mode to a configuration file. A "?" in the specified file name will be replaced by current numbers that are automatically incremented, starting with zero. The auto-increment function overwrites an existing file with a "9" in its file name. For instrument settings that may be different in manual and remote control (e.g. the repetition mode for many measurements) the manual setting is saved. The command is available in all function groups. This command is R&S® CBT-specific.

MMEMory:RECall[:ALL] ***<FileName> [,<msus>]*** Recall all configurations

Parameters	Parameter description	Def. value	Def. unit	FW vers.
"<FileName>", INTernal	Name of the config. file to be recalled Storage device of the config. file	– INTernal	– –	V3.50

Command description

This command recalls the configuration of all function groups and test modes stored in a configuration file. This command is R&S® CBT-specific.

MMEMory:RECall:CURRent ***<FileName> [,<msus>]***
Recall configurations in current function group and test mode

Parameters	Parameter description	Def. value	Def. unit	FW vers.
"<FileName>", INTernal	Name of the config. file to be recalled Storage device of the config. file	– INTernal	– –	V3.50

Command description

This command recalls the configuration of the current function group and test mode from a configuration file. The command is available in all function groups. This command is R&S® CBT-specific.

Synchronization

The *Synchronize* subsystem contains the commands for configuring the reference frequency. It corresponds to the *Reference Frequency* softkey in the *Sync.* tab of the *Connection Control* menu. Note that this tab is available in every function group.

CONFigure:SYNChronize:FREQuency:REFerence:MODE ***<Mode>*** Ref. Frequency Source

<Mode>	Parameter description	Def. value	Default unit	FW vers.
INTernal | EXTernal	Internal reference frequency used External reference frequency used	INT	–	V3.50

Command description

The command defines the source of the synchronization signal. After activating the external reference frequency (e.g. after a reset of the base system where the reference frequency is set to `INTernal`) it is necessary to allow for a setting time (~1 s) until the R&S® CBT has synchronized. The query `[SENSe:]SYNChronize:FREQuency:REFerence:LOCKed?` indicates whether the reference frequency is locked. A partial reset of all function groups with the exception of the base system does not reset the source of the reference frequency.

[SENSe:]SYNChronize:FREQuency:REFerence:LOCKed?				Ref. Frequency Not Locked
Response	Parameter description	Def. value	Def. unit	FW vers.
ON | OFF	Synchronization to reference frequency achieved Synchronization to reference frequency failed	–	–	V3.50
Command description				
This command is always a query. It indicates whether the R&S® CBT is synchronized to the (external) reference frequency. ***Note:*** *After activating the external reference frequency (command `CONFigure:SYNChronize:FREQuency:REFerence:MODE EXTernal`) it is necessary to allow for a setting time (~1 s) until the R&S® CBT has synchronized. In this case it is recommended to check whether the reference frequency is locked before starting a measurement in remote control mode.*				

Display Settings

The *[:WINDow]* subsystem activates the screensaver. All settings are in the *Misc.* tab of the *Setup* menu.

DISPlay[:WINDow][:STATe] *<Enable>*				Display
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Switch display on or off	ON	–	V3.50
Description of command				
This command switches the display of the CBT on or off.				

General Purpose Commands (All Function Groups)

The commands listed in this section perform general and administrative tasks. They are available in all function groups (RF Non Signalling, Bluetooth Non Signalling, Bluetooth Signalling, Audio Non Signalling).

Subsystem Options

The *Options* subsystem contains the commands for querying information on the instrument and the available options. It corresponds to the *Options* tab in the *Setup* menu opened via the *SETUP* key on the front panel.

SYSTem:OPTions:INFO:CURRent?			Device Info
Response	Def. value	Default unit	FW vers.
Example: Rohde&Schwarz, CBT 35-1153.9000.02,840675/018, V3.50C:SP02 2004-02-05 'RF_NSig'	–	–	V3.50
Command description			
This command returns the information on the device comprising the manufacturer, model, serial number and firmware version of the current function group. This command is always a query.			

Configuration File Management – System MMEMory

The `MMEMory` system provides mass storage capabilities for the R&S® CBT. The functionality of this system is included in the *Data* menu.

The mass storage of the CBT is always internal. The parameter *<msus>* (mass storage unit specifier) in the `MMEMory` commands denotes the section on the internal hard disk that is reserved for mass storage (directory c:\temp). The *R&S Remote Service Tool* organizes the data transfer between the CBT and an external PC or laptop; see description in Chapter 1.

The <FileName> parameter is a string. The contents of the string may contain characters for specifying subdirectories, e.g. "\TEMP\TRASH\test.txt" for the file named *test.txt* in the *TEMP\TRASH* subdirectory of the root directory or "TEMP\TRASH\test.txt" for the file named *test.txt* in the *TEMP\TRASH* subdirectory of the current directory, to be queried with the base system command `MMEMory:DIRectory [:CURRent]?`. The file name itself may contain the period as a separator for extensions.

MMEMory:SAVE:CURRent *<FileName> [,<msus>]* Save configurations in current function group and test mode				
Parameters	Parameter description	Def. value	Def. unit	FW vers.
"<FileName>", INTernal	Name of the config. file to be created Storage device of the config. file	– INTernal	– –	V3.50
Command description				
This command saves the configuration of the current function group and test mode to a configuration file. The mass storage unit specifier is always `INTernal` and therefore not needed. A "?" in the specified file name will be replaced by current numbers that are automatically incremented, starting with zero. The auto-increment function overwrites an existing file with a "9" in its file name. For instrument settings that may be different in manual and remote control (e.g. the repetition mode for many measurements) the manual setting is saved. The command is available in all function groups. This command is R&S® CBT-specific.				

MMEMory:RECall:CURRent ***<FileName> [,<msus>]*** Recall configurations in current function group and test mode				
Parameters	Parameter description	Def. value	Def. unit	FW vers.
"<FileName>", INTernal	Name of the config. file to be recalled Storage device of the config. file	– INTernal	– –	V3.50
Command description				
This command recalls the configuration of the current function group and test mode from a configuration file. The mass storage unit specifier is always `INTernal` and therefore not needed. The command is available in all function groups. This command is R&S® CBT-specific.				

Partial Reset

The *RESet* subsystem restores the (factory) default values for the current function group and test mode. It is similar to the *Reset* menu opened via the *RESET* key on the front panel.

SYSTem:RESet:CURRent Partial Reset	
Command description	FW vers.
This command sets all parameters of the current function group and test mode to default values. The command is available in all function groups. In contrast to the *Reset* menu the command restores the default values defined for remote control operation. In cases where remote and manual control use distinct settings (e.g. the repetition mode for many measurements), the manual control settings are left unchanged.	V3.50

Symbolic Status Event Register Evaluation

The following commands are used to retrieve the events reported in function group *RF*; see section *Symbolic Status Event Register Evaluation* in chapter 5.

STATus:OPERation:SYMBolic:ENABle <Event>{,<Event>} Symbolic status evaluation				
Parameter list	Parameter description	Def. Value[7]	Default Unit	FW vers.
<Event>{,<Event>} | NONE	List of symbols for events to be reported No event reported	NONE	–	V3.50
Command description				
This command enables event reporting for one or several events in the *RF* function group, i.e. it sets the corresponding bits in the `STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>:ENABle` register `(<nr> = 1 | 2, <nr_event>` denotes the RF function group) and in all sum registers up to the status byte. The events and the corresponding symbols for function group *RF* are listed in Chapter 5 (see section *Status Registers).* The symbols may be entered in arbitrary order.				

[7] The default values quoted in this command are achieved after a `STATus:PRESet` command. `*RST` does not supersede the entries in the status registers; see section *Reset Values of the Status Reporting Systems* in chapter 5.

STATus:OPERation:SYMBolic[:EVENt]?				Symbolic status evaluation
Response	Parameter description	Def. Value[8]	Default Unit	FW vers.
NONE | <Event>{,<Event>}	No event in the *RF* function group List of reported events	NONE	–	V3.50
Command description				
This command is always a query. It lists the events reported in the *RF* function group and deletes these events in the `STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>:EVENt` register as well as in all sum registers.				

[8] The default values quoted in this command are achieved after a `*CLS` command. `*RST` does not supersede the entries in the status registers; see section *Reset Values of the Status Reporting Systems* in chapter 5.

RF Measurements

The commands listed in this section belong to the *RF Non Signalling* function group.

Connection Control

The remote-control commands in this section provide settings that are valid for all measurements in the *RF* function group. They correspond to the settings in the *Connection Control* popup menu (see Chapters 3 and 4).

Subsystem LEVel (Input Level)

The subsystem *LEVel* controls the level in the RF input signal path. It corresponds to the *Analyzer* tab of the *Connection Control* menu.

[SENSe:]LEVel:MAXimum *<Level>*				Max. Level
<Level>	Parameter description	Def. value	Default unit	FW vers.
–40 dBm to +26 dBm	Max. RF input level	0.0	dBm	V3.50
Command description				
This command defines the expected maximum RF input level and sets the input measurement path accordingly. The value range depends on the external attenuation.				

Subsystem TRIGger (Trigger Mode)

The subsystem *TRIGger* determines the trigger mode. It corresponds to the *Trigger* tab in the *Connection Control* menu and the *Analyzer Level – Trigger...* hotkeys in the measurement menus.

TRIGger[:SEQuence]:SOURce *<Source>*				Source
<Source>	Parameter description	Def. value	Default unit	FW vers.
IMMediate | POWer	Free run, continuous measurement (without reference to input signal) Trigger by RF input signal level `(TRIG:SEQ:THR:POW)`	IMM	–	V3.50
Command description				
This command determines the source of the trigger event for the measurements.				

TRIGger[:SEQuence]:THReshold:POWer *<Threshold>*				Level
<Threshold>	Parameter description	Def. value	Default unit	FW vers.
LOW | **HIGH**	Low trigger threshold *(RF Max. Level* – 40 dB) High trigger threshold *(RF Max. Level* – 20 dB)	LOW	–	V3.50
Command description				
This command sets the RF input signal level at which the measurement is triggered relative to the maximum RF input level; see `[SENSe:]LEVel:MAXimum`. The setting takes effect for trigger source `POWer` only (see `TRIG:SEQ:SOUR`).				

TRIGger[:SEQuence]:DEFault *<Enable>*				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	The parameters are set to their default values All or some parameters differ from the default values	ON	–	V3.50
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* has no effect). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF).*				

Subsystem RFANalyzer... (Analyzer Settings)

The subsystem *RFANalyzer...* sets the RF analyzer to a definite frequency and bandwidth. The settings correspond to the *Analyzer Settings* in the *Analyzer/Generator* menu.

[SENSe:]RFANalyzer:FREQuency *<Frequency>*				Frequency
<Frequency>	Parameter description	Def. value	Default unit	FW vers.
2398 MHz to 2499 MHz	Frequency (1 MHz resolution)	2402 MHz	Hz	V3.50
Command description				
This command defines the input frequency of the analyzer.				

[SENSe:]RFANalyzer:BANDwidth[:RESolution] *<Bandwidth>* **[SENSe:]RFANalyzer:BWIDth[:RESolution] *<Bandwidth>***				Bandwidth
<Bandwidth>	Parameter description	Def. value	Default unit	FW vers.
10 Hz to 1 MHz	Bandwidths of the analyzer (the values are rounded in the steps 1 | 2 | 3 | 5)	1 MHz	–	V3.50
Command description				
This command defines the bandwidth of the analyzer.				

Measurement Control – Subsystem RFANalyzer

The subsystem *RFANalyzer* controls the RF analyzer. The subsystem corresponds to the *Analyzer Power* softkey in the *Analyzer/Generator* menu.

INITiate:RFANalyzer	Start new measurement		*⇒ RUN*
ABORt:RFANalyzer	Abort running measurement and switch off		*⇒ OFF*
STOP:RFANalyzer	Stop measurement after current evaluation period		*⇒ STOP*
CONTinue:RFANalyzer	Next measurement step (only *stepping mode*)		*⇒ RUN*
Command description		FW vers.	
These commands have no query form. They start or stop the measurement, setting it to the status indicated in the top right column.		V3.50	

CONFigure:RFANalyzer:EREPorting <*Mode*>				Event Reporting
<Mode>	Parameter description	Def. value	Def. unit	FW vers.
SRQ | SOPC | SRSQ | OFF	Service request Single operation complete SRQ and SRSQ No reporting	OFF	–	V3.50
Command description				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see Chapter 5).				

FETCh:RFANalyzer:STATus?				Measurement status
Returned value	Parameter description	Def. value	Def. unit	FW vers.
OFF | RUN | STOP | ERR | STEP | RDY,	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V3.50
1 to 10000 | NONE,	Counter for current evaluation period Counter not used	NONE	–	
Command description				
This command is always a query. It returns the status of the measurement (see Chapters 3 and 5).				

Subsystem RFANalyzer:CONTrol

The subsystem *RFANalyzer:CONTrol* defines the statistics of the RF analyzer power measurement. The subsystem corresponds to the *Repetition* hotkey associated with the *Analyzer Power* softkey in the *Analyzer/Generator* menu.

CONFigure:RFANalyzer:CONTrol:REPetition *<Repetition> ,<StopCondition>,<Stepmode>*				Test cycles
<Repetition>	Parameter description	Def. value	Def. unit	
CONTinuous | SINGleshot | 1 to 10000	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCondition>	Parameter description	Def. value	Def. unit	
NONE	Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | NONE	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V3.50
Command description				
This command determines the number of statistics cycles and the stepping mode for the measurement. A stop condition is not available. **Note:** In the case of READ commands (`READ:` to) the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.				

Results – Subsystem RFANalyzer:POWer?

The subsystem *RFANalyzer:POWer* starts the analyzer power measurement and returns the results. The subsystem corresponds to the *Analyzer Power* panel in the *Analyzer/Generator* menu.

READ[:SCALar]:RFANalyzer:POWer? **FETCh[:SCALar]:RFANalyzer:POWer?**	Scalar measurement results: Start single shot measurement and return results Read out measurement results (unsynchronized)			
Returned value	Description	Def. value	Default unit	FW vers.
–110.0 dBm to +26 dBm	RMS power of the RF input signal (PEP)	NAN	dBm	V3.50
Command description				
These commands are always queries. They start a measurement and return the scalar measurement result.				

Subsystem RFGenerator

The subsystem *RFGenerator* configures and controls the RF generator. It corresponds to the *Generator* tab in the popup menu *Connect. Control*.

DEFault:RFGenerator				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	The parameters are set to default values Some or all parameters differ from the default values	ON	–	V3.50
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the `RFGenerator` subsystem to default values. The setting *OFF* results in an error message. If used as a query the command returns whether all parameters are set to default values *(ON)* or not *(OFF)*.				

Subsystem RFGenerator[:TX] (TX Generator Control)

The subsystem *RFGenerator[:TX]* controls the RF generator. It corresponds to the *Generator Control* function in the *Generator* tab of the *Connection Control* menu.

INITiate:RFGenerator[:TX]	Start RF generator, reserve resources	⇒ *RUN*
ABORt:RFGenerator[:TX]	Switch off RF generator, release resources	⇒ *OFF*
Command description		FW vers.
These commands have no query form. They start or stop the RF generator for the Tx signal, setting it to the status indicated in the top right column.		V3.50

FETCh:RFGenerator[:TX]:STATus?				Generator status
Returned value	Parameter description	Def. value	Def. unit	FW vers.
OFF | RUN | ERR	Generator switched off (`ABORt` or `*RST`) Running (`INITiate`) Switched off (could not be started)	OFF	–	V3.50
Command description				
This command is always a query. It returns the current Tx generator status.				

Subsystem RFGenerator[:TX]... (TX Generator Settings)

The subsystem *RFGenerator[:TX]...* determines the level and frequency of the RF generator. The settings are provided in the *Generator* tab of the *Connection Control* menu.

SOURce:RFGenerator[:TX]:LEVel <*Level*>				RF Generator Level
<Level>	Parameter description	Def. value	Def. unit	FW vers.
–90.0 dBm to +0.0 dBm	RF generator level	–27.0	dBm	V3.50
Command description				
This command defines the RF generator level. The permissible value range depends on the external attenuation (see `SOURce:CORRection:LOSS[:MAGnitude]`).				

SOURce:RFGenerator[:TX]:FREQuency <*Frequency*>				Frequency
<Frequency>	Parameter description	Def. value	Def. unit	FW vers.
2398 MHz to 2499 MHz	Output frequency (resolution 1 MHz)	2402 MHz	Hz	V3.50
Command description				
This command defines the output frequency of the RF generator.				

SOURce:RFGenerator:FOFFset <*Offset*>				Frequency Offset
<Frequency>	Parameter description	Def. value	Def. unit	FW vers.
–250 kHz to +250 kHz	Output frequency (resolution 0.1 Hz)	0	Hz	V3.50
Command description				
This command defines an offset frequency to modify the output frequency of the RF generator.				

Subsystem RFGenerator:MODulation (Frequency Modulation)

The subsystem *RFGenerator:MODulation* determines the frequency modulation of the internal RF generator. It corresponds to the *Modulation* settings in the *Generator* tab of the *Connection Control* menu.

SOURce:RFGenerator:MODulation *<State>*				Modulation
<State>	Parameter description	Def. value	Def. unit	FW vers.
OFF | TEST	No modulation, continuous wave Continuous Bluetooth test signal modulated with a 11110000 pattern	OFF	–	V3.50
Command description				
This command determines the modulation of the RF output signal.				

Subsystem CORRection:LOSS

The subsystems in this section contain the commands for configuration of the input and output connectors and the external attenuation factors. The subsystems correspond to the *RF* tab in the popup menu *Connect. Control*.

[SENSe:]CORRection:LOSS[:MAGNitude] *<Absorption>*				Ext. Att. Input
<Absorption>	Parameter description	Def. value	Default unit	FW vers.
–50 dB to +90 dB	External input attenuation	0.0	dB	V3.50
Command description				
This commands assigns an external attenuation value to the input of the instrument.				

SOURce:CORRection:LOSS[:MAGNitude] *<Absorption>*				Ext. Att. Output
<Absorption>	Parameter description	Def. value	Default unit	FW vers.
–50 dB to +90 dB	External output attenuation	0.0	dB	V3.50
Command description				
This command assigns an external attenuation value to the outputs of the instrument. An external attenuation of x dB increases the RF generator level (`SOURce:RFGenerator[:TX]:LEVel`) by x dB.				

NPOWer (Function Group RF)

The subsystem *NPOWer* measures the power of an RF signal using a narrow-band filter with variable bandwidth. Gaussian filters with bandwidths between 10 Hz and 1 MHz are available.

The *NPOWer* measurement is performed at the frequency set via `[SENSe:]RFANalyzer:FREQuency`. The filter bandwidth *(RBW)* is set via `[SENSe:]NPOWer:BWIDth[:RESolution]`.

The CBT measures the average, maximum and minimum power of the RF signal in a basic evaluation period comprising a fixed number of samples (4096). In addition to these *Current* values the minimum and maximum power in the entire measurement and the average of the average current values, referenced to a statistics cycle, is calculated (see section *Measured Values – Subsystem NPOWer?* on p. 6.39 ff.). The measurement time depends on the filter bandwidth but never exceeds the order of magnitude of 100 ms for a single evaluation period. The frequency of the RF signal is also measured, provided that is close enough to the measurement frequency set via `[SENSe:]POWer:FREQuency:CENTer`. The characteristics of the *NPOWer* measurement makes it particularly suitable for the analysis of CW signals where no measurement curves are needed. Compared to the *Analyzer Power* measurement (subsystem `RFANalyzer`), it provides a wider range of filters, additional statistical evaluations and an additional frequency counter.

Note: *The configuration of the RF input path (`[SENSe:]LEVel:MAXimum`, `[SENSe:]LEVel:MODE`) and the trigger settings (`TRIGger[:SEQuence]:SOURce`, `TRIGger[:SEQuence]:THReshold`) can have an effect on the `NPOWer` measurement.*

INITiate:NPOWer	Start new measurement	⇒ *RUN*
ABORt:NPOWer	Abort measurement and switch off	⇒ *OFF*
STOP:NPOWer	Stop measurement	⇒ *STOP*
CONTinue:NPOWer	Next measurement step (only *counting mode*)	⇒ *RUN*
Description of command		FW vers.
These commands have no query form. They start or stop the measurement, setting it to the status given in the top right column.		V3.53

CONFigure:NPOWer:EREPorting <***Mode***>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC** | **SRSQ** | **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	V3.53
Description of command				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see Chapter 5).				

FETCh:NPOWer:STATus?				Measurement Status
Return	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN** | **STOP** | **ERR** | **STEP** | **RDY,**	Measurement in the OFF state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) OFF (could not be started) Stepping mode (<stepmode>=STEP) Stopped according to repetition mode and stop condition	OFF	–	V3.53
1 to 10000 | **NONE**	Counter for current statistics cycle No counting mode set	NONE	–	
1 to 1000 | **NONE**	Counter for current evaluation period within a cycle Statistic count set to off	NONE	–	
Description of command				
This command is always a query. It returns the status of the measurement (see Chapter 3 and Chapter 5).				

Subsystem NPOWer:CONTrol

The subsystem *NPOWer:CONTrol* defines the repetition mode, statistic count, stop condition, and stepping mode of the *NPOWer* measurement.

CONFigure:NPOWer:CONTrol *<Statistics>*, *<Repetition>*,*<StopCond>*,*<Stepmode>*				Scope of Measurement
<Statistics>	Description of parameters	Def. value	Def. unit	
1 to 1000 | **NONE**	No. of evaluation periods within a statistics cycle Statistics off	1	–	
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot** | **1 ... 10000**	Continuous measurement (until `STOP` or `ABORT)` Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY)`	SING	–	
<StopCond>	Description of parameters	Def. value	Def. unit	
SONerror | **NONE**	Start measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	–
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V3.53
Description of command				
This command defines the statistic count, repetition mode, stop condition, and stepping mode for the measurement.				

CONFigure:NPOWer:CONTrol:STATistics *<Statistics>*				Statistic Count
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	No. of evaluation periods within a statistics cycle Statistics off	1	–	V3.53
Description of command				
This command defines the number of evaluation periods that represent one statistics cycle.				

CONFigure:NPOWer:CONTrol:REPetition *<Repetition>,<StopCond>,<Stepmode>*				Test cycles
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot** | **1 ... 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCond>	Description of parameters	Def. value	Def. unit	
SONerror | **NONE**	Start measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	–
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V3.53
Description of command				
This command determines the repetition mode, the stop condition and the stepping mode for the measurement. ***Note:*** *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*				

Subsystem NPOWer:FREQuency (RBW)

The subsystem *NPOWer:FREQuency* sets the filter bandwidth of the narrow-band power measurement.

[SENSe:]NPOWer:BWIDth[:RESolution] *<Bandwidth>*				RBW
<Bandwidth>	Parameter description	Def. value	Default unit	FW vers.
10 Hz to 1 MHz	Bandwidths of power measurement (the values are rounded in 1 | 2 | 3 | 5 steps)	300 kHz	–	V3.53
Command description				
This command defines the bandwidth of the power measurement.				

Measured Values – Subsystem NPOWer?

The subsystem *NPOWer?* retrieves the results of the narrow-band power measurement (see general information on p. 6.36).

READ[:SCALar]:NPOWer? Start single shot measurement and return results
FETCh[:SCALar]:NPOWer? Read out measurement results (unsynchronized)

Returned values	Value range	Def. value	Def. unit	FW vers.
Avg. Power of Current evaluation period,	–137 dBm to +53 dBm	NAN	dBm	V3.53
Min. Power of Current evaluation period,	–137 dBm to +53 dBm	NAN	dBm	
Max. Power of Current evaluation period,	–137 dBm to +53 dBm	NAN	dBm	
Avg. Power ref. to the last stat. cycle,	–137 dBm to +53 dBm	NAN	dBm	
Min. Power of the entire measurement,	–137 dBm to +53 dBm	NAN	dBm	
Max. Power of the entire measurement	–137 dBm to +53 dBm	NAN	dBm	
Frequency	10 kHz to 2.7 GHz	NAN	Hz	

Description of command

These commands are always queries. They start the *NPOWer* measurement and return the results. As the CBT is capable of determining frequencies with an accuracy of 0.1 Hz, the frequency is returned in exponential representation and with a 10-digit mantissa.

Bluetooth Module Tests (Non Signalling)

In the *Bluetooth Non Signalling* mode, it is possible to generate an RF signal with Bluetooth specifications and to configure the RF connector of the R&S® CBT.

Subsystem RFGenerator – Generator control

The subsystem *RFGenerator* controls the RF generator. It corresponds to the *Generator Control* parameter in the *Generator* tab of the *Connect. Control* menu and the *RF Generator* softkey in the measurement menu *Analyzer/Generator*.

INITiate:RFGenerator **ABORt:RFGenerator**	Start RF generator, reserve resources ⇒ *RUN* Switch off RF generator, release resources ⇒ *OFF*
Description of command	FW vers.
These commands have no query form. They start and stop the RF generator, setting it to the status indicated in the top right column.	V3.50

FETCh:RFGenerator:STATus?				Generator Status
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN** | **ERR**	Generator switched off (`ABORt` or `*RST`) Running (`INITiate`) Switched off (could not be started)	OFF	–	V3.50
Description of command				
This command is always a query. It returns the current generator status.				

Generator Settings – Subsystem RFGenerator…

The commands in this section determine the level and frequency of the generated RF signals. The settings are provided in the *Generator* tab of the *Connect. Control* menu.

SOURce:RFGenerator:LEVel <*Level*>				RF Max. Level
<Level>	Description of parameters	Def. value	Def. unit	FW vers.
–90.0 dBm to +0.0 dBm **–90.0 dBm to –3.0 dBm**	RF generator level for Basic Rate packets RF generator level for EDR packets	–80.0 –80.0	dBm dBm	V3.50 V3.85
Description of command				
This command determines the RF generator level. The permissible value range depends on the external attenuation (see `SOURce:CORRection:LOSS[:MAGnitude]`).				

SOURce:RFGenerator:PTBZero <*Time*>				Power-up Time before Bit Zero
<Time>	Description of parameters	Def. value	Def. unit	FW vers.
LONG | **SHORt**	Approx. 25 µs Approx. 3 µs	SHORt	–	V3.80
Description of command				
This commands specifies the time interval between the start of the power ramp and the time of bit zero.				

SOURce:RFGenerator:FREQuency *<Frequency>*				RF Frequency
<Number>	Description of parameters	Def. value	Def. unit	FW vers.
2402 MHz to 2495 MHz	Output frequency (in multiples of the Bluetooth channel width of 1 MHz)	2 402 000 000	Hz	V3.50
Description of command				
This command defines the frequency of the generated Bluetooth RF carrier signal. With the command `SOURce:RFGenerator:FREQuency:UNIT`, the default frequency unit can be changed, and even Bluetooth channel numbers can be entered instead of frequencies.				

SOURce:RFGenerator:FREQuency:UNIT *<Unit>*				Frequency Unit
<Unit>	Description of parameters	Def. value	Def. unit	FW vers.
HZ | KHZ | MHZ | GHZ | CH	Frequency unit | Channel number	HZ	–	V3.50
Description of command				
This command defines whether the frequency of the RF signal generated is specified in frequency units or as an Bluetooth channel number. Frequency units must be used to select input signals that are outside the designated Bluetooth channel range. The command does not affect the default unit of the frequency offset (command `SOURce:RFGenerator:FOFFset`).				

SOURce:RFGenerator:FOFFset <*FrequencyOffset*>				Frequency Offset
<FrequencyOffset>>	Description of parameters	Def. value	Def. unit	FW vers.
–500.0 kHz to +500.0 kHz	Frequency offset	0	kHz	V3.50
Description of command				
This command determines a frequency offset for the generated signal in the selected RF channel. If it is used, the dirty transmitter is switched on (`SOURce:RFGenerator:DTX ON`) and the dirty transmitter frequency offset (`SOURce:RFGenerator:SDTX:FOFFset`) is overwritten.				

SOURce:RFGenerator:MINDex <*Index*>				Modulation Index
<Index>	Description of parameters	Def. value	Def. unit	FW vers.
0.20 to 0.44 | OFF	Modulation index of RF signal Modulation index 0.32, nominal Bluetooth freq. dev.	OFF	–	V3.50
Description of command				
This command sets the modulation index of the RF generator signal, i.e. the ratio between the actual frequency deviation of the signal and a frequency deviation of 500 kHz. If it is used, the dirty transmitter is switched on (`SOURce:RFGenerator:DTX ON`) and the dirty transmitter modulation index (`SOURce:RFGenerator:SDTX:MINDex`) is overwritten.				

SOURce:RFGenerator:PTYPe *<Type>* — Packet Type

<Type>	Description of parameters	Def. value	Def. unit	FW vers.
DH1 |	DH1 packet	DH1	–	V3.80
DH3 |	DH3 packet			
DH5 |	DH5 packet			
***E21P** |	2-DH1 packet			
***E23P** |	2-DH3 packet			
***E25P** |	2-DH5 packet			
***E31P** |	3-DH1 packet			
***E33P** |	3-DH3 packet			
***E35P**	3-DH5 packet			

Description of command

This command specifies what type of packets the R&S® CBT transmits on its generator signal.

*These packet types are only available if software option CBT-K55 has been installed *and* hardware option CBT-B55 has been fitted.

SOURce:RFGenerator:PLENgth *<Length>* — Length of Test Sequence

<Length>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 27 |	Length of test sequence in byte for a DH1 packet	27	(bytes)	V3.80
0 to 183 |	Length of test sequence in byte for a DH3 packet	183	(bytes)	
0 to 339 |	Length of test sequence in byte for a DH5 packet	339	(bytes)	
0 to 54 |	*Length of test sequence, in bytes, for a 2-DH1 packet	54		V3.85
0 to 367 |	*Length of test sequence, in bytes, for a 2-DH3 packet	367		
0 to 679 |	*Length of test sequence, in bytes, for a 2-DH5 packet	679		
0 to 83 |	*Length of test sequence, in bytes, for a 3-DH1 packet	83		
0 to 552 |	*Length of test sequence, in bytes, for a 3-DH3 packet	552		
0 to 1021	*Length of test sequence, in bytes, for a 3-DH5 packet	1021		

Description of command

This commands specifies the length of the payload for the transmitted packets. The allowed value range depends on the packet type (see command `SOURce:RFGenerator:PTYPe`).

*These packet types are only available if software option CBT-K55 has been installed *and* hardware option CBT-B55 has been fitted.

SOURce:RFGenerator:BDADdress *<Address>* — BD_Address CBT

<Address>	Description of parameters	Def. value	Def. unit	FW vers.
"<12-digit hex value>"	BD_address of the R&S® CBT	"123456123456"	–	V3.80

Description of command

This command sets the Bluetooth device address of the R&S® CBT which is transmitted on the Bluetooth generator signal.

Subsystem RFGenerator:BMODulation

The subsystem *RFGenerator:BMODulation* determines the bit sequence that is modulated onto the RF carrier signal. It corresponds to the *Generator Modulation* parameter in the *Generator* tab of the *Connect. Control* menu.

SOURce:RFGenerator:BMODulation <*Pattern*>				Generator Modulation
<Pattern>	Description of parameters	Def. value	Def. unit	FW vers.
PRBS | **ALL0** | **ALL1** | **P44** | **P22** | **P11**	Pseudo-random bit sequence All zeros All ones Four ones, then four zeros Two ones, then two zeros Alternative ones and zeros	PRBS	–	V3.50
Description of command				
The command selects a bit sequence used to modulate the RF generator signal.				

Subsystem RFGenerator: …DTX… (Dirty Transmitter)

The subsystems *RFGenerator:DTX, RFGenerator:SDTX,* and *RFGenerator:ESDTx* define the single-valued dirty transmitter settings. All parameters can be set in the *Generator* tab of the *Connect. Control* menu.

SOURce:RFGenerator:DTX <*Enable*>				Dirty Tx
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Enable or disable dirty transmitter	OFF	–	V3.50
Description of command				
This command enables or disables the dirty transmitter. Switching `OFF` the dirty transmitter is equivalent to switching off all `SOURce:RFGenerator:SDTX`… settings.				

SOURce:RFGenerator:SDTX:MINDex <*Index*>				Modulation Index, GFSK
<Index>	Description of parameters	Def. value	Def. unit	FW vers.
0.20 to 0.44 | **OFF**	Modulation index of RF signal Modulation index 0.32, nominal Bluetooth freq. dev.	OFF	–	V3.50
Description of command				
This command sets the modulation index of the RF generator signal, i.e. the ratio between the actual frequency deviation of the R&S® CBT and a frequency deviation of 500 kHz. The command overwrites the `SOURce:RFGenerator:MINDex` setting.				

SOURce:RFGenerator:SDTX:FOFFset <*Offset*>				Frequency Offset, GFSK
<Offset>	Description of parameters	Def. value	Def. unit	FW vers.
–250 kHz to +250 kHz | **OFF**	Frequency offset of RF signal Frequency offset 0 kHz.	OFF	kHz	V3.50
Description of command				
This command defines an offset of the actual frequency of the RF generator signal from the nominal Bluetooth channel frequency. The command overwrites the `SOURce:RFGenerator:FOFFset` setting. This command does not affect the DPSK-modulated portion of EDR packets (with option R&S CBT-B55/K55); to be configured using `SOURce:RFGenerator:ESDTx:FOFFset`.				

SOURce:RFGenerator:SDTX:STERror <*Error*>				Symbol Timing Error, GFSK
<Error>	Description of parameters	Def. value	Def. unit	FW vers.
–20 ppm to +20 ppm | **OFF**	Symbol timing error of RF signal Symbol timing error 0 ppm	OFF	ppm	V3.50
Description of command				
This command defines a timing error of the RF generator signal relative to the ideal slot timing. This command does not affect the DPSK-modulated portion of EDR packets (with option R&S CBT-B55/K55); to be configured using `SOURce:RFGenerator:ESDTx:STERror`.				

SOURce:RFGenerator:SDTX:FDRift <*Enable*>				Drift, GFSK
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Enable or disable drift	OFF	–	V3.50
Description of command				
This command enables or disables the periodic, packet-dependent frequency drift. This command does not affect the DPSK-modulated portion of EDR packets (with option R&S CBT-B55/K55); to be configured using `SOURce:RFGenerator:ESDTx:FDRift`.				

SOURce:RFGenerator:ESDTx:FOFFset <*Offset*>				Frequency Offset, DPSK
<Offset>	Description of parameters	Def. value	Def. unit	FW vers.
–250 kHz to +250 kHz | **OFF**	Frequency offset of RF signal Frequency offset 0 kHz.	OFF	kHz	V4.00
Description of command				
This command defines an offset of the actual frequency of the RF generator signal from the nominal Bluetooth channel frequency. This command affects the DPSK-modulated portion of EDR packets (with option R&S CBT-B55/K55); see also `SOURce:RFGenerator:SDTXD:FOFFset`.				

SOURce:RFGenerator:ESDTx:STERror <*Error*>				Symbol Timing Error, DPSK
<Error>	Description of parameters	Def. value	Def. unit	FW vers.
–20 ppm to +20 ppm | **OFF**	Symbol timing error of RF signal Symbol timing error 0 ppm	OFF	ppm	V4.00
Description of command				
This command defines a timing error of the RF generator signal relative to the ideal slot timing. This command affects the DPSK-modulated portion of EDR packets (with option R&S CBT-B55/K55); see also `SOURce:RFGenerator:SDTXD:STERror`.				

SOURce:RFGenerator:ESDTx:FDRift <*Enable*>				Drift, DPSK
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Enable or disable drift	OFF	–	V4.00
Description of command				
This command enables or disables the periodic, packet-dependent frequency drift. This command affects the DPSK-modulated portion of EDR packets (with option R&S CBT-B55/K55); see also `SOURce:RFGenerator:SDTXD:FDRift`.				

Subsystem CORRection:LOSS

The subsystems in this section contain the commands for configuration of the input and output connectors and the external attenuation factors. The subsystems correspond to the *RF* tab in the popup menu *Connect. Control*.

[SENSe:]CORRection:LOSS[:MAGNitude] *<Absorption>*				Ext. Att. Input
<Absorption>	Parameter description	Def. value	Default unit	FW vers.
–50 dB to +90 dB	External input attenuation	0.0	dB	V3.50
Command description				
This commands assigns an external attenuation value to the input of the instrument.				

SOURce:CORRection:LOSS[:MAGNitude] *<Absorption>*				Ext. Att. Output
<Absorption>	Parameter description	Def. value	Default unit	FW vers.
–50 dB to +90 dB	External output attenuation	0.0	dB	V3.50
Command description				
This command assigns an external attenuation value to the outputs of the instrument. An external attenuation of x dB increases the RF generator level (`SOURce:RFGenerator[:TX]:LEVel`) by x dB.				

Bluetooth Device Tests (Signalling Mode)

In the *Signalling* mode, the R&S® CBT is able to generate a master signal and to attempt a connection to the DUT. A broad range of signalling parameters can be configured and measurements may be performed with a connection established.

Connection Control

The remote-control commands presented in this section control the signalling (inquiry, connection, detach and signalling parameters), determine the inputs and outputs as well as the reference frequency. They correspond to the settings in the popup menu of the softkey *Connect. Control* located to the right of the headline of each main menu (see Chapter 4).

Signalling – Subsystem SIGNalling (Connection Setup and Cleardown)

The subsystem *SIGNalling* controls the setup and release of a connection between the R&S® CBT and the Bluetooth DUT and determines the signalling parameters. It corresponds to the different *Connection* tabs (for four different signalling states, see command `PROCedure:SIGNalling:ACTion`) in the popup menu *Connect. Control*.

PROCedure:SIGNalling:ACTion *<Action>*				Connection Control
<Action>	Description of parameters	Def. value	Def. unit	FW vers.
INQuiry |	Switch on master signal and start inquiry for Bluetooth devices within range	–	–	V3.50
SINQuiry |	Stop inquiry and switch off master signal			
TEST |	Switch on master signal, start paging the selected Bluetooth device, and activate its test mode as soon as the connection is established In `CONN` state or one of the substates: Force the DUT into its test mode			
STESt |	Interrupt an ongoing paging procedure, switch off the master signal and return to SBY state In `TEST` state: Release the test mode and return to the `CONN` state			
PAGE |	Switch on master signal, start paging the selected Bluetooth device and establish an ACL connection			
SPAGe |	Interrupt an ongoing connection setup, switch off the master signal and return to SBY state			
DETach |	Detach an established connection and switch off master signal			
FSTY	Force the R&S® CBT into Standby without detaching			V3.50
SNIFf |	Force the DUT to *Sniff* mode			V3.50
SSNiff |	Release the *Sniff* mode			
HOLD |	Force the DUT to *Hold* mode			
AUDio |	Establish an SCO link on top of the existing ACL connection in order to perform audio measurements			
SAUDio |	Release the *Audio* mode			
PARK |	Force the DUT to *Park* mode			V3.50
SPARk	Release the *Park* mode			
HEADset |	Activate *headset* profile*			V4.25
SHEadset |	Deactivate the *headset* profile*			
HFRee |	Activate *hands-free* profile*			
SHFRee |	Deactivate the *hands-free* profile*			
HAGateway |	Activate *headset audio gateway* profile*			
SHAGateway |	Deactivate the *headset audio gateway* profile*			
HFAGateway |	Activate *hands-free audio gateway* profile*			
SHFagateway	Deactivate the *hands-free audio gateway* profile*			
SINK	Enter *A2DP (Sink) Profile* submode**			V4.60
SSINk	Enter *A2DP (Sink) Profile* submode**			
Description of command				Sig. State
This command has no query form and no default value. It changes between the different signalling states of the R&S® CBT (see state diagram below). *) These audio profile actions are supported in V4.25 onwards when the R&S CBT-K54 option is enabled. **) These audio profile actions are supported in V4.60 onwards when the R&S CBT-K52 option is enabled.				See below

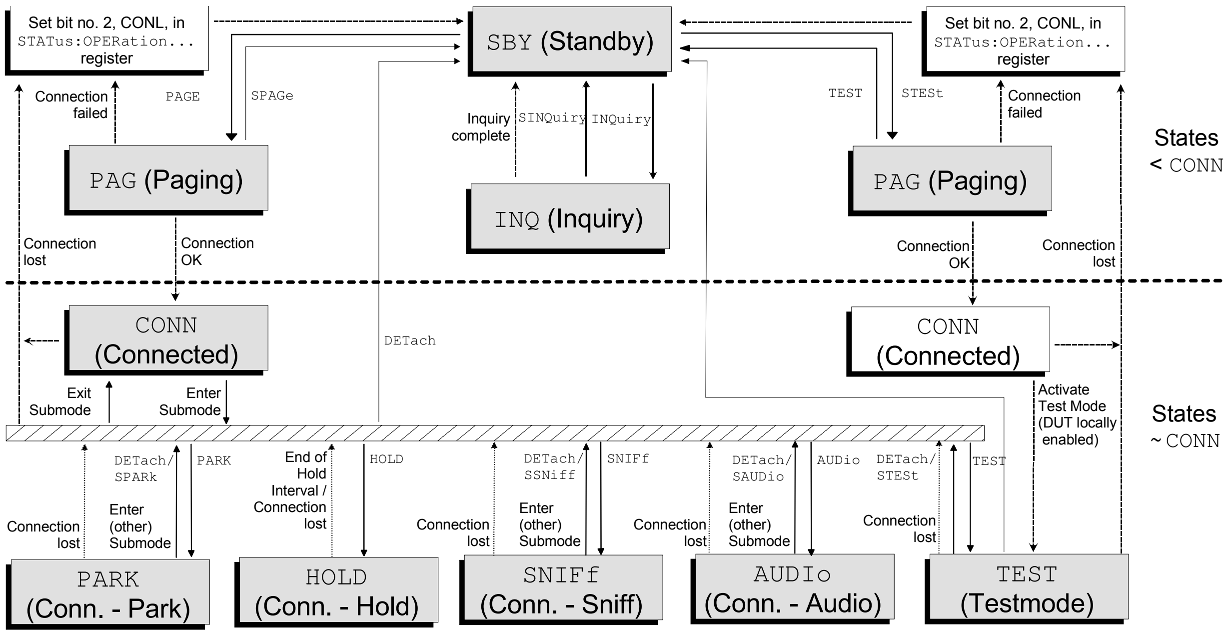


Fig. **Error! No text of specified style in document.**-1 Signalling states (shaded) of the R&S® CBT and transitions

Signalling states: See next command, [SENSe:]SIGNalling:STATe?

Actions (initiated from the R&S® CBT): See description of command `[PROCedure:]SIGNalling:ACTion`

Further transitions between the signalling states (not shown in *Fig. Error!* **No text of specified style in document.-1**) may occur, e.g. in case of errors.

[SENSe:]SIGNalling:XSTate?				Signalling State
Return	Description of parameters	Def. value	Def. unit	FW vers.
SBY | **INQ** | **PAG** | **CONN** | **TEST** | **HOLD** | **SNIF** | **PARK** | **AUD** | **DET** |	Standby; no RF signal is generated Inquiry for *Bluetooth* devices within range in progress Paging in progress (trying to establish a connection) Connection to a Bluetooth device is established Connection established, DUT in test mode Connection established, DUT in Hold mode Connection established, DUT in Sniff mode Connection established, DUT in Park mode Connection established, DUT in Audio mode Disconnecting/detaching (trying to detach from a connection)	SBY	–	V3.50
HFR | **HEAD** | **HFAG** | **HAG** |	Connection established, DUT in hands-free profile* Connection established, DUT in headset profile* Conn. established, DUT in hands-free audio gateway profile* Connection established, DUT in headset audio gateway profile* |			V4.25
SINK	Connection established, DUT in *A2DP (Sink) Profile***			V4.60
Description of command				Sig. State
This command is always a query. It returns the current signalling state. This command gives you specific information about the submode that the device under test (DUT) is in, whereas the `[SENSe:]SIGNalling:State?` command does not. In the `CONN` state, in the `TEST, HOLD, SNIF, AUD`, and `PARK` substates, and in the audio profile substates, the R&S® CBT maintains a connection to the DUT. The states are grouped together as the ~`CONN` states. The remaining states are grouped together as <`CONN` states. *) These audio profile states are supported in V4.25 onwards when the R&S CBT-K54 option is enabled. **) This audio profile state is supported in V4.60 onwards when the R&S CBT-K52 option is enabled.				all

[SENSe:]SIGNalling:STATe?				Signalling State
Return	Description of parameters	Def. value	Def. unit	FW vers.
SBY | **INQ** | **PAG** | **CONN** **DET**	Standby; no RF signal is generated Inquiry for *Bluetooth* devices within range in progress Paging in progress (trying to establish a connection) Connection to a Bluetooth device is established Detaching (trying to detach from a connection)	SBY	–	V3.50
Description of command				Sig. State
This command is always a query. It returns the current signalling state. You can use the `[SENSe:]SIGNalling:XSTate?` command to differentiate between the various submodes of a DUT in the CONN state (e.g. Hold, Park, Sniff, Audio, Test, hands free profile, …).				all

FETCh:SIGNalling:PTARgets?				Device to Page List
Return	Description of parameters	Def. value	Def. unit	FW vers.
0 to 12, **"BD00",** **"BD_address_00"** **{,"BDxx",** **"BD_address_xx"}**	Total number of devices found Device number of first inquired device BD_address of the first inquired device Up to 11 further device numbers BD01 to BD11 and BD addresses	0, "BD00", "12345678 9012"	–	V3.50
Description of command				Sig. State
This command is always a query. It returns a list of all targets available for paging. The first parameter is the total number of devices available for paging. A list of devices follows, each entry consisting of the device number (string "BDxx") and the device's *Bluetooth* device address. The first device *"BD00"* is always the default target as set in the *Network* tab. The following targets are the devices found during inquiry. If no inquiry was done or no device was found during inquiry, 0 will be returned for the number of devices found, meaning that there is only the default device available for paging.				all

CONFigure:SIGNalling:PTARget Parameters for setting: ***<Target>*** Parameters for query: ***<Target>, <BD_address>***				Device to Page
<Target>	Description of parameters	Def. value	Def. unit	
BD00 to BD11	Current number of paging target	BD00	–	
<BD_address>	Description of parameters	Def. value	Def. unit	FW vers.
"<12-digit hex value>"	Paging target's BD address	"123456789012"	–	V3.50
Description of command				Sig. State
This command selects one of the paging targets to be the device to page. If used as a query, it returns the number and BD address of the currently selected device to page. To be selected, the device must appear in the device to page list; see `FETCh:SIGNalling:PTARgets?`. If another device is selected, an error message is returned.				<CONN Query:all

PROCedure:SIGNalling:PTBZero *<Time>*				Power-up Time before Bit Zero
<Time>	Description of parameters	Def. value	Def. unit	FW vers.
LONG | **SHORt**	Approx. 25 µs Approx. 3 µs	SHORt	–	V3.80
Description of command				Sig. State
This commands specifies the time interval between the start of the power ramp and the time of bit zero.				<CONN Query:all

PROCedure:PCONtrol:STEP				Power Control Up/Down
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
UP | **DOWN**	Send increase power request to the DUT Send decrease power request to the DUT	–	–	V3.50
Description of command				Sig. State
This command sends power control commands to the DUT so that its power control capabilities can be tested.				CONN, TEST

PROCedure:PCONtrol:STATe?				Read power control state
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
RMAX | **RMIN** | **NNM**	DUT has reached its maximum power DUT has reached its maximum power No maximum or minimum power reached ("no new message")	–	–	V4.37
Description of command				Sig. State
This query returns the power control state of the DUT.				~CONN

Subsystem MSIGnal (Master Signal)

The subsystem *MSIGnal* configures how the R&S® CBT will act as a *Bluetooth* master. The subsystem corresponds to the *Master Sig.* tab in the popup menu *Connect. Control*.

CONFigure:MSIGnal:TXLevel *<Level>*				TX Level
<Level>	Description of parameters	Def. value	Def. unit	FW vers.
–90.0 dBm to +0.0 dBm	TX level	–40	dBm	V3.50
Description of command				Sig. State
This command sets the transmit level for the R&S® CBT while signalling. (Note that this is different from the level used during the BER tests.)				all

CONFigure:MSIGnal:BDADdress *<Address>*				BD_Address CBT
<Address>	Description of parameters	Def. value	Def. unit	FW vers.
"<12-digit hex value>"	BD_address of the R&S® CBT	"123456123456"	–	V3.50
Description of command				Sig. State
This command sets the Bluetooth device address of the R&S® CBT. BD_addresses can be set in single or double quotes.				SBY Q: all

CONFigure:MSIGnal:SVTout *<Number>*				Supervision Timeout
<Number>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 65535	Timeout in slots	8000	–	V3.50
Description of command				Sig. State
This value set with this command represents the number of slots of non-communication between the R&S® CBT and the DUT that can occur before the two devices detach from each other.				SBY Q: all

CONFigure:MSIGnal:HSCHeme *<Scheme>*				Connection Hopping Scheme
<Scheme>	Description of parameters	Def. value	Def. unit	FW vers.
EUSA | **FRANce**	Europe's and USA's hopping scheme France's hopping scheme	EUSA	–	V3.50
Description of command				Sig. State
This command selects the hopping scheme for the R&S® CBT while signalling. Channels and frequency ranges are: Europe/USA 2400 MHz to 2483.5 MHz, Channel$_k$: f_k = 2402+k MHz, k = 0 to 78 France 2446.5 MHz to 2483.5 MHz, Channel$_k$: f_k = 2454+k MHz, k = 0 to 22				SBY

CONFigure:MSIGnal:INQuiry:ILENgth *<Number>*				Inquiry Length
<Number>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 24	Inquiry length; integer number to be multiplied by 1.28 s	10	(1.28 s)	V3.50
Description of command				Sig. State
This command determines the maximum amount of time specified before the inquiry is halted.				SBY Q: all

CONFigure:MSIGnal:INQuiry:NOResponses *<Number>*				Number of Responses
<Number>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 12	Number of responses	12	–	V3.50
Description of command				Sig. State
This command determines the maximum number of responses from the inquiry before the inquiry is halted.				SBY

Subsystem MSIGnal:PAGing

The subsystem *MSIGnal:PAGing* configures how the R&S® CBT will attempt to page to a device under test. The subsystem corresponds to the section *Paging* of the *Master Sig.* tab in the popup menu *Connect. Control*.

CONFigure:MSIGnal:PAGing:TOUT *<Timeout>*				Page Timeout
<Timeout>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 65535	Number of slots for the timeout; the minimum value is 128 in paging mode R1 and 256 in paging mode R2	8192	(slots)	V3.50
Description of command				Sig. State
This command determines the maximum time the local LM will wait for a baseband page response from the DUT. If the time expires and the remote device has not responded to the page at baseband level, the connection attempt will be considered to have failed.				≠ PAG

CONFigure:MSIGnal:PAGing:PSRMode *<Mode>*				Page Scan Repetition mode
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
R0 | **R1** | **R2**	Paging mode R0 Paging mode R1 Paging mode R2	R2	–	V3.50
Description of command				Sig. State
This command determines the paging mode that is to be used for connection and synchronisation to a DUT.				≠ PAG

CONFigure:MSIGnal:PAGing:TARGet *<Address>*				Default BD_Address for Paging
<Address>	Description of parameters	Def. value	Def. unit	FW vers.
"<12-digit hex value>"	Default BD_address of device to page	"123456789012"	–	V3.50
Description of command				Sig. State
This command determines the address of a default device to attempt a connection to. If no inquiry was made before, this BD_address is used for paging a DUT; otherwise, the device to page can be set via `CONFigure:SIGNalling:PTARget`. BD_addresses can be set in single or double quotes.				≠ PAG

CONFigure:MSIGnal:PAGing:RSINfo <*Enable*>				Read Signalling Info
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Read signalling info from the DUT Do not read signalling info from the DUT	ON	–	V3.50
Description of command				Sig. State
This command defines whether the R&S® CBT issues commands to read supported features or other signalling information from the DUT. In the *OFF* setting the connection is made quicker, since there are less LMP packets exchanged between master and slave when connecting.				all

DEFault:MSIGnal:PAGing <*Enable*>				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values The parameters differ from the default values (partially or totally)	ON	–	V3.50
Description of command				Sig. State
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting OFF results in an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				SBY INQ

DEFault:MSIGnal <*Enable*>				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values The parameters differ from the default values (partially or totally)	ON	–	V3.50
Description of command				Sig. State
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting OFF results in an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				SBY

Subsystem MSIGnal:(…)DTX (Dirty Transmitter)

The subsystem *MSIGnal:(…)DTX* provides parameters to impair the master signal. The subsystem corresponds to the *Dirty Transmitter* section of the *Master Sig.* tab in the popup menu *Connect. Control*.

CONFigure:MSIGnal:DTX <*Mode*>				Dirty Tx
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **STAB** **UTAB** **SING**	Disable dirty transmitter Use spec table (`STDTx…`) User-defined table (`UTDTx…`) Single values (`SDTX…`)	OFF	–	V3.50
Description of command				
This command selects a scheme to configure the dirty transmitter or disables the dirty transmitter, causing the R&S® CBT to transmit an undistorted RF carrier signal.				

CONFigure:MSIGnal:DTX:SCOPe *<Scope>*				Dirty Transmitter Scope
<Scope>	Description of parameters	Def. value	Def. unit	FW vers.
RXQ | **GLOB**	Dirty transmitter settings active while a RX Quality measurement is running Settings always active	RXQuality	–	V3.50
Description of command				Sig. State
This command defines for which measurements the dirty transmitter settings are active.				all

CONFigure:MSIGnal:SDTX:MINDex <*Index*>				Modulation Index (single values)
<Index>	Description of parameters	Def. value	Def. unit	FW vers.
0.20 to 0.44 | **OFF**	Modulation index of RF signal Modulation index 0.32, nominal Bluetooth freq. dev.	OFF	–	V3.50
Description of command				
This command sets the modulation index of the RF generator signal, i.e. the ratio between the actual frequency deviation of the R&S® CBT and a frequency deviation of 500 kHz. The setting takes effect if the *Single Values* dirty transmitter scheme is selected (`CONFigure:MSIGnal:DTX SING`).				

CONFigure:MSIGnal:SDTX:FOFFset <*Offset*> **CONFigure:MSIGnal:ESDTx:FOFFset <*Offset*>**				Frequency Offset (single values, GFSK) Frequency Offset (single values, DPSK)
<Offset>	Description of parameters	Def. value	Def. unit	FW vers.
–250 kHz to +250 kHz | **OFF**	Frequency offset of RF signal Frequency offset 0 kHz.	OFF	kHz	V3.50 / V4.00
Description of command				
This command defines an offset of the actual frequency of the RF generator signal from the nominal Bluetooth channel frequency. The setting takes effect if the *Single Values* dirty transmitter scheme is selected (`CONFigure:MSIGnal:DTX SING`). The two commands affect the GFSK and DPSK modulated portions of the packets, respectively. `CONFigure:MSIGnal:ESDTx:FOFFset` requires options R&S CBT-B55/K55 and FW V4.00.				

CONFigure:MSIGnal:SDTX:STERror <*Error*> **CONFigure:MSIGnal:ESDTx:STERror <*Error*>**				Symbol Timing Error (single values, GFSK) Symbol Timing Error (single values, DPSK)
<Error>	Description of parameters	Def. value	Def. unit	FW vers.
–20 ppm to +20 ppm | **OFF**	Symbol timing error of RF signal Symbol timing error 0 ppm	OFF	ppm	V3.50 / V4.00
Description of command				
This command defines a timing error of the RF generator signal relative to the ideal slot timing. The setting takes effect if the *Single Values* dirty transmitter scheme is selected (`CONFigure:MSIGnal:DTX SING`). The two commands affect the GFSK and DPSK modulated portions of the packets, respectively. `CONFigure:MSIGnal:ESDTx:STERror` requires options R&S CBT-B55/K55 and FW V4.00.				

CONFigure:MSIGnal:SDTX:FDRift <*Enable*> **CONFigure:MSIGnal:ESDTx:FDRift <*Enable*>**		Drift (single values, GFSK) Drift (single values, DPSK)		
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Enable or disable drift	OFF	–	V3.50 / V4.00

Description of command

This command enables or disables the periodic, packet-dependent frequency drift. The setting takes effect if the *Single Values* dirty transmitter scheme is selected (`CONFigure:MSIGnal:DTX SING`). The two commands affect the GFSK and DPSK modulated portions of the packets, respectively.
`CONFigure:MSIGnal:ESDTx:FDRift` requires options R&S CBT-B55/K55 and FW V4.00.

CONFigure:MSIGnal:UTDTx:FDRift <*Enable*> **CONFigure:MSIGnal:EUTDtx:FDRift <*Enable*>**		Drift (user def. table, GFSK) Drift (user def. table, DPSK)		
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Enable or disable drift	ON	–	V3.50 / V4.00

Description of command

This command enables or disables the periodic, packet-dependent frequency drift. The setting takes effect if the *User Def. Table* dirty transmitter scheme is selected (`CONFigure:MSIGnal:DTX UTAB`). The two commands affect the GFSK and DPSK modulated portions of the packets, respectively.
`CONFigure:MSIGnal:EUTXtx:FDRift` requires options R&S CBT-B55/K55 and FW V4.00.

CONFigure:MSIGnal:UTDTx:SET<nr> *<Offset>, <Index>, <Error>*		User def. table		
<Offset>	Description of parameters	Def. value	Def. unit	FW vers.
–250 kHz to +250 kHz | **OFF**	Frequency offset of RF signal Frequency offset 0 kHz.	see below	kHz	V3.50
<Index>	Description of parameters	Def. value	Def. unit	FW vers.
0.20 to 0.44 | **OFF**	Modulation index of RF signal Modulation index 0.32	see below	–	V3.50
<Error>	Description of parameters	Def. value	Def. unit	FW vers.
–20 ppm to +20 ppm | **OFF**	Symbol timing error of RF signal Symbol timing error 0 ppm	see below	ppm	V3.50

Description of command

This command sets the ten sets of dirty transmitter parameters (<nr> = 1 to 10) in the user-defined table. The settings take effect if the *User Def. Table* dirty transmitter scheme is selected (`CONFigure:MSIGnal:DTX UTAB`).

For an overview of default values refer to the description of the commands for the individual parameters (`CONFigure:MSIGnal:UTDTx:SET<nr>:FOFFset, CONFigure:MSIGnal:UTDTx:SET<nr>:MINDex, CONFigure:MSIGnal:UTDTx:SET<nr>:STERror`).

CONFigure:MSIGnal:UTDTx:SET<nr>:FOFFset <*Offset*> Frequency Offset (user def. table, GFSK)

<Offset>	Description of parameters	Def. value	Def. unit	FW vers.
–250 kHz to +250 kHz | **OFF**	Frequency offset of RF signal Frequency offset 0 kHz.	see below	kHz	V3.50

Description of command

This command defines the ten offset values (<nr> = 1 to 10) of the actual frequency of the RF generator signal from the nominal Bluetooth channel frequency. The settings take effect if the *User Def. Table* dirty transmitter scheme is selected (`CONFigure:MSIGnal:DTX UTAB`). The command does not affect the DPSK modulated portion of the packet; see `CONFigure:MSIGnal:EUTDtx:SET<nr>:FOFFset`.

In the default setting the frequency offset values are equal to the values from the Bluetooth RF test specification (see Chapter 4), i.e.:

<nr>	1	2	3	4	5	6	7	8	9	10
Offset/[kHz]	75	14	–2	1	39	0	–42	74	–19	–75

CONFigure:MSIGnal:UTDTx:SET<nr>:MINDex <*Index*> Modulation Index (user def. table)

<Index>	Description of parameters	Def. value	Def. unit	FW vers.
0.20 to 0.44 | **OFF**	Modulation index of RF signal Modulation index 0.32, nominal Bluetooth freq. dev.	see below	–	V3.50

Description of command

This command sets the ten modulation indices (<nr> = 1 to 10) of the RF generator signal, i.e. the ratios between the actual frequency deviation of the R&S® CBT and a frequency deviation of 500 kHz. The settings take effect if the *User Def. Table* dirty transmitter scheme is selected (`CONFigure:MSIGnal:DTX UTAB`).

In the default setting the modulation indices are equal to the values from the Bluetooth RF test specification (see Chapter 4), i.e.:

<nr>	1	2	3	4	5	6	7	8	9	10
MINDex	0.28	0.30	0.29	0.32	0.33	0.34	0.29	0.31	0.28	0.35

CONFigure:MSIGnal:EUTDtx:SET<nr>:FOFFset <*Offset*> Frequency Offset (user def. table, DPSK)

<Offset>	Description of parameters	Def. value	Def. unit	FW vers.
–250 kHz to +250 kHz | **OFF**	Frequency offset of RF signal Frequency offset 0 kHz.	see below	kHz	V4.00

Description of command

This command defines the three offset values (<nr> = 1 to 3) of the actual frequency of the RF generator signal from the nominal Bluetooth channel frequency. The settings take effect if the *User Def. Table* dirty transmitter scheme is selected (`CONFigure:MSIGnal:DTX UTAB`). The command affects the DPSK modulated portion of EDR packets *(2-DH1* to *3-DH5)* and requires options R&S CBT-B55/K55.

In the default setting the frequency offset values are equal to the values from the Bluetooth RF test specification (see Chapter 4), i.e.:

<nr>	1	2	3
Offset/[kHz]	0	65	–65

CONFigure:MSIGnal:UTDTx:SET<nr>:STERror <*Error*>	Symbol Timing Error (user def. table, GFSK)			
<Error>	Description of parameters	Def. value	Def. unit	FW vers.
–20 ppm to +20 ppm | **OFF**	Symbol timing error of RF signal Symbol timing error 0 ppm	see below	ppm	V3.50
Description of command				

This command defines the ten timing error values (<nr> = 1 to 10) of the RF generator signal relative to the ideal slot timing. The setting takes effect if the *User Def. Table* dirty transmitter scheme is selected (`CONFigure:MSIGnal:DTX UTAB`). The command does not affect the DPSK modulated portion of the packet; see `CONFigure:MSIGnal:EUTDtx:SET<nr>:STERror`.

In the default setting the timing error values are equal to the values from the Bluetooth RF test specification (see Chapter 4), i.e.:

<nr>	1	2	3	4	5	6	7	8	9	10
Timing Err./[ppm]	–20	–20	+20	+20	+20	–20	–20	–20	–20	+20

CONFigure:MSIGnal:EUTDtx:SET<nr>:STERror <*Error*>	Symbol Timing Error (user def. table, DPSK)			
<Error>	Description of parameters	Def. value	Def. unit	FW vers.
–20 ppm to +20 ppm | **OFF**	Symbol timing error of RF signal Symbol timing error 0 ppm	see below	ppm	V4.00
Description of command				

This command defines the three timing error values (<nr> = 1 to 3) of the RF generator signal relative to the ideal slot timing. The setting takes effect if the *User Def. Table* dirty transmitter scheme is selected (`CONFigure:MSIGnal:DTX UTAB`). The command affects the DPSK modulated portion of EDR packets *(2-DH1* to *3-DH5)* and requires options R&S CBT-B55/K55.

In the default setting the timing error values are equal to the values from the Bluetooth RF test specification (see Chapter 4), i.e.:

<nr>	1	2	3
Timing Err./[ppm]	0	+20	–20

Subsystem DUT (Authentication)

The subsystem *DUT* is used to test the authentication procedure between the R&S® CBT and the DUT. The parameters are in the *Paging* section of the *Master Sig.* tab in the popup menu *Connect. Control*.

CONFigure:DUT:AUTHentic:ENABle *<Enable>*	Authentication Required			
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Require / do not require authentication	OFF	–	V3.57
Description of command				Sig. State
This command enables or disables authentication required by the R&S® CBT.				all

CONFigure:DUT:PINCode *<Code>*	Pin Code			
<Code>	Description of parameters	Def. value	Def. unit	FW vers.
‘<12-digit hex>’	PIN code specified as a string containing a 1 to 12-digit hexadecimal number	‘0000’	–	V3.57
Description of command				Sig. State
This command specifies the PIN code to be used for authentication.				all

CONFigure:DUT:STORe:LINK:KEYS *<Enable>*				Store Link Keys
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Store link keys No link keys stored	OFF ON	–	V4.37 V5.00
Description of command				
This command qualifies whether the link keys which a DUT sends during the authentication (pairing) process are stored.				

Subsystem SSIGnal (Slave Signal)

The subsystem *SSIGnal* configures the properties of the slave signal in the *Connected* or *Test Mode* signalling states. The subsystem corresponds to the general settings in the *Slave Sig.* tab in the popup menu *Connect. Control*.

CONFigure:SSIGnal:PCTR *<Mode>*				Power Control Mode
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ADAPtive | **FIXed**	Power control enabled Power control disabled	ADAP	–	V3.50
Description of command				Sig. State
These commands define whether or not the DUT supports adaptive power control.				all

Subsystem SSIGnal:TMODe (Test Mode)

The subsystem *SSIGnal:TMODe* configures testmode types and data to be used for tests. The subsystem corresponds to the *Testmode Type* section of the *Slave Sig.* tab in the popup menu *Connect. Control*.

The following *SSIGnal:TMODe...* subsystems are listed in separate sections:

- TX Tests (see p. 59 ff)
- Loopback Tests (see p. 61 ff)

CONFigure:SSIGnal:TMODe:TMTYpe *<Type>*				Testmode Type
<Type>	Description of parameters	Def. value	Def. unit	FW vers.
LBT | **TXT**	Loopback Tests TX Tests	LBT	–	V3.50
Description of command				Sig. State
This command selects the testmode type for TX measurements `(POWer, MODulation, SPECtrum)`.				all

CONFigure:SSIGnal:TMODe:HSCHeme *<Scheme>*				Test Mode Hopping Scheme
<Scheme>	Description of parameters	Def. value	Def. unit	FW vers.
RXTX | **EUSA** | **FRANce** | **RHOP**	RX/TX on single frequency Europe's and USA's hopping scheme France's hopping scheme Test mode's reduced hopping scheme	EUSA	–	V3.50
Description of command				Sig. State
This command selects the hopping scheme to be used in test mode. Channels and frequency ranges are: Europe/USA 2400 MHz to 2483.5 MHz, Channel$_k$: f_k = 2402+k MHz, k = 0 to 78 France 2446.5 MHz to 2483.5 MHz, Channel$_k$: f_k = 2454+k MHz, k = 0 to 22				all

CONFigure:SSIGnal:TMODe:FREQuency:UNIT *<Unit>*				Frequency Unit
<Unit>	Description of parameters	Def. value	Def. unit	FW vers.
HZ | **KHZ** | **MHZ** | **GHZ** | **CH**	Frequency unit | Channel number	HZ	–	V3.50
Description of command				Sig. State
This command defines whether the frequency of the RF signal generated is specified in frequency units or as a Bluetooth channel number.				all

Subsystem SSIGnal:TMOD:TXTests (Transmitter Tests)

The subsystem *SSIGnal:TMOD:TXTests* configures the transmitter tests on *Bluetooth* devices. The subsystem corresponds to the *TX Tests* section of the *Slave Sig.* tab in the popup menu *Connect. Control*. All commands are only effective in transmitter test mode (see `CONFigure:SSIGnal:TMODe:TMTYpe`).

CONFigure:SSIGnal:TMODe:TXTests:FREQuency *<RXTX_Freq>*				RX/TX Frequency, Transmitter Test
<RX_Freq>	Description of parameters	Def. value	Def. unit	FW vers.
2 402 MHz to 2 495 MHz	RX frequency	2402 000 000	Hz	V3.50
Description of command				Sig. State
This command defines the common RX and TX frequency of the DUT in the test mode and for transmitter *Testmode Types*. The frequency must be entered in multiples of the *Bluetooth* channel width of 1 MHz. With the command `CONFigure:SSIGnal:TMODe:FREQuency:UNIT`, the default frequency unit can be changed, and even *Bluetooth* channel numbers can be entered instead of frequencies.				all

CONFigure:SSIGnal:TMODe:TXTests:PATType *<Type>*				Pattern Type
<Type>	Description of parameters	Def. value	Def. unit	FW vers.
SPRS | **ALL1** | **ALL0** | **P11** | **P44**	Static pseudo random sequence All ones All zeros Alternative ones and zeros Four ones then four zeros	P11	–	V3.50
Description of command				Sig. State
This command sets the bit pattern for TX test mode.				all

CONFigure:SSIGnal:TMODe:TXTests:PTYPe *<Type>* Packet Type

<Type>	Description of parameters	Def. value	Def. unit	FW vers.
DH1 |	DH1 packet	DH1	–	V3.50
DH3 |	DH3 packet			
DH5 |	DH5 packet			
***E21P** |	2-DH1 packet			V3.85
***E23P** |	2-DH3 packet			
***E25P** |	2-DH5 packet			
***E31P** |	3-DH1 packet			
***E33P** |	3-DH3 packet			
***E35P**	3-DH5 packet			

Description of command	Sig. State
This command determines what type of packet is to be transmitted by the DUT during test mode. *These packet types are only available if software option CBT-K55 has been installed.	all

CONFigure:SSIGnal:TMODe:TXTests:LOTSequence:DH1Packet *<Length>* Length of Test Sequence
CONFigure:SSIGnal:TMODe:TXTests:LOTSequence:DH3Packet *<Length>*
CONFigure:SSIGnal:TMODe:TXTests:LOTSequence:DH5Packet *<Length>*
CONFigure:SSIGnal:TMODe:TXTests:LOTSequence:E21Packet *<Length>
CONFigure:SSIGnal:TMODe:TXTests:LOTSequence:E23Packet *<Length>
CONFigure:SSIGnal:TMODe:TXTests:LOTSequence:E25Packet *<Length>
CONFigure:SSIGnal:TMODe:TXTests:LOTSequence:E31Packet *<Length>
CONFigure:SSIGnal:TMODe:TXTests:LOTSequence:E33Packet *<Length>
CONFigure:SSIGnal:TMODe:TXTests:LOTSequence:E35Packet *<Length>

<Length>	Description of parameters	Def. value	Def. unit	FW vers.
0 .. 27 |	Length of test sequence in byte for a DH1 packet	27	bytes	V3.50
0 .. 183 |	Length of test sequence in byte for a DH3 packet	183	bytes	
0 .. 339 |	Length of test sequence in byte for a DH5 packet	33954	bytes	
0 to 54 |	*Length of test sequence in byte for a 2-DH1 packet	367	bytes	V3.85
0 to 367 |	*Length of test sequence in byte for a 2-DH3 packet	679	bytes	
0 to 679 |	*Length of test sequence in byte for a 2-DH5 packet	83	bytes	
0 to 83 |	*Length of test sequence in byte for a 3-DH1 packet	552	bytes	
0 to 552 |	*Length of test sequence in byte for a 3-DH3 packet	1021	bytes	
0 to 1021	*Length of test sequence in byte for a 3-DH5 packet		bytes	

Description of command	Sig. State
These commands determine the length of the payload for the transmitted packet. The allowed value range depends on the packet type (see command `CONFigure:SSIGnal:TMODe:TXTests:PTYPe`). *These packet types are only available if software option CBT-K55 has been installed.	all

CONFigure:SSIGnal:TMODe:TXTests:PPERiod *<Period>*				Poll Period
<Period>	Description of parameters	Def. value	Def. unit	FW vers.
2 to 254 **4 to 254** **6 to 254**	Poll period for x-DH1 packets (even number of slots) Poll period for x-DH3 packets (even number of slots) Poll period for x-DH4 packets (even number of slots)	2*) 4 6	(slots) (slots) (slots)	V3.50
Description of command				Sig. State
This command determines how often the poll packet from the R&S® CBT occurs. *) In firmware versions <5.00, the default poll period is 2 slots, irrespective of the packet type.				all

Subsystem SSIGnal:TMODe:LBTests (Loopback Tests)

The subsystem *SSIGnal:TMODe:LBTests* configures the loopback test mode. The subsystem corresponds to the *Loopback Tests* section of the *Slave Sig.* tab in the popup menu *Connect. Control*.

CONFigure:SSIGnal:TMODe:LBTests:FREQuency *<TX_Freq>,<RX_Freq>*				TX/RX Frequency, Loopback
<TX_Freq>	Description of parameters	Def. value	Def. unit	
2 402 MHz to 2 495 MHz,	TX frequency	2402000000	Hz	
<RX_Freq>	Description of parameters	Def. value	Def. unit	FW vers.
2 402 MHz to 2 495 MHz	RX frequency	2480000000	Hz	V3.50
Description of command				Sig. State
This command defines the frequency of the RF signals that will be generated and received by the DUT in the test mode and for loopback *Testmode Types* . Both frequencies must be entered in multiples of the *Bluetooth* channel width of 1 MHz. With the command `CONFigure:SSIGnal:TMODe:FREQuency:UNIT`, the default frequency unit can be changed, and even *Bluetooth* channel numbers can be entered instead of frequencies.				all

CONFigure:SSIGnal:TMODe:LBTests:PATType *<Type>*				Pattern Type
<Type>	Description of parameters	Def. value	Def. unit	FW vers.
DPRS | **SPRS** | **ALL1** | **ALL0** | **P11** | **P44** | **USER**	Dynamic pseudo random sequence Static pseudo random sequence All ones All zeros Alternative ones and zeros Four ones then four zeros User defined	P11	–	V3.50
Description of command				Sig. State
This command sets the bit pattern for loopback mode. The specified pattern type will be used if the testmode type is set to loopback tests (see `CONFigure:SSIGnal:TMODe:TMTYpe`).				all

CONFigure:SSIGnal:TMODe:LBTests:UDLength *<Length>*				User-defined Length
<Length>	Description of parameters	Def. value	Def. unit	FW vers.
3 to 64	Length of user defined data in bit	16	–	V3.50
Description of command				Sig. State
This command determines the length of the user defined bit sequence before it is repeated. This command is only effective if a loopback testmode type is selected (see command `CONFigure:SSIGnal:TMODe:TMTYpe`) and the loopback pattern is user defined (see command `CONFigure:SSIGnal:TMODe:LBTests:PATTern`).				all

CONFigure:SSIGnal:TMODe:LBTests:UDData *<Data>*				User-defined Data
<Data>	Description of parameters	Def. value	Def. unit	FW vers.
"<HEX Data>"	Up to 64 user defined data bits; represented by max. 16 hex characters, least significant bit last, i.e. to the right	"FF00"	–	V3.50
Description of command				Sig. State
This command determines the bit stream to be used for the user defined data. The bit stream is repeated until the complete payload is filled, removing any extra bits from the end of the stream. This command is only effective if a loopback testmode type is selected (see command `CONFigure:SSIGnal:TMODe:TMTYpe`) and if the loopback pattern is user defined (see command `CONFigure:SSIGnal:TMODe:LBTests:PATTern`).				all

CONFigure:SSIGnal:TMODe:LBTests:PTYPe *<Type>*				Packet Type
<Type>	Description of parameters	Def. value	Def. unit	FW vers.
DH1 |	DH1 packet	DH1	–	V3.50
DH3 |	DH3 packet			
DH5 |	DH5 packet			
***E21P** |	2-DH1 packet			V3.85
***E23P** |	2-DH3 packet			
***E25P** |	2-DH5 packet			
***E31P** |	3-DH1 packet			
***E33P** |	3-DH3 packet			
***E35P**	3-DH5 packet			
Description of command				Sig. State
This command determines what type of packet is to be transmitted by the DUT during loopback mode. This command is only effective if a loopback testmode type is selected (see command `CONFigure:SSIGnal:TMODe:TMTYpe`). *These packet types are only available if software option CBT-K55 has been installed *and* hardware option CBT-B55 has been fitted.				all

CONFigure:SSIGnal:TMODe:LBTests:LOTSequence:DH1Packet *<Length>* Length of Test Sequence
CONFigure:SSIGnal:TMODe:LBTests:LOTSequence:DH3Packet *<Length>*
CONFigure:SSIGnal:TMODe:LBTests:LOTSequence:DH5Packet *<Length>*
CONFigure:SSIGnal:TMODe:LBTests:LOTSequence:E21Packet *<Length>
CONFigure:SSIGnal:TMODe:LBTests:LOTSequence:E23Packet *<Length>
CONFigure:SSIGnal:TMODe:LBTests:LOTSequence:E25Packet *<Length>
CONFigure:SSIGnal:TMODe:LBTests:LOTSequence:E31Packet *<Length>
CONFigure:SSIGnal:TMODe:LBTests:LOTSequence:E33Packet *<Length>
CONFigure:SSIGnal:TMODe:LBTests:LOTSequence:E35Packet *<Length>

<Length>	Description of parameters	Def. value	Def. unit	FW vers.
0 .. 27 |	Length of test sequence in byte for a DH1 packet	27	–	V3.50
0 .. 183 |	Length of test sequence in byte for a DH3 packet	183		
0 .. 339 |	Length of test sequence in byte for a DH5 packet	339		
0 to 54 |	*Length of test sequence in byte for a 2-DH1 packet	54		V3.85
0 to 367 |	*Length of test sequence in byte for a 2-DH3 packet	367		
0 to 679 |	*Length of test sequence in byte for a 2-DH5 packet	679		
0 to 83 |	*Length of test sequence in byte for a 3-DH1 packet	83		
0 to 552 |	*Length of test sequence in byte for a 3-DH3 packet	552		
0 to 1021	*Length of test sequence in byte for a 3-DH5 packet	1021		

Description of command	Sig. State
These commands determine the length of the payload for the transmitted packet. The allowed value range depends on the packet type (see command `CONFigure:SSIGnal:TMODe:LBTests:PTYPe`). This command is only effective if a loopback testmode type is selected (see command `CONFigure:SSIGnal:TMODe:TMTYpe`). *These packet types are only available if software option CBT-K55 has been installed *and* hardware option CBT-B55 has been fitted.	all

CONFigure:SSIGnal:TMODe:LBTests:WHITening *<Enable>* Whitening

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON |	Whitening enabled	OFF	–	V3.50
OFF	Whitening disabled			

Description of command	Sig. State
This command switches whitening on or off. This command is only effective if a loopback testmode type is selected (see command `CONFigure:SSIGnal:TMODe:TMTYpe`).	all

DEFault:SSIGnal:TMODe *<Enable>* Default Settings

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON |	The parameters are set to their default values	ON	–	V3.50
OFF	The parameters differ from the default values (partially or totally)			

Description of command	Sig. State
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting OFF results in an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.	all

Subsystem NETWork (Network Parameters)

The subsystem *NETWork* sets parameters to control the DUT while it is in the *Audio, Sniff,* and *Hold* submode. It corresponds to the *Network* tab in the popup menu *Connection Control*.

DEFault:NETWork				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V3.50
Description of command				Sig. State
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting OFF results in an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				all

Subsystem NETWork:AUDio (Audio Submode)

The subsystem *NETWork:AUDio* sets parameters to control the DUT while it is in the *Audio* submode. It corresponds to the *Audio* section of the *Network* tab in the popup menu *Connection Control*.

CONFigure:NETWork:AUDio:AIRCoding *<Coding>*				Air Coding
<Version>	Description of parameters	Def. value	Def. unit	FW vers.
CVSD | **ULAW** | **ALAW**	CVSD modulation μ-law log PCM A-law log PCM	CVSD	–	V3.50
Description of command				Sig. State
This command defines the voice coding format used on the air interface (i.e. in uplink as well as in downlink direction).				≠ AUD, Q: all

CONFigure:NETWork:AUDio:BITStream *<Bit_Stream>*				Bit Stream
<Bit:Stream>	Description of parameters	Def. value	Def. unit	FW vers.
ECHO | **AIO** | **AIOL** | **DCAL** | **ECAL**	Loopback after *Delay Time* Analog In/Out Analog In/Out (Low) Decoder calibration Encoder calibration	AIO	–	V3.50 V3.80 V4.25
Description of command				Sig. State
This command defines the routing of the SCO bits in the R&S® CBT and the routing of the speech codec signals for calibration purposes.				all

CONFigure:NETWork:AUDio:DELTime *<Bit_Stream>*				Delay Time
<Bit:Stream>	Description of parameters	Def. value	Def. unit	FW vers.
0 ms to 2000 ms	Delay time	1000	ms	V3.50
Description of command				Sig. State
This command defines the time after which the R&S® CBT loops back the data received from the DUT if *Bit Stream = Echo* is set.				≠ AUD, Q: all

CONFigure:NETWork:AUDio:PTYPe *<Type>*				Packet Type
<Type>	Description of parameters	Def. value	Def. unit	FW vers.
HV1 | **HV2** | **HV3**	Packet type	HV1	–	V3.50
Description of command				Sig. State
This command defines the packet format of the SCO packets transmitted in the *Audio* state.				≠ AUD, Q: all

Subsystem NETWork:SNIFf (SNIFf Submode)

The subsystem *NETWork:SNIFf* sets parameters to control the DUT while it is in the *SNIFf* submode. It corresponds to the *Sniff Mode* section of the *Network* tab in the popup menu *Connection Control*.

CONFigure:NETWork:SNIFf:INTerval *<Slots>*				Sniff Interval
<Version>	Description of parameters	Def. value	Def. unit	FW vers.
2 slots to 65534 slots	Sniff interval, even number of slots	2048	(slots)	V3.50
Description of command				Sig. State
This command defines an even number of slots between two consecutive so-called *sniff slots* where the DUT listens to the master signal and the R&S® CBT can start transmission.				≠ SNIF, Q: all

CONFigure:NETWork:SNIFf:ATTempt *<Slots>*				Sniff Attempts
<Version>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 65535	Sniff interval	9	–	V3.50
Description of command				Sig. State
This command defines the minimum number of sniff attempts within each sniff interval. The number is usually set smaller than half the sniff interval (`CONFigure:NETWork: SNIFf:INTerval`).				≠ SNIFf, Q: all

CONFigure:NETWork:SNIFf:TOUT *<Slots>*				Sniff Timeout
<Version>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 65535	Sniff timeout	5	–	V3.50
Description of command				Sig. State
This command defines the minimum number of consecutive receive slots where the DUT keeps listening to the master signal after receiving a packet with a matching AM_ADDR. The number is usually set smaller than half the sniff interval (`CONFigure:NETWork:SNIFf:INTerval`).				≠ SNIFf, Q: all

Subsystem NETWork:HOLD (HOLD Submode)

The subsystem *NETWork:HOLD* sets parameters to control the DUT while it is in the *HOLD* submode. It corresponds to the *Hold Mode* section of the *Network* tab in the popup menu *Connection Control*.

CONFigure:NETWork:HOLD:INTerval *<Slots>*				Hold Interval
<Version>	Description of parameters	Def. value	Def. unit	FW vers.
1 slot to 65535 slots	HOLD interval	5000	(slots)	V3.50
Description of command				Sig. State
This command defines a number of slots that the DUT remains in the *HOLD* state.				≠ HOLD, Q: all

Subsystem NETWork:PARK (PARK Submode)

The subsystem *NETWork:PARK* sets parameters to control the DUT while it is in the *PARK* submode. It corresponds to the *Park Mode* section of the *Network* tab in the popup menu *Connection Control*.

CONFigure:NETWork:PARK:BINTerval *<Slots>*				Beacon Interval
<Version>	Description of parameters	Def. value	Def. unit	FW vers.
1 slot to 65535 slots	Beacon interval	1600	(slots)	V3.50
Description of command				Sig. State
This command defines the beacon interval for the *PARK* mode.				≠ PARK, Q: all

Subsystem NETWork:TEST (Testmode)

The subsystem *NETWork:PARK* configures the behavior of the R&S® CBT in testmode for specific DUT characteristics. It corresponds to the *Test Mode – DUT Characteristics* section of the *Network* tab in the popup menu *Connection Control*.

CONFigure:NETWork:TEST:RLSettling *<Time>*				RX Level Settling Time
<Time>	Description of parameters	Def. value	Def. unit	FW vers.
0 ms to 200 ms	Settling time after a level change	0.1	s	V3.54
Description of command				Sig. State
This command sets a delay time between the activation of a new measurement and the start of data acquisition.				all

CONFigure:NETWork:TEST:TCPChange *<Enable>*				Test Ctrol on Packet Change
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Enable or disable test control command	ON	–	V3.54
Description of command				Sig. State
This command qualifies whether a new *Test Control Command* is set after a change of the packet type (DH1, DH3, DH5).				all

CONFigure:NETWork:TEST:SNBehaviour *<Enable>*				*SEQN Behavior*
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
TEST | **NORM**	Test mode behavior: SEQN bit with constant value Normal mode behavior: SEQN bit toggled	TEST	–	V3.54
Description of command				Sig. State
This command defines the sequential numbering scheme of the packets.				all

A2DP Profile Selection and Codec Settings

The following commands configure the SBC codec used for the *A2DP (Sink) Profile* submode.

CONFigure:NETWork:AUDio:A2DP:CTYPe?				Codec Type
Response	Value range	Def. value	Def. unit	FW vers.
SBC	Sub-Band Coding	–	–	V4.60
Description of command				Sig. State
This command queries the codec type for the *A2DP (Sink) Profile* submode.				all

CONFigure:NETWork:AUDio:A2DP:SBC:SFRequency?				Sampling Frequency
Response	Value range	Def. value	Def. unit	FW vers.
SF48	48 kHz	–	–	V4.60
Description of command				Sig. State
This command queries the sampling frequency for the SBC codec that the DUT uses in *A2DP (Sink) Profile* submode.				all

CONFigure:NETWork:AUDio:A2DP:SBC:CMODe *<Mode>*				Channel Mode
<Mode>	Value range	Def. value	Def. unit	FW vers.
MONO | **DUAL** | **STER** | **JOIN**	MONO – single channel encoding DUAL – two independent channel encoding STEREO – two channel encoding JOINT STEREO – two channel encoding on L+R and L-R audio samples	DUAL	–	V4.60
Description of command				Sig. State
This command selects the channel mode for the SBC codec that the DUT uses in *A2DP (Sink) Profile* submode.				all

CONFigure:NETWork:AUDio:A2DP:SBC:BLENgth *<Blocks>*				Block Length
<Blocks>	Value range	Def. value	Def. unit	FW vers.
BL4 | **BL8** | **BL12** | **BL16**	4, 8, 12, or 16 blocks	BL16	–	V4.60
Description of command				Sig. State
This command selects the channel mode for the SBC codec that the DUT uses in *A2DP (Sink) Profile* submode.				all

CONFigure:NETWork:AUDio:A2DP:SBC:SBANds *<Bands>*				Sub Bands
<Bands>	Value range	Def. value	Def. unit	FW vers.
SB4 | **SB8**	4 or 8 subbands	SB8	–	V4.60
Description of command				Sig. State
This command selects the number of sub-bands for the SBC codec that the DUT uses in *A2DP (Sink) Profile* submode.				all

CONFigure:NETWork:AUDio:A2DP:SBC:AMEThod *<Method>*		Allocation Method		
<Method>	Value range	Def. value	Def. unit	FW vers.
SNR | **LOUD**	SNR or Loudness	LOUD	–	V4.60
Description of command				Sig. State
This command selects the allocation method for the SBC codec that the DUT uses in *A2DP (Sink) Profile* submode.				all

CONFigure:NETWork:AUDio:A2DP:SBC:BITPool:MINimum *<Value>*		Minimum Bitpool		
<Value>	Value range	Def. value	Def. unit	FW vers.
2 to 18	Minimum Bitpool	8	–	V4.60
Description of command				Sig. State
This command selects the minimum bitpool for the SBC codec that the DUT uses in *A2DP (Sink) Profile* submode.				all

CONFigure:NETWork:AUDio:A2DP:SBC:BITPool:MAXimum *<Value>*		Maximum Bitpool		
<Value>	Value range	Def. value	Def. unit	FW vers.
2 to 128	Maximum Bitpool	18	–	V4.60
Description of command				Sig. State
This command selects the maximum bitpool for the SBC codec that the DUT uses in *A2DP (Sink) Profile* submode.				all

Subsystems INPut, OUTPut, CORRection:LOSS

The subsystems in this section contain the commands for configuration of the input and output connectors and the external attenuation factors. The subsystems correspond to the *RF* tab in the popup menu *Connect. Control*.

[SENSe:]CORRection:LOSS[:MAGNitude] *<Absorption>*		Ext. Att. Input		
<Absorption>	Parameter description	Def. value	Def. unit	FW vers.
–50 dB to +90 dB	External input attenuation	0.0	dB	V3.50
Command description				
This commands assigns an external attenuation value to the input of the instrument.				

SOURce:CORRection:LOSS[:MAGNitude] *<Absorption>*				Ext. Att. Output
<Absorption>	Parameter description	Def. value	Def. unit	FW vers.
–50 dB to +90 dB	External output attenuation	0.0	dB	V3.50
Command description				
This command assigns an external attenuation value to the outputs of the instrument. An external attenuation of x dB increases the RF generator level (`SOURce:MSIGnal[:TX]:LEVel`) by x dB.				

CONFigure:AFRFsync:CCONfig*<Scenario>*				Connector Configuration
<Scenario>	Value range	Def. value	Def. unit	FW vers.
MONO | **ASTereo** | **DSTereo** | **MTESt** | **STESt** | **ALTest**	Analog Mono Audio Analog Stereo Audio Digital Stereo Audio Microphone Test Earphone / Speaker Test Audio Link Test	MONO	–	V4.60 V5.00
Description of command				
This command selects the AF connector configuration and thus the audio test scenario.				

Subsystem LEVel (Input Level)

The subsystem *LEVel* controls the level in the RF input signal path. It corresponds to the *Analyzer* tab in the popup menu *Connection Control*.

[SENSe:]LEVel:MODE *<Mode>*				Input level – Mode
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
MANual | **AUTomatic**	Manual entry of maximum input level Automatic setting corresponding to peak power of received bursts	MAN AUT	-	V4.35 V4.40
Description of command				
This command configures the RF analyzer for manual or automatic input path setting. In firmware versions <V4.40, the def. value is MANual.				

[SENSe:]LEVel:MAXimum *<Level>*				Max. Level
<Level>	Description of parameters	Def. value	Def. unit	FW vers.
–40 dBm to +26 dBm	Max. RF input level	+5.0	dBm	V3.50
Description of command				Sig. State
This command defines the expected maximum RF input level and sets the input measurement path accordingly. The value range depends on the external attenuation.				all

DEFault:LEVel				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V3.50
Description of command				Sig. State
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting OFF results in an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				all

Subsystem TRIGger (Trigger Mode)

The subsystem *TRIGger* defines the trigger mode. It corresponds to the *Trigger* tab in the popup menu *Connection Control.*

TRIGger[:SEQuence]:SOURce *<Source>*				Source
<Source>	Description of parameters	Def. value	Def. unit	FW vers.
SIGNalling | **POWer**	The measurement is triggered by the signalling unit Trigger by RF input signal level (`TRIG:SEQ:THR`)	SIGN	–	V3.50
Description of command				Sig. State
This command determines the source of the trigger event for the measurements.				all

TRIGger[:SEQuence]:THReshold *<Threshold>*				Level
<Threshold>	Description of parameters	Def. value	Def. unit	FW vers.
LOW | **HIGH**	Low trigger threshold *(RF Max. Level* – 40 dB) High trigger threshold *(RF Max. Level* – 20 dB)	LOW	–	V3.50
Description of command				Sig. State
This command sets the RF input signal level at which the measurement is triggered relative to the maximum RF input level; see `[SENSe:]LEVel:MAXimum`. The setting takes effect for trigger source `POWer` only (see `TRIG:SEQ:SOUR`).				all

DEFault:TRIGger[:SEQuence]				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V3.50
Description of command				Sig. State
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting OFF results in an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				all

SINFo (Signalling information)

The subsystem *SINFo* contains the commands for requesting the characteristics of the device under test. The subsystem corresponds to the *Signalling Info* output table in the menu *Bluetooth Connection Control (Connected).* The device characteristics do not actually represent a measured value, the values are provided by the device under test when a connection is established.

Note: *To speed up the connection it is possible to prevent the R&S® CBT from inquiring the DUT's properties (see command CONFigure:MSIGnal:PAGing:RSINfo). In this case some of the signalling information retrieved with the `SINFo` commands is not available.*

[SENSe:]SINFo:NAME?				Device Name
<Name>	Description of parameters	Def. value	Def. unit	FW vers.
<string>	Device name string, up to 255 characters	–""	–	V3.50
Description of command				Sig. State
This command is always a query. It returns a textual description of the DUT's name. *) Valid results are available when a connection is established, i.e. in the CONN, TEST, AUD, SNIF and HOLD states. This holds for all `...SINFo...` commands described in this section.				~CONN*)

[SENSe:]SINFo:VERSion? *<LMP>, <Company>, <Device>*				Version
<LMP>	Description of parameters	Def. value	Def. unit	
0 | 1,	LMP version according to Bluetooth spec., 1.0 or 1.1*)	NAN	–	
<Company>	Description of parameters	Def. value	Def. unit	
0 to 65535,	Company ID number, corresponding to a textual description (e.g. 0 = Ericsson; 1 = Nokia; 2 = Intel; 3= IBM; 4 = Toshiba)	NAN	–	
<Device>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 65535	Device version; company internal version number	NAN	–	V3.50
Description of command				Sig. State
This command is always a query. It returns the device's version and a code number for the manufacturer. *) Numbers 0 to 65535 are reserved. At present 0 or 1 are the only possible output values.				~CONN

[SENSe:]SINFo:COMPany? *<Company>*				Company Name
<Company>	Description of parameters	Def. value	Def. unit	
"<name>"	Company name, returned as a text string, e.g. "Rohde & Schwarz GmbH & Co. KG	"---"	–	V3.85
Description of command				Sig. State
This command is always a query. It returns the company name of the device's manufacturer.				~CONN

[SENSe:]SINFo:BDADdress?				BD_Address
<BD_Address>	Description of parameters	Def. value	Def. unit	FW vers.
	BD address of the device under test; 12 digit hex value, returned as:			V3.50
<6-digit hex value>,	Lower address part (LAP)	–,	–	
<2-digit hex value>,	Non-specific address part (NAP)	–,	–	
<4-digit hex value>,	Upper address part (UAP)	–	–	
Description of command				Sig. State
This command is always a query. It returns the BD address of the device under test. The three address parts are preceded by #H to indicate the hex format.				~CONN

[SENSe:]SINFo:CLASs:SERVice? Class of Device, Service Class

<table>
<tr><th>Returned Value</th><th>Description of parameters</th><th>Def. value</th><th>Def. unit</th><th>FW vers.</th></tr>
<tr><td>"<Service_Class1>" | "",
"<Service_Class2>" | "", ...</td><td>Identifier for service class or "", if service class is not supported</td><td>–"","", ...</td><td>–</td><td>V3.50</td></tr>
</table>

Description of command	Sig. State
This command is always a query. It returns a list of the *Service Class* services supported by the device under test. For a Bluetooth device that supports all services the list will read: "Limited Discoverable Mode","Networking","Rendering","Capturing","Object Transfer","Audio","Telephony","Information" If a service is not supported, the corresponding entry in the list is replaced by "".	~CONN

[SENSe:]SINFo:CLASs? Class of Device

Returned Values	Description of parameters	Def. value	Def. unit	FW vers.
<MajorDC>,	Major device class	–	–	V3.50
<MinorDC>	Minor device class	–	–	

Description of command	Sig. State
This command is always a query. It returns the major and the minor device class of the DUT.	~CONN

For the major device class <MajorDC>, which descibes the type of the DUT, one of the follwing values is returned:

MISC	Miscellaneous	*AUD*	Audio
COMP	Computer	*PERI*	Peripheral
PHON	Phone	*UNCL*	Unclassified
LAN	LAN Access Point		

For the minor device class <MinorDC>, which details the type of the DUT depending on the corresponding major device class (see Chapter 4), one of the follwing values is returned:

UNCL	Unclassified	*FULL*	LAN — Fully available
DESK	Computer — Desktop workstation	*U17*	LAN — 1-17% utilized
SERV	Computer — Server-class computer	*U33*	LAN — 17-33% utilized
HAND	Computer — Handheld PC/PDA	*U50*	LAN — 33-50% utilized
PAL	Computer — Pal sized PC/PDA	*U67*	LAN — 50-67% utilized
CELL	Phone — Cellular	*U83*	LAN — 67-83% utilized
CORD	Phone — Cordless	*U99*	LAN — 83-99% utilized
SMAR	Phone — Smart phone	*HEAD*	Audio — Device conforms to headset profile
WIRE	Phone — Wired modem		

[SENSe:]SINFo:PAGing? *<Mode>, <Period>, <Repetition>*				Page Scan Mode, Period and Repetition
<Mode>	Description of parameters	Def. value	Def. unit	
MAND | **OPT1** | **OPT2** | **OPT3,**	Page scan mode *Mandatory* Page scan mode *Optional 1* Page scan mode *Optional 2* Page scan mode *Optional 3*	–	–	
<Period>	Description of parameters	Def. value	Def. unit	
P0 | **P1** | **P2,**	Scan Period P0 Scan Period P1 Scan Period P2	–	–	
<Repetition>	Description of parameters	Def. value	Def. unit	FW vers.
R0 | **R1** | **R2**	Scan Repetition R0 Scan Repetition R1 Scan Repetition R2	–	–	V3.50
Description of command				Sig. State
This command is always a query. It returns settings of the DUT's paging properties.				~CONN

[SENSe:]SINFo:FEATure:MS3S?				3-Slot Packets
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported The feature is not supported	–	–	V3.50
Description of command				Sig. State
This command is always a query. It returns whether or not the feature "3 slot packets" is supported by the DUT.				~CONN

[SENSe:]SINFo:FEATure:MS5S?				5-Slot Packets
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported The feature is not supported	–	–	V3.50
Description of command				Sig. State
This command is always a query. It returns whether or not the feature "5 slot packets" is supported by the DUT.				~CONN

[SENSe:]SINFo:FEATure:ENCRyption?				Encryption
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported The feature is not supported	–	–	V3.50
Description of command				Sig. State
This command is always a query. It returns whether or not the feature "Encryption" is supported by the DUT.				~CONN

[SENSe:]SINFo:FEATure:SOFFset?				Slot Offset
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported The feature is not supported	–	–	V3.50
Description of command				Sig. State
This command is always a query. It returns whether or not the feature "Slot offset" is supported by the DUT.				~CONN

[SENSe:]SINFo:FEATure:TACCuracy?	Timing Accuracy			
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported The feature is not supported	–	–	V3.50
Description of command				Sig. State
This command is always a query. It returns whether or not the feature “Timing accuracy” is supported by the DUT.				~CONN

[SENSe:]SINFo:FEATure:SWITch?	Switch			
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported The feature is not supported	–	–	V3.50
Description of command				Sig. State
This command is always a query. It returns whether or not the feature “Switching between master and slave” is supported by the DUT.				~CONN

[SENSe:]SINFo:FEATure:HOLD?	Hold Mode			
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported The feature is not supported	–	–	V3.50
Description of command				Sig. State
This command is always a query. It returns whether or not the feature “Hold mode” is supported by the DUT.				~CONN

[SENSe:]SINFo:FEATure:SNIFf?	Sniff Mode			
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported The feature is not supported	–	–	V3.50
Description of command				Sig. State
This command is always a query. It returns whether or not the feature “Sniff mode” is supported by the DUT.				~CONN

[SENSe:]SINFo:FEATure:PARK?	Park Mode			
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported The feature is not supported	–	–	V3.50
Description of command				Sig. State
This command is always a query. It returns whether or not the feature “Park mode” is supported by the DUT.				~CONN

[SENSe:]SINFo:FEATure:RSSI?	RSSI			
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported The feature is not supported	–	–	V3.50
Description of command				Sig. State
This command is always a query. It returns whether or not the feature “RSSI” is supported by the DUT.				~CONN

[SENSe:]SINFo:FEATure:PCONtrol?				Power Control
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported The feature is not supported	–	–	V3.50
Description of command				Sig. State
This command is always a query. It returns whether or not the feature “Power control” is supported by the DUT.				~CONN

[SENSe:]SINFo:FEATure:CQDD?				Channel Quality Driven Data Rate
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported The feature is not supported	–	–	V3.50
Description of command				Sig. State
This command is always a query. It returns whether or not the feature “Channel quality driven data rate” is supported by the DUT.				~CONN

[SENSe:]SINFo:FEATure:SCOLink?				SCO Link
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported The feature is not supported	–	–	V3.50
Description of command				Sig. State
This command is always a query. It returns whether or not the feature “SCO link” is supported by the DUT.				~CONN

[SENSe:]SINFo:FEATure:HV2P?				HV2 packets
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported The feature is not supported	–	–	V3.50
Description of command				Sig. State
This command is always a query. It returns whether or not the feature “HV2 packets” is supported by the DUT.				~CONN

[SENSe:]SINFo:FEATure:HV3P?				HV3 Packets
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported The feature is not supported	–	–	V3.50
Description of command				Sig. State
This command is always a query. It returns whether or not the feature “HV3 packets” is supported by the DUT.				~CONN

[SENSe:]SINFo:FEATure:ULAW?				μ-law log
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported The feature is not supported	–	–	V3.50
Description of command				Sig. State
This command is always a query. It returns whether or not the feature “μ-law log” is supported by the DUT.				~CONN

[SENSe:]SINFo:FEATure:ALAW?				A-law log
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported The feature is not supported	–	–	V3.50
Description of command				Sig. State
This command is always a query. It returns whether or not the feature "A-law log" is supported by the DUT.				~CONN

[SENSe:]SINFo:FEATure:CVSD?				CVSD
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported The feature is not supported	–	–	V3.50
Description of command				Sig. State
This command is always a query. It returns whether or not the feature "CVSD" is supported by the DUT.				~CONN

[SENSe:]SINFo:FEATure:PSCHeme?				Paging Scheme
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported The feature is not supported	–	–	V3.50
Description of command				Sig. State
This command is always a query. It returns whether or not the feature "Optional paging scheme" is supported by the DUT.				~CONN

[SENSe:]SINFo:FEATure:TSData?				Transparent SCO Data
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported The feature is not supported	–	–	V3.50
Description of command				Sig. State
This command is always a query. It returns whether or not the feature "Transparent SCO Data" is supported by the DUT.				~CONN

[SENSe:]SINFo:FEATure:FCLag?				Flow Control Lag
<State>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 7	Flow control lag (3 bit value)	–	–	V3.50
Description of command				Sig. State
This command is always a query. It returns the 3 "Flow Control Lag" bits in decimal representation.				~CONN

[SENSe:]SINFo:FEATure:PSCHeme?				Paging Scheme
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported The feature is not supported	–	–	V3.50
Description of command				Sig. State
This command is always a query. It returns whether or not the feature "Optional paging scheme" is supported by the DUT.				~CONN

[SENSe:]SINFo:FEATure:EA2Mbps?				EDR ACL 2 Mbps
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported The feature is not supported	–	–	V3.60
Description of command				Sig. State
This command is always a query. It returns whether or not the feature "EDR ACL 2 Mbps" is supported by the DUT.				~CONN

[SENSe:]SINFo:FEATure:EA3Mbps?				EDR ACL 3 Mbps
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported The feature is not supported	–	–	V3.60
Description of command				Sig. State
This command is always a query. It returns whether or not the feature "EDR ACL 3 Mbps" is supported by the DUT.				~CONN

[SENSe:]SINFo:FEATure:EA3Slot?				3-slot EDR ACL Packets
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported The feature is not supported	–	–	V3.60
Description of command				Sig. State
This command is always a query. It returns whether or not the feature "3-slot EDR ACL Packets" is supported by the DUT.				~CONN

[SENSe:]SINFo:FEATure:EA5Slot?				5-slot EDR ACL Packets
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported The feature is not supported	–	–	V3.60
Description of command				Sig. State
This command is always a query. It returns whether or not the feature "5-slot EDR ACL Packets" is supported by the DUT.				~CONN

[SENSe:]SINFo:FEATure:LFRequest?				All DUT Features
Response	Description of parameters	Def. value	Def. unit	FW vers.
0 to 255, **...,** **0 to 255**	Byte 0 in decimal representation ... Byte 7 in decimal representation	–	–	V3.50
Description of command				Sig. State
This command is always a query. It returns the complete feature list of the DUT according to the Bluetooth specification.				~CONN

[SENSe:]SINFo:FEATure:EA2Mbps?				EDR ACL 2 Mbps
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported The feature is not supported	–	–	V3.85
Description of command				Sig. State
This command is always a query. It returns whether or not the DUT supports the Enhanced Data Rate ACL 2Mbps mode.				~CONN

[SENSe:]SINFo:FEATure:EA3Mbps?				EDR ACL 3 Mbps
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported The feature is not supported	–	–	V3.85
Description of command				Sig. State
This command is always a query. It returns whether or not the DUT supports the Enhanced Data Rate ACL 3Mbps mode.				~CONN

[SENSe:]SINFo:FEATure:EA3Slot?				3-Slot EDR ACL Packets
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported The feature is not supported	–	–	V3.85
Description of command				Sig. State
This command is always a query. It returns whether or not the DUT supports 3-slot Enhanced Data Rate ACL packets.				~CONN

[SENSe:]SINFo:FEATure:EA5Slot?				5-Slot EDR ACL Packets
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported The feature is not supported	–	–	V3.85
Description of command				Sig. State
This command is always a query. It returns whether or not the DUT supports 5-slot Enhanced Data Rate ACL packets.				~CONN

Display of Profile Info

The following commands retrieve the *Profile Info* from the connected Bluetooth® DUT. The information is available while the R&S CBT is in *A2DP (Sink) Profile* submode; otherwise all commands return `INV` values.

[SENSe:]PROFile:A2DP:S16K? **[SENSe:]PROFile:A2DP:S32K?** **[SENSe:]PROFile:A2DP:S44K?** **[SENSe:]PROFile:A2DP:S48K?**				Sampling Frequency: 16 kHz 32 kHz 44.1 kHz 48 kHz
Response	Value range	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported | not supported	–	–	V5.00
Description of command				Sig. State
These commands are always queries. They return whether or not the connected DUT supports different sampling frequencies.				SINK

[SENSe:]PROFile:A2DP:CMMN? **[SENSe:]PROFile:A2DP:CMDL?** **[SENSe:]PROFile:A2DP:CMST?** **[SENSe:]PROFile:A2DP:CMJS?**				Channel Mode: Mono Dual Stereo Joint Stereo
Response	Value range	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported | not supported	–	–	V5.00
Description of command				Sig. State
These commands are always queries. They return whether or not the connected DUT supports different channel modes.				SINK

[SENSe:]PROFile:A2DP:B04B? **[SENSe:]PROFile:A2DP:B08B?** **[SENSe:]PROFile:A2DP:B12B?** **[SENSe:]PROFile:A2DP:B16B?**				Block Length: 4 Blocks 8 Blocks 12 Blocks 16 Blocks
Response	Value range	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported | not supported	–	–	V5.00
Description of command				Sig. State
These commands are always queries. They return whether or not the connected DUT supports different block lengths.				SINK

[SENSe:]PROFile:A2DP:SB4B? **[SENSe:]PROFile:A2DP:SB8B?**				Sub Bands: 4 Bands 8 Bands
Response	Value range	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported | not supported	–	–	V5.00
Description of command				Sig. State
These commands are always queries. They return whether or not the connected DUT supports different sub bands.				SINK

[SENSe:]PROFile:A2DP:ASNR? **[SENSe:]PROFile:A2DP:ALDS?**				Allocation Method: SNR Loudness
Response	Value range	Def. value	Def. unit	FW vers.
ON | **OFF**	The feature is supported | not supported	–	–	V5.00
Description of command				Sig. State
These commands are always queries. They return whether or not the connected DUT supports different allocation methods.				SINK

[SENSe:]PROFile:A2DP:BITPool:MINimum?				Minimum Bitpool
Response	Value range	Def. value	Def. unit	FW vers.
2 to 18	Minimum bitpool value used by the DUT	–	–	V5.00
Description of command				Sig. State
This commands is always a query. It returns the minimum bitpool value reported by the DUT.				SINK

[SENSe:]PROFile:A2DP:BITPool:MAXimum?				Maximum Bitpool
Response	Value range	Def. value	Def. unit	FW vers.
2 to 128	Maximum bitpool value used by the DUT	–	–	V5.00
Description of command				Sig. State
This commands is always a query. It returns the maximum bitpool value reported by the DUT.				SINK

ACLData (Exchange of Raw Data with the DUT)

The subsystem *ACLData* contains the commands for exchanging data between the R&S® CBT and the DUT using an ACL connection. The data stream may consist of user or control data, e.g. of audio data or HCI commands to be executed on the DUT. The subsystem has no equivalent in manual control.

Note 1: *Starting with firmware version V5.00, ACL data transfer via `SOURce:ACLData` or `[SENSe:]ACLData` must be enabled explicity using `SOURce:ACLData:ENABle`.*

In older firmware versions, the data transfer via `...:ACLData` is automatically enabled until an audio profile is active. With an active audio profile, any incoming ACL data is sent to the profile.

Note 2: *The `ACLData` commands require the R&S® CBT to have a “normal” ACL connection established (signalling state CONN; no data transfer is possible in the substates TEST, AUDio, SNIFf, HOLD, PARK). The instrument uses the HCI ACL data packet header information of the current connection (4 hex bytes to encode the 12-bit connection handle, 2-bit PB flag and 2-bit BC flag) and appends the user data.*

Example: `PROC:SIGNall:ACT PAGE` *Request a connection with the DUT*
`SOUR:ACLD "0800100020030400010040000"` *Send data to the DUT.*
If the current HCI header is “00200C00”, then the first data packet transferred reads
`00200C00080010002003…`

SOURce:ACLData:ENABle *<State>*				Enable ACL Data Transfer
<State>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Enable ACL data transfer via `...:ACLData` Disable ACL data transfer via `...:ACLData`	OFF	–	V5.00
Description of command				Sig. State
This command enables or disables the transfer of ACL data via `SOURce:ACLData` or `[SENSe:]ACLData`. With disabled ACL data transfer, incoming ACL data is routed to the audio profiles.				all

SOURce:ACLData *<Data>*				Send ACL Data
<Data>	Description of parameters	Def. value	Def. unit	FW vers.
"<string>"	Stream of hex bytes, e.g. "414243" is used to send "ABC", which is 65 66 67 decimal ASCII or 41 42 43 hex.	""	–	V3.50
Description of command				Sig. State
This command sends a stream of hex bytes to the DUT. The query returns the last data string sent to the DUT. The maximum size of the data string is 39 hex bytes (78 hexadecimal characters). The hex bytes take 2 characters and must not be separated by white space.				CONN

[SENSe:]ACLData?				Receive ACL Data
Return	Description of return valuess	Def. value	Def. unit	FW vers.
"<string>"	Stream of hex bytes	"– – –"	–	V3.50
Description of command				Sig. State
This command is always a query. It returns a stream of hex bytes received from the DUT. The maximum size of the data string is 39 hex bytes (78 hexadecimal characters).				CONN

POWer Measurements

The subsystem *POWer* covers the following power measurement applications:

- The *POWer:TIME* subsystem measures the DUT's output carrier power versus time. The subsystem corresponds to the measurement menu *Power* and the associated popup menu *Power Configuration.*
- The *POWer:MPR* subsystem measures the scalar *Power* and *Modulation* parameters simultaneously and has no equivalent in manual control.
- The *POWer:RELative* subsystem measures the relative power of the DPSK and GFSK modulated sections of EDR packets. This measurement is only available if software option CBT-K55 has been installed.
- The *POWer:MPE* subsystem controls the combined relative power and DPSK modulation measurement. This measurement is only available if software option CBT-K55 has been installed.

Note:

In order to perform any kind of measurement and obtain a meaningful result, an appropriate test setup is required (see application examples in Chapter 2 of this manual). Consequently, for the measurements reported in this and the following sections, the CONNected *signalling state must be reached before any of the commands retrieving test results* `(READ...?, FETCh...?,` *or* `CALCulate...LIMit?)` *can be used. Test configurations, however, can be defined any time.*

Subsystem POWer:TIME

The subsystem *POWer:TIME* measures the DUT's output carrier power versus time. The subsystem corresponds to the measurement menu *Power,* application *Output Power,* and the associated popup menu *Power Configuration.*

Measurement Control

The subsystem *POWer:TIME…* controls the power vs. time measurement. It corresponds to the softkey *Power/Time* in the measurement menu *Power* and the associated hotkeys.

INITiate:POWer:TIME	Start new measurement	⇒	*RUN*	
ABORt:POWer:TIME	Abort measurement and switch off	⇒	*OFF*	
STOP:POWer:TIME	Stop measurement after current stat. cycle	⇒	*STOP*	
CONTinue:POWer:TIME	Next meas. step (only *stepping mode*)	⇒	*RUN*	
Description of command			Sig. State	FW vers.
These commands have no query form. They start or stop the measurement, setting it to the status indicated in the top right column.			all	V3.50

CONFigure:POWer:TIME:EREPorting *<Mode>*				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC** | **SRSQ** | **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	V3.50
Description of command				Sig. State
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see Chapter 5).				all

FETCh[:SCALar]:POWer:TIME:STATus?				Measurement Status
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN** | **STOP** | **ERR** | **STEP** | **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V3.50
1 to 10000 | **NONE,**	Counter for current statistics cycle No counting mode set	NONE	–	
0 to 1000 | **NONE**	Counter for current evaluation period within a cycle Statistic count set to off	NONE	–	
Description of command				Sig. State
This command is always a query. It returns the status of the measurement (see Chapters 3 and 5).				all

CONFigure:POWer:TIME:MMODe *<Mode>*				Measurement Mode
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ALL | **SINGle** | **SIMultaneous**	Measure and aggregate all channels of the current hop scheme Measure bursts from a definite channel only Simultaneous measurement on the five channels selected with `CONFigure:POWer:TIME:MFRequency:SIMultaneous`.	ALL	–	V3.50
Description of command				Sig. State
This command sets how many channels are to measured and whether the results are to be kept separate or aggregated. In `ALL` mode, the measurement is performed on every available burst, no matter what frequency it is on. In `SINGle` mode, the R&S® CBT measures the channel selected via `CONFigure:POWer:TIME:MFRequency`. In `SIMultaneous` mode, the R&S® CBT acquires and returns five complete sets of results; see description of the `READ:...POWer...` and `FETCh:...POWer...` commands.				all

CONFigure:POWer:TIME:MFRequency:SIMultaneous *<Meas_Freq_1>,..., <Meas_Freq_5>*				Simult. Meas. – Measured Ch.
<Meas_Freq_1> to <Meas_Freq_5>	Description of parameters	Def. value	Def. unit	FW vers.
2 402 MHz to 2 495 MHz | OFF	Measured frequency Measurement switched off	see below	Hz	V3.50
Description of command				Sig. State
This command defines the five frequencies to be measured if the measurement mode is set to `SIMultaneous` (see command `CONFigure:POWer:TIME:MMODe`). With the command `CONFigure:POWer:TIME:MFRequency:UNIT`, the default frequency unit can be changed, and even *Bluetooth* channel numbers can be entered instead of frequencies. The default frequencies correspond to the channel sequence 0, 19, 39, 59, 78.				all

CONFigure:POWer:TIME:MFRequency *<Meas_Freq>*				Single Meas. – Measured Ch.
<Meas_Freq>	Description of parameters	Def. value	Def. unit	FW vers.
2 402 MHz to 2 495 MHz	Measured frequency	2 402 000 000	Hz	V3.50
Description of command				Sig. State
This command defines the frequency to be measured if the measurement mode is set to `SINGle` (see command `CONFigure:POWer:TIME:MMODe`). With the command `CONFigure:POWer:TIME:MFRequency:UNIT`, the default frequency unit can be changed, and even *Bluetooth* channel numbers can be entered instead of frequencies.				all

CONFigure:POWer:TIME:MFRequency:UNIT *<Unit>*				Frequency Unit
<Unit>	Description of parameters	Def. value	Def. unit	FW vers.
HZ | KHZ | MHZ | GHZ | CH	Frequency unit | Channel number	HZ	–	V3.50
Description of command				Sig. State
This command defines whether the measured frequency (see command `CONFigure:POWer:TIME:MFRequency)` is specified in frequency units or as an Bluetooth channel number.				all

CONFigure:POWer:TIME:MRANge *<Start>, <Span>*		Time Scale Start, Time Scale Span		
<Start>	Description of parameters	Def. value	Def. unit	
–200 bit to 3200 bit	Start of measurement range	–200	bit	
<Span>	Description of parameters	Def. value	Def. unit	FW vers.
0.0625 to 5	Span of measurement range	1	(slots)	V3.50
Description of command				Sig. State
This command defines the measurement range for the `POWer:TIME` measurement. The second input value *<Span>* is rounded to one of the following discrete values: 0.0625 (1/16 slot) 0.125 (1/8 slot) 0.25 (1/4 slot) 0.5 (1/2 slot) 1 (slot) 2 (slots) 3 (slots) 4 (slots) 5 (slots) 2- and 3-slot spans can not be set for 1-slot packets, 4- and 5-slot spans can not be set for 1- and 3-slot packets.				all

The number of test points in the `POWer` measurement (i.e. the length of the arrays output via the `READ:ARRay:POWer:TIME...` commands) follows from the span, rounded again to correspond to an integer number of bits, and the sampling rate of the measurement. The latter depends on the packet length; it is, at most, 4 test points per bit for one-slot packets (DH1, see commands `CONFigure:SSIGnal:TMODe:...PTYPe`), 2 test points per bit for three-slot packets and 1 test point per bit for five-slot packets. If necessary the sampling rate is reduced by an appropriate factor to prevent that the number of test points exceeds the upper limit of 2500 (i.e. for <span> of 2, 3, 4 and 5). This results in the following table:

<Span>	**0.0625**	**0.125**	**0.25**	**0.5**
Symbols	**39**	**78**	**156**	**312**
No. of test points:				
1 slot packet types	157	313	625	1249
3 slot packet types	49	157	313	625
5 slot packet types	40	79	157	313

<Span>	**1**	**2**	**3**	**4**	**5**
Symbols	**625**	**1250**	**1875**	**2500**	**3125**
No. of test points:					
1 slot packet types	2500	2500	2500	2500	2500
3 slot packet types	1251	2500	2500	2500	2500
5 slot packet types	626	1251	1876	2500	2500

Subsystem POWer:CONTrol

The subsystem *POWer:CONTrol* defines the repetition mode, statistic count, and stop condition of the measurement. These settings are provided in the *Control* tab of the popup menu *Power Configuration.*

CONFigure:POWer:TIME:CONTrol *<Mode>, <Statistics>, <Repetition>, <StopCond>, <Stepmode>*

Scope of Measurement

<Mode>	Desciption of parameters	Def. value	Def. unit	
SCALar | **ARRay,**	Scalar values only (incl. limit matching) Scalar measured values and arrays	ARRay	–	
<Statistics>	Description of parameters	Def. value	Def. unit	
1 to 1000 | **NONE**	Number of bursts per statistics cycle Statistics off	100	–	
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot** | **1 to 10000,**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCond>	Description of parameters	Def. value	Def. unit	
SONerror | **NONE,**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V3.50

Description of command	Sig. State
This command restricts the type of measured values to accelerate the measurement and determines the number of bursts within a statistics cycle. **Note:** In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot. The *Repetition* parameter is valid in remote control only. Changing this parameter in remote control does not alter the repetition mode in manual control and vice versa. The default repetition mode in manual control is *Continuous*.	all

CONFigure:POWer:TIME:CONTrol:RMODe *<Mode>* Result mode

<Mode>	Desciption of parameters	Def. value	Def. unit	FW vers.
SCALar | **ARRay**	Scalar values only (incl. limit matching) Scalar measured values and arrays available	ARRay	–	V3.50

Description of command	Sig. State
This command specifies the type of measured values. If the parameter `SCALar` is set, the measurement curves (arrays, see commands `READ:ARRay:POWer:TIME...`, `READ:SUBarray:POWer:TIME...)` are no longer available but the measurement is speeded up considerably.	all

CONFigure:POWer:TIME:CONTrol:STATistics *<Statistics>*				Statistics Count
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	Number of bursts per statistics cycle Statistics off	100	–	V3.50
Description of command				Sig. State
This command specifies the type of measured values and defines the number of bursts forming a statistics cycle.				all

CONFigure:POWer:TIME:CONTrol:REPetition *<Repetition>,<StopCond>,<Stepmode>*				Test Cycles
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot** | **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCondition>	Description of parameters	Def. value	Def. unit	
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V3.50
Description of command				Sig. State
This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement. **Note:** In the case of READ commands (`READ:`...), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot. The *Repetition* parameter is valid in remote control only. Changing this parameter in remote control does not alter the repetition mode in manual control and vice versa. The default repetition mode in manual control is *Continuous*.				all

DEFault:POWer:TIME:CONTrol				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values The parameters differ from the default values (partially or totally)	ON	–	V3.50
Description of command				Sig. State
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting OFF results in an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				all

Test Configuration

The commands of the following subsystems determine the parameters of the signal power measurement. They correspond to the *Power Configuration* popup menu.

Subsystem POWer...:LIMit

The subsystem *POWer...:LIMit* defines the limit values for the power measurement. The subsystem corresponds to the tab *Limits* in the popup menu *Power Configuration.*

CONFigure:POWer:TIME:CURRent:LIMit:SCALar:ASYMmetric:UPPer:VALue Upper Power Limits
CONFigure:POWer:TIME:AVERage:LIMit:SCALar:ASYMmetric:UPPer:VALue
CONFigure:POWer:TIME:MAXimum:LIMit:SCALar:ASYMmetric:UPPer:VALue
CONFigure:POWer:TIME:MINimum:LIMit:SCALar:ASYMmetric:UPPer:VALue
<Nom_Power>, <Leak_Power>, <Peak_Power>

Parameters	Description of parameters	Def. value	Def. unit	FW vers.
–10 dBm to +30 dBm,	Upper limit for nominal power	+4.0	dBm	V3.50
–120 dBm to 0 dBm	Upper limit for leakage power	–40 *)	dBm	
–10 dBm to +30 dBm	Upper limit for peak power	+23.0	dBm	

Description of command	Sig. State
These commands define upper limits for the nominal, leakage and peak power of the current `(CURRent)`, average `(AVERage)`, minimum `(MINimum)`, and maximum `(MAXimum)` measurement curve, respectively. If a measurement rises above the limit then the result will be out of tolerance. OFF means that the limit check is disabled. *) By default the limit check is effectively disabled.	all

Upper Limits on or off
CONFigure:POWer:TIME:CURRent:LIMit:SCALar:ASYMmetric:UPPer:ENABle *<Mode>*
CONFigure:POWer:TIME:AVERage:LIMit:SCALar:ASYMmetric:UPPer:ENABle *<Mode>*
CONFigure:POWer:TIME:MAXimum:LIMit:SCALar:ASYMmetric:UPPer:ENABle *<Mode>*
CONFigure:POWer:TIME:MINimum:LIMit:SCALar:ASYMmetric:UPPer:ENABle *<Mode>*

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF,	Enable/disable upper limit check for nominal power	ON	–	V3.50
ON | OFF,	Enable/disable upper imit check for leakage power	OFF	–	
ON | OFF	Enable/disable upper limit check for peak power	ON	–	

Description of command	Sig. State
These commands enable or disable the upper limit check for the nominal, leakage and peak power.	all

CONFigure:POWer:TIME:CURRent:LIMit:SCALar:ASYMmetric:LOWer:VALue Lower Power Limits
CONFigure:POWer:TIME:AVERage:LIMit:SCALar:ASYMmetric:LOWer:VALue
CONFigure:POWer:TIME:MAXimum:LIMit:SCALar:ASYMmetric:LOWer:VALue
CONFigure:POWer:TIME:MINimum:LIMit:SCALar:ASYMmetric:LOWer:VALue
<Nom_Power>, <Leak_Power>, <Peak_Power>

<Limit>	Description of parameters	Def. value	Def. unit	FW vers.
–10 dBm to +30 dBm,	Lower limit for nominal power	–6.0	dBm	V3.50
–120 dBm to 0 dBm,	Lower limit for leakage power	–120 *)	dBm	
–10 dBm to +30 dBm	Lower limit for peak power	–5 *)	dBm	

Description of command	Sig. State
These commands define lower limits for the nominal, leakage and peak power of the current `(CURRent)`, average `(AVERage)`, minimum `(MINimum)`, and maximum `(MAXimum)` measurement curve, respectively. If a measurement falls below the limit then the result will be out of tolerance. OFF means that the limit check is disabled. *) By default the limit check is effectively disabled.	all

CONFigure:POWer:TIME:CURRent:LIMit:SCALar:ASYMmetric:LOWer:ENABle *<Mode>*
CONFigure:POWer:TIME:AVERage:LIMit:SCALar:ASYMmetric:LOWer:ENABle *<Mode>*
CONFigure:POWer:TIME:MAXimum:LIMit:SCALar:ASYMmetric:LOWer:ENABle *<Mode>*
CONFigure:POWer:TIME:MINimum:LIMit:SCALar:ASYMmetric:LOWer:ENABle *<Mode>*

Lower Limits on or off

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF,**	Enable/disable lower limit check for nominal power	ON	–	V3.50
ON | **OFF,**	Enable/disable lower limit check for leakage power	OFF	–	
ON | **OFF**	Enable/disable lower limit check for peak power	OFF	–	

Description of command	Sig. State
These commands enable or disable the lower limit check for the nominal, leakage and peak power.	all

CONFigure:POWer:TIME:CURRent:LIMit:SCALar:ASYMmetric[:COMBined]:VALue *<Limit>*
CONFigure:POWer:TIME:AVERage:LIMit:SCALar:ASYMmetric[:COMBined]:VALue *<Limit>*
CONFigure:POWer:TIME:MAXimum:LIMit:SCALar:ASYMmetric[:COMBined]:VALue *<Limit>*
CONFigure:POWer:TIME:MINimum:LIMit:SCALar:ASYMmetric[:COMBined]:VALue *<Limit>*
<Nom_Power_Upp>, <Nom_Power_Low>, <Leak_Power_Upp>,
<Leak_Power_Low>, <Peak_Power_Upp>, <Peak_Power_Low> Upper and Lower Power Limits

<Limit>	Description of parameters	Def. value	Def. unit	FW vers.
–10 dBm to +30 dBm,	Upper limit for nominal power	+4.0	dBm	V3.50
–120 dBm to 0 dBm,	Lower limit for nominal power	–6.0	dBm	
–10 dBm to +30 dBm,	Upper limit for leakage power	–40 *)	dBm	
–10 dBm to +30 dBm,	Lower limit for leakage power	–120 *)	dBm	
–120 dBm to 0 dBm,	Upper limit for peak power	+23.0	dBm	
–10 dBm to +30 dBm	Lower limit for peak power	–5 *)	dBm	

Description of command	Sig. State
These commands define lower limits for the nominal, leakage and peak power of the current `(CURRent)`, average `(AVERage)`, minimum `(MINimum)`, and maximum `(MAXimum)` measurement curve, respectively. OFF means that the limit check is disabled. *) By default the limit check is effectively disabled.	all

CONFigure:POWer:TIME:CURRent:LIMit:SCALar:ASYMmetric[:COMBined]:ENABle *<Mode>*
CONFigure:POWer:TIME:AVERage:LIMit:SCALar:ASYMmetric[:COMBined]:ENABle *<Mode>*
CONFigure:POWer:TIME:MAXimum:LIMit:SCALar:ASYMmetric[:COMBined]:ENABle *<Mode>*
CONFigure:POWer:TIME:MINimum:LIMit:SCALar:ASYMmetric[:COMBined]:ENABle *<Mode>*

Upper and Lower Limits on or off

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF,**	Enable or disable upper limit check for nominal power	ON	–	V3.50
ON | **OFF,**	Enable or disable lower limit check for nominal power	ON	–	
ON | **OFF,**	Enable or disable upper limit check for leakage power	OFF	–	
ON | **OFF,**	Enable or disable lower limit check for leakage power	OFF	–	
ON | **OFF,**	Enable or disable upper limit check for peak power	ON	–	
ON | **OFF**	Enable or disable lower limit check for peak power	ON	–	

Description of command	Sig. State
These commands enable or disable the upper and lower limit check for the nominal, leakage and peak power.	all

CONFigure:POWer:TIME:PTIMing:CURRent:LIMit:SCALar:ASYMmetric:UPPer:VALue *<Limit>*
CONFigure:POWer:TIME:PTIMing:AVERage:LIMit:SCALar:ASYMmetric:UPPer:VALue *<Limit>*
CONFigure:POWer:TIME:PTIMing:MAXimum:LIMit:SCALar:ASYMmetric:UPPer:VALue *<Limit>*
CONFigure:POWer:TIME:PTIMing:MINimum:LIMit:SCALar:ASYMmetric:UPPer:VALue *<Limit>*

Upper Limits for Packet Timing

<Limit>	Description of parameters	Def. value	Def. unit	FW vers.
–15 µs to 15 µs	Upper limit for packet timing	+10*)	µs	V3.50

Description of command	Sig. State
These commands define upper limits for the packet timing of the current `(CURRent)`, average `(AVERage)`, minimum `(MINimum)`, and maximum `(MAXimum)` measurement curve, respectively. If a measurement rises above the limit then the result will be out of tolerance. OFF means that the limit check is disabled. *) By default the limit check is effectively disabled.	all

CONFigure:POWer:TIME:PTIMing:CURRent:LIMit:SCALar:ASYMmetric:UPPer:ENABle *<Mode>*
CONFigure:POWer:TIME:PTIMing:AVERage:LIMit:SCALar:ASYMmetric:UPPer:ENABle *<Mode>*
CONFigure:POWer:TIME:PTIMing:MAXimum:LIMit:SCALar:ASYMmetric:UPPer:ENABle *<Mode>*
CONFigure:POWer:TIME:PTIMing:MINimum:LIMit:SCALar:ASYMmetric:UPPer:ENABle *<Mode>*

Upper Limits on or off

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Enable or disable the upper limit check	OFF	–	V3.50

Description of command	Sig. State
These commands enable or disable the upper limit check for the packet timing.	all

CONFigure:POWer:TIME:PTIMing:CURRent:LIMit:SCALar:ASYMmetric:LOWer:VALue *<Limit>*
CONFigure:POWer:TIME:PTIMing:AVERage:LIMit:SCALar:ASYMmetric:LOWer:VALue *<Limit>*
CONFigure:POWer:TIME:PTIMing:MAXimum:LIMit:SCALar:ASYMmetric:LOWer:VALue *<Limit>*
CONFigure:POWer:TIME:PTIMing:MINimum:LIMit:SCALar:ASYMmetric:LOWer:VALue *<Limit>*

Lower Limits for Packet Timing

<Limit>	Description of parameters	Def. value	Def. unit	FW vers.
–15 µs to 15 µs	Lower limit for packet timing	–10*)	µs	V3.50

Description of command	Sig. State
These commands define lower limits for the packet timing of the current `(CURRent)`, average `(AVERage)`, minimum `(MINimum)`, and maximum `(MAXimum)` measurement curve, respectively. If a measurement falls below the limit then the result will be out of tolerance. OFF means that the limit check is disabled. *) By default the limit check is effectively disabled.	all

CONFigure:POWer:TIME:PTIMing:CURRent:LIMit:SCALar:ASYMmetric:LOWer:ENABle *<Mode>*
CONFigure:POWer:TIME:PTIMing:AVERage:LIMit:SCALar:ASYMmetric:LOWer:ENABle *<Mode>*
CONFigure:POWer:TIME:PTIMing:MAXimum:LIMit:SCALar:ASYMmetric:LOWer:ENABle *<Mode>*
CONFigure:POWer:TIME:PTIMing:MINimum:LIMit:SCALar:ASYMmetric:LOWer:ENABle *<Mode>*

Lower Limits on or off

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Enable or disable the entire limit check	OFF	–	V3.50

Description of command	Sig. State
These commands enable or disable the upper and lower limit check for the packet timing.	all

CONFigure:POWer:TIME:PTIMing:CURRent:LIMit:SCALar:ASYMmetric[:COMBined]:VALue
CONFigure:POWer:TIME:PTIMing:AVERage:LIMit:SCALar:ASYMmetric[:COMBined]:VALue
CONFigure:POWer:TIME:PTIMing:MAXimum:LIMit:SCALar:ASYMmetric[:COMBined]:VALue
CONFigure:POWer:TIME:PTIMing:MINimum:LIMit:SCALar:ASYMmetric[:COMBined]:VALue
<Upper>,<Lower> — Upper and Lower Limits for Packet Timing

Parameters	Description of parameters	Def. value	Def. unit	FW vers.
–15 µs to 15 µs, **–15 µs to 15 µs**	Upper limit for packet timing Lower limit for packet timing	+10*) –10*)	µs µs	V3.50

Description of command	Sig. State
These commands define upper and lower limits for the packet timing of the current `(CURRent)`, average `(AVERage)`, minimum `(MINimum)`, and maximum `(MAXimum)` measurement curve, respectively. OFF means that the limit check is disabled. *) By default the limit check is effectively disabled.	all

CONFigure:POWer:TIME:PTIMing:CURRent:LIMit:SCALar:ASYMmetric[:COMBined]:ENABle
CONFigure:POWer:TIME:PTIMing:AVERage:LIMit:SCALar:ASYMmetric[:COMBined]:ENABle
CONFigure:POWer:TIME:PTIMing:MAXimum:LIMit:SCALar:ASYMmetric[:COMBined]:ENABle
CONFigure:POWer:TIME:PTIMing:MINimum:LIMit:SCALar:ASYMmetric[:COMBined]:ENABle
<Mode> — Upper and Lower Limits on or off

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF,** **ON** | **OFF**	Enable or disable the upper limit check Enable or disable the lower limit check	OFF OFF	– –	V3.50

Description of command	Sig. State
These commands enable or disable the upper and lower limit check for the packet timing.	all

DEFault:POWer:TIME:LIMit — Default Settings

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values The parameters differ from the default values (partially or totally)	ON	–	V3.50

Description of command	Sig. State
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting OFF results in an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.	all

Subsystem SUBarrays:POWer:TIME

The subsystem *SUBarrays:POWer:TIME* defines the measurement range and the type of output values.

CONFigure:SUBarrays:POWer:TIME **<Mode>,<Start>,<Samples>{,<Start>,<Samples>}**		Definition of Subarrays		
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ALL | **ARIThmetical** | **MINimum** | **MAXimum** | **IVAL** | **XMAXimum** | **XMINimum** | **PAVG,**	Return all measurement values Return arithm. mean value in every subrange Return minimum value in every subrange Return maximum value in every subrange Return single interpolated value at <Start> Return x-axis value of maximum and maximum Return x-axis value of minimum and minimum Return arithmetic mean value in every subrange	ALL	–	V3.50 V5.00
<Start>	Description of parameters	Def. value	Def. unit	
–200 bit to 3200 bit,	Start time in current range	NAN	bit	
<Samples>	Description of parameters	Def. value	Def. unit	
1 to 2500	No. of samples in range	NAN 2500	–	
Description of command				Sig. State
This command configures the `READ:SUBarrays:POWer:TIME...`, `FETCh:SUBarrays:POWer:TIME...` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by a start time and the number of test points which are located on a fixed, equidistant grid. For <Mode> = IVAL, the <Samples> parameter is ignored and the R&S CBT returns a single measurement value corresponding to the abscissa value <Start>. If <Start> is located between two test points with valid results then the result is calculated from the results at these two adjacent test points by linear interpolation. The subranges may overlap but must be within the total range of the *POWer:TIME* measurement defined via `CONFigure:POWer:TIME:MRANge`. Test points outside this range are not measured (result *NAN)* and do not enter into the ARIThmetical, MINimum and MAXimum values. By default, only one range corresponding to the total measurement range is used and all measurement values are returned.				all

Measured Values

The commands in the following section determine and return the results of the power versus time measurement. They correspond to the graphical menu *Power* with its various display elements.

	Scalar results:
READ[:SCALar]:POWer:TIME?	Start single shot measurement and return results
FETCh[:SCALar]:POWer:TIME?	Read out measurement results (unsynchronized)

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–128 dBm to 30 dBm,	Nominal power for current meas. curve	NAN	dBm	V3.50
–128 dBm to 30 dBm,	Nominal power for average curve	NAN	dBm	
–128 dBm to 30 dBm,	Nominal power for minimum curve	NAN	dBm	
–128 dBm to 30 dBm,	Nominal power for maximum curve	NAN	dBm	
–128 dBm to 30 dBm,	Leakage power (x4)	NAN	dBm	
–128 dBm to 30 dBm,	Peak power (x4)	NAN	dBm	
–20 µs to 20 µs,	Packet timing (x4)	NAN	µs	
0% to 100%,	Burst out of tolerance (power)	NAN	%	
0% to 100%	Burst out of tolerance (packet timing)	NAN	%	

Description of commands	Sig. State
These commands are always queries. They start a measurement (`READ...`) and return all scalar measurement results. The symbol (x4) behind a value indicates that the list contains four results corresponding to the *Current,* the *Average,* the *Minimum,* and the *Maximum* measurement curve, respectively.	TEST, CONN

These commands are always queries. They start a measurement (`READ...`) and return all scalar measurement results. The symbol (x4) behind a value indicates that the list contains four results corresponding to the *Current,* the *Average,* the *Minimum,* and the *Maximum* measurement curve, respectively.

- `READ` starts a single shot measurement and returns the results.
- `FETCh` outputs the results without taking care of the measurement state.

The meaning and the number of the returned values depends on the measurement mode set via `CONFigure:POWer:TIME:MMODe`

- In the `ALL` mode, the R&S® CBT measures all channels and returns the average result.
- In `SINGle` mode, the R&S® CBT measures the channel selected via `CONFigure:POWer:TIME:MFRequency` and returns the corresponding result.
- In `SIMultaneous` mode, the R&S® CBT acquires and returns five complete sets of results corresponding to the five channels selected with `CONFigure:POWer:TIME:MFRequency:SIMultaneous`.. This means that the whole list described in the *Returned Values* column above is repeated five times.

For more details refer to the description of aggregated and separate channels in Chapter 4.

CALCulate[:SCALar]:POWer:TIME:MATChing:LIMit? Scalar Limit Matching

<Result>	Description of parameters	Def. value	Def. unit	FW vers.
Nominal Power (4x), **Leakage Power (4x),** **Peak Power (4x),** **Packet Timing (4x)**	For all measured values: NMAU | NMAL | INV | OK	INV INV INV INV	–	V3.50

Description of commands	Sig. State
This command is always a query. It indicates whether and in which way the permissible tolerances for the scalar measured values (see commands above) have been exceeded. The symbol (x4) behind a value indicates that the list contains four results corresponding to the *Current,* the *Average,* the *Minimum,* and the *Maximum* measurement curve, respectively. Possible values are: *NMAU* Result is above the limit *NMAL* Result is below the limit *INV* Result is invalid *OK* Result is valid The meaning and the number of the returned values depends on the measurement mode set via `CONFigure:POWer:TIME:MMODe`; see description of `READ...?, FETCh...?` commands above.	TEST, CONN

READ:ARRay:POWer:TIME:CURRent? Burst Power
READ:ARRay:POWer:TIME:AVERage?
READ:ARRay:POWer:TIME:MAXimum?
READ:ARRay:POWer:TIME:MINimum? Start single shot measurement and return results
FETCh:ARRay:POWer:TIME:CURRent?
FETCh:ARRay:POWer:TIME:AVERage?
FETCh:ARRay:POWer:TIME:MAXimum?
FETCh:ARRay:POWer:TIME:MINimum? Read measurement results (unsynchronized)

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–128.0 dB to + 30.0 dB	BurstPower[1], 1^{st} value for burst power	NAN	dB	V3.50
...	...	...	...	
–128.0 dB to + 30.0 dB	BurstPower[n], n^{th} value for burst power	NAN	dB	

Description of command	Sig. State
These commands are always queries. They return the burst power versus time at fixed, equidistant test points. The total number n of samples and their position on the time axis depends on the measurement range and the packet type. For an overview see command `CONFigure:POWer:TIME:MRANge`. The meaning of the returned values depends on the measurement mode set via `CONFigure:POWer:TIME:MMODe`: • In `ALL` mode, the R&S® CBT measures all available channels and returns the trace averaged over all these channels. • In `SINGle` mode, the R&S® CBT measures the channel selected via `CONFigure:POWer:TIME:MFRequency` and returns the corresponding trace. • In `SIMultaneous` mode, the R&S® CBT measures the channels selected with `CONFigure:POWer:TIME:MFRequency:SIMultaneous`.and returns the trace averaged over these channels. The calculation of *current, average, maximum* and *minimum* values is explained in Chapter 3 (*display mode*).	TEST, CONN

READ:SUBarrays:POWer:TIME:CURRent? **READ:SUBarrays:POWer:TIME:AVERage?** **READ:SUBarrays:POWer:TIME:MAXimum?** **READ:SUBarrays:POWer:TIME:MINimum?** **FETCh:SUBarrays:POWer:TIME:CURRent?** **FETCh:SUBarrays:POWer:TIME:AVERage?** **FETCh:SUBarrays:POWer:TIME:MAXimum?** **FETCh:SUBarrays:POWer:TIME:MINimum?**	Subarray Results Start single shot measurement and return results Read measurement results (unsynchronized)			
Ret. values per subrange	Description of parameters	Def. value	Def. unit	FW vers.
–128.0 dB... + 30.0 dB **...** **–128.0 dB... + 30.0 dB**	BurstPower[1], 1st value for burst power ... BurstPower[n], nth value for burst power	NAN ... NAN	dB ... dB	V3.50
Description of command				Sig. State
These commands are always queries. They output the burst power versus time in the subranges defined by means of the `CONFigure:SUBarrays:POWer:TIME` command. A valid subrange must be defined before the `READ:SUBarrays...`, `FETCh:SUBarrays...` command group can be used. The `CONFigure:SUBarrays:POWer:TIME` command defines a maximum of 32 subranges. If one of the statistical modes `(ARIThmetical, MINimum, MAXimum…)` is set, only one value is returned per subrange. The calculation of *current, average, minimum,* and *maximum* results is explained in Chapter 3 (see *display mode*).				TEST, CONN

POWer:MPR Measurement

The subsystem *POWer:MPR* combines the *MODulation* and *POWer* systems, i.e. it measures the scalar *Modulation* and *Power* parameters simultaneously. The subsystem contains all commands for measurement control and for the output of measurement results. Configurations such as limits must be defined separately in the *POWer:TIME* and *MODulation:DEViation* systems.

Due to the restriction to scalar results, the combined *POWer:MPR* measurement is quicker than the separate *POWer:TIME* and *MODulationDEViation* measurements and should be used whenever the measurement curves (arrays) are not needed. It corresponds to the *Modulation Power* measurement control softkey and the associated output fields in the *Overview* measurement menu.

Measurement Control

The commands in this section control the combined power and modulation measurement.

INITiate:POWer:MPR	Start new measurement		⇒ *RUN*
ABORt:POWer:MPR	Abort running measurement and switch off		⇒ *OFF*
STOP:POWer:MPR	Stop measurement after current stat. cycle		⇒ *STOP*
CONTinue:POWer:MPR	Next meas. step (only *stepping mode*)		⇒ *RUN*
Description of command		Sig. State	FW vers.
These commands have no query form. They start and stop the combined power and modulation measurement, setting it to the status indicated in the top right column.		all	V3.50

CONFigure:POWer:MPR:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC** | **SRSQ** | **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	V3.50
Description of command				Sig. State
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see Chapter 5).				all

FETCh:POWer:MPR:STATus?				Measurement Status
Return	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN** | **STOP** | **ERR** | **STEP** | **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V3.50
1 to 10000 | **NONE,**	Counter for current statistics cycle No counting mode set	NONE	–	
1 to 1000 | **NONE**	Counter for current evaluation period within a cycle Statistic count set to off	NONE	–	
Description of command				Sig. State
This command is always a query. It returns the status of the measurement (see Chapters 3 and 5).				all

CONFigure:POWer:MPR:MMODe *<Mode>*				Measurement Mode
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ALL | **SINGle** | **SIMultaneous**	Measure and aggregate all channels of the current hop scheme Measure bursts from a definite channel only Simultaneous measurement on the five channels selected with `CONFigure:POWer:MPR:MFRequency:SIMultaneous`.	ALL	–	V3.50
Description of command				Sig. State
This command sets how many channels are to measured and whether the results are to be kept separate or aggregated. In `ALL` mode, the measurement is performed on every available burst, no matter what frequency it is on. In `SINGle` mode, the R&S® CBT measures the channel selected via `CONFigure:POWer:MPR:MFRequency`. In `SIMultaneous` mode, the R&S® CBT takes and returns five complete sets of results; see description of the `READ:...POWer...`, `FETCh:...POWer...` commands.				all

CONFigure:POWer:MPR:MFRequency:SIMultaneous *<Meas_Freq_1>,..., <Meas_Freq_5>*				Simult. Meas. – Measured Ch.
<Meas_Freq_1> to <Meas_Freq_5>	Description of parameters	Def. value	Def. unit	FW vers.
2 402 MHz to 2 495 MHz | **OFF**	Measured frequency Measurement switched off	see below	Hz	V3.50
Description of command				Sig. State
This command defines the five frequencies to be measured if the measurement mode is set to `SIMultaneous` (see command `CONFigure:POWer:MPR:MMODe`). With the command `CONFigure:POWer:MPR:MFRequency:UNIT`, the default frequency unit can be changed, and even *Bluetooth* channel numbers can be entered instead of frequencies. The default frequencies correspond to the channel sequence 0, 19, 39, 59, 78.				all

CONFigure:POWer:MPR:MFRequency *<Meas_Freq>*				Display Frequency
<Meas_Freq>	Description of parameters	Def. value	Def. unit	FW vers.
2 402 MHz to 2 495 MHz	Measured frequency	2402 000 000	Hz	V3.50
Description of command				Sig. State
This command defines the frequency to be measured if the measurement mode is set to `SINGle` (see command `CONFigure:POWer:MPR:MMODe`). With the command `CONFigure:POWer:MPR:MFRequency:UNIT`, the default frequency unit can be changed, and even *Bluetooth* channel numbers can be entered instead of frequencies.				all

CONFigure:POWer:MPR:MFRequency:UNIT *<Unit>*				Frequency Unit
<Unit>	Description of parameters	Def. value	Def. unit	FW vers.
HZ | **KHZ** | **MHZ** | **GHZ** | **CH**	Frequency unit | Channel number	HZ	–	V3.50
Description of command				Sig. State
This command defines whether the measured frequency (see command `CONFigure:POWer:MPR:MFRequency)` is specified in frequency units or as an Bluetooth channel number.				all

CONFigure:POWer:MPR:FILTer:BWIDth <Width>				Filter Bandwidth
<Width>	Description of parameters	Def. value	Def. unit	FW vers.
WIDE | **NARR**	2 MHz bandwidth filter 1.3 MHz bandwidth filter	NARR	–	V3.85
Description of command				Sig. State
Selects the resolution bandwidth of the measurement filter used for POWer:MPR measurements.				all

Subsystem POWer:MPR:CONTrol

The subsystem *POWer:MPR:CONTrol* defines the repetition mode, statistic count, and stop condition of the measurement.

CONFigure:POWer:MPR:CONTrol:STATistics *<Statistics>*				Statistics Count
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	Number of bursts per statistics cycle Statistics off	100	–	V3.50
Description of command				Sig. State
This command specifies the type of measured values and defines the number of bursts forming a statistics cycle.				all

CONFigure:POWer:MPR:CONTrol:REPetition *<Repetition>,<StopCond>,<Stepmode>*				Test Cycles
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot** | **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCondition>	Description of parameters	Def. value	Def. unit	
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V3.50
Description of command				Sig. State
This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement. **Note:** In the case of READ commands (`READ:`...), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.				all

DEFault:POWer:MPR:CONTrol				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V3.50
Description of command				Sig. State
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting *OFF* has no effect). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				all

Measured Values

The following commands determine and return the results of the combined power and modulation measurement.

Scalar Results:

READ[:SCALar]:POWer:MPR? Start single shot measurement and return results

FETCh[:SCALar]:POWer:MPR? Read out measurement results (unsynchronized)

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–128 dBm to 30 dBm,	Nominal Power (x4)	NAN	dBm	V3.50
–128 dBm to 30 dBm,	Leakage Power (x4)	NAN	dBm	
–128 dBm to 30 dBm,	Peak Power (x4)	NAN	dBm	
–20 µs to 20 µs,	Packet Timing (x4)	NAN	µs	
–250 kHz to +250 kHz,	Frequency Accuracy (x4)	NAN	kHz	
–250 kHz to +250 kHz,	Frequency Drift (x4)	NAN	kHz	
–999 kHz/50 µs to 999 kHz/50 µs,	Maximum Drift Rate (x4)	NAN	kHz/50 µs	
0 kHz to 250 kHz	Average Frequency Deviation (x4)	NAN	kHz	
0 kHz to 250 kHz	Minimum Frequency Deviation (x4)	NAN	kHz	
0 kHz to 250 kHz	Maximum Frequency Deviation (x4)	NAN	kHz	
0% to 100%	Bursts out of Tolerance (Power)	NAN	%	
0% to 100%	Bursts out of Tolerance (Timing)	NAN	%	
0% to 100%	Bursts out of Tolerance (Modulation)	NAN	%	

Description of command	Sig. State
These commands are always queries. They start a combined power and modulation measurement and output all scalar measurement results. The symbol (x4) behind a value indicates that the list contains four results corresponding to the *Current,* the *Average,* the *Minimum,* and the *Maximum* measurement, respectively. • `READ` starts a single shot measurement and returns the results. • `FETCh` outputs the results without taking care of the measurement state. The meaning and the number of the returned values depends on the measurement mode set via `CONFigure:POWer:MPR:MMODe` • In the `ALL` mode, the R&S® CBT measures all channels and returns the average result. • In `SINGle` mode, the R&S® CBT measures the channel selected via `CONFigure:POWer:MPR:MFRequency` and returns the corresponding result. • In `SIMultaneous` mode, the R&S® CBT takes and returns five complete sets of results corresponding to the channel sequence 0, 23, 46, 69, 93. This means that the whole list described in the *Returned Values* column above is repeated five times. For more details refer to the description of aggregated and separate channels in Chapter 4.	TEST, CONN

CALCulate:POWer:MPR:MATChing:LIMit?				Limit Matching
Returned values	Value range	Def. value	Def. unit	FW vers.
Nominal power (x4), **Leakage power (x4),** **Peak power (x4),** **Packet timing (x4),** **Frequency Accuracy (x4),** **Frequency Drift (x4),** **Maximum Drift Rate (x4),** **Average Frequency Deviation (x4)** **Minimum Frequency Deviation (x4)** **Maximum Frequency Deviation (x4)**	For all measured values: NMAU | NMAL | INV | OK	INV INV INV INV INV INV INV INV	– – – – – – – –	V3.50
Description of command				Sig. State
This command is always a query. It indicates whether and in which way the permissible tolerances for the scalar results (see above command) in the *power vs time* and the *modulation* measurement have been exceeded. The following messages may be output for all values: NMAU Tolerance value underflow *not matching, underflow* NMAL Tolerance value exceeded *not matching, overflow* INV Measurement invalid *invalid* OK Tolerance value matched				TEST, CONN

Subsystem POWer:RELative

The commands in this section control the relative power measurement. They correspond to the measurement control softkey *Relative Power* in the measurement menu *Power* and the associated hotkeys. This measurement is only available if software option CBT-K55 has been installed.

INITiate:POWer:RELative	Start new measurement	⇒	*RUN*
ABORt:POWer:RELative	Abort measurement and switch off	⇒	*OFF*
STOP:POWer:RELative	Stop measurement after current stat. cycle	⇒	*STOP*
CONTinue:POWer:RELative	Next meas. step (only *stepping mode)*	⇒	*RUN*
Description of command		Sig. State	FW vers.
These commands have no query form. They start or stop the measurement, setting it to the status indicated in the top right column.		all	V3.85

CONFigure:POWer:RELative:EREPorting <Mode>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC** | **SRSQ** | **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	V3.85
Description of command				Sig. State
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see Chapter 5).				all

FETCh[:SCALar]:POWer:RELative:STATus?				Measurement Status
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN** | **STOP** | **ERR** | **STEP** | **RDY,**	Measurement in the *OFF* state (*RST or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (STOP) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V3.85
1 to 10000 | **NONE,**	Counter for current statistics cycle No counting mode set	NONE	–	
0 to 1000 | **NONE**	Counter for current evaluation period within a cycle Statistic count set to off	NONE	–	
Description of command				Sig. State
This command is always a query. It returns the status of the measurement (see Chapters 3 and 5).				all

CONFigure:POWer:RELative:MMODe *<Mode>* Measurement Mode

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ALL | **SINGle** | **SIMultaneous**	Measure and aggregate all channels of the current hop scheme Measure bursts from a definite channel only Simultaneous measurement on the five channels selected with `CONFigure:POWer:RELative:MFRequency:SIMultaneous`.	ALL	–	V3.85

Description of command	Sig. State
This command sets how many channels are to be measured and whether the results are to be kept separate or aggregated. In `ALL` mode, the measurement is performed on every available burst, no matter what frequency it is on. In `SINGle` mode, the R&S CBT measures the channel selected via `CONFigure:POWer:RELative:MFRequency`. In `SIMultaneous` mode, the R&S CBT acquires and returns five complete sets of results; see description of the `READ:...POWer...` and `FETCh:...POWer...` commands.	all

CONFigure:POWer:RELative:MFRequency:SIMultaneous *<Meas_Freq_1>,..., <Meas_Freq_5>* Simult. Meas. – Measured Ch.

<Meas_Freq_1> to <Meas_Freq_5>	Description of parameters	Def. value	Def. unit	FW vers.
2402000000 to 2495000000 | **OFF**	Measured frequency Measurement switched off	see below	Hz	V3.85

Description of command	Sig. State
This command defines the five frequencies to be measured if the measurement mode is set to `SIMultaneous` (see command `CONFigure:POWer:RELative:MMODe)`. With the command `CONFigure:POWer:RELative:MFRequency:UNIT`, the default frequency unit can be changed, and even *Bluetooth* channel numbers can be entered instead of frequencies. The default frequencies correspond to the channel sequence 0, 19, 39, 59, 78.	all

CONFigure:POWer:RELative:MFRequency *<Meas_Freq>* Single Meas. – Measured Ch.

<Meas_Freq>	Description of parameters	Def. value	Def. unit	FW vers.
2402000000 to 2495000000	Measured frequency	2 4 0 2 000000	Hz	V3.85

Description of command	Sig. State
This command defines the frequency to be measured if the measurement mode is set to `SINGle` (see command `CONFigure:POWer:RELative:MMODe)`. With the command `CONFigure:POWer:RELative:MFRequency:UNIT`, the default frequency unit can be changed, and even *Bluetooth* channel numbers can be entered instead of frequencies.	all

CONFigure:POWer:RELative:MFRequency:UNIT *<Unit>* Frequency Unit

<Unit>	Description of parameters	Def. value	Def. unit	FW vers.
HZ | **KHZ** | **MHZ** | **GHZ** | **CH**	Frequency unit | Channel number	HZ	–	V3.85

Description of command	Sig. State
This command defines whether the measured frequency (see command `CONFigure:POWer:RELative:MFRequency)` is specified as a frequency or as a Bluetooth channel number.	all

CONFigure:POWer:RELative:MRANge *<Start>, <Span>* Time Scale Start, Time Scale Span

<Start>	Description of parameters	Def. value	Def. unit	
–200 to 3200	Start of measurement range	–200	symbol	
<Span>	Description of parameters	Def. value	Def. unit	FW vers.
0.0625 to 5	Span of measurement range	1	slots	V3.85

Description of command	Sig. State
This command defines the measurement range for the `POWer:RELative` measurement. The second input value *<Span>* is rounded to one of the following discrete values: 0.0625 (1/16 slot), 0.125 (1/8 slot), 0.25 (1/4 slot), 0.5 (1/2 slot), 1 (slot), 2 (slots), 3 (slots), 4 (slots), 5 (slots). 2- and 3-slot spans can not be set for 1-slot packets, 4- and 5-slot spans can not be set for 1- and 3-slot packets.	all

The number of test points in the `POWer` measurement (i.e. the length of the arrays output via the `READ:ARRay:POWer:RELative...` commands) follows from the span, rounded again to correspond to an integer number of symbols, and the sampling rate of the measurement. The latter depends on the packet length; it is generally 4 test points per symbol for one-slot packets (see commands `CONFigure:SSIGnal:TMODe:...PTYPe)`, 2 test points per symbol for three-slot packets, and 1 test point per symbol for five-slot packets. If necessary the sampling rate is reduced by an appropriate factor to prevent the number of test points exceeding the upper limit of 2500. This results in the following table:

<Span>	**0.0625**	**0.125**	**0.25**	**0.5**
Symbols	**39**	**78**	**156**	**312**
No. of test points:				
1 slot packet types	157	313	625	1249
3 slot packet types	49	157	313	625
5 slot packet types	40	79	157	313

<Span>	**1**	**2**	**3**	**4**	**5**
Symbols	**625**	**1250**	**1875**	**2500**	**3125**
No. of test points:					
1 slot packet types	2500	2500	2500	2500	2500
3 slot packet types	1251	2500	2500	2500	2500
5 slot packet types	626	1251	1876	2500	2500

Subsystem POWer:CONTrol

The subsystem *POWer:CONTrol* defines the repetition mode, statistic count, and stop condition of the measurement. These settings are provided in the *Control* tab of the popup menu *Power Configuration.*

CONFigure:POWer:RELative:CONTrol *<Mode>, <Statistics>, <Repetition>, <StopCond>, <Stepmode>*				Scope of Measurement
<Mode>	Desciption of parameters	Def. value	Def. unit	FW vers.
SCALar | **ARRay,**	Scalar values only (incl. limit matching) Scalar measured values and arrays	ARR	–	V3.85
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	Number of bursts per statistics cycle Statistics off (equivalent to 1)	100	–	V3.85
<Repetition>	Description of parameters	Def. value	Def. unit	FW vers.
CONTinuous | **SINGleshot |** **1 to 10000,**	Continuous measurement (until `STOP` or `ABORT)` Single shot measurement (until `Status = RDY)` Multiple measurement (counting, until `Status = STEP | RDY)`	SING	–	V3.85
<StopCond>	Description of parameters	Def. value	Def. unit	FW vers.
SONerror | **NONE,**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	V3.85
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V3.85
Description of command				Sig. State
This command restricts the type of measured values, in order to accelerate the measurement, and determines the number of bursts within a statistics cycle. **Note:** For READ commands (READ:...), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot. The <Repetition> parameter is valid in remote control only. Changing this parameter in remote control does not alter the repetition mode in manual control and vice versa. The default repetition mode in manual control is *Continuous.*				all

CONFigure:POWer:RELative:CONTrol:RMODe *<Mode>*				Result mode
<Mode>	Desciption of parameters	Def. value	Def. unit	FW vers.
SCALar | **ARRay**	Scalar values only (incl. limit matching) Scalar measured values and arrays available	ARR	–	V3.85
Description of command				Sig. State
This command specifies the type of measured values. If the parameter `SCALar` is set, the measurement curves (arrays, see commands `READ:ARRay:POWer:RELative...,` `READ:SUBarray:POWer:RELative...)` are no longer available but the measurement is speeded up considerably.				all

CONFigure:POWer:RELative:CONTrol:STATistics *<Statistics>*				Statistics Count
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	Number of bursts per statistics cycle Statistics off (equivalent to 3)	100	–	V3.85
Description of command				Sig. State
This command specifies the type of measured values and defines the number of bursts forming a statistics cycle.				all

CONFigure:POWer:RELative:CONTrol:REPetition *<Repetition>,<StopCondition>,<StepMode>*				Test Cycles
<Repetition>	Description of parameters	Def. value	Def. unit	FW vers.
CONTinuous | **SINGleshot** | **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (counting, until `Status = STEP | RDY`)	SING	–	V3.85
<StopCondition>	Description of parameters	Def. value	Def. unit	FW vers.
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	V3.85
<StepMode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V3.85
Description of command				Sig. State
This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement. **Note:** For READ commands (READ:...), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot. The <Repetition> parameter is valid in remote control only. Changing this parameter in remote control does not alter the repetition mode in manual control and vice versa. The default repetition mode in manual control is *Continuous.*				all

DEFault:POWer:RELative:CONTrol *<Enable>*				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V3.85
Description of command				Sig. State
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting OFF results in an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF).*				all

Limits - Subsystem POWer...:LIMit

The subsystem *POWer...:LIMit* defines the limit values for the power measurement. The subsystem corresponds to the tab *Limits* in the popup menu *Power Configuration.*

CONFigure:POWer:RELative:CURRent:LIMit:SCALar:ASYMmetric:UPPer:VALue Upper Power Limits
CONFigure:POWer:RELative:AVERage:LIMit:SCALar:ASYMmetric:UPPer:VALue
CONFigure:POWer:RELative:MINimum:LIMit:SCALar:ASYMmetric:UPPer:VALue
CONFigure:POWer:RELative:MAXimum:LIMit:SCALar:ASYMmetric:UPPer:VALue
<GFSK_Power>, <DPSK_Power>, <Relative_Power>, <Guard_Time>

Parameters	Description of parameters	Def. value	Def. unit	FW vers.
–10 dBm to +30 dBm,	Upper limit for GFSK portion	+4.0 *)	dBm	V3.85
–10 dBm to +30 dBm,	Upper limit for DPSK portion	+4.0 *)	dBm	
–10 dBm to +30 dB,	Upper limit for (DPSK – GFSK)	+1.0	dB	
3 µs to 7 µs	Upper limit for guard time	+5.25	µs	V4.00

Description of command	Sig. State
These commands define upper limits for the GFSK, DPSK and relative power of the current `(CURRent)`, average `(AVERage)`, minimum `(MINimum)` and aximum `(MAXimum)` measurement curve, respectively. If a measurement falls below the limit then the result will be out of tolerance. *) By default the limit check is effectively disabled.	all

CONFigure:POWer:RELative:CURRent:LIMit:SCALar:ASYMmetric:UPPer:ENABle Upper Limits on or off
CONFigure:POWer:RELative:AVERage:LIMit:SCALar:ASYMmetric:UPPer:ENABle
CONFigure:POWer:RELative:MINimum:LIMit:SCALar:ASYMmetric:UPPer:ENABle
CONFigure:POWer:RELative:MAXimum:LIMit:SCALar:ASYMmetric:UPPer:ENABle
<Enable_1>, <Enable_2>, <Enable_3>, <Enable_4>

<Enable_n>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF,	Enable/disable upper limit check for GFSK portion	OFF	–	V3.85
ON | OFF,	Enable/disable upper limit check for DPSK portion	OFF	–	
ON | OFF,	Enable/disable upper limit check for (DPSK – GFSK)	ON	–	
ON | OFF	Enable/disable upper limit check for guard time	ON	–	V4.00

Description of command	Sig. State
These commands enable or disable the upper limit check for GFSK, DPSK and relative power.	all

CONFigure:POWer:RELative:CURRent:LIMit:SCALar:ASYMmetric:LOWer:VALue Lower Power Limits
CONFigure:POWer:RELative:AVERage:LIMit:SCALar:ASYMmetric:LOWer:VALue
CONFigure:POWer:RELative:MINimum:LIMit:SCALar:ASYMmetric:LOWer:VALue
CONFigure:POWer:RELative:MAXimum:LIMit:SCALar:ASYMmetric:LOWer:VALue
<GFSK_Power>, <DPSK_Power>, <Relative_Power>, <Guard_Time>

<Limits>	Description of parameters	Def. value	Def. unit	FW vers.
–10 dBm to +30 dBm,	Lower limit for GFSK portion	–6.0 *)	dBm	V3.85
–10 dBm to +30 dBm,	Lower limit for DPSK portion	–6.0 *)	dBm	
–10 dBm to +30 dBm,	Lower limit for (DPSK – GFSK)	–4	dB	
3 µs to 7 µs	Lower limit for guard time	+4.75	µs	V4.00

Description of command	Sig. State
These commands define lower limits for the GFSK, DPSK and relative power of the current `(CURRent)`, average `(AVERage)`, minimum `(MINimum)` and maximum `(MAXimum)` measurement curve, respectively. If a measurement falls below the limit then the result will be out of tolerance. *) By default the limit check is effectively disabled.	all

CONFigure:POWer:RELative:CURRent:LIMit:SCALar:ASYMmetric:LOWer:ENABle Lower Limits on or off
CONFigure:POWer:RELative:AVERage:LIMit:SCALar:ASYMmetric:LOWer:ENABle
CONFigure:POWer:RELative:MINimum:LIMit:SCALar:ASYMmetric:LOWer:ENABle
CONFigure:POWer:RELative:MAXimum:LIMit:SCALar:ASYMmetric:LOWer:ENABle
<Enable_1>, <Enable_2>, <Enable_3>, <Enable_4>

<Enable_n>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF,	Enable/disable lower limit check for GFSK portion	OFF	–	V3.85
ON | OFF,	Enable/disable lower limit check for DPSK portion	OFF	–	
ON | OFF,	Enable/disable lower limit check for (DPSK – GFSK)	ON	–	
ON | OFF	Enable/disable lower limit check for guard time	ON	–	V4.00

Description of command	Sig. State
These commands enable or disable the lower limit check for the GFSK, DPSK and relative power.	all

Upper and Lower Power Limits
CONFigure:POWer:RELative:CURRent:LIMit:SCALar:ASYMmetric[:COMBined]:VALue
CONFigure:POWer:RELative:AVERage:LIMit:SCALar:ASYMmetric[:COMBined]:VALue
CONFigure:POWer:RELative:MINimum:LIMit:SCALar:ASYMmetric[:COMBined]:VALue
CONFigure:POWer:RELative:MAXimum:LIMit:SCALar:ASYMmetric[:COMBined]:VALue
<GFSK_Upp>, <GFSK_Low>, <DPSK_Upp>, <DPSK_Low>,
< RelativePower_Upp>, <RelativePower_Low>, <Guard_Time_Low>, <Guard_Time_Upp>

<Limit>	Description of parameters	Def. value	Def. unit	FW vers.
–10 dBm to +30 dBm,	Upper limit for GFSK portion	+4.0 *)	dBm	V3.85
–10 dBm to +30 dBm,	Lower limit for GFSK portion	–6.0 *)	dBm	
–10 dBm to +30 dBm,	Upper limit for DPSK portion	+4.0 *)	dBm	
–10 dBm to +30 dBm,	Lower limit for DPSK portion	–6.0 *)	dBm	
–10 dBm to +30 dBm,	Upper limit for (DPSK – GFSK)	+1.0	dB	
–10 dBm to +30 dBm,	Lower limit for (DPSK – GFSK)	–4.0	dB	
3 µs to 7 µs,	Upper limit for guard time	+5.25	µs	V4.00
3 µs to 7 µs	Lower limit for guard time	+4.75	µs	

Description of command	Sig. State
These commands define lower limits for the GFSK, DPSK and relative power of the current `(CURRent)`, average `(AVERage)`, minimum `(MINimum)` and maximum `(MAXimum)measurement` curve, respectively. *) By default the limit check is effectively disabled.	all

Upper and Lower Limits on or off

CONFigure:POWer:RELative:CURRent:LIMit:SCALar:ASYMmetric[:COMBined]:ENABle
CONFigure:POWer:RELative:AVERage:LIMit:SCALar:ASYMmetric[:COMBined]:ENABle
CONFigure:POWer:RELative:MINimum:LIMit:SCALar:ASYMmetric[:COMBined]:ENABle
CONFigure:POWer:RELative:MAXimum:LIMit:SCALar:ASYMmetric[:COMBined]:ENABle
<Enable_1>, …, <Enable_8>

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF,	Enable or disable upper limit check for GFSK portion	OFF	–	V3.85
ON | OFF,	Enable or disable lower limit check for GFSK portion	OFF	–	
ON | OFF,	Enable or disable upper limit check for DPSK portion	OFF	–	
ON | OFF,	Enable or disable lower limit check for DPSK portion	OFF	–	
ON | OFF,	Enable or disable upper limit check for (DPSK – GFSK)	ON	–	
ON | OFF,	Enable or disable lower limit check for (DPSK – GFSK)	ON	–	
ON | OFF,	Enable/disable upper limit check for guard time	ON	–	V4.00
ON | OFF	Enable/disable lower limit check for guard time	ON	–	

Description of command	Sig. State
These commands enable or disable the upper and lower limit check for the GFSK, DPSK and relative power.	all

DEFault:POWer:RELative:LIMit ***<Enable>*** Default Settings

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V3.85

Description of command	Sig. State
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting OFF results in an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF).*	all

Subsystem SUBarrays:POWer:RELative

The subsystem *SUBarrays:POWer:RELative* defines the measurement range and the type of output values.

CONFigure:SUBarrays:POWer:RELative <Mode>,<Start>,<Samples>{,<Start>,<Samples>}				Definition of Subarrays
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ALL |	Return all measurement values	ALL	–	V3.85
ARIThmetical |	Return arithm. mean value in every subrange			
MINimum |	Return minimum value in every subrange			
MAXimum |	Return maximum value in every subrange			
IVAL |	Return single interpolated value at <Start>			
XMAXimum |	Return x-axis value of maximum and maximum			
XMINimum |	Return x-axis value of minimum and minimum			
PAVG,	Return arithmetic mean value in every subrange			V5.00
<Start>	Description of parameters	Def. value	Def. unit	FW vers.
–200 to 3200	Start time in current range	NAN	symbol	V3.85
<Samples>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 2500	No. of samples in range	NAN	–	V3.85
Description of command				Sig. State
This command configures the `READ:SUBarrays:POWer:RELative...` and `FETCh:SUBarrays:POWer:RELative...` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by a start time and the number of test points which are located on a fixed, equidistant grid. For <Mode> = IVAL, the <Samples> parameter is ignored and the R&S CBT returns a single measurement value corresponding to the abscissa value <Start>. If <Start> is located between two test points with valid results then the result is calculated from the results at these two adjacent test points by linear interpolation. The subranges may overlap but must be within the total range of the *POWer:RELative* measurement defined via `CONFigure:POWer:RELative:MRANge`. Test points outside this range are not measured (result is *NAN)* and do not enter into the ARIThmetical, MINimum and MAXimum values. By default, only one range corresponding to the total measurement range is used and all measurement values are returned.				all

Measured Values

The commands in the following section determine and return the results of the power versus time measurement. They correspond to the graphical menu *Power* with its various display elements.

				Scalar results:
READ[:SCALar]:POWer:RELative?				Start single shot measurement and return results
FETCh[:SCALar]:POWer:RELative?				Read out measurement results (unsynchronized)
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–128 dBm to +30 dBm,	GFSK portion (x4)	NAN	dBm	V3.85
–128 dBm to +30 dBm,	DPSK portion (x4)	NAN	dBm	
–128 dB to 30 dB,	DPSK – GFSK (x4)	NAN	dB	
3 µs to 7 µs	Guard time (x4)	NAN	µs	
0% to 100%	Burst out of tolerance (power)	NAN	%	V4.00

Description of commands	Sig. State
These commands are always queries. They start a measurement (READ...) and return all scalar measurement results. The symbol (x4) after a parameter, above, indicates that the list contains four results corresponding to the *Current,* the *Average,* the *Minimum,* and the *Maximum* measurement curve, respectively. • `READ` starts a single shot measurement and returns the results. • `FETCh` outputs the results without taking care of the measurement state. The meaning and the number of the returned values depends on the measurement mode set via `CONFigure:POWer:RELative:MMODe` • In the `ALL` mode, the R&S CBT measures all channels and returns the average result. • In `SINGle` mode, the R&S CBT measures the channel selected via `CONFigure:POWer:RELative:MFRequency` and returns the corresponding result. • In `SIMultaneous` mode, the R&S CBT acquires and returns five complete sets of results corresponding to the five channels selected with `CONFigure:POWer:RELative:MFRequency:SIMultaneous.`. This means that the whole list described in the *Returned Values* column above is repeated five times. For more details refer to the description of aggregated and separate channels in Chapter 4.	TEST, CONN

CALCulate[:SCALar]:POWer:RELative:MATChing:LIMit?				Scalar Limit Matching
<Result>	Description of parameters	Def. value	Def. unit	FW vers.
GFSK portion (x4), **DPSK portion (x4),** **DPSK – GFSK (x4),** **Guard time (x4)**	For all measured values: NMAU | NMAL | INV | OK	INV INV INV INV	–	V3.85 V4.00
Description of commands				Sig. State
This command is always a query. It indicates whether and in which way the permissible tolerances for the scalar measured values (see commands above) have been exceeded. The symbol (x4) after a value, above, indicates that the list contains four results corresponding to the *Current,* the *Average,* the *Minimum,* and the *Maximum* measurement curve, respectively. Possible values are: *NMAU* Result is above the limit *NMAL* Result is below the limit *INV* Result is invalid *OK* Result is valid The meaning and the number of the returned values depends on the measurement mode set via `CONFigure:POWer:RELative:MMODe`; see description of `READ...?` and `FETCh...?` commands above.				TEST, CONN

READ:ARRay:POWer:RELative:CURRent? **READ:ARRay:POWer:RELative:AVERage?** **READ:ARRay:POWer:RELative:MAXimum?** **READ:ARRay:POWer:RELative:MINimum?** **FETCh:ARRay:POWer:RELative:CURRent?** **FETCh:ARRay:POWer:RELative:AVERage?** **FETCh:ARRay:POWer:RELative:MAXimum?** **FETCh:ARRay:POWer:RELative:MINimum?**				Burst Power Start single shot measurement and return results Read measurement results (unsynchronized)
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–128.0 dB to +30.0 dB **...** **–128.0 dB to +30.0 dB**	1st value for relative power ... nth value for relative power	NAN ... NAN	dB ... dB	V3.85
Description of command				Sig. State
These commands are always queries. They return the relative power versus time at fixed, equidistant test points. The total number, n, of samples and their position on the time axis depends on the measurement range and the packet type. For an overview see command `CONFigure:POWer:RELative:MRANge`. The meaning of the returned values depends on the measurement mode set via `CONFigure:POWer:RELative:MMODe`: • In `ALL` mode, the R&S CBT measures all available channels and returns the trace averaged over all these channels. • In `SINGle` mode, the R&S CBT measures the channel selected via `CONFigure:POWer:RELative:MFRequency` and returns the corresponding trace. • In `SIMultaneous` mode, the R&S CBT measures the channels selected with `CONFigure:POWer:RELative:MFRequency:SIMultaneous.and` returns the trace averaged over these channels. The calculation of *current, average, maximum* and *minimum* values is explained in Chapter 3 (display *mode).*				TEST, CONN

READ:SUBarrays:POWer:RELative:CURRent? **READ:SUBarrays:POWer:RELative:AVERage?** **READ:SUBarrays:POWer:RELative:MAXimum?** **READ:SUBarrays:POWer:RELative:MINimum?** **FETCh:SUBarrays:POWer:RELative:CURRent?** **FETCh:SUBarrays:POWer:RELative:AVERage?** **FETCh:SUBarrays:POWer:RELative:MAXimum?** **FETCh:SUBarrays:POWer:RELative:MINimum?**	Subarray Results Start single shot measurement and return results Read measurement results (unsynchronized)			
Ret. values per subrange	Description of parameters	Def. value	Def. unit	FW vers.
–128.0 dB to +30.0 dB **...** **–128.0 dB to +30.0 dB**	1st value for relative power ... nth value for relative power	NAN ... NAN	dB ... dB	V3.85
Description of command				Sig. State
These commands are always queries. They output the burst power versus time in the subranges defined by means of the `CONFigure:SUBarrays:POWer:RELative` command. A valid subrange must be defined before the `READ:SUBarrays...` and `FETCh:SUBarrays...` command group can be used. The `CONFigure:SUBarrays:POWer:RELative` command defines a maximum of 32 subranges. If one of the statistical modes `(ARIThmetical, MINimum, MAXimum…)` is set, only one value is returned per subrange. The calculation of *current, average, minimum,* and *maximum* results is explained in Chapter 3 (see *display mode).*				TEST, CONN

Overview
(Combined EDR Relative Power and DPSK Modulation)

The commands in this section control the EDR Overview measurement (combined Relative Power and DPSK modulation measurements). There are no corresponding softkeys as this is purely a remote control action. This measurement is only available if software option CBT-K55 has been installed.

INITiate:POWer:MPE **ABORt:POWer:MPE** **STOP:POWer:MPE** **CONTinue:POWer:MPE**	Start new measurement Abort running measurement and switch off Stop measurement after current stat. cycle Next measurement step (only *stepping mode)*	*⇒ RUN* *⇒ OFF* *⇒ STOP* *⇒ RUN*
Description of command	Sig. State	FW vers.
These commands start and stop the overview measurement, setting it to the status indicated in the top right column. These commands have no query form.	all	V3.85

CONFigure:POWer:MPE:EREPorting *<Mode>* — Event Reporting

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC** | **SRSQ** | **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	V3.85

Description of command	Sig. State
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see Chapter 5).	all

CONFigure:POWer:MPE:MFRequency *<Meas_Freq>* — Display Frequency

<Meas_Freq>	Description of parameters	Def. value	Def. unit	FW vers.
2402000000 to 2495000000	Measured frequency	2402000000	Hz	V3.85

Description of command	Sig. State
This command defines the frequency to be measured if the measurement mode is set to `SINGle` (see command `CONFigure:POWer:MPE:MMODE)` . With the command `CONFigure:POWer:MPE:MFRequency:UNIT`, the default frequency unit can be changed, and even *Bluetooth* channel numbers can be entered instead of frequencies.	all

CONFigure:POWer:MPE:MFRequency:SIMultaneous *<Meas_Freq_1>,..., <Meas_Freq_5>* — Simult. Meas. – Measured Ch.

<Meas_Freq_1> to <Meas_Freq_5>	Description of parameters	Def. value	Def. unit	FW vers.
2402 MHz to 2495 MHz | **OFF**	Measured frequency Measurement switched off	see below	Hz	V4.35

Description of command	Sig. State
This command defines the five frequencies to be measured if the measurement mode is set to `SIMultaneous` (see command `CONFigure:POWer:MPE:MMODe`). With the command `CONFigure:POWer:MPE:MFRequency:UNIT`, the default frequency unit can be changed, and even *Bluetooth* channel numbers can be entered instead of frequencies. The default frequencies correspond to the channel sequence 0, 19, 39, 59, 78.	all

CONFigure:POWer:MPE:MFRequency:UNIT<Unit> — Frequency Unit

<Unit>	Description of parameters	Def. value	Def. unit	FW vers.
HZ | **KHZ** | **MHZ** | **GHZ** | **CH**	Frequency unit | Channel number	HZ	–	V3.85

Description of command	Sig. State
This command defines whether the measured frequency (see command `CONFigure:POWer:MPE:MFRequency)` is specified as a frequency or as an Bluetooth channel number.	all

CONFigure:POWer:MPE:MMODE *<Mode>*				Measurement Mode
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ALL |	Measure and aggregate all channels of the current hop scheme	ALL	–	V3.85
SINGle |	Measure bursts from a definite channel only			
SIMultaneous	Simultaneous measurement on the five channels selected with the command: `CONFigure:POWer:MPE:MFRequency:SIMultaneous.`			
Description of command				Sig. State
This command sets how many channels are to be measured and whether the results are to be kept separate or aggregated. In `ALL` mode, the measurement is performed on every available burst, no matter what frequency it is on. In `SINGle` mode, the R&S CBT measures the channel selected via `CONFigure:POWer:MPE:MFRequency.` In `SIMultaneous` mode, the R&S CBT takes and returns five complete sets of results; see description of the `READ:...POWer...` and `FETCh:...POWer...` commands.				all

FETCh[:SCALar]:POWer:MPE:STATus?				Measurement Status
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
OFF |	Measurement in the *OFF* state (*RST or `ABORt`)	OFF	–	V3.85
RUN |	Running (after `INITiate, CONTinue` or `READ`)			
STOP |	Stopped (STOP)			
ERR |	*OFF* (could not be started)			
STEP |	Stepping mode *(<stepmode>=STEP)*			
RDY,	Stopped according to repetition mode and stop condition			
1 to 10000 |	Counter for current statistics cycle	NONE	–	
NONE,	No counting mode set			
0 to 1000 |	Counter for current evaluation period within a cycle	NONE	–	
NONE	Statistic count set to off			
Description of command				Sig. State
This command is always a query. It returns the status of the measurement (see Chapters 3 and 5).				all

CONFigure:POWer:MPE:FILTer:BWIDth <Width>				Filter Bandwidth
<Width>	Description of parameters	Def. value	Def. unit	FW vers.
WIDE |	2 MHz bandwidth filter	NARR	–	V3.85
NARR	1.3 MHz bandwidth filter			
Description of command				Sig. State
Selects the resolution bandwidth of the measurement filter used for POWer:MPE measurements.				all

Scalar results

READ[:SCALar]:POWer:MPE? Start single *shot* measurement return results
FETCh[:SCALar]:POWer:MPE? Read out measurement results (unsynchronized)

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–128 to 30,	GFSK portion (x4)	NAN	dBm	V3.85
–128 to 30,	DPSK portion (x4)	NAN	dBm	
–128 to 30,	DPSK – GFSK (x4)	NAN	dBm	
3 µs to 7 µs	Guard time (x4)	NAN	µs	V4.00
–250 to +250,	Frequency stability ωi (x4),	NAN	kHz	V3.85
–250 to +250,	Frequency stability $\omega i + \omega o_{max}$ (x4),	NAN	kHz	
–250 to +250,	Frequency stability ωo_{max} (x4),	NAN	kHz	
0 to 1,	RMS DEVM (x4),	NAN	%	
0 to 1,	Peak DEVM (x4),	NAN	%	
0 to 100,	99% DEVM	NAN	%	
0 to 100,	Burst out of tolerance (power)	NAN	%	
0 to 100	Burst out of tolerance (power)	NAN	%	

Description of commands	Sig. State
These commands are always queries. They start a measurement (READ...) and return all scalar measurement results. The symbol (x4) after a value, above, indicates that the list contains four results corresponding to the *Current,* the *Average,* the *Minimum,* and the *Maximum* measurement curve, respectively. • READ starts a single shot measurement and returns the results. • FETCh outputs the results without taking care of the measurement state. The *meaning* and the *number* of the returned values depends on the measurement mode set via `CONFigure:POWer:MPE:MMODe` • In the ALL *mode,* the R&S CBT measures all *channels* and returns the average result. • In SINGle mode, the R&S CBT measures the channel selected via `CONFigure:POWer:RELative:MFRequency` and returns the corresponding result. • In SIMultaneous mode, the R&S CBT acquires and returns five complete sets of results corresponding to `the` five channels selected with `CONFigure:POWer:RELative:MFRequency:SIMultaneous..` This means that the whole list described in the *Returned Values* column above is repeated five times. For more details refer to the description of aggregated and separate channels in Chapter 4.	TEST, CONN

CALCulate[:SCALar]:POWer:MPE:MATChing:LIMit?				Scalar Limit Matching
<Result>	Description of parameters	Def. value	Def. unit	FW vers.
GFSK portion (x4),		INV	–	V3.85
DPSK portion (x4),	For all measured values:	INV		
DPSK – GFSK (x4),	NMAU | NMAL | INV | OK	INV		
Guard time (x4),		INV		V4.00
Frequency stability ωi (x4),		INV		V3.85
Frequency stability $\omega_i + \omega_{o\ max}$ (x4),		INV		
Frequency stability $\omega_{o\ max}$ (x4),		INV		
RMS DEVM (x4),		INV		
Peak DEVM (x4),		INV		
99% DEVM Burst Out		INV		
Burst out of tolerance (power)		INV		
Burst out of tolerance (power)		INV		

Description of commands	Sig. State
This command indicates whether and in which way the permissible tolerances for the scalar measured values (see commands above) have been exceeded. This command is always a query. The symbol (x4) after a value, above, indicates that the list contains four results corresponding to the *Current,* the *Average,* the *Minimum,* and the *Maximum* measurement curve, respectively. Possible values are: *NMAU* Result is above the limit *NMAL* Result is below the limit *INV* Result is invalid *OK* Result is valid The meaning and the number of the returned values depends on the measurement mode set via `CONFigure:POWer:RELative:MMODe;` see description of `READ...?` and `FETCh...?` commands above.	TEST, CONN

MODulation Measurements

The subsystem *MODulation* covers the following modulation measurement applications:

- The *MODulation:DEViation* subsystem measures the modulation accuracy of GFSK-modulated Basic Rate packets.
- The *MODulation:DPSKeying* subsystem measures the modulation accuracy in the DPSK and GFSK modulated sections of EDR packets.
- *The MODulation:ENCoding* subsystem measures the bit error rate for packets that the Bluetooth EUT transansmits in *TX Tests* mode.
- *The MODulation:IQANalyzer:DPSKeying* subsystem measures the I/Q vectors and the DEVM.
- *The MODulation:PDIFference* subsystem measures the phase difference between consecutive symbols.

The *MODulation:DPSKeying*, *MODulation:ENCoding, MODulation:IQANalyzer:DPSKeying,* and *MODulation:PDIFference* measurements are only available if software option CBT-K55 has been installed.

Subsystem Modulation:DEViation

The subsystem *MODulation:DEViation* measures the modulation parameters, i.e. the frequency errors, for GFSK-modulatied Basic Rate packets. The subsystem corresponds to the measurement menu *Modulation,* application *Modulation GFSK,* and the associated popup menu *Modulation Configuration.*

Control of Measurement – Subsystem Modulation

The commands in this section control the modulation measurement. They correspond to the measurement control softkey *Modulation GFSK* in the measurement menu *Modulation* and the associated hotkeys.

INITiate:MODulation:DEViation	Start new measurement		⇒ *RUN*
ABORt:MODulation:DEViation	Abort running measurement and switch off		⇒ *OFF*
STOP:MODulation:DEViation	Stop measurement after current stat. cycle		⇒ *STOP*
CONTinue:MODulation:DEViation	Next measurement step (only *stepping mode*)		⇒ *RUN*
Description of command		Sig. State	FW vers.
These commands have no query form. They start and stop the modulation measurement, setting it to the status indicated in the top right column.		all	V3.50

CONFigure: MODulation:DEViation:EREPorting *<Mode>*				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ |	Service request	OFF	–	V3.50
SOPC |	Single operation complete			
SRSQ |	SRQ and SRSQ			
OFF	No reporting			
Description of command				Sig. State
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see Chapter 5).				all

FETCh:MODulation:DEViation:STATus?				Measurement Status
Ret. values	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN** | **STOP** | **ERR** | **STEP** | **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V3.50
1 to 10000 | **NONE,**	Counter for current statistics cycle No counting mode set	NONE	–	
1 to 1000 | **NONE**	Counter for current evaluation period within a cycle Statistic count set to off	NONE	–	
Description of command				Sig. State
This command is always a query. It returns the status of the measurement (see Chapters 3 and 5).				all

CONFigure:MODulation:DEViation:MMODe *<Mode>*				Measurement Mode
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ALL | **SINGle** | **SIMultaneous**	Measure and aggregate all channels of the current hop scheme Measure bursts from a definite channel only Simultaneous measurement on the five channels selected with `CONFigure:MODulation:DEViation:MFRequency:SIMultaneous`.	ALL	–	V3.50
Description of command				Sig. State
This command sets how many channels are to measured and whether the results are to be kept separate or aggregated. In `ALL` mode, the measurement is performed on every available burst, no matter what frequency it is on. In `SINGle` mode, the R&S® CBT measures the channel selected via `CONFigure:MODulation:DEViation:MFRequency`. In `SIMultaneous` mode, the R&S® CBT takes and returns five complete sets of results; see description of the `READ:...MODulation...`, `FETCh:...MODulation...` commands.				all

CONFigure:MODulation:DEViation:MFRequency:SIMultaneous *<Meas_Freq_1>,..., <Meas_Freq_5>*				Simult. Meas. – Measured Ch.
<Meas_Freq_1> to <Meas_Freq_5>	Description of parameters	Def. value	Def. unit	FW vers.
2 402 MHz to 2 495 MHz | **OFF**	Measured frequency Measurement switched off	see below	Hz	V3.50
Description of command				Sig. State
This command defines the five frequencies to be measured if the measurement mode is set to `SIMultaneous` (see command `CONFigure:MODulation:DEViation:MMODe`). With the command `CONFigure:MODulation:DEViation:MFRequency:UNIT`, the default frequency unit can be changed, and even *Bluetooth* channel numbers can be entered instead of frequencies. The default frequencies correspond to the channel sequence 0, 19, 39, 59, 78.				all

CONFigure:MODulation:DEViation:MFRequency *<Meas_Freq>*				Display Frequency
<Meas_Freq>	Description of parameters	Def. value	Def. unit	FW vers.
2 402 MHz to 2 495 MHz	Measured frequency	2 402000 000	Hz	V3.50
Description of command				Sig. State
This command defines the frequency to be measured if the measurement mode is set to `SINGle` (see command `CONFigure:MODulation:DEViation:MMODe`). With the command `CONFigure:MODulation:DEViation:MFRequency:UNIT`, the default frequency unit can be changed, and even *Bluetooth* channel numbers can be entered instead of frequencies.				all

CONFigure:MODulation:DEViation:MFRequency:UNIT *<Unit>*				Frequency Unit
<Unit>	Description of parameters	Def. value	Def. unit	FW vers.
HZ | KHZ | MHZ | GHZ | CH	Frequency unit | Channel number	HZ	–	V3.50
Description of command				Sig. State
This command defines whether the measured frequency (see command `CONFigure:MODulation:DEViation:MFRequency)` is specified in frequency units or as an Bluetooth channel number.				all

CONFigure:MODulation:DEViation:MRANge *<Start>, <Span>*				Time Scale Start, Time Scale Span
<Start>	Description of parameters	Def. value	Def. unit	
–200 bit to 3200 bit	Start of measurement range	–200	bit	
<Span>	Description of parameters	Def. value	Def. unit	FW vers.
0.0625 to 1	Span of measurement range	1	(slots)	V3.50
Description of command				Sig. State
This command defines the measurement range for the `MODulation:DEViation` measurement. The second input value *<Span>* is rounded to one of the following discrete values: 0.0625 (1/16 slot) 0.125 (1/8 slot) 0.25 (1/4 slot) 0.5 (1/2 slot) 1 (slot)				all

The number of test points in the `MODulation` measurement (i.e. the length of the arrays output via the `READ:ARRay:MODulation:DEViation...` commands) follows from the span, rounded again to correspond to an integer number of bits, and a constant sampling rate of 4 test points per bit. This results in the following table:

<Span>	0.0625	0.125	0.25	0.5	1
Symbols	39	78	156	313	625
No. of test points	157	313	625	1249	2500

CONFigure:MODulation:DEViation:FILTer:BWIDth *<Width>*				Filter Bandwidth
<Width>	Description of parameters	Def. value	Def. unit	FW vers.
WIDE | **NARR**	2 MHz bandwidth filter 1.3 MHz bandwidth filter	NARR	–	V3.85
Description of command				Sig. State
Selects the resolution bandwidth of the measurement filter used for *Modulation GFSK* measurements.				all

CONFigure:MODulation:DEViation:FDALgorithm *<Algorithm>*		Freq. Dev. Algorithm		
<Mode>	Desciption of parameters	Def. value	Def. unit	FW vers.
BCAV | **IAV**	Bit centered average Integration aveerage	BCAV	–	V3.50
Description of command				Sig. State
Defines how the R&S® CBT averages the frequency deviation and calculates the average frequency over a 01010101 bit sequence. The algorithm is used for `MODulation` and for `POWer:MPR` measurements.				all

Subsystem MODulation:DEViation:CONTrol

The subsystem *MODulation:DEViation:CONTrol* defines the scope of the modulation measurement. The settings are provided in the *Control* tab of the popup menu *Modulation Configuration*.

CONFigure:MODulation:DEViation:CONTrol *<Mode>, <Statistics>, <Repetition>, <StopCond>, <Stepmode>*		Scope of Measurement		
<Mode>	Desciption of parameters	Def. value	Def. unit	
SCALar | **ARRay,**	Scalar values only (incl. limit matching) Scalar measured values and arrays	ARRay	–	
<Statistics>	Description of parameters	Def. value	Def. unit	
1 to 1000 | **NONE**	Number of bursts per statistics cycle Statistics off	100	–	
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot** | **1 to 10000,**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCond>	Description of parameters	Def. value	Def. unit	
SONerror | **NONE,**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V3.50
Description of command				Sig. State
This command restricts the type of measured values to accelerate the measurement and determines the number of bursts within a statistics cycle. **Note:** In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot. The *Repetition* parameter is valid in remote control only. Changing this parameter in remote control does not alter the repetition mode in manual control and vice versa. The default repetition mode in manual control is *Continuous.*				all

CONFigure:MODulation:DEViation:CONTrol:RMODe *<Mode>*				Result mode
<Mode>	Desciption of parameters	Def. value	Def. unit	FW vers.
SCALar | **ARRay**	Scalar values only (incl. limit matching) Scalar measured values and arrays available	ARRay	–	V3.50
Description of command				Sig. State
This command specifies the type of measured values. If the parameter `SCALar` is set, the measurement curves (arrays, see commands `READ:ARRay:POWer:TIME...`, `READ:SUBarray:POWer:TIME...`) are no longer available but the measurement is speeded up considerably.				all

CONFigure:MODulation:DEViation:CONTrol:STATistics *<Statistics>*				Statistics Count
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	Number of bursts per statistics cycle Statistics off	100	–	V3.50
Description of command				Sig. State
This command specifies the type of measured values and defines the number of bursts forming a statistics cycle.				all

CONFigure:MODulation:DEViation:CONTrol:REPetition *<Repetition>,<StopCond>,<Stepmode>*				Test Cycles
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot** | **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCondition>	Description of parameters	Def. value	Def. unit	
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V3.50
Description of command				Sig. State
This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement. ***Note:*** *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.* The *Repetition* parameter is valid in remote control only. Changing this parameter in remote control does not alter the repetition mode in manual control and vice versa. The default repetition mode in manual control is *Continuous*.				all

DEFault:MODulation:DEViation:CONTrol				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values The parameters differ from the default values (partially or totally)	ON	–	V3.50
Description of command				Sig. State
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting OFF results in an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF).*				all

Limits – Subsystem MODulation:DEViation:LIMit

The subsystem *MODulation:DEViation:LIMit* defines tolerance values for the modulation measurement. The subsystem corresponds to the tab *Limits* in the popup menu *Modulation.*

CONFigure:MODulation:DEViation:CURRent:LIMit:SCALar:ASYMmetric:UPPer:VALue **CONFigure:MODulation:DEViation:AVERage:LIMit:SCALar:ASYMmetric:UPPer:VALue** **CONFigure:MODulation:DEViation:MAXimum:LIMit:SCALar:ASYMmetric:UPPer:VALue** **CONFigure:MODulation:DEViation:MINimum:LIMit:SCALar:ASYMmetric:UPPer:VALue** *<Freq_Acc>, <Freq_Drift>, <Max_Drift_Rate>, <Freq_Dev_Aver>, <Freq_Dev_Max>, <Freq_Dev_Min>*				Upper Modulation Limits
<Limit>	Description of parameters	Def. value	Def. unit	FW vers.
–250 kHz to +250 kHz, **–250 kHz to +250 kHz,** **–500 kHz/50 µs to +500 kHz/50 µs,** **0 kHz to +250 kHz,** **0 kHz to +250 kHz,** **0 kHz to +250 kHz,**	Upper limit for frequency accuracy Upper limit for frequency drift Upper limit for max. drift rate Upper limit for average frequency deviation Upper limit for minimum freq. dev. Upper limit for maximum freq. dev.	+75 +25 20 175 175 175 *)	kHz kHz kHz/50 µs kHz kHz kHz	V3.50
Description of command				Sig. State
These commands define upper limits for the nominal power of the current `(CURRent)`, average `(AVERage)`, minimum `(MINimum)`, and maximum `(MAXimum)` measurement curve, respectively. If a measurement rises above the limit then the result will be out of tolerance. OFF means that the limit check is switched off. *) By default the limit check is effectively disabled.				all

CONFigure:MODulation:DEViation:CURRent:LIMit:SCALar:ASYMmetric:UPPer:ENABle
CONFigure:MODulation:DEViation:AVERage:LIMit:SCALar:ASYMmetric:UPPer:ENABle
CONFigure:MODulation:DEViation:MAXimum:LIMit:SCALar:ASYMmetric:UPPer:ENABle
CONFigure:MODulation:DEViation:MINimum:LIMit:SCALar:ASYMmetric:UPPer:ENABle
<Mode_1>, ..., <Mode_6> Upper Limits on or off

<Mode_n>	Description of parameters	Def. value	Def. unit	FW vers.
	Enable or disable the upper limit check for:			V3.50
ON | OFF,	Frequency accuracy	ON	–	
ON | OFF,	Frequency drift	ON	–	
ON | OFF,	Max. drift rate	ON	–	
ON | OFF,	Average frequency deviation	ON	–	
ON | OFF,	Minimum freq. dev.	OFF	–	
ON | OFF	Maximum freq. dev.	OFF	–	

Description of command	Sig. State
These commands enable or disable the upper limit check of the modulation quantities.	all

CONFigure:MODulation:DEViation:CURRent:LIMit:SCALar:ASYMmetric:LOWer:VALue
CONFigure:MODulation:DEViation:AVERage:LIMit:SCALar:ASYMmetric:LOWer:VALue
CONFigure:MODulation:DEViation:MAXimum:LIMit:SCALar:ASYMmetric:LOWer:VALue
CONFigure:MODulation:DEViation:MINimum:LIMit:SCALar:ASYMmetric:LOWer:VALue
<Freq_Acc>, <Freq_Drift>, <Max_Drift_Rate>, <Freq_Dev_Aver>, <Freq_Dev_Max>, <Freq_Dev_Min> Lower Modulation Limits

<Limit>	Description of parameters	Def. value	Def. unit	FW vers.
–250 kHz to +250 kHz	Lower limit for frequency accuracy	–75	kHz	V3.50
–250 kHz to +250 kHz	Lower limit for frequency drift	–25	kHz	
–500 kHz/50 µs to +500 kHz/50 µs,	Lower limit for max. drift rate	–20	kHz/50 µs	
0 kHz to +250 kHz	Lower limit for average frequency deviation	115	kHz	
0 kHz to +250 kHz	Lower limit for minimum freq. dev.	115	kHz	
0 kHz to +250 kHz	Lower limit for maximum freq. dev.	115 *)	kHz	

Description of command	Sig. State
These commands define lower limits for the nominal power of the current `(CURRent)`, average `(AVERage)`, minimum `(MINimum)`, and maximum `(MAXimum)` measurement curve, respectively. If a measurement falls below the limit then the result will be out of tolerance. OFF means that the limit check is switched off. *) By default the limit check is effectively disabled.	all

CONFigure:MODulation:DEViation:CURRent:LIMit:SCALar:ASYMmetric:LOWer:ENABle
CONFigure:MODulation:DEViation:AVERage:LIMit:SCALar:ASYMmetric:LOWer:ENABle
CONFigure:MODulation:DEViation:MAXimum:LIMit:SCALar:ASYMmetric:LOWer:ENABle
CONFigure:MODulation:DEViation:MINimum:LIMit:SCALar:ASYMmetric:LOWer:ENABle
<Mode_1>, ..., <Mode_6> Lower Limits on or off

<Mode_n>	Description of parameters	Def. value	Def. unit	FW vers.
	Enable or disable the lower limit check for:			V3.50
ON | OFF,	Frequency accuracy	ON	–	
ON | OFF,	Frequency drift	ON	–	
ON | OFF,	Max. drift rate	ON	–	
ON | OFF,	Average frequency deviation	ON	–	
ON | OFF,	Minimum freq. dev.	OFF	–	
ON | OFF	Maximum freq. dev.	OFF	–	

Description of command	Sig. State
These commands enable or disable the lower limit check of the modulation quantities.	all

CONFigure:MODulation:DEViation:CURRent:LIMit:SCALar:ASYMmetric[:COMBined]:VALue
CONFigure:MODulation:DEViation:AVERage:LIMit:SCALar:ASYMmetric[:COMBined]:VALue
CONFigure:MODulation:DEViation:MAXimum:LIMit:SCALar:ASYMmetric[:COMBined]:VALue
CONFigure:MODulation:DEViation:MINimum:LIMit:SCALar:ASYMmetric[:COMBined]:VALue
<Freq_Acc_Upp>, <Freq_Acc_Low>, <Freq_Drift_Upp>, <Freq_Drift_Low>,
<Max_Drift_Rate_Upp>, <Max_Drift_Rate_Low>, <Freq_Dev_Upp_Aver>, <Freq_Dev_Low_Aver>
<Freq_Dev_Upp_Max>, <Freq_Dev_Low_Max> <Freq_Dev_Upp_Min>, <Freq_Dev_Low_Min>
Upper and Lower Modulation Limits

<Limit>	Description of parameters	Def. value	Def. unit	FW vers.
–250 kHz to +250 kHz	Upper limit for frequency accuracy	+75	kHz	V3.50
–250 kHz to +250 kHz	Lower limit for frequency accuracy	–75	kHz	
–250 kHz to +250 kHz	Upper limit for frequency drift	+25	kHz	
–250 kHz to +250 kHz	Lower limit for frequency drift	–25	kHz	
–500 kHz/50 µs to +500 kHz/50 µs,	Upper limit for max. drift rate	+20	kHz/ 50 µs	
–500 kHz/50 µs to +500 kHz/50 µs,	Lower limit for max. drift rate	–20	kHz/ 50 µs	
0 kHz to +250 kHz	Upper limit for average frequency deviation	175	kHz	
0 kHz to +250 kHz	Lower limit for average freq. dev.	115	kHz	
0 kHz to +250 kHz	Upper limit for minimum freq. dev.	175	kHz	
0 kHz to +250 kHz	Lower limit for minimum freq. dev.	115	kHz	
0 kHz to +250 kHz	Upper limit for maximum freq. dev.	175 *)	kHz	
0 kHz to +250 kHz	Lower limit for maximum freq. dev.	115 *)	kHz	

Description of command	Sig. State
These commands define upper and lower limits for the nominal power of the current `(CURRent)`, average `(AVERage)`, minimum `(MINimum)`, and maximum `(MAXimum)` measurement curve, respectively. If a measurement falls below the limit then the result will be out of tolerance. OFF means that the limit check is switched off. *) By default the limit check is effectively disabled.	all

CONFigure:MODulation:DEViation:CURRent:LIMit:SCALar:ASYMmetric[:COMBined]:ENABle
CONFigure:MODulation:DEViation:AVERage:LIMit:SCALar:ASYMmetric[:COMBined]:ENABle
CONFigure:MODulation:DEViation:MAXimum:LIMit:SCALar:ASYMmetric[:COMBined]:ENABle
CONFigure:MODulation:DEViation:MINimum:LIMit:SCALar:ASYMmetric[:COMBined]:ENABle ***<Mode_1>, ..., <Mode_12>***

All Limits on or off

<Mode_n>	Description of parameters	Def. value	Def. unit	FW vers.
	Enable or disable the limit check for:			V3.50
ON | OFF, ON | OFF,	Frequency accuracy (upper, lower)	ON, ON	–	
ON | OFF, ON | OFF,	Frequency drift (upper, lower)	ON, ON	–	
ON | OFF, ON | OFF,	Max. drift rate (upper, lower)	ON, ON	–	
ON | OFF, ON | OFF,	Average freq. Dev. (upper, lower)	ON, ON	–	
ON | OFF, ON | OFF,	Minimum freq. dev. (upper, lower)	OFF, OFF	–	
ON | OFF, ON | OFF	Maximum freq. dev. (upper, lower)	OFF, OFF	–	

Description of command	Sig. State
These commands enable or disable the upper and lower limit check of the modulation quantities.	all

Bits out of Tolerance – Threshold

CONFigure:MODulation:DEViation:BATHreshold:THReshold[:VALue] ***<Freq_Dev>***

<Freq_Dev>	Description of parameters	Def. value	Def. unit	FW vers.
0 kHz to +250 kHz	Lower limit for frequency deviation	115	kHz	V3.50

Description of command	Sig. State
This command defines the lower limit for the frequency deviation, to be used for the calculation of the *Bits out of Tolerance* result (command `FETCh[:SCALar]:MODulation:DEViation:BATHreshold?`)	all

Bits out of Tolerance – Conformance Limit

CONFigure:MODulation:DEViation:BATHreshold:CLIMit[:VALue] ***<Percentage>***

<Percentage>	Description of parameters	Def. value	Def. unit	FW vers.
0.00 % to +100.00 %	Conformance limit	99.90	%	V3.50

Description of command	Sig. State
This command defines the minimum percentage of bits where the frequency deviation must lie above the *Threshold*, to be used for the calculation of the *Bits out of Tolerance* result (command `FETCh[:SCALar]:MODulation:DEViation:BATHreshold?`)	all

Bits out of Tolerance – Enable Limit Check

CONFigure:MODulation:DEViation:BATHreshold:CLIMit:ENABle ***<Enable>***

<Limit>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Enable or disable limit check	ON	–	V3.50

Description of command	Sig. State
This command enables or disables the limit check for the *Bits out of Tolerance* result (command `FETCh[:SCALar]:MODulation:DEViation:BATHreshold?`)	all

DEFault:MODulation:DEViation:LIMit *<Mode>*		Default Settings		
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V3.50
Description of command				Sig. State
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting OFF results in an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				all

Subsystem SUBarrays:MODulation:DEViation

The subsystem *SUBarrays:MODulation:DEViation* defines the measurement range and the type of output values.

CONFigure:SUBarrays:MODulation:DEViation **<Mode>,<Start>,<Samples>{,<Start>,<Samples>}**		Definition of Subarrays		
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ALL | **ARIThmetical** | **MINimum** | **MAXimum** | **IVAL** | **XMAXimum** | **XMINimum** | **PAVG,**	Return all measurement values Return arithm. mean value in every subrange Return minimum value in every subrange Return maximum value in every subrange Return single interpolated value at <Start> Return x-axis value of maximum and maximum Return x-axis value of minimum and minimum Return arithmetic mean value in every subrange	ALL	–	V3.50 V5.00
<Start>	Description of parameters	Def. value	Def. unit	
–200 bit to 3200 bit,	Start time in current range	NAN	bit	
<Samples>	Description of parameters	Def. value	Def. unit	
0 to 2500*)	No. of samples in range	NAN	–	
Description of command				Sig. State
This command configures the `READ:SUBarrays:MODulation:DEViation...`, `FETCh:SUBarrays:MODulation:DEViation...` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by a start time and the number of test points which are located on a fixed, equidistant grid. For <Mode> = IVAL, the <Samples> parameter is ignored and the R&S CBT returns a single measurement value corresponding to the abscissa value <Start>. If <Start> is located between two test points with valid results then the result is calculated from the results at these two adjacent test points by linear interpolation. The subranges may overlap but must be within the total range of the *MODulation:DEViation* measurement defined via `CONFigure:MODulation:DEViation:MRANge`. Test points outside this range are not measured (result *NAN)* and do not enter into the ARIThmetical, MINimum and MAXimum values. By default, only one range corresponding to the total measurement range is used and all measurement values are returned. *) **Useful range; see** `CONFigure:MODulation:DEViation:MRANge`. The command also accepts values >2500.				all

Measured Values

The following commands start a measurement and return the measurement results. They correspond to the different output elements in the graphical measurement menu *MODulation:DEViation.*

Scalar Results

READ[:SCALar]:MODulation:DEViation? Start single shot measurement and return results

FETCh[:SCALar]:MODulation:DEViation? Read out meas. results (unsynchronized)

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–250 kHz to +250 kHz,	Frequency Accuracy (x4),	NAN	kHz	V3.50
–250 kHz to +250 kHz,	Frequency Drift (x4),	NAN	kHz	
–999 kHz/50 µs to 999 kHz/50 µs,	Maximum Drift Rate (x4)	NAN	kHz/50µs	
0 kHz to +250 kHz,	Average Frequency Deviation (x4),	NAN	kHz	
0 kHz to +250 kHz,	Minimum Frequency Deviation (x4),	NAN	kHz	
0 kHz to +250 kHz,	Maximum Frequency Deviation (x4),	NAN	kHz	
–128 dBm to 30 dBm,	Average Burst Power	NAN	dBm	
0% to 100%	Burst out of Tolerance	NAN	%	

Description of command	Sig. State
These commands are always queries. They start a measurement (`READ...`) and return all scalar measurement results. The symbol (x4) behind a value indicates that the list contains four results corresponding to the *Current,* the *Average,* the *Minimum,* and the *Maximum* measurement curve, respectively. The meaning and the number of the returned values depends on the measurement mode set via `CONFigure:MODulation:DEViation:MMODe` • In the `ALL` mode, the R&S® CBT measures all channels and returns the average result. • In `SINGle` mode, the R&S® CBT measures the channel selected via `CONFigure:MODulation:DEViation:MFRequency` and returns the corresponding result. • In `SIMultaneous` mode, the R&S® CBT acquires and returns five complete sets of results corresponding to the five channels selected with `CONFigure:MODulation:DEViation:MFRequency:SIMultaneous`. This means that the whole list described in the *Returned Values* column above is repeated five times. For more details refer to the description of aggregated and separate channels in Chapter 4.	TEST

Scalar Results incl. "Bits out of Tolerance"

READ[:SCALar]:MODulation:DEViation:EXTended? Start single shot measurement and return results
FETCh[:SCALar]:MODulation:DEViation:EXTended? Read out meas. results (unsynchronized)

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–250 kHz to +250 kHz,	Frequency Accuracy (x4),	NAN	kHz	V3.50
–250 kHz to +250 kHz,	Frequency Drift (x4),	NAN	kHz	
–999 kHz/50 µs to 999 kHz/50 µs,	Maximum Drift Rate (x4)	NAN	kHz/50 µs	
0 kHz to +250 kHz,	Average Frequency Deviation (x4),	NAN	kHz	
0 kHz to +250 kHz,	Minimum Frequency Deviation (x4),	NAN	kHz	
0 kHz to +250 kHz,	Maximum Frequency Deviation (x4),	NAN	kHz	
0% to 100%,	Bits above threshold	NAN	%	
–128 dBm to 30 dBm,	Average Burst Power	NAN	dBm	
0% to 100%	Burst out of Tolerance	NAN	%	

Description of command — Sig. State: TEST

These commands are always queries. They start a measurement (`READ...`) and return all scalar measurement results. The symbol (x4) behind a value indicates that the list contains four results corresponding to the *Current,* the *Average,* the *Minimum,* and the *Maximum* measurement curve, respectively.

The meaning and the number of the returned values depends on the measurement mode set via `CONFigure:MODulation:DEViation:MMODe`

- In the `ALL` mode, the R&S® CBT measures all channels and returns the average result.
- In `SINGle` mode, the R&S® CBT measures the channel selected via `CONFigure:MODulation:DEViation:MFRequency` and returns the corresponding result.
- In `SIMultaneous` mode, the R&S® CBT acquires and returns five complete sets of results corresponding to the five channels selected with `CONFigure:MODulation:DEViation:MFRequency:SIMultaneous`. This means that the whole list described in the *Returned Values* column above is repeated five times.

For more details refer to the description of aggregated and separate channels in Chapter 4.

Bits out of Tolerance

FETCh[:SCALar]:MODulation:DEViation:BAThreshold? Read out meas. results (unsynchronized)

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
0% to 100%	Bits out of Tolerance	NAN	%	V3.50

Description of command — Sig. State: TEST

These commands are always queries. They start a measurement (`READ...`) and return the *Bits out of Tolerance* result. The meaning and the number of the returned values depends on the measurement mode set via `CONFigure:MODulation:DEViation: MMODe`

- In the `ALL` mode, the R&S® CBT measures all channels and returns the average result.
- In `SINGle` mode, the R&S® CBT measures the channel selected via `CONFigure:MODulation:DEViation:MFRequency` and returns the corresponding result.
- In `SIMultaneous` mode, the R&S® CBT takes and returns five complete sets of results corresponding to the channel sequence selected with `CONFigure:MODulation:DEViation:MFRequency:SIMultaneous`. This means that the value is repeated five times.

For more details refer to the description of aggregated and separate channels in Chapter 4.

CALCulate:MODulation:DEViation:MATChing:LIMit?				Limit Matching
Returned values	Value range	Def. value	Def. unit	FW vers.
Frequency Accuracy (x4), **Frequency Drift (x4),** **Maximum Drift Rate (x4),** **Average Freq. Deviation (x4),** **Minimum Freq. Deviation (x4),** **Maximum Freq. Deviation (x4)**	For all measured values: NMAU | NMAL | INV | OK	INV INV INV INV INV INV	– – – – – –	V3.50
Description of command				Sig. State
This command is always a query. It indicates whether and in which way the permissible error limits for the scalar measured values (see command above) have been exceeded. The symbol (x4) behind a value indicates that the list contains four results corresponding to the *Current,* the *Average,* the *Minimum,* and the *Maximum* measurement curve, respectively. Possible values are: *NMAU* Result is above the limit *NMAL* Result is below the limit *INV* Result is invalid *OK* Result is valid The meaning and the number of the returned values depends on the measurement mode set via `CONFigure:MODulation:DEViation:MMODe`; see description of `READ...?, FETCh...?` commands above.				TEST

READ:ARRay:MODulation:DEViation:CURRent? Frequency Deviation
READ:ARRay:MODulation:DEViation:AVERage?
READ:ARRay:MODulation:DEViation:MINimum?
READ:ARRay:MODulation:DEViation:MAXimum?
Start single shot measurement and return results ⇒ *RUN*
FETCh:ARRay:MODulation:DEViation:CURRent?
FETCh:ARRay:MODulation:DEViation:AVERage?
FETCh:ARRay:MODulation:DEViation:MINimum?
FETCh:ARRay:MODulation:DEViation:MAXimum?
Read measurement results (unsynchronized) ⇒ *RUN*

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–250.0 kHz to +250 kHz, **... ,** **–250.0 kHz to +200 kHz**	1^{st} value for frequency deviation, ..., nth value for frequency deviation	NAN ... NAN	kHz ... kHz	V3.50

Description of command	Sig. State
These commands are always queries. They return the frequency deviation versus time at fixed, equidistant test points. With a constant sampling rate of 4 test points per bit, the number n and the position of the test points depends on the measurement range, see command `CONFigure:MODulation: DEViation:MRANge.`	TEST

The meaning of the returned values depends on the measurement mode set via `CONFigure:MODulation:DEViation:MMODe`:

- In `ALL` mode, the R&S® CBT measures all available channels and returns the trace averaged over all these channels.
- In `SINGle` mode, the R&S® CBT measures the channel selected via `CONFigure:MODulation:DEViation:MFRequency` and returns the corresponding trace.
- In `SIMultaneous` mode, the R&S® CBT measures the channels selected with `CONFigure:MODulation:DEViation:MFRequency:SIMultaneous` and returns the trace averaged over these channels.

The calculation of *current, average, maximum* and *minimum* values is explained in Chapter 3 (*display mode*).

READ:SUBarrays:MODulation:DEViation:CURRent? Subarray Results
READ:SUBarrays:MODulation:DEViation:AVERage?
READ:SUBarrays:MODulation:DEViation:MINimum?
READ:SUBarrays:MODulation:DEViation:MAXimum?
Start single shot measurement and return results ⇒ *RUN*
FETCh:SUBarrays:MODulation:DEViation:CURRent?
FETCh:SUBarrays:MODulation:DEViation:AVERage?
FETCh:SUBarrays:MODulation:DEViation:MINimum?
FETCh:SUBarrays:MODulation:DEViation:MAXimum?
Read measurement results (unsynchronized) ⇒ *RUN*

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–250.0 kHz to +250 kHz, **... ,** **–250.0 kHz to +250 kHz**	1st value for frequency deviation, ..., xth value for frequency deviation	NAN ... NAN	kHz ... kHz	V3.50

Description of command	Sig. State
These commands are always queries. They output the frequency deviation versus time in the subranges defined by means of the `CONFigure:SUBarrays:MODulation:DEViation` command. A valid subrange must be defined before the `READ:SUBarrays..., FETCh:SUBarrays...` command group can be used. The `CONFigure:SUBarrays:MODulation:DEViation` command defines a maximum of 32 subranges. If one of the statistical modes `(ARIThmetical, MINimum, MAXimum…)` is set, only one value is returned per subrange. The calculation of *current, average, minimum,* and *maximum* results is explained in Chapter 3 (see *display mode*).	TEST

Subsystem Modulation:DPSKeying

The commands in this section control the modulation measurement for DPSK-modulated EDR packets. They correspond to the measurement control softkey *Modulation DPSK* in the measurement menu *Modulation* and the associated hotkeys. This measurement is only available if software option CBT-K55 has been installed.

INITiate:MODulation:DPSKeying	Start new measurement		⇒ *RUN*
ABORt:MODulation:DPSKeying	Abort running measurement and switch off		⇒ *OFF*
STOP:MODulation:DPSKeying	Stop measurement after current stat. cycle		⇒ *STOP*
CONTinue:MODulation:DPSKeying	Next measurement step (only *stepping mode)*		⇒ *RUN*
Description of command		Sig. State	FW vers.
These commands have no query form. They start and stop the modulation DPSK measurement, setting it to the status indicated in the top right column.		all	V3.85

CONFigure:MODulation:DPSKeying:EREPorting <Mode>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC** | **SRSQ** | **OFF**	Service request Single operation complete SRQ and SRSQ No reporting	OFF	–	V3.85
Description of command				Sig. State
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see Chapter 5).				all

FETCh:MODulation:DPSKeying:STATus?				Measurement Status
Ret. values	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN** | **STOP** | **ERR** | **STEP** | **RDY,**	Measurement in the *OFF* state (*RST or `ABORt`) Running (after `INITiate`, `CONTinue` or `READ`) Stopped (STOP) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V3.85
1 to 10000 | **NONE,**	Counter for current statistics cycle No counting mode set	NONE	–	
1 to 1000 | **NONE**	Counter for current evaluation period within a cycle Statistic count set to off	NONE	–	
Description of command				Sig. State
This command is always a query. It returns the status of the measurement (see Chapters 3 and 5).				all

CONFigure:MODulation:DPSKeying:MMODe *<Mode>*				Measurement Mode
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ALL | **SINGle** | **SIMultaneous**	Measure and aggregate all channels of the current hop scheme Measure bursts from a definite channel only Simultaneous measurement on the five channels selected with the command `CONFigure:MODulation:DPSKeying:MFRequency:SIMultaneous.`	ALL	–	V3.85
Description of command				Sig. State
This command sets how many channels are to measured and whether the results are to be kept separate or aggregated. In `ALL` mode, the measurement is performed on every available burst, no matter what frequency it is on. In `SINGle` mode, the R&S® CBT measures the channel selected via `CONFigure:MODulation:DPSKeying:MFRequency.` In `SIMultaneous` mode, the R&S® CBT takes and returns five complete sets of results; see description of the `READ:...MODulation...,` `and FETCh:...MODulation...` commands.				all

CONFigure:MODulation:DPSKeying:MFRequency:SIMultaneous *<Meas_Freq_1>,..., <Meas_Freq_5>*				Simult. Meas. – Measured Ch.
<Meas_Freq_1> to <Meas_Freq_5>	Description of parameters	Def. value	Def. unit	FW vers.
2402 MHz to 2495 MHz | **OFF**	Measured frequency Measurement switched off	see below	Hz	V3.85
Description of command				Sig. State
This command defines the five frequencies to be measured if the measurement mode is set to `SIMultaneous` (see command `CONFigure:MODulation:DPSKeying:MMODe)`. With the command `CONFigure:MODulation:DPSKeying:MFRequency:UNIT`, the default frequency unit can be changed, and even *Bluetooth* channel numbers can be entered instead of frequencies. The default frequencies correspond to the channel sequence 0, 19, 39, 59, 78.				all

CONFigure:MODulation:DPSKeying:MFRequency *<Meas_Freq>*				Display Frequency
<Meas_Freq>	Description of parameters	Def. value	Def. unit	FW vers.
2402 MHz to 2495 MHz	Measured frequency	2402 000 000	Hz	V3.85
Description of command				Sig. State
This command defines the frequency to be measured if the measurement mode is set to `SINGle` (see command `CONFigure:MODulation:DPSKeying:MMODe)`. With the command `CONFigure:MODulation:DPSKeying:MFRequency:UNIT`, the default frequency unit can be changed, and even *Bluetooth* channel numbers can be entered instead of frequencies.				all

CONFigure:MODulation:DPSKeying:MFRequency:UNIT *<Unit>*				Frequency Unit
<Unit>	Description of parameters	Def. value	Def. unit	FW vers.
HZ | **KHZ** | **MHZ** | **GHZ** | **CH**	Frequency unit | Channel number	HZ	–	V3.85
Description of command				Sig. State
This command defines whether the measured frequency (see command `CONFigure:MODulation:DPSKeying:MFRequency)` is specified in frequency units or as a Bluetooth channel number.				all

CONFigure:MODulation:DPSKeying:MRANge *<Start>*, *<Span>*				Time Scale Start, Time Scale Span
<Start>	Description of parameters	Def. value	Def. unit	FW vers.
–200 to 3200	Start of measurement range	–200	symbol	V3.85
<Span>	Description of parameters	Def. value	Def. unit	FW vers.
0.0625 to 5	Span of measurement range	1	slots	V3.85
Description of command				Sig. State
This command defines the measurement range for the `MODulation:DPSKeying` measurement. The second input value *<Span>* is rounded to one of the following discrete values: 0.0625 (1/16 slot), 0.125 (1/8 slot), 0.25 (1/4 slot), 0.5 (1/2 slot), 1 (slot), 2 (slots), 3 (slots), 4 (slots), 5 (slots) This command is used to determine the first symbol position and number of symbols returned by the `READ:ARRay:MODulation:DPSKeying...` commands. The span setting directly affects the number of symbols returned:				all

<Span> (slots)	0.0625	0.125	0.25	0.5	1	2	3	4	5
Symbols	39	78	156	312	625	1250	1875	2500	3125

CONFigure:MODulation:DPSKeying:FILTer:BWIDth *<Width>*				Filter Bandwidth
<Width>	Description of parameters	Def. value	Def. unit	FW vers.
WIDE | **NARR**	2 MHz bandwidth filter 1.3 MHz bandwidth filter	WIDE	–	V3.85
Description of command				Sig. State
Selects the resolution bandwidth of the measurement filter used for for *Modulation DPSK* measurements.				all

Subsystem MODulation:DPSKeying:CONTrol

The subsystem *MODulation:DPSKeying:CONTrol* defines the scope of the modulation measurement. The corresponding settings are in the *Control* tab of the popup menu *Modulation Configuration.*

CONFigure:MODulation:DPSKeying:CONTrol *<Mode>, <Statistics>, <Repetition>, <StopCond>, <Stepmode>*				Scope of Measurement
<Mode>	Desciption of parameters	Def. value	Def. unit	FW vers.
SCALar | **ARRay,**	Scalar values only (incl. limit matching) Scalar measured values and arrays	ARRay	–	V3.85
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	Number of bursts per statistics cycle Statistics off (equivalent to 1)	100	–	V3.85
<Repetition>	Description of parameters	Def. value	Def. unit	FW vers.
CONTinuous | **SINGleshot** | **1 to 10000,**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (counting, until `Status = STEP | RDY`)	SING	–	V3.85
<StopCond>	Description of parameters	Def. value	Def. unit	FW vers.
SONerror | **NONE,**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	V3.85
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V3.85
Description of command				Sig. State
This command restricts the type of measured values to accelerate the measurement and determines the number of bursts within a statistics cycle. **Note:** For READ commands (READ:...), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot. The <Repetition> parameter is valid in remote control only. Changing this parameter in remote control does not alter the repetition mode in manual control and vice versa. The default repetition mode in manual control is *Continuous.*				all

CONFigure:MODulation:DPSKeying:CONTrol:RMODe *<Mode>*				Result mode
<Mode>	Desciption of parameters	Def. value	Def. unit	FW vers.
SCALar | **ARRay**	Scalar values only (include limit matching) Scalar measured values and arrays available	ARRay	–	V3.85
Description of command				Sig. State
This command specifies the type of measured values. If the parameter `SCALar` is set, the measurement curves (arrays, see commands `READ:ARRay:POWer:TIME...`, `READ:SUBarray:POWer:TIME...)` are no longer available but the measurement is sped up considerably.				all

CONFigure:MODulation:DPSKeying:CONTrol:STATistics *<Statistics>*				Statistics Count
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	Number of bursts per statistics cycle Statistics off (equivalent to 1)	100	–	V3.85
Description of command				Sig. State
This command specifies the type of measured values and defines the number of bursts forming a statistics cycle.				all

CONFigure:MODulation:DPSKeying:CONTrol:REPetition <Repetition>,<StopCondition>,<StepMode> — Test Cycles

<Repetition>	Description of parameters	Def. value	Def. unit	FW vers.
CONTinuous | **SINGleshot |** **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (counting, until `Status = STEP | RDY`)	SING	–	V3.85
<StopCondition>	Description of parameters	Def. value	Def. unit	FW vers.
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	V3.85
<StepMode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V3.85

Description of command	Sig. State
This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement. **Note:** For READ commands (READ:...), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot. The <Repetition> parameter is valid in remote control only. Changing this parameter in remote control does not alter the repetition mode in manual control and vice versa. The default repetition mode in manual control is *Continuous.*	all

DEFault:MODulation:DPSKeying:CONTrol *<Enable>* — Default Settings

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V3.85

Description of command	Sig. State
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting OFF results in an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF).*	all

Limits – Subsystem MODulation:DPSKeying:LIMit

The subsystem *MODulation:DPSKeying:LIMit* defines tolerance values for the modulation measurement. The subsystem corresponds to the tab *Limits* in the popup menu *Modulation Configuration.*

Upper Modulation DPSK Limits

CONFigure:MODulation:DPSKeying:CURRent:LIMit:SCALar:ASYMmetric:UPPer:VALue
CONFigure:MODulation:DPSKeying:AVERage:LIMit:SCALar:ASYMmetric:UPPer:VALue
CONFigure:MODulation:DPSKeying:MINimum:LIMit:SCALar:ASYMmetric:UPPer:VALue
CONFigure:MODulation:DPSKeying:MAXimum:LIMit:SCALar:ASYMmetric:UPPer:VALue
<Freq_Stability_ωi>, <Freq_Stability_ ωi + ωo $_{max}$***>, <Freq_Stability_ ωo*** $_{max}$***>, <RMS_DEVM_π/4_DQPSK>, <RMS_DEVM_8DPSK>, <Peak_DEVM_π/4_DQPSK>, <Peak_DEVM_8DPSK>***

<Limit>	Description of parameters	Def. value	Def. unit	FW vers.
–250 kHz to +250 kHz,	Upper limit for frequency stability ωi	+75	kHz	V3.85
–250 kHz to +250 kHz,	Upper limit for freq. stability ωi + ωo $_{max}$	+75	kHz	
–250 kHz to +250 kHz,	Upper limit for freq. stability ωo $_{max}$	10	kHz	
0 to 1,	Upper limit for RMS DEVM π/4 DQPSK	0.20	–	
0 to 1,	Upper limit for RMS DEVM 8DPSK	0.13	–	
0 to 1,	Upper limit for Peak DEVM π/4 DQPSK	0.35	–	
0 to 1	Upper limit for Peak DEVM 8DPSK.	0.25	–	

Description of command	Sig. State
These commands define upper limits for the frequency stability and DEVM results of the current `(CURRent)`, average `(AVERage)`, minimum `(MINimum)`, and maximum `(MAXimum)` measurement, respectively. If a measurement rises above the limit then the result will be out of tolerance. OFF means that the limit check is switched off.	all

Upper Limits on or off

CONFigure:MODulation:DPSKeying:CURRent:LIMit:SCALar:ASYMmetric:UPPer:ENABle
CONFigure:MODulation:DPSKeying:AVERage:LIMit:SCALar:ASYMmetric:UPPer:ENABle
CONFigure:MODulation:DPSKeying:MINimum:LIMit:SCALar:ASYMmetric:UPPer:ENABle
CONFigure:MODulation:DPSKeying:MAXimum:LIMit:SCALar:ASYMmetric:UPPer:ENABle
<Enable_1>, ..., <Enable_7>

<Enable_n>	Description of parameters	Def. value	Def. unit	FW vers.
	Enable or disable the upper limit check for:			V3.85
ON | OFF,	Frequency stability ωi	ON	–	
ON | OFF,	Frequency stability ωi + ωo $_{max}$	ON	–	
ON | OFF,	Frequency stability ωo $_{max}$	ON	–	
ON | OFF,	RMS DEVM π/4 DQPSK	ON	–	
ON | OFF,	RMS DEVM 8DPSK	ON	–	
ON | OFF,	Peak DEVM π/4 DQPSK	ON	–	
ON | OFF	Peak DEVM 8DPSK	ON	–	

Description of command	Sig. State
These commands enable or disable the upper limit check of the modulation DPSK quantities.	all

Lower Modulation Limits

CONFigure:MODulation:DPSKeying:CURRent:LIMit:SCALar:ASYMmetric:LOWer:VALue
CONFigure:MODulation:DPSKeying:AVERage:LIMit:SCALar:ASYMmetric:LOWer:VALue
CONFigure:MODulation:DPSKeying:MINimum:LIMit:SCALar:ASYMmetric:LOWer:VALue
CONFigure:MODulation:DPSKeying:MAXimum:LIMit:SCALar:ASYMmetric:LOWer:VALue
<Freq_Stab_ωi>,<Freq_Stab_ ωi + ωo max>, <Freq_Stab_ ωo max>

<Limit>	Description of parameters	Def. value	Def. unit	FW vers.
–250 kHz to +250 kHz,	Lower limit for frequency stability ωi	–75	kHz	V3.85
–250 kHz to +250 kHz,	Lower limit for freq. stability ωi + $ωo_{max}$	–75	kHz	
–250 kHz to +250 kHz	Lower limit for freq. stability $ωo_{max}$	–10	kHz	

Description of command	Sig. State
These commands define lower limits for the nominal power of the current `(CURRent)`, average `(AVERage)`, minimum `(MINimum)`, and maximum `(MAXimum)` measurement curve, respectively. If a measurement falls below the limit then the result will be out of tolerance.	all

Lower Limits on or off

CONFigure:MODulation:DPSKeying:CURRent:LIMit:SCALar:ASYMmetric:LOWer:ENABle
CONFigure:MODulation:DPSKeying:AVERage:LIMit:SCALar:ASYMmetric:LOWer:ENABle
CONFigure:MODulation:DPSKeying:MINimum:LIMit:SCALar:ASYMmetric:LOWer:ENABle
CONFigure:MODulation:DPSKeying:MAXimum:LIMit:SCALar:ASYMmetric:LOWer:ENABle
<Enable_1>, <Enable_2>, <Enable_3>

<Enable_n>	Description of parameters	Def. value	Def. unit	FW vers.
	Enable or disable the lower limit check for:			V3.85
ON | OFF,	Frequency stability ωi	ON	–	
ON | OFF,	Frequency stability ωi + $ωo_{max}$	ON	–	
ON | OFF	Frequency stability $ωo_{max}$	ON	–	

Description of command	Sig. State
These commands enable or disable the lower limit check of the modulation DPSK quantities.	all

Upper and Lower Modulation DPSK Limits

CONFigure:MODulation:DPSKeying:CURRent:LIMit:SCALar:ASYMmetric[:COMBined]:VALue
CONFigure:MODulation:DPSKeying:AVERage:LIMit:SCALar:ASYMmetric[:COMBined]:VALue
CONFigure:MODulation:DPSKeying:MAXimum:LIMit:SCALar:ASYMmetric[:COMBined]:VALue
CONFigure:MODulation:DPSKeying:MINimum:LIMit:SCALar:ASYMmetric[:COMBined]:VALue

<Freq_Stab_ωi_Upp>,<Freq_Stab_ωi_Low>,
<Freq_Stab_ ωi + ωo $_{max\_Upp}$>,<Freq_Stab_ ωi + ωo $_{max\_Low}$>,
<Freq_Stab_ ωo $_{max\_Upp}$>,<Freq_Stab_ ωo $_{max\_Low}$>,
<RMS_DEVM_π/4_DQPSK_Upp>,<RMS_DEVM_8DPSK_Upp>,
<Peak_DEVM_π/4_DQPSK_Upp>,<Peak_DEVM_8DPSK_Upp>

<Limit>	Description of parameters	Def. value	Def. unit	FW vers.
–250 kHz to +250 kHz	Upper limit for frequency stability ωi	+75	kHz	V3.85
–250 kHz to +250 kHz	Lower limit for frequency stability ωi	–75	kHz	
–250 kHz to +250 kHz	Upper limit for freq. stability ωi + ωo $_{max}$	+75	kHz	
–250 kHz to +250 kHz	Lower limit for freq. stability ωi + ωo $_{max}$	–75	kHz	
–250 kHz to +250 kHz	Upper limit for freq. stability ωo $_{max}$	+10	kHz	
–250 kHz to +250 kHz	Lower limit for freq. stability ωo $_{max}$	–10	kHz	
0 to 1,	Upper limit for RMS DEVM π/4 DQPSK	0.20	–	
0 to 1,	Upper limit for RMS DEVM 8DPSK	0.13	–	
0 to 1,	Upper limit for Peak DEVM π/4 DQPSK	0.35	–	
0 to 1	Upper limit for Peak DEVM 8DPSK	0.25	–	

Description of command	Sig. State
These commands define upper and lower limits for the nominal power of the current `(CURRent)`, average `(AVERage)`, minimum `(MINimum)`, and maximum `(MAXimum)` measurement curve, respectively. If a measurement falls below the limit then the result will be out of tolerance.	all

All Limits on or off

CONFigure:MODulation:DPSKeying:CURRent:LIMit:SCALar:ASYMmetric[:COMBined]:ENABle
CONFigure:MODulation:DPSKeying:AVERage:LIMit:SCALar:ASYMmetric[:COMBined]:ENABle
CONFigure:MODulation:DPSKeying:MAXimum:LIMit:SCALar:ASYMmetric[:COMBined]:ENABle
CONFigure:MODulation:DPSKeying:MINimum:LIMit:SCALar:ASYMmetric[:COMBined]:ENABle

<Enable_1> ... <Enable_16>

<Enable_n>	Description of parameters	Def. value	Def. unit	FW vers.
	Enable or disable the limit check for:			V3.85
ON | OFF,	Frequency stability ωi (upper)	ON, ON	–	
ON | OFF,	Frequency stability ωi (lower)	ON, ON	–	
ON | OFF,	Frequency stab. ωi + ωo $_{max}$ (upper)	ON, ON	–	
ON | OFF,	Frequency stab. ωi + ωo $_{max}$ (lower)	ON, ON	–	
ON | OFF,	Frequency stability ωo $_{max}$ (upper)	ON, ON	–	
ON | OFF,	Frequency stability ωo $_{max}$ (lower)	ON, ON	–	
ON | OFF,	RMS DEVM π/4 DQPSK (upper)	ON, ON	–	
ON | OFF,	RMS DEVM 8DPSK (upper)	ON, ON	–	
ON | OFF,	Peak DEVM π/4 DQPSK (upper)	ON, ON	–	
ON | OFF	Peak DEVM 8DPSK (upper)	ON, ON	–	

Description of command	Sig. State
These commands enable or disable the upper and lower limit check of the modulation quantities.	all

CONFigure:MODulation:DPSKeying:DEVMagnitude:THReshold[:VALue] <π/4_DQPSK_DEVM_Threshold>, <8DPSK_DEVM_Threshold>				99% DEVM – Threshold
<DEVM>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 1 **0 to 1**	Lower limits for π/4 DQPSK thresholds Lower limits for 8DPSK thresholds	0.3 0.2	– –	V3.85
Description of command				Sig. State
This command defines the π/4 DQPSK and 8DPSK thresholds, to be used in connection with the conformance limit (`CONFigure:MODulation:DPSKeying:DEVMagnitude :CLIMit[:VALue]`).				all

CONFigure:MODulation:DPSKeying:DEVMagnitude:CLIMit[:VALue] ***<π/4DQPSK_DEVM_CLimit>, <8DPSK_DEVM_CLimit>***				99% DEVM – Conformance Limit
<CLimit>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 100 **0 to 100**	Conformance limit for π/4 DQPSK DEVM Conformance limit for 8DPSK DEVM	99 99	% %	V3.85
Description of command				Sig. State
This command defines the minimum percentage of symbols which must have a DEVM of less than or equal to the defined threshold (`CONFigure:MODulation:DPSKeying:DEVMagnitude: THReshold[:VALue]).`				all

CONFigure:MODulation:DPSKeying:DEVMagnitude:CLIMit:ENABle ***<Enable_1>, <Enable_2>***				99% DEVM – Enable Limit Check
<Enable_n>	Description of parameters	Def. value	Def. unit	FW vers.
 ON | OFF, **ON | OFF**	Enable or disable conformance limit check for: π/4 DQPSK DEVM 8DPSK DEVM	 ON ON	 – –	V3.85
Description of command				Sig. State
This command enables or disables the 99% DEVM conformance limit check.				all

DEFault:MODulation:DPSKeying:LIMit ***<Enable>***				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V3.85
Description of command				Sig. State
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting OFF results in an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF).*				all

Subsystem SUBarrays:MODulation:DPSKeying

The subsystem *SUBarrays:MODulation:DPSKeying* defines the measurement range and the type of output values.

CONFigure:SUBarrays:MODulation:DPSKeying *<Mode>,<Start>,<Samples>{,<Start>,<Samples>}*				Definition of Subarrays
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ALL | **ARIThmetical** | **MINimum** | **MAXimum** | **IVAL** | **XMAXimum** | **XMINimum** | **PAVG,**	Return all measurement values Return arithm. mean value in every subrange Return minimum value in every subrange Return maximum value in every subrange Return single interpolated value at <Start> Return x-axis value of maximum and maximum Return x-axis value of minimum and minimum Return arithmetic mean value in every subrange	ALL	–	V3.85 V5.00
<Start>	Description of parameters	Def. value	Def. unit	
–200 to 3200	Start time in current range	NAN	symbols	
<Samples>	Description of parameters	Def. value	Def. unit	
0 to 3125 *)	No. of samples in range	NAN	–	
Description of command				Sig. State
This command configures the `READ:SUBarrays:MODulation:DPSKeying...` and `FETCh:SUBarrays:MODulation:DPSKeying...` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by a start time and the number of test points which are located on a fixed, equidistant grid. For <Mode> = IVAL, the <Samples> parameter is ignored and the R&S CBT returns a single measurement value corresponding to the abscissa value <Start>. If <Start> is located between two test points with valid results then the result is calculated from the results at these two adjacent test points by linear interpolation. The subranges may overlap but must be within the total range of the `MODulation:DPSKeying` measurement defined via `CONFigure:MODulation:DPSKeying:MRANge`. Test points outside this range are not measured (result is *NAN)* and do not enter into the ARIThmetical, MINimum and MAXimum values. By default, only one range corresponding to the total measurement range is used and all measurement values are returned. *) **Useful range; see** `CONFigure:MODulation:DPSKeying:MRANge`. The command also accepts values >3125.				all

Measured Values

The following commands start a measurement and return the measurement results. They correspond to the different output elements in the graphical measurement menu *MODulation DPSK.*

				Scalar Results
READ[:SCALar]:MODulation:DPSKeying?				Start single shot measurement and return results
FETCh[:SCALar]:MODulation:DPSKeying?				Read out meas. results (unsynchronized)
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–250 kHz to +250 kHz,	Frequency stability ωi (x4),	NAN	kHz	V3.85
–250 kHz to +250 kHz,	Frequency stability ωi + ωo $_{max}$ (x4),	NAN	kHz	
–250 kHz to +250 kHz,	Frequency stability ωo $_{max}$ (x4),	NAN	kHz	
0 to 1,	RMS DEVM (x4),	NAN	–	
0 to 1,	Peak DEVM (x4),	NAN	–	
–128 dBm to 30 dBm	Average Burst Power,	NAN	dBm	
0 to 100	99% DEVM	NAN	%	
Description of command				Sig. State
These commands are always queries. They start a measurement (READ...) and return all scalar measurement results. The symbol (x4) after a value, above, indicates that the list contains four results corresponding to the *Current,* the *Average,* the *Minimum,* and the *Maximum* measurement curve, respectively. The meaning and the number of the returned values depends on the measurement mode set via `CONFigure:MODulation:DPSKeying:MMODe` • In the `ALL` mode, the R&S® CBT measures all channels and returns the average result. • In `SINGle` mode, the R&S® CBT measures the channel selected via `CONFigure:MODulation:DPSKeying:MFRequency` and returns the corresponding result. • In `SIMultaneous` mode, the R&S® CBT acquires and returns five complete sets of results corresponding to the five channels selected with `CONFigure:MODulation:DPSKeying:MFRequency:SIMultaneous`. This means that the whole list described in the *Returned Values* column above is repeated five times. For more details refer to the description of aggregated and separate channels in Chapter 4.				TEST

CALCulate:MODulation:DPSKeying:MATChing:LIMit? — Limit Matching

Returned values	Value range	Def. value	Def. unit	FW vers.
Frequency stability ωi (x4),	For all measured values: NMAU | NMAL | INV | OK	INV	–	V3.85
Frequency stability ωi + ωo $_{max}$ (x4),		INV	–	
Frequency stability ωo $_{max}$ (x4),		INV	–	
RMS DEVM (x4),		INV	–	
Peak DEVM (x4),		INV	–	
Average Burst Power (x1),		INV	–	
99%DEVM (x1)		INV	–	

Description of command	Sig. State
This command is always a query. It indicates whether and in which way the permissible error limits for the scalar measured values (see command above) have been exceeded. The symbol (x4) behind a value indicates that the list contains four results corresponding to the *Current,* the *Average,* the *Minimum,* and the *Maximum* measurement curve, respectively.	TEST

Possible values are:

Possible values are:	*NMAU*	Result is above the limit
	NMAL	Result is below the limit
	INV	Result is invalid
	OK	Result is valid

The meaning and the number of the returned values depends on the measurement mode set via `CONFigure:MODulation:DPSKeying:MMODe`; see description of `READ...?` and `FETCh...?` commands above.

Peak DEVM and RMS DEVM results are supplied depending on the current modulation type (π/4DQPSK or 8DPSK).

READ:ARRay:MODulation:DPSKeying:CURRent? **READ:ARRay:MODulation:DPSKeying:AVERage?** **READ:ARRay:MODulation:DPSKeying:MINimum?** **READ:ARRay:MODulation:DPSKeying:MAXimum?**	DEVM
Start single shot measurement and return results	⇒ *RUN*
FETCh:ARRay:MODulation:DPSKeying:CURRent? **FETCh:ARRay:MODulation:DPSKeying:AVERage?** **FETCh:ARRay:MODulation:DPSKeying:MINimum?** **FETCh:ARRay:MODulation:DPSKeying:MAXimum?**	
Read measurement results (unsynchronized)	⇒ *RUN*

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
0 to 1, **...,** **0 to 1**	1st value for DEVM, ..., nth value for DEVM	NAN ... NAN		V3.85

Description of command	Sig. State
These commands are always queries. They return the DEVM versus time at fixed, equidistant test points. The number of and the position of the test points depends on the measurement range, see the command `CONFigure:MODulation:DPSKeying:MRANge`. The meaning of the returned values depends on the measurement mode set via `CONFigure:MODulation:DPSKeying:MMODe`: • In `ALL` mode, the R&S® CBT measures all available channels and returns the trace averaged over all these channels. • In `SINGle` mode, the R&S® CBT measures the channel selected via `CONFigure:MODulation:DPSKeying:MFRequency` and returns the corresponding trace. • In `SIMultaneous` mode, the R&S® CBT measures the channels selected with `CONFigure:MODulation:DPSKeying:MFRequency:SIMultaneous` and returns the trace averaged over these channels. The calculation of *current, average, maximum* and *minimum* values is explained in Chapter 3 (display *mode).*	TEST

READ:SUBarrays:MODulation:DPSKeying:CURRent? **READ:SUBarrays:MODulation:DPSKeying:AVERage?** **READ:SUBarrays:MODulation:DPSKeying:MINimum?** **READ:SUBarrays:MODulation:DPSKeying:MAXimum?** Start single shot measurement and return results ⇒ *RUN* **FETCh:SUBarrays:MODulation:DPSKeying:CURRent?** **FETCh:SUBarrays:MODulation:DPSKeying:AVERage?** **FETCh:SUBarrays:MODulation:DPSKeying:MINimum?** **FETCh:SUBarrays:MODulation:DPSKeying:MAXimum?** Read measurement results (unsynchronized) ⇒ *RUN*				Subarray Results
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
0 to 1, **... ,** **0 to 1**	1^{st} value for DEVM, ..., n^{th} value for DEVM	NAN ... NAN		V3.85
Description of command				Sig. State
These commands are always queries. They output the DEVM versus time in the subranges defined by means of the `CONFigure:SUBarrays:MODulation:DPSKeying` command. A valid subrange must be defined before the `READ:SUBarrays...`, and `FETCh:SUBarrays...` command group can be used. The `CONFigure:MODulation:DPSKeying:MRANge` command can also be used to affect the number of returned values. The `CONFigure:SUBarrays:MODulation:DPSKeying` command defines a maximum of 32 subranges. If one of the statistical modes `(ARIThmetical, MINimum, MAXimum…)` is set, only one value is returned per subrange. The calculation of *current, average, minimum,* and *maximum* results is explained in Chapter 3 (see *display mode).*				TEST

Modulation Encoding

The commands in this section control the EDR differential phase encoding measurement. They correspond to the measurement control softkey *Modulation Encoding* in the measurement menu *Modulation* and the associated hotkeys. This measurement is only available if software option CBT-K55 has been installed.

INITiate:MODulation:ENCoding	Start new measurement		⇒ *RUN*
ABORt:MODulation:ENCoding	Abort running measurement and switch off		⇒ *OFF*
STOP:MODulation:ENCoding	Stop measurement after current stat. cycle		⇒ *STOP*
CONTinue:MODulation:ENCoding	Next measurement step (only *stepping mode*)		⇒ *RUN*
Description of command		Sig. State	FW vers.
These commands have no query form. They start and stop the modulation encoding measurement, setting it to the status indicated in the top right column.		all	V4.00

CONFigure:MODulation:ENCoding:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC** | **SRSQ** | **OFF**	Service request Single operation complete SRQ and SRSQ No reporting	OFF	–	V4.00
Description of command				Sig. State
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see Chapter 5).				all

FETCh:MODulation:ENCoding:STATus?				Measurement Status
Ret. values	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN** | **STOP** | **ERR** | **STEP** | **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate`, `CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V4.00
1 to 10000 | **NONE,**	Counter for current statistics cycle No counting mode set	NONE	–	
1 to 1000 | **NONE**	Counter for current evaluation period within a cycle Statistic count set to off	NONE	–	
Description of command				Sig. State
This command is always a query. It returns the status of the measurement (see Chapters 3 and 5).				all

Subsystem MODulation:ENCoding:CONTrol

The subsystem *MODulation:ENCoding:CONTrol* defines the scope of the modulation measurement. The settings are provided in the *Control* tab of the popup menu *Modulation Configuration*.

CONFigure:MODulation:ENCoding:CONTrol *<Mode>, <Statistics>, <Repetition>, <StopCondition>, <StepMode>*				Scope of Measurement
<Mode>	Desciption of parameters	Def. value	Def. unit	FW vers.
SCALar | **ARRay,**	Scalar values only (incl. limit matching) Scalar measured values and arrays	ARR	–	V4.00
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	Number of bursts per statistics cycle Statistics off (equivalent to 1)	100	–	V4.00
<Repetition>	Description of parameters	Def. value	Def. unit	FW vers.
CONTinuous | **SINGleshot** | **1 to 10000,**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	V4.00
<StopCondition>	Description of parameters	Def. value	Def. unit	FW vers.
SONerror | **NONE,**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	V4.00
<StepMode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V4.00
Description of command				Sig. State
This command restricts the type of measured values to accelerate the measurement and determines the number of bursts within a statistics cycle. **Note:** In the case of READ commands (`READ:`...), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot. The <Repetition> parameter is valid in remote control only. Changing this parameter in remote control does not alter the repetition mode in manual control and vice versa. The default repetition mode in manual control is *Continuous*.				all

CONFigure:MODulation:ENCoding:CONTrol:STATistics *<Statistics>*				Statistics Count
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	Number of bursts per statistics cycle Statistics off (equivalent to 3)	100	–	V4.00
Description of command				Sig. State
This command specifies the type of measured values and defines the number of bursts forming a statistics cycle.				all

CONFigure:MODulation:ENCoding:CONTrol:REPetition ***<Repetition>,<StopCond>,<Stepmode>***				Test Cycles
<Repetition>	Description of parameters	Def. value	Def. unit	FW vers.
CONTinuous | **SINGleshot** | **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	V4.00
<StopCondition>	Description of parameters	Def. value	Def. unit	FW vers.
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	V4.00
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V4.00
Description of command				Sig. State
This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement. **Note:** For READ commands (`READ:`...), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot. The <Repetition> parameter is valid in remote control only. Changing this parameter in remote control does not alter the repetition mode in manual control and vice versa. The default repetition mode in manual control is *Continuous*.				all

DEFault:MODulation:ENCoding:CONTrol ***<Enable>***				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V4.00
Description of command				Sig. State
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting OFF results in an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				all

Limits – Subsystem MODulation:ENCoding:LIMit

The subsystem *MODulation:ENCoding:LIMit* defines tolerance values for the modulation encoding measurement. There are two limits: BER and packets with 0 bit errors. There is only an upper limit for the BER and only a lower limit for the packets with 0 bit errors. The subsystem corresponds to the tab *Limits* in the popup menu *Modulation.*

Lower Modulation Encoding Limit

CONFigure:MODulation:ENCoding:CURRent:LIMit:SCALar:ASYMmetric:UPPer:VALue ***<BER_Limit>***

<BER_Limit>	Description of parameters	Def. value	Def. unit	FW vers.
0.00 to 100.00	Upper limit for bit error rate (BER)	0.1	%	V4.00
Description of command				Sig. State
This command defines the upper limit for the bit error rate in the modulation encoding measurement. If a measurement rises above the limit then the result will be out of tolerance. Increment between values is 0.01.				all

Upper Limits On or Off

CONFigure:MODulation:ENCoding:CURRent:LIMit:SCALar:ASYMmetric:UPPer:ENABle ***<Enable>***

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Enable or disable the upper limit check for: Bit error rate (BER)	OFF	–	V4.00
Description of command				Sig. State
These commands enable or disable the limit check of the BER encoding modulation quantities.				all

Lower Modulation Encoding Limit

CONFigure:MODulation:ENCoding:CURRent:LIMit:SCALar:ASYMmetric:LOWer:VALue ***<Zero_Errors_Limit>***

<Zero_Errors_Limit>	Description of parameters	Def. value	Def. unit	FW vers.
0.00 to 100.00	Lower limit for packets with 0 bit errors	99	%	V4.00
Description of command				Sig. State
This command defines the lower limit for the percentage of packets with 0 bit errors in the modulation encoding measurement. If a measurement falls below the limit then the result will be out of tolerance.				all

Lower Limits On or Off

CONFigure:MODulation:ENCoding:CURRent:LIMit:SCALar:ASYMmetric:LOWer:ENABle ***<Enable>***

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Enable or disable the lower limit check for: Lower limit for packets with 0 bit errors	ON	–	V4.00
Description of command				Sig. State
These commands enable or disable the lower limit check of the modulation quantities.				all

Upper and Lower Modulation Encoding Limits

CONFigure:MODulation:ENCoding:CURRent:LIMit:SCALar:ASYMmetric[:COMBined]:VALue ***<BER_Limit>, <Zero_Errors_Limit>***

<Limit>	Description of parameters	Def. value	Def. unit	FW vers.
0.00 to 100.00	Upper limit for bit error rate (BER)	0.1	%	V4.00
0.00 to 100.00	Lower limit for packets with 0 bit errors	99	%	

Description of command	Sig. State
These commands defines the limits for the modulation encoding measurement. If a measurement of BER rises above the *<BER_Limit>*, or a measurement of the packets with 0 bit errors falls below the *<Zero_Errors_Limit>* then the result will be out of tolerance.	all

All Limits On or Off

CONFigure:MODulation:ENCoding:CURRent:LIMit:SCALar:ASYMmetric[:COMBined]:ENABle ***<Enable_1>, <Enable_2>***

<Enable_n>	Description of parameters	Def. value	Def. unit	FW vers.
	Enable or disable the limit check for:			V4.00
ON | OFF,	bit error rate (upper)	OFF	–	
ON | OFF	packets with 0 bit errors (lower)	ON	–	

Description of command	Sig. State
These commands enable or disable the limit checks of the modulation encoding measurement.	all

DEFault:MODulation:ENCoding:LIMit ***<Enable>*** Default Settings

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON |	The parameters are set to their default values	ON	–	V4.00
OFF	Some or all parameters differ from the default values			

Description of command	Sig. State
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting OFF results in an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.	all

Measured Values

The following commands start a measurement and return the measurement results. They correspond to the different output elements in the graphical measurement menu *Modulation Encoding.*

Scalar Results

READ[:SCALar]:MODulation:ENCoding? Start single shot measurement and return results

FETCh[:SCALar]:MODulation:ENCoding? Read out meas. results (unsynchronized)

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
0 to 100	Bit Error Rate (upper)	NAN	%	V4.00
0 to 100	Packets with 0 bit errors (lower)	NAN	%	

Description of command	Sig. State
These commands are always queries. They start a measurement (`READ...`) and return all scalar measurement results.	TEST

CALCulate:MODulation:ENCoding:MATChing:LIMit?				Limit Matching
Returned values	Value range	Def. value	Def. unit	FW vers.
Bit Error Rate (BER), **Packets with zero bit errors**	For all measured values: NMAU | NMAL | INV | OK	INV INV	– –	V4.00
Description of command				Sig. State
This command is always a query. It indicates whether and in which way the permissible error limits for the scalar measured values (see command above) have been exceeded. Possible values are: *NMAU* Result is above the limit *NMAL* Result is below the limit *INV* Result is invalid *OK* Result is valid				TEST

Modulation IQ Analyzer DPSK

The commands in this section control the modulation measurement's IQ analyzer application. They correspond to the measurement menu *Modulation* and the associated softkeys and hotkeys.

INITiate:MODulation:IQANalyzer:DPSKeying	Start new measurement	*⇒ RUN*
ABORt:MODulation:IQANalyzer:DPSKeying	Abort running measurement and switch off	*⇒ OFF*
STOP:MODulation:IQANalyzer:DPSKeying	Stop measurement after current stat. cycle	*⇒ STOP*
CONTinue:MODulation:IQANalyzer:DPSKeying	Next measurement step (only *stepping mode*)	*⇒ RUN*

Description of command	Sig. State	FW vers.
These commands have no query form. They start and stop the modulation IQAnalyzer DPSK measurement, setting it to the status indicated in the top right column.	all	V4.30

CONFigure:MODulation:IQANalyzer:DPSKeying:EREPorting <*Mode*> — Event Reporting

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ |	Service request	OFF	–	V4.30
SOPC |	Single operation complete			
SRSQ |	SRQ and SRSQ			
OFF	No reporting			

Description of command	Sig. State
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see Chapter 5).	all

FETCh:MODulation:IQANalyzer:DPSKeying:STATus? — Measurement Status

Ret. values	Description of parameters	Def. value	Def. unit	FW vers.
OFF |	Measurement in the *OFF* state (`*RST` or `ABORt`)	OFF	–	V4.30
RUN |	Running (after `INITiate`, `CONTinue` or `READ`)			
STOP |	Stopped (`STOP`)			
ERR |	*OFF* (could not be started)			
STEP |	Stepping mode *(<stepmode>=STEP)*			
RDY,	Stopped according to repetition mode and stop condition			
1 to 10000 |	Counter for current statistics cycle			
NONE,	No counting mode set	NONE	–	
1 to 1000 |	Counter for current evaluation period within a cycle			
NONE	Statistic count set to off	NONE	–	

Description of command	Sig. State
This command is always a query. It returns the status of the measurement (see Chapters 3 and 5).	all

CONFigure:MODulation:IQANalyzer:DPSKeying:SYMBol:MODE <*Mode*> — Symbol Mode

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ABS |	Absolute	ABS	–	V4.30
DIFF |	Differential			
ERR |	Error Vector			

Description of command	Sig. State
This command sets which type of I/Q data is calculated; Absolute, Differential or Error Vector.	all

CONFigure:MODulation:IQANalyzer:DPSKeying:MMODe *<Mode>*				Measurement Mode
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ALL | **SINGle** | **SIMultaneous**	Measure and aggregate all channels of the current hop scheme Measure bursts from a definite channel only Simultaneous measurement on the five channels selected with the command `CONFigure:MODulation:IQANalyzer:DPSKeying:MFRequency:SIMultaneous`.	ALL	–	V4.30
Description of command				Sig. State
This command sets how many channels are to measured and whether the results are to be kept separate or aggregated. In `ALL` mode, the measurement is performed on every available burst, no matter what frequency it is on. In `SINGle` mode, the R&S® CBT measures the channel selected via `CONFigure:MODulation:IQANalyzer:DPSKeying:MFRequency`. In `SIMultaneous` mode, the R&S® CBT takes and returns five complete sets of results; see description of the `READ:...MODulation...`, `and FETCh:...MODulation...` commands.				all

CONFigure:MODulation:IQANalyzer:DPSKeying:MFRequency:SIMultaneous *<Meas_Freq_1>,..., <Meas_Freq_5>*				Simult. Meas. – Measured Ch.
<Meas_Freq_1> to <Meas_Freq_5>	Description of parameters	Def. value	Def. unit	FW vers.
2 402 MHz to 2 495 MHz | **OFF**	Measured frequency Measurement switched off	see below	Hz	V4.30
Description of command				Sig. State
This command defines the five frequencies to be measured if the measurement mode is set to `SIMultaneous` (see command `CONFigure:MODulation:IQANalyzer:DPSKeying:MMODe`). With the command `CONFigure:MODulation:IQANalyzer:DPSKeying:MFRequency:UNIT`, the default frequency unit can be changed, and even *Bluetooth* channel numbers can be entered instead of frequencies. The default frequencies correspond to the channel sequence 0, 19, 39, 59, 78.				all

CONFigure:MODulation:IQANalyzer:DPSKeying:MFRequency *<Meas_Freq>*				Display Frequency
<Meas_Freq>	Description of parameters	Def. value	Def. unit	FW vers.
2 402 MHz to 2 495 MHz	Measured frequency	2 40200000	Hz	V4.30
Description of command				Sig. State
This command defines the frequency to be measured if the measurement mode is set to `SINGle` (see command `CONFigure:MODulation:IQANalyzer:DPSKeying:MMODe`). With the command `CONFigure:MODulation:IQANalyzer:DPSKeying:MFRequency:UNIT`, the default frequency unit can be changed, and even *Bluetooth* channel numbers can be entered instead of frequencies.				all

CONFigure:MODulation:IQANalyzer:DPSKeying:MFRequency:UNIT *<Unit>*				Frequency Unit
<Unit>	Description of parameters	Def. value	Def. unit	FW vers.
HZ | **KHZ** | **MHZ** | **GHZ** | **CH**	Frequency unit | Channel number	HZ	–	V4.30
Description of command				Sig. State
This command defines whether the measured frequency (see command `CONFigure:MODulation:IQANalyzer:DPSKeying:MFRequency)` is specified in frequency units or as a Bluetooth channel number.				all

Subsystem MODulation:IQANalyzer:DPSKeying:CONTrol

The subsystem *MODulation:IQANalyzer:DPSKeying:CONTrol* defines the scope of the modulation measurement. The settings are provided in the *Control* tab of the popup menu *Modulation Configuration*.

CONFigure:MODulation:IQANalyzer:DPSKeying:CONTrol *<Mode>, <Statistics>, <Repetition>, <StopCond>, <Stepmode>*				Scope of Measurement
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SCALar | **ARRay,**	Scalar values only (incl. limit matching) Scalar measured values and arrays	ARRay	–	V4.30
<Statistics>	Description of parameters	Def. value	Def. unit	
1 to 1000 | **NONE**	Number of bursts per statistics cycle Statistics off (equivalent to 1)	100	–	
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot |** **1 to 10000,**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCond>	Description of parameters	Def. value	Def. unit	
SONerror | **NONE,**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	
Description of command				Sig. State
This command restricts the type of measured values to accelerate the measurement and determines the number of bursts within a statistics cycle. **Note:** In the case of READ commands (`READ:`...), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot. The <Repetition> parameter is valid in remote control only. Changing this parameter in remote control does not alter the repetition mode in manual control and vice versa. The default repetition mode in manual control is *Continuous.*				all

CONFigure:MODulation:IQANalyzer:DPSKeying:CONTrol:RMODe *<Mode>*				Result mode
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SCALar | **ARRay**	Scalar values only (include limit matching) Scalar measured values and arrays available	ARRay	–	V4.30
Description of command				Sig. State
This command specifies the type of measured values. If the parameter `SCALar` is set, the measurement curves (arrays, see commands `READ:ARRay:MODulation:IQANalyzer:DPSKeying ...)` are no longer available but the measurement is sped up considerably.				all

CONFigure:MODulation:IQANalyzer:DPSKeying:CONTrol:STATistics *<Statistics>*				Statistics Count
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	Number of bursts per statistics cycle Statistics off (equivalent to 1)	100	–	V4.30
Description of command				Sig. State
This command specifies the type of measured values and defines the number of bursts forming a statistics cycle.				all

CONFigure:MODulation:IQANalyzer:DPSKeying:CONTrol:REPetition ***<Repetition>, <StopCondition>, <StepMode>***				Test Cycles
<Repetition>	Description of parameters	Def. value	Def. unit	FW vers.
CONTinuous | **SINGleshot** | **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	V4.30
<StopCondition>	Description of parameters	Def. value	Def. unit	
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	
<StepMode>	Description of parameters	Def. value	Def. unit	
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	
Description of command				Sig. State
This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement. **Note:** In the case of READ commands (`READ:`...), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot. The <Repetition> parameter is valid in remote control only. Changing this parameter in remote control does not alter the repetition mode in manual control and vice versa. The default repetition mode in manual control is *Continuous.*				all

DEFault:MODulation:IQANalyzer:DPSKeying:CONTrol ***<Enable>***				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V4.30
Description of command				Sig. State
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting OFF results in an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF).*				all

Select Bandwidth

The subsystem *MODulation:IQANalyzer:DPSKeying:FILTer* provides analyzer settings for the IQ Analyzer measurement. The subsystem corresponds to the tab *Analyzer* in the popup menu *Modulation Configuration.*

CONFigure:MODulation:IQANalyzer:DPSKeying:FILTer:BWIDth *<Width>*				Filter Bandwidth
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
WIDE | **NARRow**	2 MHz bandwidth filter 1.3 MHz bandwidth filter	WIDE	–	V4.30
Description of command				Sig. State
Selects the resolution bandwidth of the measurement filter used for the *I/Q Analyzer DPSK* application.				all

Limits – Subsystem MODulation:IQANalyzer:DPSKeying:LIMit

The subsystem *MODulation:IQANalyzer:DPSKeying:LIMit* defines tolerance values for the modulation IQ Analyzer measurement. The subsystem corresponds to the tab *Limits* in the popup menu *Modulation Configuration.*

CONFigure:MODulation:IQANalyzer:DPSKeying:CURRent:LIMit:SCALar:ASYMmetric:UPPer:VALue ***<Freq_Stability_ωi>, <Freq_Stability_ ωi + ωo max>, <Freq_Stability_ ωo max>, <RMS_DEVM_π/4_DQPSK>, <RMS_DEVM_8DPSK>, <Peak_DEVM_π/4_DQPSK>, <Peak_DEVM_8DPSK>***				Upper Modulation DPSK Limits
<Limit>	Description of parameters	Def. value	Def. unit	FW vers.
–250 kHz to +250 kHz, **–250 kHz to +250 kHz,** **–250 kHz to +250 kHz,**	Upper limit for frequency stability ω_i Upper limit for freq. stability $\omega_i + \omega_{o\,max}$ Upper limit for freq. stability $\omega_{o\,max}$	+75 +75 10	kHz kHz kHz	V4.30
0 to 1, **0 to 1,** **0 to 1,** **0 to 1**	Upper limit for RMS DEVM π/4 DQPSK Upper limit for RMS DEVM 8DPSK Upper limit for Peak DEVM π/4 DQPSK Upper limit for Peak DEVM 8DPSK.	0.20 0.13 0.35 0.25	– – – –	
Description of command				Sig. State
This command defines upper limits for the nominal power of the current `(CURRent)` measurement . If a measurement rises above the limit then the result will be out of tolerance. OFF means that the limit check is switched off.				all

Upper Limits on or off

CONFigure:MODulation:IQANalyzer:DPSKeying:CURRent:LIMit:SCALar:ASYMmetric:UPPer:ENABle ***<Enable_1>, ..., <Enable_7>***

<Enable_n>	Description of parameters	Def. value	Def. unit	FW vers.
	Enable or disable the upper limit check for:			V4.30
ON | OFF,	Frequency stability ω_i	ON	–	
ON | OFF,	Frequency stability $\omega_i + \omega_{o\,max}$	ON	–	
ON | OFF,	Frequency stability $\omega_{o\,max}$	ON	–	
ON | OFF,	RMS DEVM π/4 DQPSK	ON	–	
ON | OFF,	RMS DEVM 8DPSK	ON	–	
ON | OFF,	Peak DEVM π/4 DQPSK	ON	–	
ON | OFF	Peak DEVM 8DPSK.	ON	–	

Description of command	Sig. State
This command enables or disables the upper limit check of the modulation DPSK quantities.	all

Lower Modulation Limits

CONFigure:MODulation:IQANalyzer:DPSKeying:CURRent:LIMit:SCALar:ASYMmetric:LOWer:VALue ***<Freq_Stab_ω_i>,<Freq_Stab_ $\omega_i + \omega_{o\,max}$>, <Freq_Stab_ $\omega_{o\,max}$>***

<Limit>	Description of parameters	Def. value	Def. unit	FW vers.
–250 kHz to +250 kHz,	Lower limit for frequency stability ω_i	–75	kHz	V4.30
–250 kHz to +250 kHz,	Lower limit for freq. stability $\omega_i + \omega_{o\,max}$	–75	kHz	
–250 kHz to +250 kHz	Lower limit for freq. stability $\omega_{o\,max}$	–10	kHz	

Description of command	Sig. State
This command defines lower limits for the nominal power of the current `(CURRent)`,measurement. If a measurement falls below the limit then the result will be out of tolerance. *) By default the limit check is effectively disabled.	all

Lower Limits on or off

CONFigure:MODulation:IQANalyzer:DPSKeying:CURRent:LIMit:SCALar:ASYMmetric:LOWer:ENABle ***<Enable_1>, <Enable_2>, <Enable_3>***

<Enable_n>	Description of parameters	Def. value	Def. unit	FW vers.
	Enable or disable the lower limit check for:			V4.30
ON | OFF,	Frequency stability ω_i	ON	–	
ON | OFF,	Frequency stability $\omega_i + \omega_{o\,max}$	ON	–	
ON | OFF	Frequency stability $\omega_{o\,max}$	ON	–	

Description of command	Sig. State
This command enables or disables the lower limit check of the modulation DPSK quantities.	all

Upper and Lower Modulation DPSK Limits

CONFigure:MODulation:IQANalyzer:DPSKeying:CURRent:LIMit:SCALar:ASYMmetric[:COMBined]:VALue
<Freq_Stab_ωi_Upp>, <Freq_Stab_ωi_Low>, <Freq_Stab_ ωi + ωo max_Upp>, <Freq_Stab_ ωi + ωo max_Low>, <Freq_Stab_ ωo max_Upp>, <Freq_Stab_ ωo max_Low>, <RMS_DEVM_π/4_DQPSK_Upp>, <RMS_DEVM_8DPSK_Upp>, <Peak_DEVM_π/4_DQPSK_Upp>, <Peak_DEVM_8DPSK_Upp>

<Limit>	Description of parameters	Def. value	Def. unit	FW vers.
–250 kHz to +250 kHz	Upper limit for frequency stability ω_i	+75	kHz	V4.30
–250 kHz to +250 kHz	Lower limit for frequency stability ω_i	–75	kHz	
–250 kHz to +250 kHz	Upper limit for freq. stability $\omega_i + \omega_{o\,max}$	+75	kHz	
–250 kHz to +250 kHz	Lower limit for freq. stability $\omega_i + \omega_{o\,max}$	–75	kHz	
–250 kHz to +250 kHz	Upper limit for freq. stability $\omega_{o\,max}$	+10	kHz	
–250 kHz to +250 kHz	Lower limit for freq. stability $\omega_{o\,max}$	–10	kHz	
0 to 1,	Upper limit for RMS DEVM π/4 DQPSK	0.20	–	
0 to 1,	Upper limit for RMS DEVM 8DPSK	0.13	–	
0 to 1,	Upper limit for Peak DEVM π/4 DQPSK	0.35	–	
0 to 1	Upper limit for Peak DEVM 8DPSK	0.25	–	

Description of command	Sig. State
This command defines the upper and lower limits for the nominal power of the current measurement. If a measurement falls below the limit then the result will be out of tolerance.	all

All Limits on or off

CONFigure:MODulation:IQANalyzer:DPSKeying:CURRent:LIMit:SCALar:ASYMmetric [:COMBined]:ENABle ***<Enable_1>, ..., <Enable_10>***

<Enable_n>	Description of parameters	Def. value	Def. unit	FW vers.
	Enable or disable the limit check for:			V4.30
ON | OFF,	Frequency stability ω_i (upper, lower)	ON, ON	–	
…,	Frequency stab. $\omega_i + \omega_{o\,max}$ (upper, lower)	ON, ON	–	
	Frequency stability $\omega_{o\,max}$ (upper, lower)	ON, ON	–	
	RMS DEVM π/4 DQPSK (upper)	ON,	–	
	RMS DEVM 8DPSK (upper)	ON,	–	
…,	Peak DEVM π/4 DQPSK (upper)	ON,	–	
ON | OFF	Peak DEVM 8DPSK (upper)	ON	–	

Description of command	Sig. State
This command enables or disables the upper and lower limit check of the modulation quantities.	all

99% DEVM –Threshold

CONFigure:MODulation:IQANalyzer:DPSKeying:DEVMagnitude:THReshold[:VALue]
<π/4_DQPSK_DEVM_Threshold>, <8DPSK_DEVM_Threshold>

<DEVM>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 1,	π/4 DQPSK DEVM threshold	0.3	–	V4.30
0 to 1	8DPSK DEVM threshold	0.2	–	

Description of command	Sig. State
This command defines the π/4 DQPSK and 8DPSK thresholds, to be used in connection with the conformance limit (`CONFigure:MODulation:IQANalyzer:DPSKeying:DEVMagnitude:CLIMit[:VALue]`).	all

99% DEVM – Conformance Limit

CONFigure:MODulation:IQANalyzer:DPSKeying:DEVMagnitude:CLIMit[:VALue] ***<π/4DQPSK_DEVM_CLimit>, <8DPSK_DEVM_CLimit>***

<CLimit>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 100, **0 to 100**	Conformance limit for π/4 DQPSK DEVM Conformance limit for 8DPSK DEVM	99 99	% %	V4.30

Description of command	Sig. State
This command defines the minimum percentage of symbols which must have a DEVM of less than or equal to the defined threshold (`CONFigure:MODulation:IQANalyzer:DPSKeying:DEVMagnitude:THReshold[:VALue]`).	all

99% DEVM – Enable Limit Check

CONFigure:MODulation:IQANalyzer:DPSKeying:DEVMagnitude:CLIMit:ENABle ***<Enable_1>, <Enable_2>***

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
 ON | OFF, **ON | OFF**	Enable or disable conformance limit check for: π/4 DQPSK DEVM 8DPSK DEVM	 ON ON	 – –	V4.30

Description of command	Sig. State
This command enables or disables the 99% DEVM conformance limit check.	all

DEFault:MODulation:IQANalyzer:DPSKeying:LIMit ***<Enable>*** — Default Settings

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V4.30

Description of command	Sig. State
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting OFF results in an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.	all

Measured Values

The following commands start a measurement and return the measurement results. They correspond to the different output elements in the graphical measurement menu *Modulation.*

Scalar Results

READ[:SCALar]:MODulation:IQANalyzer:DPSKeying? Start single shot measurement and return results

FETCh[:SCALar]:MODulation:IQANalyzer:DPSKeying? Read out meas. results (unsynchronized)

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–250 kHz to +250 kHz,	Frequency stability ω_i (x4),	NAN	kHz	V4.30
–250 kHz to +250 kHz,	Frequency stability $\omega_i + \omega_{o\ max}$ (x4),	NAN	kHz	
–250 kHz to +250 kHz,	Frequency stability $\omega_{o\ max}$ (x4),	NAN	kHz	
0 to 1,	RMS DEVM (x4),	NAN	–	
0 to 1,	Peak DEVM (x4),	NAN	–	
–128 dBm to +30 dBm	Average Burst Power,	NAN	dBm	
0% to 100%	99% DEVM	NAN	%	

Description of command — Sig. State: TEST

These commands are always queries. They start a measurement (`READ...`) and return all scalar measurement results. The symbol (x4) after a value, above, indicates that the list contains four results corresponding to the *Current,* the *Average,* the *Minimum,* and the *Maximum* measurement curve, respectively.

The meaning and the number of the returned values depends on the measurement mode set via `CONFigure:MODulation:IQANalyzer:DPSKeying:MMODe`

- In the `ALL` mode, the R&S® CBT measures all channels and returns the average result.
- In `SINGle` mode, the R&S® CBT measures the channel selected via `CONFigure:MODulation:IQANalyzer:DPSKeying:MFRequency` and returns the corresponding result.
- In `SIMultaneous` mode, the R&S® CBT acquires and returns five complete sets of results corresponding to the five channels selected with `CONFigure:MODulation:IQANalyzer:DPSKeying:MFRequency:SIMultaneous`. This means that the whole list described in the *Returned Values* column above is repeated five times.

For more details refer to the description of aggregated and separate channels in Chapter 4.

Peak DEVM and RMS DEVM results are supplied depending on the current modulation type (π/4DQPSK or 8DPSK).

CALCulate:MODulation:IQANalyzer:DPSKeying:MATChing:LIMit?				Limit Matching
Returned values	Value range	Def. value	Def. unit	FW vers.
Frequency stability ω_i , **Frequency stability $\omega_i + \omega_{o\,max}$,** **Frequency stability $\omega_{o\,max}$,** **RMS DEVM ,** **Peak DEVM,** **99%DEVM**	For all measured values: NMAU | NMAL | INV | OK	INV INV INV INV INV INV	– – – – – –	V4.30
Description of command				Sig. State
This command is always a query. It indicates whether and in which way the permissible error limits for the scalar measured values (see command above) have been exceeded. Possible values are: *NMAU* Result is above the limit *NMAL* Result is below the limit *INV* Result is invalid *OK* Result is valid The meaning and the number of the returned values depends on the measurement mode set via `CONFigure:MODulation:IQANlyzer:DPSKeying:MMODe`; see description of `READ...?` and `FETCh...?` commands above. Peak DEVM and RMS DEVM results are supplied depending on the current modulation type (π/4DQPSK or 8DPSK).				TEST

READ:ARRay:MODulation:IQANalyzer:DPSKeying:IPHase? Start single shot measurement and return results **FETCh:ARRay:MODulation:IQANalyzer:DPSKeying:IPHase?** Read measurement results (unsynchronized)				DEVM ⇒ *RUN* ⇒ *RUN*
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–2 to +2, **...,** **–2 to +2**	1st value, ..., kth value	NAN ... NAN		V4.30
Description of command				Sig. State
This command is always a query. It returns the I-Phase values. The number of returned values k depends on the packet type, on the number n of payload bytes in the packet (the *Length of Test Sequence* defined via `CONFigure:SSIGnal:TMODe:…LOTSequence…`, and on the diagram type (symbol mode, `CONFigure:MODulation:IQANalyzer:DPSKeying:SYMBol:MODE`, see detailed description in chapter 4): • For 2-DHx packets, k is equal to 50 * floor [(56+8n) / 2] +1 for the absolute symbol mode, 50N * floor [(56+8n) / 2] for the other symbol modes. • For 3-DHx packets, k is equal to 50 * floor [(68+8n) / 3] +1 for the absolute symbol mode, 50N * floor [(68+8n) / 3] for the other symbol modes. The meaning of the returned values depends on the measurement mode set via `CONFigure:MODulation:IQANalyzer:DPSKeying:MMODe`: • In `ALL` mode, the R&S® CBT measures all available channels and returns the trace averaged over all these channels. • In `SINGle` mode, the R&S® CBT measures the channel selected via `CONFigure:MODulation:IQANalyzer:DPSKeying:MFRequency` and returns the corresponding trace. • In `SIMultaneous` mode, the R&S® CBT measures the channels selected with `CONFigure:MODulation:IQANalyzer:DPSKeying:MFRequency:SIMultaneous` and returns the trace averaged over these channels.				TEST

READ:ARRay:MODulation:IQANalyzer:DPSKeying:QPHase? DEVM
Start single shot measurement and return results ⇒ *RUN*
FETCh:ARRay:MODulation:IQANalyzer:DPSKeying:QPHase?
Read measurement results (unsynchronized) ⇒ *RUN*

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–2 to +2, **...,** **–2 to +2**	1st value, ..., kth value	NAN ... NAN		V4.30

Description of command	Sig. State
This command is always a query. It returns the Q-Phase values.The number of returned values k depends on the packet type, on the number n of payload bytes in the packet (the *Length of Test Sequence* defined via `CONFigure:SSIGnal:TMODe:…LOTSequence…`, and on the diagram type (symbol mode, `CONFigure:MODulation:IQANalyzer:DPSKeying:SYMBol:MODE`, see detailed description in chapter 4): • For 2-DHx packets, k is equal to 50 * floor [(56+8n) / 2] +1 for the absolute symbol mode, 50N * floor [(56+8n) / 2] for the other symbol modes. • For 3-DHx packets, k is equal to 50 * floor [(68+8n) / 3] +1 for the absolute symbol mode, 50N * floor [(68+8n) / 3] for the other symbol modes. The meaning of the returned values depends on the measurement mode set via `CONFigure:MODulation:IQANalyzer:DPSKeying:MMODe`: • In `ALL` mode, the R&S® CBT measures all available channels and returns the trace averaged over all these channels. • In `SINGle` mode, the R&S® CBT measures the channel selected via `CONFigure:MODulation:IQANalyzer:DPSKeying:MFRequency` and returns the corresponding trace. • In `SIMultaneous` mode, the R&S® CBT measures the channels selected with `CONFigure:MODulation:IQANalyzer:DPSKeying:MFRequency:SIMultaneous` and returns the trace averaged over these channels.	TEST

Phase Difference

The commands in this section control the modulation measurement's *Phase Difference* application. They correspond to the measurement menu *Modulation* and the associated softkeys and hotkeys.

INITiate:MODulation:PDIFference	Start new measurement		⇒ *RUN*
ABORt:MODulation:PDIFference	Abort running measurement and switch off		⇒ *OFF*
STOP:MODulation:PDIFference	Stop measurement after current stat. cycle		⇒ *STOP*
CONTinue:MODulation:PDIFference	Next measurement step (only *stepping mode*)		⇒ *RUN*
Description of command		Sig. State	FW vers.
These commands have no query form. They start and stop the Phase Difference measurement, setting it to the status indicated in the top right column.		all	V4.30

CONFigure:MODulation:PDIFference:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC** | **SRSQ** | **OFF**	Service request Single operation complete SRQ and SRSQ No reporting	OFF	–	V4.30
Description of command				Sig. State
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see Chapter 5).				all

FETCh:MODulation:PDIFference:STATus?				Measurement Status
Ret. values	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN** | **STOP** | **ERR** | **STEP** | **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate`, `CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V4.30
1 to 10000 | **NONE,**	Counter for current statistics cycle No counting mode set	NONE	–	
1 to 1000 | **NONE**	Counter for current evaluation period within a cycle Statistic count set to off	NONE	–	
Description of command				Sig. State
This command is always a query. It returns the status of the measurement (see Chapters 3 and 5).				all

CONFigure:MODulation:PDIFference:MMODe *<Mode>* — Measurement Mode

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ALL |	Measure and aggregate all channels of the current hop scheme	ALL	–	V4.30
SINGle |	Measure bursts from a definite channel only			
SIMultaneous	Simultaneous measurement on the five channels selected with the command `CONFigure:MODulation:PDIFference:MFRequency:SIMultaneous`.			

Description of command	Sig. State
This command sets how many channels are to measured and whether the results are to be kept separate or aggregated. In `ALL` mode, the measurement is performed on every available burst, no matter what frequency it is on. In `SINGle` mode, the R&S® CBT measures the channel selected via `CONFigure:MODulation:PDIFference:MFRequency`. In `SIMultaneous` mode, the R&S® CBT takes and returns five complete sets of results; see description of the `READ:...MODulation...`, `and FETCh:...MODulation...` commands.	all

CONFigure:MODulation:PDIFference:MFRequency:SIMultaneous *<Meas_Freq_1>,..., <Meas_Freq_5>* — Simult. Meas. – Measured Ch.

<Meas_Freq_1> to <Meas_Freq_5>	Description of parameters	Def. value	Def. unit	FW vers.
2 402 MHz to 2 495 MHz |	Measured frequency	see below	Hz	V4.30
OFF	Measurement switched off			

Description of command	Sig. State
This command defines the five frequencies to be measured if the measurement mode is set to `SIMultaneous` (see command `CONFigure:MODulation:PDIFference:MMODe`). With the command `CONFigure:MODulation:PDIFference:MFRequency:UNIT`, the default frequency unit can be changed, and even *Bluetooth* channel numbers can be entered instead of frequencies. The default frequencies correspond to the channel sequence 0, 19, 39, 59, 78.	all

CONFigure:MODulation:PDIFference:MFRequency *<Meas_Freq>* — Display Frequency

<Meas_Freq>	Description of parameters	Def. value	Def. unit	FW vers.
2 402 MHz to 2 495 MHz	Measured frequency	2 40200000	Hz	V4.30

Description of command	Sig. State
This command defines the frequency to be measured if the measurement mode is set to `SINGle` (see command `CONFigure:MODulation:PDIFference:MMODe`). With the command `CONFigure:MODulation:PDIFference:MFRequency:UNIT`, the default frequency unit can be changed, and even *Bluetooth* channel numbers can be entered instead of frequencies.	all

CONFigure:MODulation:PDIFference:MFRequency:UNIT *<Unit>* — Frequency Unit

<Unit>	Description of parameters	Def. value	Def. unit	FW vers.
HZ | **KHZ** | **MHZ** | **GHZ** |	Frequency unit |	HZ	–	V4.30
CH	Channel number			

Description of command	Sig. State
This command defines whether the measured frequency (see command `CONFigure:MODulation:PDIFference:MFRequency)` is specified in frequency units or as an Bluetooth channel number.	all

CONFigure:MODulation:PDIFference:MRANge *<Start>, <Span>* Time Scale Start, Time Scale Span

<Start>	Description of parameters	Def. value	Def. unit	FW vers.
–200 to 3200	Start of measurement range	–200	symbol	V4.30
<Span>	Description of parameters	Def. value	Def. unit	FW vers.
0.0625 to 5	Span of measurement range	1	slots	V4.30

Description of command	Sig. State
This command defines the measurement range for the `MODulation:PDIFference` measurement. The second input value *<Span>* is rounded to one of the following discrete values: 0.0625 (1/16 slot) 0.125 (1/8 slot) 0.25 (1/4 slot) 0.5 (1/2 slot) 1 (slot) 2(slot) 3(slot) 4(slot) 5(slot)	all

This command is used to determine the first symbol position and number of symbols returned by the `READ:ARRay:MODulation:PDIFference...` commands. The span setting directly affects the number of symbols returned:

<Span> (slots):	0.0625	0.125	0.25	0.5	1	2	3	4	5
Symbols:	39	78	156	312	625	1250	1875	2500	3125

CONFigure:MODulation:PDIFference:FILTer:BWIDth *<Width>* Filter Bandwidth

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
WIDE | **NARRow**	2 MHz bandwidth filter 1.3 MHz bandwidth filter	WIDE	–	V4.30

Description of command	Sig. State
Selects the resolution bandwidth of the measurement filter used for the *Phase Difference* application.	all

Subsystem MODulation:PDIFference:CONTrol

The subsystem *MODulation:PDIFference:CONTrol* defines the scope of the modulation measurement. The settings are provided in the *Control* tab of the popup menu *Modulation Configuration*.

CONFigure:MODulation:PDIFference:CONTrol ***<Mode>, <Statistics>, <Repetition>, <StopCond>, <Stepmode>***		Scope of Measurement		
<Mode>	Desciption of parameters	Def. value	Def. unit	FW vers.
SCALar | **ARRay,**	Scalar values only (incl. limit matching) Scalar measured values and arrays	ARRay	–	V4.30
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	Number of bursts per statistics cycle Statistics off (equivalent to 1)	100	–	V4.30
<Repetition>	Description of parameters	Def. value	Def. unit	FW vers.
CONTinuous | **SINGleshot** | **1 to 10000,**	Continuous measurement (until `STOP` or `ABORT)` Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY)`	SING	–	V4.30
<StopCond>	Description of parameters	Def. value	Def. unit	FW vers.
SONerror | **NONE,**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	V4.30
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V4.30
Description of command				Sig. State
This command restricts the type of measured values to accelerate the measurement and determines the number of bursts within a statistics cycle. **Note:** In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot. The <Repetition> parameter is valid in remote control only. Changing this parameter in remote control does not alter the repetition mode in manual control and vice versa. The default repetition mode in manual control is *Continuous*.				all

CONFigure:MODulation:PDIFference:CONTrol:RMODe ***<Mode>***		Result mode		
<Mode>	Desciption of parameters	Def. value	Def. unit	FW vers.
SCALar | **ARRay**	Scalar values only (include limit matching) Scalar measured values and arrays available	ARRay	–	V4.30
Description of command				Sig. State
This command specifies the type of measured values. If the parameter `SCALar` is set, the measurement curves (arrays, see commands `READ:ARRay:POWer:TIME...`, `READ:SUBarray:POWer:TIME...)` are no longer available but the measurement is sped up considerably.				all

CONFigure:MODulation:PDIFference:CONTrol:STATistics *<Statistics>*				Statistics Count
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	Number of bursts per statistics cycle Statistics off (equivalent to 1)	100	–	V4.30
Description of command				Sig. State
This command specifies the type of measured values and defines the number of bursts forming a statistics cycle.				all

CONFigure:MODulation:PDIFference:CONTrol:REPetition ***<Repetition>,<StopCondition>,<StepMode>***				Test Cycles
<Repetition>	Description of parameters	Def. value	Def. unit	FW vers.
CONTinuous | **SINGleshot** | **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	V4.30
<StopCondition>	Description of parameters	Def. value	Def. unit	FW vers.
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	V4.30
<StepMode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V4.30
Description of command				Sig. State
This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement. **Note:** In the case of READ commands (`READ:`...), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot. The <Repetition> parameter is valid in remote control only. Changing this parameter in remote control does not alter the repetition mode in manual control and vice versa. The default repetition mode in manual control is *Continuous.*				all

DEFault:MODulation:PDIFference:CONTrol ***<Enable>***				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V4.30
Description of command				Sig. State
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting OFF results in an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF).*				all

Subsystem SUBarrays:MODulation:PDIFFerence

The subsystem *SUBarrays:MODulation:PDIFference* defines the measurement range and the type of output values.

CONFigure:SUBarrays:MODulation: PDIFference *<Mode>,<Start>,<Samples>{,<Start>,<Samples>}*				Definition of Subarrays
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ALL |	Return all measurement values	ALL	–	V4.30
ARIThmetical |	Return arithm. mean value in every subrange			
MINimum |	Return minimum value in every subrange			
MAXimum |	Return maximum value in every subrange			
IVAL |	Return single interpolated value at <Start>			
XMAXimum |	Return x-axis value of maximum and maximum			
XMINimum |	Return x-axis value of minimum and minimum			
PAVG,	Return arithmetic mean value in every subrange			V5.00
<Start>	Description of parameters	Def. value	Def. unit	
–200 to 3200	Start time in current range	NAN	symbol	
<Samples>	Description of parameters	Def. value	Def. unit	
0 to 2500	No. of samples in range	NAN	–	
Description of command				Sig. State
This command configures the `READ:SUBarrays:MODulation:PDIFference...` and `FETCh:SUBarrays:MODulation:PDIFference...` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the second numerical parameter) or a single statistical value is returned. The subranges are defined by a start time and the number of test points which are located on a fixed, equidistant grid. For <Mode> = IVAL, the <Samples> parameter is ignored and the R&S CBT returns a single measurement value corresponding to the abscissa value <Start>. If <Start> is located between two test points with valid results then the result is calculated from the results at these two adjacent test points by linear interpolation. The subranges may overlap but must be within the total range of the `MODulation:PDIFference` measurement defined via `CONFigure:MODulation:PDIFference:MRANge`. Test points outside this range are not measured (result is *NAN)* and do not enter into the ARIThmetical, MINimum and MAXimum values. By default, only one range corresponding to the total measurement range is used and all measurement values are returned.				all

Measured Values

The following commands start a measurement and return the measurement results. They correspond to the different output elements in the graphical measurement menu *Modulation.*

READ:ARRay:MODulation:PDIFference:CURRent? Phase Difference
READ:ARRay:MODulation:PDIFference:AVERage?
READ:ARRay:MODulation:PDIFference:MINimum?
READ:ARRay:MODulation:PDIFference:MAXimum?
Start single shot measurement and return results ⇒ *RUN*
FETCh:ARRay:MODulation:PDIFference:CURRent?
FETCh:ARRay:MODulation:PDIFference:AVERage?
FETCh:ARRay:MODulation:PDIFference:MINimum?
FETCh:ARRay:MODulation:PDIFference:MAXimum?
Read measurement results (unsynchronized) ⇒ *RUN*

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–1 to +1 (approx.), **...,** **–1 to +1 (approx.)**	1st value for Phase Difference, ..., nth value for Phase Difference	NAN ... NAN	rad / π rad / π	V4.30

Description of command	Sig. State
These commands are always queries. They return the (normalized) Phase Difference versus time at fixed, equidistant test points. The R&S® CBT returns one value per symbol; the number n of returned values and their position on the time axis depends on the measurement range, see the command `CONFigure:MODulation:PDIFference:MRANge`. The meaning of the returned values depends on the measurement mode set via `CONFigure:MODulation:PDIFference:MMODe`: • In `ALL` mode, the R&S® CBT measures all available channels and returns the trace averaged over all these channels. • In `SINGle` mode, the R&S® CBT measures the channel selected via `CONFigure:MODulation:PDIFference:MFRequency` and returns the corresponding trace. • In `SIMultaneous` mode, the R&S® CBT measures the channels selected with `CONFigure:MODulation:PDIFference:MFRequency:SIMultaneous` and returns the trace averaged over these channels. The calculation of *current, average, maximum* and *minimum* values is explained in Chapter 3 (*display mode*).	TEST

READ:SUBarrays:MODulation:PDIFference:CURRent? **READ:SUBarrays:MODulation:PDIFference:AVERage?** **READ:SUBarrays:MODulation:PDIFference:MINimum?** **READ:SUBarrays:MODulation:PDIFference:MAXimum?**	Subarray Results
Start single shot measurement and return results	⇒ *RUN*
FETCh:SUBarrays:MODulation:PDIFference:CURRent? **FETCh:SUBarrays:MODulation:PDIFference:AVERage?** **FETCh:SUBarrays:MODulation:PDIFference:MINimum?** **FETCh:SUBarrays:MODulation:PDIFference:MAXimum?**	
Read measurement results (unsynchronized)	⇒ *RUN*

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–1 to +1 (approx.), **...,** **–1 to +1 (approx.)**	1st value for Phase Difference, ..., nth value for Phase Difference	NAN ... NAN	rad / π rad / π	V4.30

Description of command	Sig. State
These commands are always queries. They output the Phase Difference versus time in the subranges defined by means of the `CONFigure:SUBarrays:MODulation:PDIFference` command. A valid subrange must be defined before the `READ:SUBarrays...`, and `FETCh:SUBarrays...` command group can be used. The `CONFigure:MODulation:PDIFference:MRANge` command can also be used to affect the number of returned values. The `CONFigure:SUBarrays:MODulation:PDIFference` command defines a maximum of 32 subranges. If one of the statistical modes `(ARIThmetical, MINimum, MAXimum…)` is set, only one value is returned per subrange. The calculation of *current, average, minimum,* and *maximum* results is explained in Chapter 3 (see *display mode*).	TEST

Spectrum Measurements

The subsystem *SPECtrum* covers the following measurement applications:

- The *SPECtrum:ACPower* subsystem measures the Adjacent Channel Power. The subsystem corresponds *ACP* application of the *Spectrum* measurement.
- The *SPECtrum:BWIDth* subsystem measures the 20 dB bandwidth. The subsystem corresponds *20 dB Bandwidth* application of the *Spectrum* measurement.
- The `SPECtrum:FRANge`…subsystem measures the power of the Bluetooth signal from the DUT at up to 110 frequency points using a fixed 100 kHz partition. The subsystem corresponds to the *Frequency Range* application of the *Spectrum* measurement.

SPECtrum:ACPower

The subsystem *SPECtrum:ACPower* measures the Adjacent Channel Power. The subsystem corresponds to the measurement menu *Spectrum,* application *ACP,* and the associated popup menu *Spectrum Configuration.*

Measurement Control

The commands in this section control the spectrum measurement. They correspond to the softkey *ACP* in the measurement menu *Spectrum*.

INITiate:SPECtrum:ACPower	Start new measurement	⇒	*RUN*
ABORt:SPECtrum:ACPower	Abort measurement and switch off	⇒	*OFF*
STOP:SPECtrum:ACPower	Stop measurement after current stat. cycle	⇒	*STOP*
CONTinue:SPECtrum:ACPower	Next meas. step (only *stepping mode*)	⇒	*RUN*

Description of command	Sig. State	FW vers.
These commands have no query form. They start or stop the measurement, setting it to the status indicated in the top right column.	all	V3.57

CONFigure:SPECtrum:ACPower:EREPorting <*Mode*> Event Reporting

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ |	Service request	OFF	–	V3.57
SOPC |	Single operation complete			
SRSQ |	SRQ and SOPC			
OFF	No reporting			

Description of command	Sig. State
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see Chapter 5).	all

FETCh[:SCALar]:SPECtrum:ACPower:STATus?				Measurement Status
Ret. values	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN |** **STOP |** **ERR |** **STEP |** **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V3.57
1 to 10000 | **NONE,**	Counter for current statistics cycle No counting mode set	NONE	–	
0 to 1000 | **NONE**	Counter for current evaluation period within a cycle Statistic count set to off	NONE	–	
Description of command				Sig. State
This command is always a query. It returns the status of the measurement (see Chapters 3 and 5).				all

Subsystem SPECtrum:ACPower:CONTrol

The subsystem *SPECtrum:...CONTrol* defines the statistics (repetition mode, statistic count, and stop condition) of the measurement. These settings are provided in the *Control* tab of the popup menu *Spectrum Configuration.*

CONFigure:SPECtrum:ACPower:CONTrol *<Mode>, <Statistics>, <Repetition>, <StopCond>, <Stepmode>*				Scope of Measurement
<Mode>	Desciption of parameters	Def. value	Def. unit	FW vers.
SCALar,	Scalar values only (incl. limit matching)	SCALar	–	V3.57
<Statistics>	Description of parameters	Def. value	Def. unit	
1 to 1000 | **NONE**	Number of sweeps per statistics cycle Statistics off (equivalent to 1)	10	–	
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot |** **1 to 10000,**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCond>	Description of parameters	Def. value	Def. unit	
SONerror | **NONE,**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V3.57
Description of command				Sig. State
This command restricts the type of measured values to accelerate the measurement and determines the number of sweeps within a statistics cycle. **Note:** In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot. The *Repetition* parameter is valid in remote control only. Changing this parameter in remote control does not alter the repetition mode in manual control and vice versa. The default repetition mode in manual control is *Continuous*.				all

CONFigure:SPECtrum:ACPower:CONTrol:STATistics *<Statistics>*				Statistics Count
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	Number of sweeps per statistics cycle Statistics off (equivalent to 1)	10	–	V3.57
Description of command				Sig. State
This command specifies the type of measured values and defines the number of sweeps forming a statistics cycle.				all

CONFigure:SPECtrum:ACPower:CONTrol:REPetition *<Repetition>,<StopCond>,<Stepmode>*				Test Cycles
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot** | **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCondition>	Description of parameters	Def. value	Def. unit	
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V3.57
Description of command				Sig. State
This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement. **Note:** In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot. The *Repetition* parameter is valid in remote control only. Changing this parameter in remote control does not alter the repetition mode in manual control and vice versa. The default repetition mode in manual control is *Continuous*.				all

Test Configuration

The commands of the following subsystems determine the parameters of the signal power measurement. The settings are part of the *Control* and of the *Analyzer* tab in the *Spectrum Configuration* menu.

CONFigure:SPECtrum:ACPower:GATing *<Enable>*				Gating
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	ACP gating is enabled ACP gating is disabled	OFF	–	V4.20
Description of command				Sig. State
This command changes the state of the ACP measurement. When ACP Gating is enabled the measurement is performed only on the part of the burst starting at the end of the GFSK part of the burst and ending at the end of the burst (including the ramp down part). This command affects the number of the measurement results and limit checks returned by commands (see `READ[:SCALar]:SPECtrum:ACPower?` and `CALCulate[:SCALar]:SPECtrum:ACPower:MATChing:LIMit?` commands).				all

CONFigure:SPECtrum:ACPower:CCHannel *<Channel>*				Center Channel
<Meas_Freq>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 93	Center channel	0	–	V3.57
Description of command				Sig. State
This command selects the center channel for the ACP measurement.				all

CONFigure:SPECtrum:ACPower:MCHannel:RELative ***<Ch_–3>, <Ch_–2>, <Ch_–1>, <Ch_+1>, <Ch_+2>, <Ch_+3>***				Lower/Upper Channels
<Ch_–3>* | *<Ch_–2>* | *<Ch_–1>	Description of parameters	Def. value	Def. unit	FW vers.
–97 to 0, –97 to 0, –97 to 0,	Lower channels	–3, –2, –1,	–	V3.57
<Ch_+1>* | *<Ch_+2>* | *<Ch_+3>	Description of parameters	Def. value	Def. unit	FW vers.
0 to +97, 0 to +97, 0 to +97	Upper channels	+1, +2, +3	–	V3.57
Description of command				Sig. State
This command selects the lower and upper channels for the ACP measurement in units relative to the center channel (`CONFigure:SPECtrum:ACPower:CCHannel`). The frequency of each channel (calculated as the center channel frequency plus n times 1 MHz where n is the relative channel number) must be in the range between 2398 MHz and 2499 MHz. Each channel number can be replaced by *OFF* to disable the measurement at this channel.				all

CONFigure:SPECtrum:ACPower:DMODe *<Mode>*				Detector Mode
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
AVG | **PEAK** | **RMS**	Average detector Peak detector RMS detector	AVG	–	V3.57
Description of command				Sig. State
This command selects the detector mode for the ACP measurement.				all

CONFigure:SPECtrum:ACPower:LUNit *<Mode>*				Level Unit
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ABS | **REL**	Absolute ACP results (in dBm) ACP relative to the center channel power (in dB)	ABS	–	V3.57
Description of command				Sig. State
This command selects the level unit for the ACP measurement. The setting is relevant for the ACP results returned by `READ[:SCALar]:SPECtrum:ACPower?` etc.				all

Limits (Subsystem SPECtrum:ACPower:...:LIMit)

The subsystem *SPECtrum:ACPower...:LIMit* defines the limit values for the ACP measurement. The settings are part of the *Limits* tab in the *Spectrum Configuration* menu.

Spectrum Limits, Upper Channels

CONFigure:SPECtrum:ACPower:PEAK:LIMit:SCALar:ASYMmetric:UCHannel:VALue *<Limits>*
CONFigure:SPECtrum:ACPower:AVERage:LIMit:SCALar:ASYMmetric:UCHannel:VALue *<Limits>*
CONFigure:SPECtrum:ACPower:RMS:LIMit:SCALar:ASYMmetric:UCHannel:VALue *<Limits>*

<Limits>	Description of parameters	Def. value	Def. unit	FW vers.
–40 dBm to 0 dBm, **–40 dBm to 0 dBm,** **–40 dBm to 0 dBm**	Upper limit for ACP: Ch +1, Upper limit for ACP: Ch +2, Upper limit for ACP: Ch +3	See below	dBm	V3.57

Description of command	Sig. State
These commands define upper limits for the ACP measurement in the upper channels. The fourth-level keywords `(PEAK, AVERage, RMS)` denote the detector mode (`CONFigure:SPECtrum:ACPower:DMODe`). OFF means that the limit check is switched off. The default limits for the `AVERage` and `RMS` detectors and channels no. +3, +2, and +1 are –20 dBm, –20 dBm, and –5 dBm. The default values for the `PEAK` detector are +5 dB higher.	all

Spectrum Limits, Lower Channels

CONFigure:SPECtrum:ACPower:PEAK:LIMit:SCALar:ASYMmetric:LCHannel:VALue *<Limits>*
CONFigure:SPECtrum:ACPower:AVERage:LIMit:SCALar:ASYMmetric:LCHannel:VALue *<Limits>*
CONFigure:SPECtrum:ACPower:RMS:LIMit:SCALar:ASYMmetric:LCHannel:VALue *<Limits>*

<Limits>	Description of parameters	Def. value	Def. unit	FW vers.
–40 dBm to 0 dBm, **–40 dBm to 0 dBm,** **–40 dBm to 0 dBm**	Upper limit for ACP: Ch –3, Upper limit for ACP: Ch –2, Upper limit for ACP: Ch –1	See below	dBm	V3.57

Description of command	Sig. State
These commands define upper limits for the ACP measurement in the lower channels. The fourth-level keywords `(PEAK, AVERage, RMS)` denote the detector mode (`CONFigure:SPECtrum:ACPower:DMODe`). OFF means that the limit check is switched off. The default limits for the `AVERage` and `RMS` detectors and channels no. –3, –2, and –1 are –20 dBm, –20 dBm, and –5 dBm. The default values for the `PEAK` detector are +5 dB higher.	all

Enable/Disable Spectrum Limits, Upper Channels

CONFigure:SPECtrum:ACPower:PEAK:LIMit:SCALar:ASYMmetric:UCHannel:ENABle *<Enable>*
CONFigure:SPECtrum:ACPower:AVERage:LIMit:SCALar:ASYMmetric:UCHannel:ENABle *<Enable>*
CONFigure:SPECtrum:ACPower:RMS:LIMit:SCALar:ASYMmetric:UCHannel:ENABle *<Enable>*

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF, **ON | OFF,** **ON | OFF**	Upper limit for ACP: Ch +1, Upper limit for ACP: Ch +2, Upper limit for ACP: Ch +3	See below	dBm	V3.57

Description of command	Sig. State
These commands enable or *(`ON`)* or disable *(`OFF`)* the ACP limit check in the upper channels. The fourth-level keywords `(PEAK, AVERage, RMS)` denote the detector mode (`CONFigure:SPECtrum:ACPower:DMODe`). By default the limit check is `ON` for the `AVERage` detector and channels +2 and +3. For all other channels and detectors, the limit check is *`OFF`.*	all

Enable/Disable Spectrum Limits, Lower Channels

CONFigure:SPECtrum:ACPower:PEAK:LIMit:SCALar:ASYMmetric:LCHannel:ENABle _<Enable>_
CONFigure:SPECtrum:ACPower:AVERage:LIMit:SCALar:ASYMmetric:LCHannel:ENABle _<Enable>_
CONFigure:SPECtrum:ACPower:RMS:LIMit:SCALar:ASYMmetric:LCHannel:ENABle _<Enable>_

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF,** **ON** | **OFF,** **ON** | **OFF**	Upper limit for ACP: Ch –3, Upper limit for ACP: Ch –2, Upper limit for ACP: Ch –1	See below	dBm	V3.57

Description of command	Sig. State
These commands enable or *(ON)* or disable *(OFF)* the ACP limit check in the lower channels. The fourth-level keywords (PEAK, AVERage, RMS) denote the detector mode (CONFigure:SPECtrum:ACPower:DMODe). By default the limit check is ON for the AVERage detector and channels –2 and –3. For all other channels and detectors, the limit check is *OFF*.	all

Spectrum Limits, $P_{TX-26\,dB}$ – P_{TXref} channels

CONFigure:SPECtrum:ACPower:PEAK:LIMit:SCALar:ASYMmetric:PDELta:VALue _<Limits>_
CONFigure:SPECtrum:ACPower:AVERage:LIMit:SCALar:ASYMmetric:PDELta:VALue _<Limits>_
CONFigure:SPECtrum:ACPower:RMS:LIMit:SCALar:ASYMmetric:PDELta:VALue _<Limits>_

<Limits>	Description of parameters	Def. value	Def. unit	FW vers.
–60 dB to 0 dB, **–60 dB to 0 dB**	Upper limit for ACP: Ch –1, Upper limit for ACP: Ch +1	–26 –26	dB dB	V4.20

Description of command	Sig. State
These commands define upper, relative limits for the $P_{TX-26\,dB}$ – P_{TXref} measurement. The fourth-level keywords (PEAK, AVERage, RMS) denote the detector mode (CONFigure:SPECtrum:ACPower:DMODe). OFF means that the limit check is switched off.	all

Enable/Disable Spectrum Limits, $P_{TX-26\,dB}$ – P_{TXref} Channels

CONFigure:SPECtrum:ACPower:PEAK:LIMit:SCALar:ASYMmetric:PDELta:ENABle _<Enable>_
CONFigure:SPECtrum:ACPower:AVERage:LIMit:SCALar:ASYMmetric:PDELta:ENABle _<Enable>_
CONFigure:SPECtrum:ACPower:RMS:LIMit:SCALar:ASYMmetric:PDELta:ENABle _<Enable>_

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF,** **ON** | **OFF**	Upper limit for ACP: Ch –1, Upper limit for ACP: Ch +1	ON ON	–	V4.20

Description of command	Sig. State
These commands enable or *(ON)* or disable *(OFF)* the ACP limit check in the $P_{TX-26\,dB}$ – P_{TXref} channels. The fourth-level keywords (PEAK, AVERage, RMS) denote the detector mode (CONFigure:SPECtrum:ACPower:DMODe). By default the limit check is ON for the AVERage detector, *OFF* for the other detectors.	all

Measured Values

The commands in the following section determine and return the results of the ACP measurement. They correspond to the graphical menu *Spectrum* with its various display elements.

				Scalar results:
READ[:SCALar]:SPECtrum:ACPower?				Start single shot measurement and return results
FETCh[:SCALar]:SPECtrum:ACPower?				Read out measurement results (unsynchronized)
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–100 dBm to +30 dBm (x6),	ACP (Current),	NAN	dBm	V3.57
–100 dBm to +30 dBm (x6),	ACP (Average),	NAN	dBm	
–100 dBm to +30 dBm (x6),	ACP (Maximum),	NAN	dBm	
–100 dBm to +30 dBm,	Center channel power (Current),	NAN	dBm	
–100 dBm to +30 dBm (x2),	$P_{TX-26\ dB}$ (Current),	NAN	dBm	V4.20
–100 dBm to +30 dBm (x2),	$P_{TX-26\ dB}$ (Average),	NAN	dBm	
–100 dBm to +30 dBm (x2),	$P_{TX-26\ dB}$ (Maximum),	NAN	dBm	
–100 dB to 0 dB (x2),	$P_{TX-26\ dB} - P_{TXref}$ (Current),	NAN	dB	
–100 dB to 0 dB (x2),	$P_{TX-26\ dB} - P_{TXref}$ (Average),	NAN	dB	
–100 dB to 0 dB (x2),	$P_{TX-26\ dB} - P_{TXref}$ (Maximum),	NAN	dB	
–100 dBm to +30 dBm	P_{TXref} (Current)	NAN	dBm	
Description of commands				Sig. State
These commands are always queries. They start a measurement (`READ...`) and/or return all scalar measurement results. The symbol (x6) behind a value indicates that the list contains six results corresponding to the lower channels –3, –2, –1 and the upper channels +1, +2, +3, respectively. The symbol (x2) behind a value indicates that the list contains two results corresponding to channels –1 and +1. If relative levels are selected (`CONFigure:SPECtrum:ACPower:LUNit REL`), the ACP and $P_{TX-26\ dB}$ results are returned in relative units. To retrieve both the absolute and the relative results, use `READ[:SCALar]:SPECtrum:ACPower:EXTended?` The $P_{TX-26\ dB}$, $P_{TX-26\ dB} - P_{TXref}$, and P_{TXref} results are only available when gating is on (see `CONFigure:SPECtrum:ACPower:GATing`). • `READ`… starts a single shot measurement and returns the results. • `FETCh`… reads the results without taking care of the measurement state..				TEST, CONN

READ[:SCALar]:SPECtrum:ACPower:EXTended? **FETCh[:SCALar]:SPECtrum:ACPower:EXTended?**	Scalar results: Start single shot measurement and return results Read out measurement results (unsynchronized)			
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–100 dBm to +30 dBm (x6),	ACP (Current),	NAN	dBm	V4.20
–100 dBm to +30 dBm (x6),	ACP (Average),	NAN	dBm	
–100 dBm to +30 dBm (x6),	ACP (Maximum),	NAN	dBm	
–100 dB to +30 dB (x6),	ACP relative (Current),	NAN	dB	
–100 dB to +30 dB (x6),	ACP relative (Average),	NAN	dB	
–100 dB to +30 dB (x6),	ACP relative (Maximum),	NAN	dB	
–100 dBm to +30 dBm,	Center channel power (Current),	NAN	dBm	
–100 dBm to +30 dBm (x2),	$P_{TX–26\ dB}$ (Current),	NAN	dBm	
–100 dBm to +30 dBm (x2),	$P_{TX–26\ dB}$ (Average),	NAN	dBm	
–100 dBm to +30 dBm (x2),	$P_{TX–26\ dB}$ (Maximum),	NAN	dBm	
–100 dB to 0 dB (x2),	$P_{TX–26\ dB} – P_{TXref}$ (Current),	NAN	dB	
–100 dB to 0 dB (x2),	$P_{TX–26\ dB} – P_{TXref}$ (Average),	NAN	dB	
–100 dB to 0 dB (x2),	$P_{TX–26\ dB} – P_{TXref}$ (Maximum),	NAN	dB	
–100 dBm to +30 dBm	P_{TXref} (Current)	NAN	dBm	
Description of commands				Sig. State
These commands are always queries. They start a measurement (`READ...`) and/or return all scalar measurement results. The symbol (x6) behind a value indicates that the list contains six results corresponding to the lower channels –3, –2, –1 and the upper channels +1, +2, +3, respectively. The symbol (x2) behind a value indicates that the list contains two results corresponding to channels –1 and +1. The $P_{TX–26\ dB}$, $P_{TX–26\ dB} – P_{TXref}$, and P_{TXref} results are only available when gating is on (see `CONFigure:SPECtrum:ACPower:GATing`). • `READ`… starts a single shot measurement and returns the results. • `FETCh`… reads the results without taking care of the measurement state.				TEST, CONN

CALCulate[:SCALar]:SPECtrum:ACPower:MATChing:LIMit?	Scalar Limit Matching			
<Result>	Description of parameters	Def. value	Def. unit	FW vers.
ACP (Current) (x6),	For all measured values:	INV	–	V3.57
ACP (Average) (x6),	NMAU | INV | OK	INV		
ACP (Maximum) (x6),		INV		
$P_{TX–26\ dB} – P_{TXref}$ (Current) (x2),		INV		V4.20
$P_{TX–26\ dB} – P_{TXref}$ (Average) (x2),		INV		
$P_{TX–26\ dB} – P_{TXref}$ (Maximum) (x2)		INV		
Description of commands				Sig. State
This command is always a query. It indicates whether and in which way the permissible tolerances for the scalar measured values (see commands above) have been exceeded. The symbol (x6) behind a value indicates that the list contains six results corresponding to the lower channels –3, –2, –1 and the upper channels +1, +2, +3, respectively. The symbol (x2) behind a value indicates that the list contains two results corresponding to channels –1 and +1. The $P_{TX–26\ dB} – P_{TXref}$ results are only available when gating is on (see `CONFigure:SPECtrum :ACPower:GATing`). Possible values are: *NMAU* Result is above the limit *INV* Result is invalid *OK* Limit check passed				TEST, CONN

SPECtrum:BWIDth...

The subsystem *SPECtrum:BWIDth* measures the 20 dB bandwidth. The subsystem corresponds to the measurement menu *Spectrum,* application *20 dB Bandwidth,* and the associated popup menu *Spectrum Configuration.*

Control of Measurement

The commands in this section control the spectrum measurement. They correspond to the softkey *Bandwidth* in the measurement menu *Spectrum*.

INITiate:SPECtrum:BWIDth	Start new measurement	⇒	*RUN*
ABORt:SPECtrum:BWIDth	Abort measurement and switch off	⇒	*OFF*
STOP:SPECtrum:BWIDth	Stop measurement after current stat. cycle	⇒	*STOP*
CONTinue:SPECtrum:BWIDth	Next meas. step (only *stepping mode*)	⇒	*RUN*
Description of command		Sig. State	FW vers.
These commands have no query form. They start or stop the measurement, setting it to the status indicated in the top right column.		all	V3.54

CONFigure:SPECtrum:BWIDth:EREPorting <*Mode*>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC** | **SRSQ** | **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	V3.54
Description of command				Sig. State
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see Chapter 5).				all

FETCh[:SCALar]:SPECtrum:BWIDth:STATus?				Measurement Status
Ret. values	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN** | **STOP** | **ERR** | **STEP** | **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate`, `CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V3.54
1 to 10000 | **NONE,**	Counter for current statistics cycle No counting mode set	NONE	–	
0 to 1000 | **NONE**	Counter for current evaluation period within a cycle Statistic count set to off	NONE	–	
Description of command				Sig. State
This command is always a query. It returns the status of the measurement (see Chapters 3 and 5).				all

Subsystem SPECtrum:...CONTrol

The subsystem *SPECtrum:...CONTrol* defines the statistics (repetition mode, statistic count, and stop condition) of the measurement. These settings are in the *Control* tab of the popup menu *Spectrum Configuration.*

CONFigure:SPECtrum:BWIDth:CONTrol *<Mode>, <Statistics>, <Repetition>, <StopCond>, <Stepmode>* — Scope of Measurement

<Mode>	Desciption of parameters	Def. value	Def. unit	FW vers.
SCALar | **ARRay,**	Scalar values only (incl. limit matching) Scalar measured values and arrays	ARRay	–	V3.54
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	Number of sweeps per statistics cycle Statistics off (equivalent to 1)	10	–	V3.54
<Repetition>	Description of parameters	Def. value	Def. unit	FW vers.
CONTinuous | **SINGleshot |** **1 to 10000,**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	V3.54
<StopCond>	Description of parameters	Def. value	Def. unit	FW vers.
SONerror | **NONE,**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	V3.54
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V3.54

Description of command	Sig. State
This command restricts the type of measured values to accelerate the measurement and determines the number of sweeps within a statistics cycle. **Note:** In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot. The *Repetition* parameter is valid in remote control only. Changing this parameter in remote control does not alter the repetition mode in manual control and vice versa. The default repetition mode in manual control is *Continuous*.	all

CONFigure:SPECtrum:BWIDth:CONTrol:RMODe *<Mode>* — Result mode

<Mode>	Desciption of parameters	Def. value	Def. unit	FW vers.
SCALar | **ARRay**	Scalar values only (incl. limit matching) Scalar measured values and arrays available	ARRay	–	V3.54

Description of command	Sig. State
This command specifies the type of measured values. If the parameter `SCALar` is set, the measurement curves (arrays, see commands `READ:ARRay:SPECtrum:BWIDth...`, `READ:SUBarray:SPECtrum:BWIDth...`) are no longer available but the measurement is speeded up considerably.	all

CONFigure:SPECtrum:BWIDth:CONTrol:STATistics *<Statistics>*				Statistics Count
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	Number of sweeps per statistics cycle Statistics off (equivalent to 1)	10	–	V3.54
Description of command				Sig. State
This command specifies the type of measured values and defines the number of sweeps forming a statistics cycle.				all

CONFigure:SPECtrum:BWIDth:CONTrol:REPetition *<Repetition>,<StopCond>,<Stepmode>*				Test Cycles
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot** | **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCondition>	Description of parameters	Def. value	Def. unit	
SONerror | **NONE**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V3.54
Description of command				Sig. State
This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement. **Note:** In the case of READ commands (`READ:`...), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot. The *Repetition* parameter is valid in remote control only. Changing this parameter in remote control does not alter the repetition mode in manual control and vice versa. The default repetition mode in manual control is *Continuous*.				all

Test Configuration

The commands of the following subsystems determine the parameters of the signal power measurement. The settings are part of the *Control* and of the *Analyzer* tab in the *Spectrum Configuration* menu.

CONFigure:SPECtrum:BWIDth:MMODe *<Mode>*				Measurement Mode
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ALL | **SINGle**	Measure all channels of the current hop scheme Measure bursts from a definite channel only	ALL	–	V3.54
Description of command				Sig. State
This command sets which channels are to measured. In `ALL` mode, the measurement is performed on every available burst, no matter what frequency it is on. In `SINGle` mode, the R&S® CBT measures the channel selected via `CONFigure:SPECtrum:BWIDth:MCHannel`.				all

CONFigure:SPECtrum:BWIDth:MFRequency *<Frequency>*		Single Freq. Meas. – Measured Frequency		
<Frequency>	Description of parameters	Def. value	Def. unit	FW vers.
2 402 MHz to 2 495 MHz	Measured frequency	2402 000 000	Hz	V3.54
Description of command				Sig. State
This command defines the frequency to be measured if the measurement mode is set to `SINGle` (see command `CONFigure:SPECtrum:BWIDth:MMODe`). With the command `CONFigure:SPECtrum:BWIDth:MFRequency:UNIT`, the default frequency unit can be changed, and even *Bluetooth* channel numbers can be entered instead of frequencies. The default frequency corresponds to the channel 0.				all

CONFigure:SPECtrum:BWIDth:MFRequency:UNIT *<Unit>*				Frequency Unit
<Unit>	Description of parameters	Def. value	Def. unit	FW vers.
HZ | KHZ | MHZ | GHZ | CH	Frequency unit | Channel number	HZ	–	V3.54
Description of command				Sig. State
This command defines whether the measured frequency (see command `CONFigure:SPECtrum:BWIDth:MFRequency)` is specified in frequency units or as an Bluetooth channel number.				all

CONFigure:SPECtrum:BWIDth:DLEVel *<Level>*				Detection Level
<Meas_Freq>	Description of parameters	Def. value	Def. unit	FW vers.
–0.1 dB to –50.0 dB	Detection level	–20	dB	V3.54
Description of command				Sig. State
This command defines the off-peak signal level at which the bandwidth is measured.				all

Limits (Subsystem SPECtrum:BWIDth...:LIMit)

The subsystem *SPECtrum:BWIDth...:LIMit* defines the limit values for the 20 dB bandwidth measurement. The settings are part of the *Limits* tab in the *Spectrum Configuration* menu.

CONFigure:SPECtrum:BWIDth:CURRent:LIMit:SCALar:ASYMmetric:UPPer:VALue **CONFigure:SPECtrum:BWIDth:AVERage:LIMit:SCALar:ASYMmetric:UPPer:VALue** **CONFigure:SPECtrum:BWIDth:MAXimum:LIMit:SCALar:ASYMmetric:UPPer:VALue *<Limit>***				Spectrum Limits
<Limit>	Description of parameters	Def. value	Def. unit	FW vers.
0.05 MHz to 3.30 MHz	Upper limit for bandwidth	1	MHz	V3.54
Description of command				Sig. State
These commands define upper limits for the bandwidth of the current `(CURRent)`, average `(AVERage)`, and maximum `(MAXimum)` measurement curve, respectively. OFF means that the limit check is switched off.				all

CONFigure:SPECtrum:BWIDth:CURRent:LIMit:SCALar:ASYMmetric:UPPer:ENABle Spectrum Limits
CONFigure:SPECtrum:BWIDth:AVERage:LIMit:SCALar:ASYMmetric:UPPer:ENABle
CONFigure:SPECtrum:BWIDth:MAXimum:LIMit:SCALar:ASYMmetric:UPPer:ENABle ***<Enable>***

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Enable or disable limit check	See below	–	V3.54

Description of command	Sig. State
These commands switches the limit check for the current `(CURRent)`, average `(AVERage)`, and maximum `(MAXimum)` measurement curve on or off. By default, the limit check is enabled for the maximum curve, disabled for the current and average curves.	all

Measured Values

The commands in the following section determine and return the results of the 20 dB bandwidth measurement. They correspond to the graphical menu *Spectrum* with its various display elements.

Scalar results:
READ[:SCALar]:SPECtrum:BWIDth? Start single shot measurement and return results
FETCh[:SCALar]:SPECtrum:BWIDth? Read out measurement results (unsynchronized)

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–100 dBm to +30 dBm,	Emission Peak (Current),	NAN	dBm	V3.54
–100 dBm to +30 dBm,	Emission Peak (Average),	NAN	dBm	
–100 dBm to +30 dBm,	Emission Peak (Maximum),	NAN	dBm	
–1.65 MHz to 0 MHz,	f_L (Current),	NAN	Hz	
0 MHz to +1.65 MHz,	f_H (Current),	NAN	Hz	
0 MHz to 3.3 MHz,	$f_H – f_L$ (Current),	NAN	Hz	
–1.65 MHz to 0 MHz,	f_L (Average),	NAN	Hz	
0 MHz to +1.65 MHz,	f_H (Average),	NAN	Hz	
0 MHz to 3.3 MHz,	$f_H – f_L$ (Average),	NAN	Hz	
–1.65 MHz to 0 MHz,	f_L (Maximum),	NAN	Hz	
0 MHz to +1.65 MHz	f_H (Maximum),	NAN	Hz	
0 MHz to 3.3 MHz,	$f_H – f_L$ (Maximum),	NAN	Hz	

Description of commands	Sig. State
These commands are always queries. They start a measurement (`READ...`) and/or return all scalar measurement results. The symbol (x4) behind a value indicates that the list contains four results corresponding to the *Current,* the *Average,* the *Minimum,* and the *Maximum* measurement curve, respectively. • `READ`... starts a single shot measurement and returns the results. • `FETCh`... reads the results without taking care of the measurement state.	TEST, CONN

CALCulate[:SCALar]:SPECtrum:BWIDth:MATChing:LIMit?				Scalar Limit Matching
<Result>	Description of parameters	Def. value	Def. unit	FW vers.
Bandwidth limit (current), **Bandwidth limit (average),** **Bandwidth limit (maximum)**	For all measured values: NMAU | INV | OK	INV INV INV	–	V3.57
Description of commands				Sig. State
This command is always a query. It indicates whether and in which way the permissible tolerances for the scalar measured values (see commands above) have been exceeded. Possible values are: *NMAU* Result is above the limit *INV* Result is invalid *OK* Limit check passed				TEST, CONN

READ:ARRay:SPECtrum:BWIDth:CURRent? **READ:ARRay:SPECtrum:BWIDth:AVERage?** **READ:ARRay:SPECtrum:BWIDth:MAXimum?** **FETCh:ARRay:SPECtrum:BWIDth:CURRent?** **FETCh:ARRay:SPECtrum:BWIDth:AVERage?** **FETCh:ARRay:SPECtrum:BWIDth:MAXimum?**	Spectrum Curve Start single shot measurement and return results Read measurement results (unsynchronized)			
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–128.0 dB to + 0.0 dB **...** **–128.0 dB to + 0.0 dB**	Power[1], 1st value for emission power ... Power[n], 564th value for emission power	NAN ... NAN	dB ... dB	V3.57
Description of command				Sig. State
These commands are always queries. They return the normalized output power fixed, equidistant frequency points. The total number n of samples is 564; their position is between –1.1 MHz and +1.1 MHz relative to the center frequency of the measured Bluetooth channel with an approximate interval of 3.9KHz between points. The meaning of the returned values depends on the measurement mode set via `CONFigure:SPECtrum:BWIDth:MMODe`: • In `ALL` mode, the R&S CBT measures all available channels and returns the trace averaged over all these channels. • In `SINGle` mode, the R&S CBT measures the channel selected via `CONFigure:SPECtrum:BWIDth:MFRequency` and returns the corresponding trace. The calculation of *current, average* and *maximum* values is explained in Chapter 3 (*display mode*).				TEST, CONN

SPECtrum:FRANge…

The `SPECtrum:FRANge`…subsystem measures the power of the Bluetooth signal from the DUT at up to 110 frequency points using a fixed 100 kHz partition. The subsystem corresponds to the measurement menu *Spectrum,* application *Frequency Range,* and the associated popup menu *Spectrum Configuration.*

Condensed programming example

The following command sequence illustrates the basic steps for a *Frequency Range* measurement. Suppose your Bluetooth device operates in the frequency range between 2402 MHz and 2480 MHz:

`CBTBT: *RST`
Reset instrument
`CBTBT: CONFigure:SSIGnal:TMODe:HSCHeme RXTX`
Frequency hopping off
`CBTBT: CONFigure:SSIGnal:TMODe:LBTests:FREQuency 2402MHz, 2402MHz`
Set DUT to lowest TX (and RX) frequency
`CBTBT: CONFigure:SPECtrum:FRANge:CONTrol:STATistics 50`
Average over 50 measurements
`CBTBT: CONFigure:SPECtrum:FRANge:MWINdow -3, 7`
Select a start frequency of 2399 MHz and a stop frequency of 2405 MHz
`CBTBT: READ[:SCALar]: SPECtrum:FRANge:LFRequency?`
Start measurement, return the lower limit frequency f_L. To comply with the specification the value must be ≥ 2400 MHz.
`CBTBT: CONFigure:SPECtrum:FRANge:MWINdow 73, 11`
Select a start frequency of 2475 MHz and a stop frequency of 2485 MHz
`CBTBT: READ[:SCALar]:SPECtrum:FRANge:HFRequency?`
Start measurement, return the upper limit frequency f_H. To comply with the specification the value must be ≤ 2483.5 MHz.

INITiate:SPECtrum:FRANge	Start new measurement		⇒ *RUN*
ABORt:SPECtrum:FRANge	Abort running measurement and switch off		⇒ *OFF*
STOP: SPECtrum:FRANge	Stop measurement after current stat. cycle		⇒ *STOP*
CONTinue: SPECtrum:FRANge	Next measurement step (only *stepping mode*)		⇒ *RUN*
Description of command		Sig. State	FW vers.
These commands have no query form. They start and stop the frequency range measurement, setting it to the status indicated in the top right column.		all	V4.25

CONFigure: SPECtrum:FRANge:EREPorting <***Mode***>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC** | **SRSQ** | **OFF**	Service request Single operation complete SRQ and SRSQ No reporting	OFF	–	V4.25
Description of command				Sig. State
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see Chapter 5).				all

FETCh: SPECtrum:FRANge:STATus?				Measurement Status
Ret. values	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN |** **STOP |** **ERR |** **STEP |** **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V4.25
1 to 1000 | **NONE,**	Counter for current statistics cycle No counting mode set	NONE	–	
1 to 1000 | **NONE**	Counter for current evaluation period within a cycle Statistic count set to off	NONE	–	
Description of command				Sig. State
This command is always a query. It returns the status of the measurement (see Chapters 3 and 5).				all

CONFigure: SPECtrum:FRANge:CONTrol:STATistics *<Statistics>*				Statistics Count
<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 1000 | **NONE**	Number of measurements to be averaged Single measurement, no averaging	50	–	V4.25
Description of command				Sig. State
This command specifies the number of measurements the R&S CBT performs in order to obtain an averaged result. Each measurement provide power results at each frequency .				all

CONFigure:SPECtrum:FRANge:MWINdow *<Start>,<Span>*				Measurement Window
<Start>, <Span>	Description of parameters	Def. value	Def. unit	FW vers.
–4 to 73, **(2398 MHz to 2475 MHz)**	Starting channel (frequency) of the measurement window	–3	–	V4.25
1 to 11 **(1 MHz to 11 MHz)**	Measurement window span	7		
Description of command				Sig. State
This command specifies the starting point and the span of the measurement window. The number of results returned by the frequency range `READ:ARRay...` and `READ:SCALar...` commands is ten times the measurement window span.				all

CONFigure:SPECtrum:FRANge:THReshold *<Threshold>*				Power Threshold Count
<Threshold>	Description of parameters	Def. value	Def. unit	FW vers.
–100 dBm to 0 dBm	The value of the threshold to calculate f_H and f_L results	–30 dBm	–	V4.25
Description of command				Sig. State
This command specifies the threshold value for the frequency range measurement. The default value is corresponding to the Bluetooth specification.				all

Limits (Subsystem SPECtrum:FRANge...:LIMit)

The subsystem *SPECtrum:FRANge...:LIMit* defines the limit values for the *Frequency Range* measurement. The settings are part of the *Limits* tab in the *Spectrum Configuration* menu.

CONFigure:SPECtrum:FRANge:LIMit:SCALar:ASYMmetric[:COMBined]:VALue
<FL_FH_Upper>, <FL_FH_Lower> Upper and Lower f_L and f_H Limits

<FL_FH_Upper>, <FL_FH_Lower>	Description of parameters	Def. value	Def. unit	FW vers.
2397.55 MHz to 2485.45 MHz, **2397.55 MHz to 2485.45 MHz**	Upper limit for f_L and f_H Lower limit for f_L and f_H	2483.5 2400.0	MHz MHz	V4.25
Description of command				Sig. State
These commands define upper and lower limits for f_L and f_H. OFF means that the limit check is disabled.				all

CONFigure:SPECtrum:FRANge:LIMit:SCALar:ASYMmetric[:COMBined]:ENABle
<FL_FH_Upper>, <FL_FH_Lower> Upper and Lower Limits on or off

<FL_FH_Upper>, <FL_FH_Lower>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF, **ON | OFF**	Enable or disable upper limit check for f_L and f_H Enable or disable lower limit check for f_L and f_H	ON ON	– –	V4.25
Description of command				Sig. State
These commands enable or disable the upper and lower limit check for the f_L and f_H measurements.				all

Measured Values

The commands in the following section determine and return the results of the *Frequency Range* measurement. They correspond to the graphical menu *Spectrum* with its various display elements.

Power results

READ:ARRay:SPECtrum:FRANge? — Start single shot measurement and return results ⇒ *RUN*
FETCh:ARRay:SPECtrum:FRANge? — Read measurement results (unsynchronized) ⇒ *RUN*

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–140 dBm to 0 dBm, **…** **–140 dBm to 0 dBm**	1st power measured at 100 KHz interval nth power measured at 100 KHz interval	NAN … NAN	dBm … dBm	V4.25
Description of command				Sig. State
These commands are always queries. They return the power measured at 100 kHz intervals in the range specified by the `CONFigure:SPECtrum:FRANge:MWINdow` command. For this command the detector is always peak and the result mode is average. The number n of results is ten times the measurement window span (see `CONFigure:SPECtrum:FRANge:MWINdow`).				TEST

READ[:SCALar]: SPECtrum:FRANge:LFRequency? **READ[:SCALar]: SPECtrum:FRANge:HFRequency?** Start single shot measurement and return results ⇒ *RUN* **FETCh[:SCALar]:SPECtrum:FRANge: LFRequency?** **FETCh[:SCALar]:SPECtrum:FRANge: HFRequency?** Read measurement results (unsynchronized) ⇒ *RUN*				Limit frequencies
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
2397.55 MHz to 2475.45 MHz	The lowest (f_L) or the highest (f_H) frequency below the threshold	NAN	MHz	V4.25
Description of command				Sig. State
These commands are always queries. They return the f_L and f_H values as the specified in the test spec. • `READ[:SCALar]:SPECtrum:FRANge:LFRequency?` command should be used with the measurement window set to 2399 MHz to 2405 MHz (7 channels window from Ch –3 to Ch 3) and the DUT transmitting at the lowest frequency (2402 MHz, Ch 0). • `READ[:SCALar]:SPECtrum:FRANge: HFRequency?` should be used with the measurement window set to 2475 MHz to 2485 MHz (11 channels window from Ch. 73 to Ch 83) and the DUT transmitting at the highest frequency (2480 MHz, Ch 78). For setting the measurement window parameters see `CONFigure:SPECtrum:FRANge:MWINdow` command.				TEST

CALCulate[:SCALar]:SPECtrum:FRANge:MATChing:LIMit?				Scalar Limit Matching
<Result>	Description of parameters	Def. value	Def. unit	FW vers.
f_L limit check , **f_H limit check**	For all measured values: NMAU | NMAL | INV | OK	INV INV	– –	V4.25
Description of commands				Sig. State
This command is always a query. It indicates whether and in which way the permissible tolerances for the scalar measured values (see commands above) have been exceeded. Possible values are: *NMAU* Result is above the limit *NMAL* Result is below the limit *INV* Result is invalid *OK* Result is valid				TEST, CONN

Receiver Quality Measurements

The subsystem *Receiver Quality* comprises the commands for all measurements of the receiver quality context. The settings are used to assess the quality of the device under test's receiver. The subsystem corresponds to the main menu *Receiver Quality* and the associated popup menu *Receiver Quality Configuration.*

Receiver Quality – BER Application

The subsystem *RXQuality:BER* contains the commands for receiver quality measurements in the BER mode. The subsystem corresponds to the main menu *Receiver Quality,* application *BER* and the corresponding parts of the associated popup menu *Receiver Quality Configuration.*

Measurement Control

The following commands control the BER measurement.

INITiate:RXQuality:BER	Start new measurement	⇒	*RUN*
ABORt:RXQuality:BER	Abort running measurement and switch off	⇒	*OFF*
STOP:RXQuality:BER	Stop measurement	⇒	*STOP*
CONTinue:RXQuality:BER	Next measurement step (only *stepping mode*)	⇒	*RUN*

Description of command	Sig. State	FW vers.
These commands have no query form. They start or stop the current BER measurement, setting it to the status indicated in the top right column.	all	V3.50

CONFigure:RXQuality:BER:EREPorting <Mode> Event Reporting

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ |	Service request	OFF	–	V3.50
SOPC |	Single operation complete			
SRSQ |	SRQ and SRSQ			
OFF	No reporting			

Description of command	Sig. State
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see Chapter 5).	all

FETCh:RXQuality:BER:STATus?				Measurement Status
Return	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN** | **STOP** | **ERR** | **STEP** | **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V3.50
1 to 10000 | **NONE,**	Counter for current statistics cycle No counting mode set	NONE	–	
1 to 400 000 | **NONE**	Counter for current evaluation period within a cycle Statistic count set to off	NONE	–	
Description of command				Sig. State
This command is always a query. It returns the status of the measurement (see Chapter 5).				all

CONFigure:RXQuality:BER:TSETup <TestSetup>				Test Setup
<Test Setup>	Description of parameters	Def. value	Def. unit	FW vers.
T1 | **T2** | **T3** | **T4** | **T5**	BER Application Test Setup 1 BER Application Test Setup 2 BER Application Test Setup 3 BER Application Test Setup 4 BER Application Test Setup 5	T1	–	V3.50
Description of command				Sig. State
This command selects one out of 5 test setups, i.e. one data set holding the parameters of a particular BER receiver quality measurement. When the test setup is changed, the running measurement is stopped and all measured values are invalidated.				all

Subsystem RXQuality:BER:...CONTrol

The subsystem *RXQuality:BER:...CONTrol* defines the scope of the BER measurement. The settings are provided in the *Control* tab of the popup menu *Receiver Quality Configuration.*

CONFigure:RXQuality:BER:TSETup<nr>:CONTrol
<Statistics>, <Repetition>, <Stop Condition>, <Stepmode> — Statistics

<Statistics>	Description of parameters	Def. value	Def. unit	
1 to 400 000 | **NONE,**	Number of packets per statistic cycle No statistics (equivalent to 1)	1000*)	–	
<Repetition>	**Description of parameters**	**Def. value**	**Def. unit**	
CONTinuous | **SINGleshot |** **1 to 10000,**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<Stop Condition>	**Description of parameters**	**Def. value**	**Def. unit**	
SONerror | **NONE,**	Stop measurement in case of error (stop on limit failure, tolerance exceeded) Continue measurement even in case of error	NONE	–	
<Stepmode>	**Description of parameters**	**Def. value**	**Def. unit**	**FW vers.**
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V3.50

Description of command	Sig. State
This command defines the number of packets to be measured in a BER measurement cycle. The suffix <nr> refers to the selected test setup (<nr> = 1 to 5).	all

Note: In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.

The *Repetition* parameter is valid in remote control only. Changing this parameter in remote control does not alter the repetition mode in manual control and vice versa. The default repetition mode in manual control is *Continuous*.

*) The default values depend on the test setup:

Test Setup	T1	T2	T3	T4	T5
<Statistics>	1000	7408	7408	1093	590
<Repetition>	SING	SING	SING	SING	SING
<Stop Condition>	None	None	None	None	None

CONFigure:RXQuality:BER:TSETup<nr>:CONTrol:STATistics <Statistics> — Statistics

<Statistics>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 400 000 | **NONE**	Number of packets per statistic cycle No statistics (equivalent to 1)	1000*)	–	V3.50

Description of command	Sig. State
This command defines the number of packets to be measured in a BER measurement cycle. The suffix <nr> refers to the selected test setup (<nr> = 1 to 5). *) The default values depend on the test setup; see command `CONFigure:RXQuality:BER:TSETup<nr>:CONTrol`	all

CONFigure:RXQuality:BER:TSETup<nr>:CONTrol:REPetition <Repetition>, <Stop Condition>				Test Cycles
<Repetition>	Description of parameters	Def. value*)	Def. unit	
CONTinuous | **SINGleshot |** **1 to 10000**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<Stop Condition>	Description of parameters	Def. value		
SONerror | **NONE**	Stop measurement in case of error (stop on limit failure, tolerance exceeded) Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V3.50
Description of command				Sig. State
This command determines the repetition mode and the stop condition for the measurement. The suffix <nr> refers to the selected test setup (<nr> = 1 to 5). ***Note:*** *In the case of READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.* The *Repetition* parameter is valid in remote control only. Changing this parameter in remote control does not alter the repetition mode in manual control and vice versa. The default repetition mode in manual control is *Continuous*. *) The default values depend on the test setup; see command `CONFigure:RXQuality:BER:TSETup<nr> :CONTrol`				all

Subsystem RXQuality:BER:...LEVel

The subsystem *RXQuality:BER:...LEVel* sets the R&S® CBT TX level used for BER receiver quality measurements. The subsystem corresponds to the *TX Level* parameter in the *Master Sig.* tab in the popup menu *Receiver Quality Configuration.*

CONFigure:RXQuality:BER:TSETup<nr>:LEVel <Level>				TX Level
<Level>	Description of parameters	Def. value	Def. unit	FW vers.
–90 dBm to 0 dBm	RF output level for BER	–70.0*	dBm	V3.50
Description of command				Sig. State
This command defines the output power of the R&S® CBT transmitter for a BER test. The suffix <nr> refers to the selected test setup (<nr> = 1 to 5). The BER TX level does not affect any other measurements (see command `CONFigure:MSIGnal:TXLevel <Level>`). *) The default value for test setup T1 is –40 dBm. The default value for test setup T2 is –20 dBm.				all

BER Test Signal

The commands in the following section define the test signal that the R&S CBT generates for the BER measurement. The subsystem corresponds to the subsection *Loopback* of tab *Control*, BER application, in the popup menu *Receiver Quality Configuration.*

CONFigure:RXQuality:BER:TSETup<nr>:HSCHeme *<Scheme>*				BER Hopping Scheme
<Scheme>	Description of parameters	Def. value	Def. unit	FW vers.
RXTX | **EUSA** | **FRANce** | **RHOP**	RX/TX on single frequency Europe's and USA's hopping scheme France's hopping scheme Test mode's reduced hopping scheme	EUSA	–	V3.50
Description of command				Sig. State
These commands select the hopping scheme to be used in test mode. Channels and frequency ranges are: Europe/USA 2400 MHz to 2483.5 MHz, Channel$_k$: f_k = 2402+k MHz, k = 0 to 78 France 2446.5 MHz to 2483.5 MHz, Channel$_k$: f_k = 2454+k MHz, k = 0 to 22				all

CONFigure:RXQuality:BER:TSETup<nr>:FREQuency *<TX_Freq>,<RX_Freq>*				TX/RX Frequency, BER
<TX_Freq>	Description of parameters	Def. value	Def. unit	
2 402 MHz to 2 495 MHz,	TX frequency	2480000000	Hz	
<RX_Freq>	Description of parameters	Def. value	Def. unit	FW vers.
2 402 MHz to 2 495 MHz	RX frequency	2402000000	Hz	V3.50
Description of command				Sig. State
These commands define the frequency of the RF signals that will be generated and received by the DUT during `RXQuality:BER` measurements. Both frequencies must be entered in multiples of the *Bluetooth* channel width of 1 MHz.				all

CONFigure:RXQuality:BER:TSETup<nr>:PATType <*Type*>				Pattern Type
<Type>	Description of parameters	Def. value	Def. unit	FW vers.
DPRS | **SPRS** | **ALL1** | **ALL0** | **P11** | **P44** | **USER**	Dynamic pseudo random sequence Static pseudo random sequence All ones All zeros Alternative ones and zeros Four ones then four zeros User defined	SPRS	–	V3.50
Description of command				Sig. State
This command sets the bit pattern for BER measurements. The suffix <nr> refers to the selected test setup (<nr> = 1 to 5).				all

CONFigure:RXQuality:BER:TSETup<nr>:PTYPe <*Type*> Packet Type

<Type>	Description of parameters	Def. value	Def. unit	FW vers.
DH1 |	DH1 packet	**DH1	–	V3.50
DH3 |	DH3 packet			
DH5 |	DH5 packet			
***E21P** |	2-DH1 packet			V4.00
***E23P** |	2-DH3 packet			
***E25P** |	2-DH5 packet			
***E31P** |	3-DH1 packet			
***E33P** |	3-DH3 packet			
***E35P**	3-DH5 packet			

Description of command	Sig. State
This command determines what type of packet is to be transmitted by the DUT during loopback mode. The suffix <nr> refers to the selected test setup (<nr> = 1 to 5). * These packet types are only available if software option CBT-K55 has been installed *and* hardware option CBT-B55 has been fitted. ** The default packet type for test setup T4 (T5) is DH3 (DH5).	all

Length of Test Sequence

CONFigure:RXQuality:BER:TSETup<nr>:LOTSequence:DH1Packet <*Length*>
CONFigure:RXQuality:BER:TSETup<nr>:LOTSequence:DH3Packet <*Length*>
CONFigure:RXQuality:BER:TSETup<nr>:LOTSequence:DH5Packet <*Length*>
***CONFigure:RXQuality:BER:TSETup<nr>:LOTSequence:E21Packet <*Length*>**
***CONFigure:RXQuality:BER:TSETup<nr>:LOTSequence:E23Packet <*Length*>**
***CONFigure:RXQuality:BER:TSETup<nr>:LOTSequence:E25Packet <*Length*>**
***CONFigure:RXQuality:BER:TSETup<nr>:LOTSequence:E31Packet <*Length*>**
***CONFigure:RXQuality:BER:TSETup<nr>:LOTSequence:E33Packet <*Length*>**
***CONFigure:RXQuality:BER:TSETup<nr>:LOTSequence:E35Packet <*Length*>**

<Length>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 27 |	Length of test sequence, in bytes, for a DH1 packet	27	bytes	V3.50
0 to 183 |	Length of test sequence, in bytes, for a DH3 packet	183		
0 to 339 |	Length of test sequence, in bytes, for a DH5 packet	339		
0 to 54 |	*Length of test sequence, in bytes, for a 2-DH1 packet	54		V4.00
0 to 367 |	*Length of test sequence, in bytes, for a 2-DH3 packet	367		
0 to 679 |	*Length of test sequence, in bytes, for a 2-DH5 packet	679		
0 to 83 |	*Length of test sequence, in bytes, for a 3-DH1 packet	83		
0 to 552 |	*Length of test sequence, in bytes, for a 3-DH3 packet	552		
0 to 1021	*Length of test sequence, in bytes, for a 3-DH5 packet	1021		

Description of command	Sig. State
This command determines the length of the payload for the transmitted packet. The allowed value range depends on the packet type (see command `CONFigure:RXQuality:BER:TSETup<nr>:PTYPe`). The suffix <nr> refers to the selected test setup (<nr> = 1 to 5). *These packet types are only available if software option CBT-K55 has been installed *and* hardware option CBT-B55 has been fitted.	all

CONFigure:RXQuality:BER:TSETup<nr>:UDLength <*Length*> User defined Length

<Length>	Description of parameters	Def. value	Def. unit	FW vers.
3 to 64	Length of user defined data in bit	16	–	V3.50

Description of command	Sig. State
This command determines the length of the user defined bit sequence before it is repeated. The suffix <nr> refers to the selected test setup (<nr> = 1 to 5). The specified value will be used if the loopback pattern is user defined (see command `CONFigure:RXQuality:BER:TSETup<nr>:PATType`).	all

CONFigure:RXQuality:BER:TSETup<nr>:UDData <*Data*> User defined Data

<Data>	Description of parameters	Def. value	Def. unit	FW vers.
<HEX Data>	Up to 64 user defined data bits; represented by max. 16 hex characters, least significant bit last, i.e. to the right	"FF00"	–	V3.50

Description of command	Sig. State
This command determines the bit stream to be used for the user defined data. The bit stream is repeated until the complete payload is filled, removing any extra bits from the end of the stream. The suffix <nr> refers to the selected test setup (<nr> = 1 to 5). The specified value will be used if the loopback pattern is user defined (see command `CONFigure:RXQuality:BER:TSETup<nr>:LBACk:PATTYpe`).	all

CONFigure:RXQuality:BER:TSETup<nr>:WHITening <*Enable*> Whitening

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Whitening enabled Whitening disabled	OFF	–	V3.50

Description of command	Sig. State
These commands switch whitening on or off.	all

CONFigure:RXQuality:BER:TSETup<nr>:DELay <*Delay*> Delay

<Delay>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Use loopback with delay Do not use loopback with delay	OFF	–	V3.50

Description of command	Sig. State
This command determines whether delayed loopback should be used in the DUT. The suffix <nr> refers to the selected test setup (<nr> = 1 to 5).	all

DEFault:RXQuality:BER:TSETup<nr> Default Settings

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to default values Some or all parameters differ from the default values	ON	–	V3.50

Description of command	Sig. State
As a *setting command* with the setting *ON* this command sets all parameters of the subsystem to default values (the setting OFF results in an error message). This also includes the `BER:LIMit` settings. As a query, this command returns whether all parameters are set to default values *(ON)* or not *(OFF)*. The suffix <nr> refers to the selected test setup (<nr> = 1 to 5).	all

Subsystem RXQuality:BER...:LIMit

The subsystem *RXQuality:BER...:LIMit* defines tolerance values for the BER measurement. The subsystem corresponds to the tab *Limits* in the popup menu *Receiver Quality Configuration.*

CONFigure:RXQuality:BER:TSETup<nr>:LIMit:SCALar:ASYMmetric[:COMBined] <BER>, <BER_Enable>, <PER>, <PER_Enable> — BER Limit

Parameters	Description of parameters	Def. value	Def. unit	FW vers.
0% to 100%,	Upper limit for bit error rate (BER)	0.10	%	V3.50
ON | OFF	Enable or disable BER limit check	ON	–	
0% to 100%,	Upper limit for packet error rate (PER)	0.01	%	
ON | OFF	Enable or disable PER limit check	OFF	–	

Description of command	Sig. State
This command defines an upper limit for the bit error rate and the packet error rate for test setup number <nr> and switches the limit checks on or off.	all

CONFigure:RXQuality:BER:TSETup<nr>:LIMit:SCALar:ASYMmetric[:COMBined]:VALue <BER>, <PER> — BER Limit

Parameters	Description of parameters	Def. value	Def. unit	FW vers.
0% to 100%,	Upper limit for bit error rate (BER)	0.10	%	V3.50
0% to 100%	Upper limit for packet error rate (PER)	0.01	%	

Description of command	Sig. State
This command defines an upper limit for the bit error rate and the packet error rate for test setup number <nr>.	all

CONFigure:RXQuality:BER:TSETup<nr>:LIMit:SCALar:ASYMmetric[:COMBined]:ENABle <BER_Enable>, <PER_Enable> — BER Limit On/Off

Parameters	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF,	Enable or disable BER limit check	ON	–	V3.50
ON I OFF	Enable or disable PER limit check	OFF	–	

Description of command	Sig. State
This command switches the BER or PER limit checks on or off.	

DEFault:RXQuality:BER:TSETup<nr>:LIMit — Default Settings

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON |	The parameters are set to default values	ON	–	V3.50
OFF	Some or all parameters differ from the default value			

Description of command	Sig. State
As a *setting command* with the setting *ON* this command sets all parameters of the subsystem to default values (the setting OFF results in an error message). As a query, this command returns whether all parameters are set to default values *(ON)* or not *(OFF)*. The suffix <nr> refers to the selected test setup (<nr> = 1 to 5).	all

Measured Values

The following commands measure and return the bit error rate and compares it with the tolerance values. The subsystem corresponds to the output elements in the measurement menu *Receiver Quality* for the BER application.

READ[:SCALar]:RXQuality:BER? **FETCh[:SCALar]:RXQuality:BER?**	Scalar Results: Start BER measurement and return results Read out meas. results (unsynchronized)			
<BER>	Description of parameters	Def. value	Def. unit	
0 % to 100 %,	Percentage of bit errors that occurred within the current statistical cycle	NAN	%	
<PER>	Description of parameters	Def. value	Def. unit	
0 % to 100 %,	Percentage of packet errors that occurred within the current statistical cycle	NAN	%	
<Packets received>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 1000	Total number of packets received successfully	NAN	–	V3.50
Description of command				Sig. State
These commands are always queries. They start a bit-error-rate test and output the measurement results (see also detailed explanation of measured values in Chapter 4).				TEST

FETCh[:SCALar]:RXQuality:BER:DETail?	Scalar Results Read out meas. results (unsynchronized)			
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
0 % to 100 %, **0 % to 100 %,** **0 % to 100 %,** **0 % to 100 %,** **0 % to 100 %,** **0 % to 100 %,** **0 % to 100 %,** **0 % to 100 %**	Bit error rate, Not acknowledged (NAK) rate, Missing packet rate (PER detail), HEC error rate (PER detail), CRC error rate (PER detail), Wrong packet type rate (PER detail), Wrong payload length rate (PER detail), Packet error rate (PER total)	NAN NAN NAN NAN NAN NAN NAN NAN	% % % % % % % %	V4.20
Description of command				Sig. State
This command is always a query. An `INIT:RXQuality:BER` command must have been issued prior to the `FETCh`… in order to receive valid results.				TEST

CALCulate:RXQuality:BER:MATChing:LIMit?	Limit Matching			
<BER>	Value range	Def. value	Def. unit	
NMAU | **INV** | **OK**	BER result is above the limit BER result is invalid BER result is valid	INV	–	
<PER>	Value range	Def. value	Def. unit	FW vers.
NMAU | **INV** | **OK**	PER result is above the limit PER result is invalid PER result is valid	INV	–	V3.50
Description of command				Sig. State
This command is always a query. It indicates whether and in which way the permissible error limits for the measured values of the bit error rate test (see command above) have been exceeded.				TEST

Receiver Quality – BER Search Application

The subsystem *RXQuality:SBER* contains the commands for receiver quality measurement in *BER Search* mode. The subsystem corresponds to the main menu *Receiver Quality,* application *BER Search* and the corresponding sections in the associated popup menu *Receiver Quality Configuration.*

Measurement Control

The following commands control the *BER Search* measurement. They correspond to the *BER Search* measurement control softkey.

INITiate:RXQuality:SBER	Start new measurement	⇒	*RUN*
ABORt:RXQuality:SBER	Abort running measurement and switch off	⇒	*OFF*
STOP:RXQuality:SBER	Stop measurement	⇒	*STOP*
CONTinue:RXQuality:SBER	Next measurement step (only *stepping mode*)	⇒	*RUN*
Description of command		Sig. State	FW vers.
These commands have no query form. They start or stop the *BER Search* measurement, setting it to the status indicated in the top right column.		all	V3.50

CONFigure: RXQuality:SBER:EREPorting <Mode>				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC** | **SRSQ** | **OFF**	Service request Single operation complete SRQ and SRSQ No reporting	OFF	–	V3.50
Description of command				Sig. State
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see Chapter 5).				all

FETCh:RXQuality:SBER:STATus?				Measurement Status
Return	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN** | **STOP** | **ERR** | **STEP** | **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate`, `CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V3.50
1 to 1000 | **NONE**	Number of packets to average No averaging (equivalent to 1)	NONE	–	
Description of command				Sig. State
This command is always a query. It returns the status of the measurement (see Chapter 5).				all

Subsystem RXQuality:SBER:CONTrol

The subsystem *RXQuality:SBER:CONTrol* defines the scope of the *BER Search* measurement. The settings are provided in the *Control* tab of the popup menu *Receiver Quality Configuration.*

CONFigure:RXQuality:SBER:CONTrol:STATistics <Packets>, <Search Value>, <Search Cycles>				BER Search Statistics
<Packets>	Description of parameters	Def. value	Def. unit	
1 to 10000 | **NONE,**	Number of packets to calculate the average values for the measurement with no averaging	20	–	
<Search Value>	Description of parameters	Def. value	Def. unit	
0% to 100%,	Condition to look for to terminate the measurement, i.e. the condition to represent the sensitivity level of the DUT's receiver; percentage of bit errors (BER) within the BER test	0.1	%	
<Search Cycles>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 100	Number of cycles to conduct the measurement over. One cycle consists of the number of packets declared in the *Packets* field.	41	–	V3.50
Description of command				Sig. State
This command defines the parameters for the *BER Search* application.				all

Subsystem RXQuality:SBER:...LEVel

The subsystem *RXQuality:BER:...LEVel* sets the R&S® CBT TX level used for *BER Search* measurements. The subsystem corresponds to the *TX Level* parameter in the *Master Sig.* tab in the popup menu *Receiver Quality Configuration.*

CONFigure:RXQuality:SBER:LEVel *<Lower_Level>, <Upper_Level>*				Srch. Upper/Lower Level
<Lower_Level>	Description of parameters	Def. value	Def. unit	
–90 dBm to +0 dBm ,	Lowest TX level	–90.0	dBm	
<Upper_Level>	Description of parameters	Def. value	Def. unit	FW vers.
–90 dBm to +0 dBm	Lowest TX level	–70.0	dBm	V3.50
Description of command				Sig. State
This command defines the lowest and the highest output power of the R&S® CBT transmitter to use in the *BER Search* application.				all

Subsystem RXQuality:SBER

The subsystem *RXQuality:SBER* defines the test signal that the R&S CBT generates for *BER Search* measurements. The subsystem corresponds to the subsection *Loopback* of tab *Control*, *BER Search* application, in the popup menu *Receiver Quality Configuration.*

CONFigure:RXQuality:SBER[:LBACk]:HSCHeme *<Scheme>*				SBER Hopping Scheme
<Scheme>	Description of parameters	Def. value	Def. unit	FW vers.
RXTX | **EUSA** | **FRANce** | **RHOP**	RX/TX on single frequency Europe's and USA's hopping scheme France's hopping scheme Test mode's reduced hopping scheme	RXTX	–	V3.50
Description of command				Sig. State
These commands select the hopping scheme to be used in test mode. Channels and frequency ranges are: Europe/USA 2400 MHz to 2483.5 MHz, Channel$_k$: f_k = 2402+k MHz, k = 0 to 78 France 2446.5 MHz to 2483.5 MHz, Channel$_k$: f_k = 2454+k MHz, k = 0 to 22				all

CONFigure:RXQuality:SBER:FREQuency *<TX_Freq>,<RX_Freq>*				TX/RX Frequency, SBER
<TX_Freq>	Description of parameters	Def. value	Def. unit	
2 402 MHz to 2 495 MHz,	TX frequency	2402000000	Hz	
<RX_Freq>	Description of parameters	Def. value	Def. unit	FW vers.
2 402 MHz to 2 495 MHz	RX frequency	2480000000	Hz	V3.50
Description of command				Sig. State
These commands define the frequency of the RF signals that will be generated and received by the DUT during `RXQuality:BER` measurements. Both frequencies must be entered in multiples of the *Bluetooth* channel width of 1 MHz. With the command `CONFigure:RXQuality:SBER:FREQuency:UNIT`, the default frequency unit can be changed, and even *Bluetooth* channel numbers can be entered instead of frequencies.				all

CONFigure:RXQuality:SBER:PATType *<Type>*				Pattern Type
<Type>	Description of parameters	Def. value	Def. unit	FW vers.
DPRS | **SPRS** | **ALL1** | **ALL0** | **P11** | **P44** | **USER**	Dynamic pseudo random sequence Static pseudo random sequence All ones All zeros Alternative ones and zeros Four ones then four zeros User defined	SPRS	–	V3.50
Description of command				Sig. State
This command sets the bit pattern for BER Search tests.				all

CONFigure:RXQuality:SBER:PTYPe *<Type>* — Packet Type

<Type>	Description of parameters	Def. value	Def. unit	FW vers.
DH1 |	DH1 packet	**DH1	–	V3.50
DH3 |	DH3 packet			
DH5 |	DH5 packet			
***E21P** |	2-DH1 packet			V4.00
***E23P** |	2-DH3 packet			
***E25P** |	2-DH5 packet			
***E31P** |	3-DH1 packet			
***E33P** |	3-DH3 packet			
***E35P**	3-DH5 packet			

Description of command	Sig. State
This command determines what type of packet is to be transmitted by the DUT during loopback mode. The suffix <nr> refers to the selected test setup (<nr> = 1 to 5). * These packet types are only available if software option CBT-K55 has been installed *and* hardware option CBT-B55 has been fitted. ** The default packet type for test setup T4 (T5) is DH3 (DH5).	all

Length of Test Sequence

CONFigure:RXQuality:SBER:LOTSequence:DH1Packet *<Length>*
CONFigure:RXQuality:SBER:LOTSequence:DH3Packet *<Length>*
CONFigure:RXQuality:SBER:LOTSequence:DH5Packet *<Length>*
***CONFigure:RXQuality:SBER:LOTSequence:E21Packet** *<Length>*
***CONFigure:RXQuality:SBER:LOTSequence:E23Packet** *<Length>*
***CONFigure:RXQuality:SBER:LOTSequence:E25Packet** *<Length>*
***CONFigure:RXQuality:SBER:LOTSequence:E31Packet** *<Length>*
***CONFigure:RXQuality:SBER:LOTSequence:E33Packet** *<Length>*
***CONFigure:RXQuality:SBER:LOTSequence:E35Packet** *<Length>*

<Length>	Description of parameters	Def. value	Def. unit	FW vers.
0 to 27 |	Length of test sequence, in bytes, for a DH1 packet	27	bytes	V3.50
0 to 183 |	Length of test sequence, in bytes, for a DH3 packet	183		
0 to 339 |	Length of test sequence, in bytes, for a DH5 packet	339		
0 to 54 |	*Length of test sequence, in bytes, for a 2-DH1 packet	54		V4.00
0 to 367 |	*Length of test sequence, in bytes, for a 2-DH3 packet	367		
0 to 679 |	*Length of test sequence, in bytes, for a 2-DH5 packet	679		
0 to 83 |	*Length of test sequence, in bytes, for a 3-DH1 packet	83		
0 to 552 |	*Length of test sequence, in bytes, for a 3-DH3 packet	552		
0 to 1021	*Length of test sequence, in bytes, for a 3-DH5 packet	1021		

Description of command	Sig. State
This command determines the length of the payload for the transmitted packet. The allowed value range depends on the packet type (see command `CONFigure:RXQuality:SBER:PTYPe`). The suffix <nr> refers to the selected test setup (<nr> = 1 to 5). *These packet types are only available if software option CBT-K55 has been installed *and* hardware option CBT-B55 has been fitted.	all

CONFigure:RXQuality:SBER:UDLength *<Length>*				User defined Length
<Length>	Description of parameters	Def. value	Def. unit	FW vers.
3 to 64	Length of user defined data in bit	16	–	V3.50
Description of command				Sig. State
This command determines the length of the user defined bit sequence before it is repeated. The specified value will be used if the loopback pattern is user defined (see command `CONFigure:RXQuality:SBER:PATType`).				all

CONFigure:RXQuality:SBER:UDData *<Data>*				User defined Data
<Data>	Description of parameters	Def. value	Def. unit	FW vers.
<HEX Data>	Up to 64 user defined data bits; represented by max. 16 hex characters, least significant bit last, i.e. to the right	"FF00"	–	V3.50
Description of command				Sig. State
This command determines the bit stream to be used for the user defined data. The bit stream is repeated until the complete payload is filled, removing any extra bits from the end of the stream. This command is only available if the loopback pattern is user defined (see command `CONFigure:RXQuality:SBER:PATTern`).				all

CONFigure:RXQuality:SBER:WHITening *<Enable>*				Whitening
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Whitening enabled Whitening disabled	OFF	–	V3.50
Description of command				Sig. State
These commands switch whitening on or off.				all

CONFigure:RXQuality:SBER:DELay *<Delay>*				Delay
<Delay>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Use loopback delay Do not use loopback delay	OFF	–	V3.50
Description of command				Sig. State
This command determines whether delayed loopback should be used in the DUT.				all

DEFault:RXQuality:SBER				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to default values Some or all parameters differ from the default values	ON	–	V3.50
Description of command				Sig. State
As a *setting command* with the setting *ON* this command sets all parameters of the subsystem to default values (the setting OFF results in an error message). This also includes the `SBER:LIMit` settings. As a query, this command returns whether all parameters are set to default values *(ON)* or not *(OFF).*				all

Measured Values

The following commands measure and return the results of the *BER Search* application. The subsystem corresponds to the measurement menu *Receiver Quality* for the *BER Search* application.

				Scalar Results:
READ[:SCALar]:RXQuality:SBER?				Start BER Search measurement and return results
FETCh[:SCALar]: RXQuality:SBER?				Read out results (unsynchronized)
<BER>	Description of parameters	Def. value	Def. unit	
0 to 100 %	Percentage of bit errors that have occurred within the current statistical cycle	NAN	%	
<PER>	Description of parameters	Def. value	Def. unit	
0 to 100 %	Percentage of packet errors that have occurred within the current statistical cycle	NAN	%	
<TX_Level>	Description of parameters	Def. value	Def. unit	
–137 dBm to 13 dBm	Current R&S® CBT generator level	NAN	dBm	
<Packets received>	Description of parameters	Def. value	Def. unit	
0 to 1000	Total number of packets received successfully	NAN	–	
<Search Result>	Description of parameters	Def. value	Def. unit	FW vers.
–137 dBm to 13 dBm	Result of the BER search iteration	NAN	dBm	V3.50
Description of command				Sig. State
These commands are always queries. They start a bit-error-rate test `(READ...)` and return the measurement results (see also detailed explanation of measured values in Chapter 4). <TX_Level> is available while the R&S® CBT transmits a BER test signal; a <Search Result> is available only after the iteration has been terminated successfully.				TEST

Audio Generator and Analyzer (Option R&S CBT-B41)

Audio measurements form a separate function group *(Audio Non Signalling* mode, AUDIO_NSig) with associated secondary address. The *Signalling* mode is not available for audio measurements. However, it is possible to perform audio measurements in *Bluetooth Signalling* mode (e.g. to connect to a Bluetooth DUT and switch over to perform additional audio measurements). The *Bluetooth Signalling* mode provides additional audio-related commands (for example, the `ROUTe:SPENcoder...` and `ROUTe:SPDecoder...` commands).

The audio function group provides the following independent measurements:

- In a single-tone audio measurement, the R&S CBT generates an audio signal at constant level and frequency (see section *AF Generator (AFGenerator)* on p. 6.212) and analyzes a single-tone audio input signal (see section *Audio Analyzer (AFANalyzer)* on p. 6.207).
- In a multitone measurement (see section *Multitone Measurement (MULTitone* on p. 6.214), the R&S CBT generates a composite audio signal consisting of up to 20 distinct test tones and analyzes an audio input signal containing the same tones.
- In the total harmonic distortion (THD) measurement (see section *Total Harmonic Noise Measurement (THD)* on p. 6.243), the R&S CBT provides a single-frequency audio test signal with adjustable power and very low harmonic distortion and measures the AF power at the generator frequency (1st harmonic labeled d1) and at the 2nd, 3rd … 9th harmonics.

Note: *The single-tone generator and the multitone audio measurement must not be running simultaneously. In manual control, this is ensured because the single-tone audio generator is automatically switched off upon switchover to the* Multitone *menu and vice versa. In remote control, the conflict must be resolved explicitly:*

- *The single tone AF generator must be switched off before a multitone measurement is started.*
- *A running multitone measurement must be aborted before the single tone AF generator is switched on.*

In the case of two conflicting audio measurements, the `READ...`, `FETCh...` commands will result in an error message.

Two independent audio circuits are provided:

- In the primary audio circuit (subsystems `AFANalyzer[:PRIMary]` and `AFGenerator[:PRIMary]` for single tone measurements, `MULTitone:AF1Channel` and `THD:AF1Channel` for the other measurements), the audio signals are applied to the connectors AF 1 OUT (output, AF generator signal) and AF 1 IN (input) on the R&S CBT front panel. The `[:PRIMary]` single tone audio circuit corresponds to the *Analyzer 1* application in the *Audio Analyzer/Generator* menu. The `MULTitone:AF1Channel` and `THD:AF1Channel` audio circuits correspond to the *AF Chan. One* applications.
- In the secondary audio circuit (subsystems `AFANalyzer:SECondary` and `AFGenerator:SECondary` for single tone measurements, `MULTitone:AF2Channel` and `THD:AF2Channel` for the other measurements), the audio signals are applied to the connectors AF 2 OUT (output, AF generator signal) and AF 2 IN (input) on the R&S CBT front panel. The `:SECondary` single tone audio circuit corresponds to the *Analyzer 2* application in the *Audio Analyzer/Generator* menu. The `MULTitone:AF2Channel` and `THD:AF2Channel` audio circuits correspond to the *AF Chan. Two* applications.

With the exception of the input and output connectors, the two audio circuits are identical. Configurations such as the input path (`AFLevel`) can be set independently. All remote control commands are analogous.

The *Stereo* applications for the *Multitone* and *THD* measurements are combinations of the primary and secondary circuit applications.

Note: *In addition to the commands listed below the Audio function group also provides the general purpose commands described above in this chapter:*

SYSTem:OPTions:INFO:CURRent?
MMEMory:SAVE:CURRent <FileName> [,<msus>]
MMEMory:RECall:CURRent <FileName> [,<msus>]
SYSTem:RESet:CURRent

Subsystem AFLevel (AF Input Level)

The subsystem `AFLevel` configures the input path for audio signals. The commands correspond to the *Analyzer Level* softkey in the *Audio* measurement menus with the hotkeys *Mode* and *AF Max. Level*. The settings are valid for all *Audio* applications; for an overview refer to the table below.

Audio Channel	Manual Control, Menu	Application keyword	`AFLevel` keywords
Single tone, channel 1	Analyzer/Generator	`[:PRIMary]`	`[:PRIMary]`
Single tone, channel 2	–	`:SECondary`	`:SECondary`
Multitone, channel 1	Multitone, AF Chan. One	`AF1Channel`	`[:PRIMary]`
Multitone, channel 2	Multitone, AF Chan. Two	`AF2Channel`	`:SECondary`
Multitone, stereo	Multitone, Stereo	`STEReo`	`[:PRIMary]` `:SECondary`
Total harmonic distortion, channel 1	THD, AF Chan. One	`AF1Channel`	`[:PRIMary]`
Total harmonic distortion, channel 2	THD, AF Chan. Two	`AF2Channel`	`:SECondary`
Total harmonic distortion, stereo	THD, Stereo	`STEReo`	`[:PRIMary]` `:SECondary`

[SENSe:]AFLevel[:PRIMary]:MODE *<Mode>*
[SENSe:]AFLevel:SECondary:MODE *<Mode>*
Input level – Mode

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
MANual | **AUTomatic**	Manual setting Automatic setting	AUT	–	V4.25

Description of command

These commands select manual setting of the maximum input level via `[SENSe:]AFLevel…:MAXimum` or automatic setting according to the average power of the applied audio signal.

[SENSe:]AFLevel[:PRIMary]:MAXimum *<Level>*
[SENSe:]AFLevel:SECondary:MAXimum *<Level>*
AF Max. Level

<Level>	Description of parameters	Def. value	Def. unit	FW vers.
0.05 mV to +30 V	Maximum audio input voltage	1	V	V4.25

Description of command

This command defines the maximum expected AF input level.

[SENSe:]AFLevel[:PRIMary]:FSCale:MAXimum *<Level>* [SENSe:]AFLevel:SECondary:FSCale:MAXimum *<Level>*	AF Max. Level, digital analyzer			
<Level>	Description of parameters	Def. value	Def. unit	FW vers.
0.00000 FS to 1.0000 FS	AF max. level	1.00000	FS	V4.60
Description of command				
This command defines the maximum expected AF input level for digital analyzers.				

[SENSe:]AFLevel:DEFault				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V4.25
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting OFF results in an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				

Audio Analyzer (AFANalyzer)

The AFANalyzer subsystem measures the single tone audio signal. It corresponds to the *Analyzer* softkey in the main menu *Audio Analyzer/Generator* and the associated output fields.

Subsystem AFANalyzer (Measurement Control)

The subsystem *AFANalyzer* controls the single-tone audio analysis.

		Analyzer
INITiate:AFANalyzer[:PRIMary] INITiate:AFANalyzer:SECondary	Start new AF measurement	⇒ *RUN*
STOP:AFANalyzer[:PRIMary] STOP:AFANalyzer:SECondary	Stop AF measurement after current evaluation period	⇒*STOP*
ABORt:AFANalyzer[:PRIMary] ABORt:AFANalyzer:SECondary	Abort and switch off AF analyzer	⇒ *OFF*
CONTinue:AFANalyzer[:PRIMary] CONTinue:AFANalyzer:SECondary	Next measurement step (only stepping mode)	⇒ *RUN*
Description of command		FW vers.
These commands have no query form. They start and stop the AF analyzer, setting it to the status given in the top right column.		V4.25

CONFigure:AFANalyzer[:PRIMary]:EREPorting *<Mode>*
CONFigure:AFANalyzer:SECondary:EREPorting *<Mode>*

Event Reporting

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ |	Service request	OFF	–	V4.25
SOPC |	Single operation complete			
SRSQ |	SRQ and SRSQ			
OFF	No reporting			

Description of command

This command defines the events generated when the measurement is terminated or stopped (event reporting see chapter 5)

FETCh:AFANalyzer[:PRIMary]:STATus?
FETCh:AFANalyzer:SECondary:STATus?

Measurement Status

Return	Description of parameters	Def. value	Def. unit	FW vers.
OFF |	Measurement in the OFF state (`*RST` or `ABORt`)	OFF	–	V4.25
RUN |	Running (after `INITiate`, `CONTinue` or `READ`)			
STOP |	Stopped (`STOP`)			
ERR |	OFF (could not be started)			
STEP |	Stepping mode (`<stepmode> = STEP`)			
RDY ,	Stopped according to repetition mode and stop condition			
1 to 10000 |	Counter for current statistics cycle			
NONE	No counting mode set	NONE	–	

Description of command

This command is always a query. It returns the status of the measurement (see chapters 3 and 5) and the number of the current statistics cycle.

CONFigure:AFANalyzer[:PRIMary]:MTReduce <Mode>, <Frequency>
CONFigure:AFANalyzer:SECondary:MTReduce

Reduce Measurement Time

<Mode>	Description of parameters	Def. value	Def. unit	
LOWF |	Measurement time according to lowest frequency (10 kHz)	LOWF	–	
EXPF	Measurement time according to *<Frequency>*			
<Frequency>	Description of parameters	Def. value	Def. unit	FW vers.
10 Hz to 21 kHz	Expected frequency of the audio input signal	100	Hz	V4.25

Description of command

This command is to reduce the measurement time the audio analyzer uses to calculate the measurement results *(<Mode>=EXPF);* see section *Subsystem AFANalyzer... (Measured Values)* on page 6.212. The measurement time must be adapted to the period of the input signal, which is the reverse of the frequency. Therefore, the audio measurement can be accelerated for high-frequency signals. In the *LOWF* mode, *<Frequency>* is not taken into account.

Subsystem AFANalyzer...:CONTrol (Control)

The subsystem *AFANalyzer:...CONTrol* defines the scope of the audio analysis and sets the reference frequency for the distortion measurement. The settings are provided in the *Control* and *Distortion* tabs of the *Analyzer Configuration* popup menu.

CONFigure:AFANalyzer[:PRIMary]:CONTrol:REPetition
CONFigure:AFANalyzer:SECondary:CONTrol:REPetition
<Repetition>, <StopCondition>, <Stepmode> — Test Cycles

<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot |** **1 to 10000**	Continuous measurement (until `STOP` or `ABORt`) Single shot measurement (until `Status = RDY`) Multiple measurement (counting, `until Status = STEP | RDY`)	SING	–	
<StopCondition>	Description of parameters	Def. value	Def. unit	
NONE	Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistic cycle Continue measurement according to its rep. mode	NONE	–	V4.25

Description of command

This command determines the number of statistics cycles and the stepping mode for the measurement. A stop condition is not available.

Note: *For READ commands (`READ:...`) the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*

CONFigure:AFANalyzer[:PRIMary]:CONTrol:DIStortion[:FREQuency] *<Frequency>*
CONFigure:AFANalyzer:SECondary:CONTrol:DIStortion[:FREQuency] *<Frequency>* — Frequency

<Frequency>	Description of parameters	Def. value	Def. unit	FW vers.
20 Hz to 21000 Hz	Reference frequency for distortion measurement	1000	Hz	V4.25

Description of command

This command determines the reference frequency for the harmonic distortion measurement.

CONFigure:AFANalyzer[:PRIMary]:CONTrol:COUPling *<Coupling>*
CONFigure:AFANalyzer:SECondary:CONTrol:COUPling *<Coupling>* — AF Path Coupling

<Coupling>	Description of parameters	Def. value	Def. unit	FW vers.
AC | **DC**	AC coupling of AF path DC coupling of AF path	AC (`[:PRIMary]` channel) DC (`:SECondary` channel)	–	V4.25

Description of command

These commands determine the AF path coupling for measurements using the AF analyzer.

Subsystem AFANalyzer...:FILTer (Filter)

The subsystem `AFANalyzer:...FILTer` configures the input path of the AF analyzer. The subsystem corresponds to the *Filter* tab in the *Analyzer Configuration* menu. The input path of the AF analyzer is as shown below:

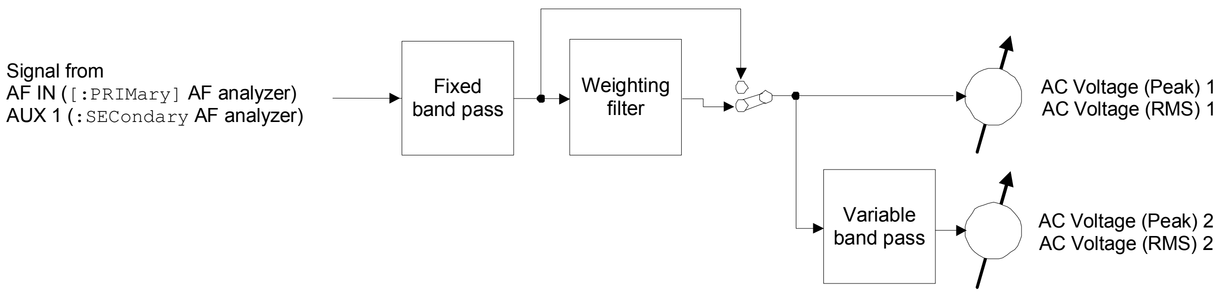


Fig. 6-1 AF analyzer input path configuration

CONFigure:AFANalyzer[:PRIMary]:FILTer:VBPass:CFRequency *<Center>* Frequency
CONFigure:AFANalyzer:SECondary:FILTer:VBPass:CFRequency *<Center>*

<Center>	Description of parameters	Def. value	Def. unit	FW vers.
20 Hz to 21000 Hz	Center frequency of band pass	1000	Hz	V4.25

Description of command

This command determines the center frequency of the variable band pass.

CONFigure:AFANalyzer[:PRIMary]:FILTer:VBPass:BWIDth *<Bandwidth>* Bandwidth
CONFigure:AFANalyzer:SECondary:FILTer:VBPass:BWIDth *<Bandwidth>*

<Bandwidth>	Description of parameters	Def. value	Def. unit	FW vers.
10 Hz to 1000 Hz	Bandwidth of band pass	200	Hz	V4.25

Description of command

This command determines the bandwidth of the variable band pass filter.

CONFigure:AFANalyzer[:PRIMary]:FILTer:WEIGhting *<Weighting>* Weighting Filter
CONFigure:AFANalyzer:SECondary:FILTer:WEIGhting *<Weighting>*

<Weighting>	Description of parameters	Def. value	Def. unit	FW vers.
A |	Switch on A-weighted filter	OFF	–	V4.30
CME |	Switch on C-message weighted filter			V4.25
CCI |	Switch on CCITT weighting filter			
OFF	No weighting filter			

Description of command

This command selects the weighting filter after the fixed band pass (see Fig. 6-1).

Bandwidth (AC Coup.)

CONFigure:AFANalyzer[:PRIMary]:FILTer:BPASs:ACCoupling ***<Band pass>***
CONFigure:AFANalyzer:SECondary:FILTer:BPASs:ACCoupling ***<Band pass>***

<Band pass>	Description of parameters	Def. value	Def. unit	FW vers.
	R&S CBT band pass filter with a bandwidth of	BP16	–	V4.25
BP01 |	0 Hz to 250 Hz			
BP02 |	6 Hz to 250 Hz			
BP03 |	50 Hz to 250 Hz			
BP04 |	0 Hz to 3000 Hz			
BP05 |	6 Hz to 3000 Hz			
BP06 |	50 Hz to 3000 Hz			
BP07 |	300 Hz to 3000 Hz			
BP08 |	0 Hz to 4000 Hz			
BP09 |	6 Hz to 4000 Hz			
BP10 |	50 Hz to 4000 Hz			
BP11 |	300 Hz to 4000 Hz			
BP12 |	0 Hz to 15000 Hz			
BP13 |	6 Hz to 15000 Hz			
BP14 |	50 Hz to 15000 Hz			
BP15 |	300 Hz to 15000 Hz			
BP16 |	0 Hz to 21000 Hz			
BP17 |	6 Hz to 21000 Hz			
BP18 |	50 Hz to 21000 Hz			
BP19	500 Hz to 5000 Hz			V4.30

Description of command

This command selects the first band pass in the AF analyzer to be used if the AF path coupling is set to AC (see `CONFigure:AFANalyzer...:COUPling` command).

Bandwidth (DC Coup.)

CONFigure:AFANalyzer[:PRIMary]:FILTer:BPASs:DCCoupling ***<Band pass>***
CONFigure:AFANalyzer:SECondary:FILTer:BPASs:DCCoupling ***<Band pass>***

<Band pass>	Description of parameters	Def. value	Def. unit	FW vers.
	R&S CBT band pass filter with a bandwidth of	BP17	–	V4.25
BP02 |	6 Hz to 250 Hz			
BP03 |	50 Hz to 250 Hz			
BP05 |	6 Hz to 3000 Hz			
BP06 |	50 Hz to 3000 Hz			
BP07 |	300 Hz to 3000 Hz			
BP09 |	6 Hz to 4000 Hz			
BP10 |	50 Hz to 4000 Hz			
BP11 |	300 Hz to 4000 Hz			
BP13 |	6 Hz to 15000 Hz			
BP14 |	50 Hz to 15000 Hz			
BP15 |	300 Hz to 15000 Hz			
BP17 |	6 Hz to 21000 Hz			
BP18 |	50 Hz to 21000 Hz			
BP19	500 Hz to 5000 Hz			V4.30

Description of command

This command selects the first band pass in the AF analyzer to be used if the AF path coupling is set to DC (see `CONFigure:AFANalyzer...:COUPling` command).

Subsystem AFANalyzer... (Measured Values)

The subsystem *AFANalyzer...* starts the audio analysis and returns the results.

READ[:SCALar]:AFANalyzer[:PRIMary]? **READ[:SCALar]:AFANalyzer:SECondary?** **FETCh[:SCALar]:AFANalyzer[:PRIMary]?** **FETCh[:SCALar]:AFANalyzer:SECondary?**	Scalar Results Start single shot meas. and return results Read out meas. results (unsynchronized)			
Return	Description of parameters	Def. value	Def. unit	FW vers.
PeakVoltage1,	0 V to 42.4 V	NAN	V	V4.25
RMSVoltage1,	0 V to 30 V	NAN	V	
DCVoltage,	–30 V to 30 V	NAN	V	
THD + N,	0 % to 100%	NAN	%	
PeakVoltage2,	0 V to 42.4 V	NAN	V	V4.25
RMSVoltage2,	0 V to 30 V	NAN	V	
Frequency,	10 Hz to 204.8 kHz	NAN	Hz	
SINAD,	–	NAN	dB	V4.30
THD	0 % to 100%	NAN	%	V4.35

Description of command

These commands are always queries. They start a measurement and output all scalar measurement results (see also Fig. 6-1). These are:

- Peak1 and RMS1 value of AC voltage after first band pass and the weighting filter
- DC voltage
- Total harmonic distortion and noise (THD + N)
- Peak2 and RMS2 value of AC voltage after first band pass and second band pass (variable band pass)
- Frequency counter
- Signal-to-Noise-and-Distortion ratio (SINAD)
- Total harmonic distortion (THD)

AF Generator (AFGenerator)

The subsystem AFGenerator configures and controls the AF generator. It corresponds to the measurement softkey *Generator* in the measurement menu *Audio Analyzer/Generator* and the associated input fields.

INITiate:AFGenerator[:PRIMary] **INITiate:AFGenerator:SECondary** **ABORt:AFGenerator:[PRIMary]** **ABORt:AFGenerator:SECondary**	AF Generator Control Start AF generator, reserve resources ⇒ *RUN* Switch off AF generator, release resources ⇒ *OFF*
Description of command	FW vers.
These commands have no query form. They start and stop the AF generator, setting it to the status given in the top right column. **Note:** *A running multitone measurement must be aborted before the single tone AF generator is switched on. See note in section* Audio Generator and Analyzer *on page 6.205.*	V4.25

FETCh:AFGenerator[:PRIMary]:STATus?
FETCh:AFGenerator:SECondary:STATus?

Generator Status

Return	Description of parameters	Def. value	Def. unit	FW vers.
OFF |	Generator switched off (`ABORt`, `*RST` or `OFF` due to conflict of resources)	OFF	–	V4.25
RUN |	Running (`INITiate`)			
ERR	Switched off (could not be started)			

Description of command

This command is always a query. It returns the current generator status.

SOURce:AFGenerator[:PRIMary]:LEVel <*Level*>
SOURce:AFGenerator:SECondary:LEVel <*Level*>

Generator Level

<Level>	Description of parameters	Def. value	Def. unit	FW vers.
0.01 mV to 5.0 V	AF generator voltage	1	V	V4.25

Description of command

This command defines the RMS voltage of the generated AC audio signal or the constant DC voltage, depending on the selected signal type (see command `SOURce:AFGenerator...SMODe`). Use `ABORt:AFGenerator`… to turn off the AF generator entirely.

SOURce:AFGenerator[:PRIMary]:FSCale:LEVel <*Level*>
SOURce:AFGenerator:SECondary:FSCale:LEVel <*Level*>

Generator Level, digital generator

<Level>	Description of parameters	Def. value	Def. unit	FW vers.
0.00000 FS to 1.0000 FS	AF generator voltage	1.00000	FS	V4.60

Description of command

This command defines the level of the generated AC audio signal or the constant DC voltage, depending on the selected signal type (see command `SOURce:AFGenerator...SMODe`), and for test scenarios where a digital generator is used. Use `ABORt:AFGenerator`… to turn off the AF generator entirely.

SOURce:AFGenerator[:PRIMary]:FREQuency <*Frequency*>
SOURce:AFGenerator:SECondary:FREQuency <*Frequency*>

Frequency

<Frequency>	Description of parameters	Def. value	Def. unit	FW vers.
20 Hz to 21 kHz	AF-Generator frequency	1000	Hz	V4.25

Description of command

This command determines the AF generator frequency.

SOURce:AFGenerator[:PRIMary]:SMODe <*Signal*>
SOURce:AFGenerator:SECondary:SMODe <*Signal*>

Generator Signal

<Frequency>	Description of parameters	Def. value	Def. unit	FW vers.
AC | **DC**	AF generator signal type	AC	–	V4.25

Description of command

This command determines whether the AF generator signal is an AC or DC signal.

Multitone Measurement (MULTitone)

The subsystem *MULTitone* measures the level of an audio test signal comprising up to 20 test tones. The subsystem corresponds to the measurement menu *Multitone* and the associated popup menu *Multitone Configuration.*

In analogy to the `AFGenerator` and `AFANalyzer` subsystems reported above, the *Multitone* measurement provides two independent circuits:

- In the first audio channel (subsystem `MULTitone:AF1Channel...`), the audio signals are applied to the connectors AF 1 OUT (output, AF generator signal) and AF 1 IN (input) on the R&S CBT front panel. The first audio channel corresponds to the *Multitone* menu, application *AF Chan. One,* and the associated configuration menu.
- In the second audio channel (subsystem `MULTitone:AF2Channel...`), the audio signals are applied to the connectors AF 2 OUT (output, AF generator signal) and AF 2 IN (input) on the R&S CBT front panel. The second audio channel corresponds to the *Multitone* menu, application *AF Chan. Two,* and the associated configuration menu.

With the exception of the input and output connectors, the two audio circuits are identical. All remote control commands are analogous.

The *Stereo* application is a combination of the previous two applications, where the R&S generates and analyzes two audio signals at equal or different frequencies. The stereo commands are reported in section *MULTitone:STEReo Subsystem* on p. 6.228 .

Single-Tone Measurement (MULTitone:AF<n>Channel)

The commands in the following sections control the multitone measurement in the first and second audio channel.

Measurement Control – Subsystem MULTitone

The subsystem *MULTitone* controls the measurement. It corresponds to the softkey *AF Chan. One* in the measurement menu *Multitone* and some of the associated hotkeys.

INITiate:MULTitone:AF1Channel **INITiate:MULTitone:AF2Channel**	Start new measurement	⇒ *RUN*
ABORt:MULTitone:AF1Channel **ABORt:MULTitone:AF2Channel**	Abort running measurement and switch off	⇒ *OFF*
STOP:MULTitone:AF1Channel **STOP:MULTitone:AF2Channel**	Stop measurement after current stat. cycle	⇒ *STOP*
CONTinue:MULTitone:AF1Channel **CONTinue:MULTitone:AF2Channel**	Next measurement step (only *stepping mode*)	⇒ *RUN*

Description of command	FW vers.
These commands have no query form. They start and stop the measurement, setting it to the status indicated in the top right column. **Note:** *The single tone AF generator must be switched off before a multitone measurement is started. See note in section* Audio Generator and Analyzer *on p. 6.205.*	V4.25

CONFigure:MULTitone:AF1Channel:EREPorting *<Mode>*
CONFigure:MULTitone:AF2Channel:EREPorting *<Mode>*
Event Reporting

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC** | **SRSQ** | **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	V4.25

Description of command

This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5).

FETCh:MULTitone:AF1Channel:STATus?
FETCh:MULTitone:AF2Channel:STATus?
Measurement Status

Ret. values	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN** | **STOP** | **ERR** | **STEP** | **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V4.25
1 to 10000 | **NONE**	Counter for current statistics cycle No counting mode set	NONE	–	

Description of command

This command is always a query. It returns the status of the measurement (see chapters 3 and 5).

DISPlay:MULTitone:AF1Channel:GRID *<Enable>*
DISPlay:MULTitone:AF2Channel:GRID *<Enable>*
Grid on/off

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Switch on grid lines Switch off grid lines	ON	–	V4.25

Description of command

This command switches the grid lines in the test diagrams on or off.

CONFigure:MULTitone:AF1Channel:COUPling *<Coupling>*
CONFigure:MULTitone:AF2Channel:COUPling *<Coupling>*
Path Coupling (AF IN)

<Coupling>	Description of parameters	Def. value	Def. unit	FW vers.
AC | **DC**	AC coupling of AF path DC coupling of AF path	AC (`:AF1Channel`) DC (`:AF2Channel`)	–	V4.25

Description of command

This command determines the AF path coupling for multitone measurements.

CONFigure:MULTitone:AF1Channel:RLEVel *<Voltage>*
CONFigure:MULTitone:AF2Channel:RLEVel *<Voltage>*
AF Reference Level

<Voltage>	Description of parameters	Def. value	Def. unit	FW vers.
0.001 V to 5.000 V	Reference Level	0.010	V	V4.25

Description of command

This command defines the AF reference level, i.e. the 0-dB line in the test diagram.

CONFigure:MULTitone:AF1CHannel:FSCale:RLEVel *<Voltage>* AF Reference Level, digital analyzer
CONFigure:MULTitone:AF2CHannel:FSCale:RLEVel *<Voltage>*

<Voltage>	Description of parameters	Def. value	Def. unit	FW vers.
0.00000 FS to 1.0000 FS	Reference Level	1.0000	FS	V4.60

Description of command

This command defines the AF reference level, i.e. the 0-dB line in the test diagram for test scenarios where a digital analyzer is used.

CONFigure:MULTitone:AF1Channel:RMODe *<Reference>* Result
CONFigure:MULTitone:AF2Channel:RMODe *<Reference>*

<Reference>	Description of parameters	Def. value	Def. unit	FW vers.
RLEV | **TON<nr>**	Results relative to the reference level Results relative to level at test tone <nr>, where <nr> = 1 to 20	TON4	–	V4.25

Description of command

This command defines the reference value for the results of the *Multitone* measurement. The reference level is defined via `CONFigure:MULTitone:AF1Channel:RLEVel`. To choose one of the test tones no. 1 to 20, it must be enabled via the `CONFigure:MULTitone:AF1Channel:TDEFinition:TONE<nr>` command.

CONFigure:MULTitone:AF1Channel:AFGLead *<Time>* AF Generator Lead
CONFigure:MULTitone:AF2Channel:AFGLead *<Time>*

<Time>	Description of parameters	Def. value	Def. unit	FW vers.
0 s to 0.1 s	Hold off time	0.014	s	V4.25

Description of command

This command defines a hold off time for the AF generator.

Test Configuration

The commands of the following subsystems configure the *Multitone* measurement. They correspond to the *Multitone Configuration* menu.

Subsystem MULTitone:...CONTrol

The subsystem *MULTitone:...CONTrol* defines the scope of the measurement. It corresponds to the *Control* tab in the popup menu *Multitone Configuration.*

CONFigure:MULTitone:AF1Channel:CONTrol:REPetition Test Cycles
CONFigure:MULTitone:AF2Channel:CONTrol:REPetition
<Repetition>, <StopCond>, <Stepmode>

<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot** | **1 to 10000,**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCond>	Description of parameters	Def. value	Def. unit	
SONerror | **NONE,**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V4.25

Description of command

This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement.

Note: *For READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*

Subsystem SUBarrays:MULTitone:...

The subsystem *SUBarrays:MULTitone:...* defines the measurement range and the type of output values.

CONFigure:SUBarrays:MULTitone:AF1Channel Definition of Subarrays
CONFigure:SUBarrays:MULTitone:AF2Channel
<Mode>,<Start>,<Samples>{,<Start>,<Samples>}

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
ALL |	Return all measurement values	ALL	–	V4.25
ARIThmetical |	Return arithm. mean value in every subrange			
MINimum |	Return minimum value in every subrange			
MAXimum |	Return maximum value in every subrange			
IVAL |	Return single interpolated value at <Start>			
XMAXimum |	Return x-axis value of maximum and maximum			
XMINimum |	Return x-axis value of minimum and minimum			
PAVG,	Return arithmetic mean value in every subrange			V5.00
<Start>	Description of parameters	Def. value	Def. unit	
1 to 20,	Start test tone in current range	1	–	
<Samples>	Description of parameters	Def. value	Def. unit	FW vers.
1 to 20	Number of test tones in current range	20	–	V4.25

Description of command

This command configures the `READ:SUBarrays:MULTitone:AF1Channel...` and `FETCh:SUBarrays:MULTitone:AF1Channel...` commands. It restricts the measurement to up to 32 subranges where either all measurement results (the number of which is given by the <Samples> parameter) or a single statistical value is returned.

For <Mode> = IVAL, the <Samples> parameter is ignored and the R&S CBT returns a single measurement value corresponding to the abscissa value <Start>. If <Start> is located between two test points with valid results then the result is calculated from the results at these two adjacent test points by linear interpolation.

The subranges are subsets of the full range of test tones defined via `CONFigure:MULTitone:AF1Channel:TONE<nr>`. Each subrange contains all test tones between the start test tone (test tone no. <Start>) and test tone no. <Start> + <Samples> – 1. Test points inside this range that are disabled are not measured (result *NAN)* and do not enter into the ARIThmetical, MINimum and MAXimum values.

By default, only one range corresponding to the total measurement range is used and all measurement values are returned.

Tolerance values – Subsystem MULTitone:...LIMit

The subsystem *MULTitone:...LIMit* defines tolerance values for the *Multitone* measurement. The subsystem corresponds to the *Limits* tab of the popup menu *Multitone Configuration.*

CONFigure:MULTitone:AF1Channel:LIMit:LINE:ASYMmetric:UPPer
CONFigure:MULTitone:AF2Channel:LIMit:LINE:ASYMmetric:UPPer
<Limit_1>, <Enable_1>, ... <Limit_20>, <Enable_20> Upper Limit, Overall

<Limit_nr>	Description of parameters	Def. value	Def. unit	
–80 dB to +80 dB,	Upper limit line at tone <nr>	See below	dB	
<Enable_nr>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Enable upper limit line at tone <nr>	ON	–	V4.25

Description of command

This command configures the upper limit lines and enables the limit check at the 20 test tones that can be defined via `CONFigure:MULTitone:AF1Channel:TONE<nr>`.

By default, the limit check is switched on at all tones and the following limit lines apply:

Tone <nr>	Limit Line/[dB]	Enable	Tone <nr>	Limit Line/[dB]	Enable
1	–9.5	ON	11	+5.6	ON
2	–6.2	ON	12	+6.3	ON
3	–3.8	ON	13	+6.9	ON
4	–1.9	ON	14	+7.5	ON
5	–0.3	ON	15	+8.0	ON
6	+1.0	ON	16	+8.6	ON
7	+2.1	ON	17	+9.1	ON
8	+3.1	ON	18	+9.6	ON
9	+4.0	ON	19	+10.0	ON
10	+4.8	ON	20	+10.5	ON

CONFigure:MULTitone:AF1Channel:TONE<nr>:LIMit:LINE:ASYMmetric:UPPer
CONFigure:MULTitone:AF2Channel:TONE<nr>:LIMit:LINE:ASYMmetric:UPPer
<Limit>, <Enable> Upper Limit, Single Point

<Limit>	Description of parameters	Def. value	Def. unit	
–80 dB to +80 dB,	Upper limit line at tone <nr>	See below	dB	
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Enable upper limit line at tone <nr>	ON	–	V4.25

Description of command

This command configures the upper limit and enables the limit check at one of 20 test tones that can be defined via `CONFigure:MULTitone:AF1Channel:TONE<nr>`. The test tones are numbered by <nr> = 1 to 20. The default limits at all test points are quoted in the previous command.

CONFigure:MULTitone:AF1Channel:LIMit:LINE:ASYMmetric:LOWer
CONFigure:MULTitone:AF2Channel:LIMit:LINE:ASYMmetric:LOWer
<Limit_1>, <Enable_1>, ... <Limit_20>, <Enable_20> — Lower Limits, Overall

<Limit_nr>	Description of parameters	Def. value	Def. unit	
–80 dB to +80 dB,	Lower limit line at tone <nr>	See below	dB	
<Enable_nr>	**Description of parameters**	**Def. value**	**Def. unit**	**FW vers.**
ON | OFF	Enable lower limit line at tone <nr>	ON	–	V4.25

Description of command

This command configures the lower limit lines and enables the limit check at the 20 test tones that can be defined via `CONFigure:MULTitone:AF1Channel:TONE<nr>`.

By default, the limit check is switched on at all tones and the following limit lines apply:

Tone <nr>	Limit Line/[dB]	Enable	Tone <nr>	Limit Line/[dB]	Enable
1	–13.5	ON	11	+1.6	ON
2	–10.2	ON	12	+2.3	ON
3	–7.8	ON	13	+2.9	ON
4	–5.9	ON	14	+3.5	ON
5	–4.3	ON	15	+4.0	ON
6	–3.0	ON	16	+4.6	ON
7	–1.9	ON	17	+5.0	ON
8	–0.9	ON	18	+5.0	ON
9	0.0	ON	19	+5.0	ON
10	+0.8	ON	20	+5.0	ON

CONFigure:MULTitone:AF1Channel:TONE<nr>:LIMit:LINE:ASYMmetric:LOWer
CONFigure:MULTitone:AF2Channel:TONE<nr>:LIMit:LINE:ASYMmetric:LOWer
<Limit>, <Enable> — Lower Limit, Single Point

<Limit>	Description of parameters	Def. value	Def. unit	
–80 dB to +80 dB,	Lower limit line at tone <nr>	See below	dB	
<Enable>	**Description of parameters**	**Def. value**	**Def. unit**	**FW vers.**
ON | OFF	Enable lower limit line at tone <nr>	ON	–	V4.25

Description of command

This command configures the lower limit and enables the limit check at one of 20 test tones that can be defined via `CONFigure:MULTitone:AF1Channel:TONE<nr>`. The test tones are numbered by <nr> = 1 to 20. The default limits at all test points are quoted in the previous command.

DEFault:MULTitone:AF1Channel:LIMit:LINE *<Enable>* — Default Settings
DEFault:MULTitone:AF2Channel:LIMit:LINE *<Enable>*

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V4.25

Description of command

If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting OFF results in an error message).

If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.

DEFault:MULTitone:LIMit:LINE *<Enable>*				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V4.25
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem (including `AF1Channel` and `AF2Channel`) to their default values (the setting OFF results in an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				

Test Tones – Subsystem MULTitone:...TDEFinition

The subsystem *MULTitone:...TDEFinition* configures the audio test signal used for the *Multitone* measurement. The subsystem corresponds to the *Tone Def.* tab of the popup menu *Multitone Configuration.*

CONFigure:MULTitone:AF1Channel:TDEFinition **CONFigure:MULTitone:AF2Channel:TDEFinition** ***<Freq_1>, <Lev_1>, <Enable_1>, ... <Freq_20>, <Lev_20>, <Enable_20>***				Test Tones
<Freq_nr>	Description of parameters	Def. value	Def. unit	
10 Hz to 16000 Hz,	Frequency of test tone <nr>	See below	Hz	
<Lev_nr>	Description of parameters	Def. value	Def. unit	
0.0 V to 5.0 V*),	Level at test tone <nr>	See below	V	
<Enable_nr>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Switch on / off test tone <nr>	See below	–	V4.25
Description of command				

This command enables and configures up to 20 test tones. The minimum frequency spacing between two tones is 1 Hz. The sum of all test tones must not exceed the maximum AF generator level quoted in the data sheet.

*) The sum of the levels of all enabled tones must not exceed 5.0 V.

The following default test tones are provided:

Tone <nr>	Frequency/[Hz]	Level/[V]	Enable	Tone <nr>	Frequency/[Hz]	Level/[V]	Enable
1	300	0.01	ON	11	1700	0.01	ON
2	440	0.01	ON	12	1840	0.01	ON
3	580	0.01	ON	13	1980	0.01	ON
4	720	0.01	ON	14	2120	0.01	ON
5	860	0.01	ON	15	2260	0.01	ON
6	1004	0.01	ON	16	2400	0.01	ON
7	1140	0.01	ON	17	2540	0.01	ON
8	1280	0.01	ON	18	2680	0.01	ON
9	1420	0.01	ON	19	2820	0.01	ON
10	1560	0.01	ON	20	3000	0.01	ON

Note: *If the level of all test tones is derived from a total level (TLEVel setting in the CONFigure:MULTitone:AF1Channel:TDEFinition:MODE command), the individual level settings are ignored. The* <Frequency> *and* <Enable> *parameter settings are still effective.*

CONFigure:MULTitone:AF1CHannel:FSCale:TDEFinition **CONFigure:MULTitone:AF2CHannel:FSCale:TDEFinition** ***<Freq_1>, <Lev_1>, <Enable_1>, ... <Freq_20>, <Lev_20>, <Enable_20>***				Test Tones, digital generator
<Freq_nr>	Description of parameters	Def. value	Def. unit	
10 Hz to 16000 Hz,	Frequency of test tone <nr>	See below	Hz	
<Lev_nr>	Description of parameters	Def. value	Def. unit	
0.00000 FS to 1.0000 FS*),	Level at test tone <nr>	See below	FS	0
<Enable_nr>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Switch on / off test tone <nr>	See below	–	V4.60

Description of command

This command enables and configures up to 20 test tones for test scenarios where a digital generator is used. The minimum frequency spacing between two tones is 1 Hz. The sum of all test tones must not exceed the maximum AF generator level quoted in the data sheet.

*) The sum of the levels of all enabled tones must not exceed 1.0000.

The following default test tones are provided:

Tone <nr>	Frequency/[Hz]	Level/[FS]	Enable	Tone <nr>	Frequency/[Hz]	Level/[FS]	Enable
1	300	0.05	ON	11	1700	0.05	ON
2	440	0.05	ON	12	1840	0.05	ON
3	580	0.05	ON	13	1980	0.05	ON
4	720	0.05	ON	14	2120	0.05	ON
5	860	0.05	ON	15	2260	0.05	ON
6	1004	0.05	ON	16	2400	0.05	ON
7	1140	0.05	ON	17	2540	0.05	ON
8	1280	0.05	ON	18	2680	0.05	ON
9	1420	0.05	ON	19	2820	0.05	ON
10	1560	0.05	ON	20	3000	0.05	ON

Note: *If the level of all test tones is derived from a total level (TLEVel setting in the* `CONFigure:MULTitone:AF1Channel:TDEFinition:MODE` *command), the individual level settings are ignored. The* <Frequency> *and* <Enable> *parameter settings are still effective.*

CONFigure:MULTitone:AF1Channel:TDEFinition:TONE<nr> **CONFigure:MULTitone:AF2Channel:TDEFinition:TONE<nr>** ***<Frequency>, <Level>, <Enable>***				Test Tones
<Frequency>	Description of parameters	Def. value	Def. unit	
10 Hz to 16000 Hz,	Frequency of test tone <nr>	See below	Hz	
<Level>	Description of parameters	Def. value	Def. unit	
0.0 V to 5.0 V*),	AF level test tone <nr>	See below	V	
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Switch on / off test tone <nr>	See below	–	V4.25

Description of command

This command enables and configures one of up to 20 test tones (<nr> = 1 to 20). The default values for all test tones are given in the previous command.

*) The sum of the levels of all enabled tones must not exceed 5.0 V.

Note: *If the level of all test tones is derived from a total level (TLEVel setting in the CONFigure:MULTitone:AF1Channel:TDEFinition:MODE command), the* <Level> *setting is ignored. The* <Frequency> *and* <Enable> *parameter setting is still effective.*

CONFigure:MULTitone:AF1CHannel:FSCale:TDEFinition:TONE<nr> Test Tones, digital generator
CONFigure:MULTitone:AF2CHannel:FSCale:TDEFinition:TONE<nr>
<Frequency>, <Level>, <Enable>

<Frequency>	Description of parameters	Def. value	Def. unit	
10 Hz to 16000 Hz,	Frequency of test tone <nr>	See below	Hz	
<Level>	Description of parameters	Def. value	Def. unit	
0.00000 FS to 1.0000 FS*),	AF level test tone <nr>	See below	FS	0
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Switch on / off test tone <nr>	See below	–	V4.60

Description of command

This command enables and configures one of up to 20 test tones (<nr> = 1 to 20) for test scenarios where a digital generator is used. The default values for all test tones are given in the previous command.

*) The sum of the levels of all enabled tones must not exceed 1.0000.

Note: *If the level of all test tones is derived from a total level (TLEVel setting in the* `CONFigure:MULTitone:AF1Channel:TDEFinition:MODE` *command), the* <Level> *setting is ignored. The* <Frequency> *and* <Enable> *parameter setting is still effective.*

CONFigure:MULTitone:AF1Channel:TDEFinition:MODE *<Mode>* Level Selection
CONFigure:MULTitone:AF2Channel:TDEFinition:MODE *<Mode>*

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SEParate | **TLEVel**	Use separate levels for each tone Use total level	SEParate	–	V4.25

Description of command

This command defines how the voltage of each of the test tones is determined.

- In the default setting `SEParate`, the levels of all tones are defined separately and may differ from each other (see command `CONFigure:MULTitone:...:TDEFinition` above).
- In the setting `TLEV`, the total AF generator level set via `CONFigure:MULTitone:...:TDEFinition:TLEVel` is evenly distributed among all **enabled** test tones. Test tones can still be enabled or disabled and their frequency can be changed (see `CONF:MULT:...TDEF...` commands above), but level settings will be ignored as long as `TLEV` remains effective.

CONFigure:MULTitone:AF1Channel:TDEFinition:TLEVel *<Total_Level>* Total Level
CONFigure:MULTitone:AF2Channel:TDEFinition:TLEVel *<Total_Level>*

<Total_Level>	Description of parameters	Def. value	Def. unit	FW vers.
0.019 mV to 5.0 V	Total level/voltage (sum of all test tones)	0.200	V	V4.25

Description of command

This command defines the total AF generator level that is evenly distributed among all enabled test tones. The total level setting comes into effect after the level selection mode is set to `TLEV` (see `CONFigure:MULTitone:...TDEFinition:MODe` command above). The total level must not exceed the maximum AF generator level quoted in the data sheet.

CONFigure:MULTitone:AF1CHannel:FSCale:TDEFinition:TLEVel *<Total_Level>* Total Level, digital generator **CONFigure:MULTitone:AF2CHannel:FSCale:TDEFinition:TLEVel *<Total_Level>***				
<Total_Level>	Description of parameters	Def. value	Def. unit	FW vers.
0.00000 FS to 1.0000 FS	Total level/voltage (sum of all test tones)	1.0000	FS	V4.60
Description of command				
This command defines the total digital AF generator level that is evenly distributed among all enabled test tones. The total level setting comes into effect after the level selection mode is set to `TLEV` (see `CONFigure:MULTitone:...TDEFinition:MODe` command). The total level must not exceed the maximum AF generator level quoted in the data sheet.				

DEFault:MULTitone:AF1Channel:TDEFinition *<Enable>* **DEFault:MULTitone:AF2Channel:TDEFinition *<Enable>*** Default Settings				
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V4.25
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting OFF results in an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				

DEFault:MULTitone:TDEFinition *<Enable>* Default Settings				
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V4.25
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem (including `AF1Channel` and `AF2Channel`) to their default values (the setting OFF results in an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				

Path Configuration – Subsystem MULTitone:AF1Channel:FILTer

The subsystem *MULTitone:AF1Channel:FILTer* configures the voice-processing equipment used for the *Multitone* measurement. The subsystem corresponds to the *Filters* tab of the popup menu *Multitone Configuration.*

CONFigure:MULTitone:AF1Channel:FILTer:BPASs:DCCoupling Band Pass, DC Coupling
CONFigure:MULTitone:AF2Channel:FILTer:BPASs:DCCoupling
<Bandpass>

<Bandpass>	Description of parameters	Def. value	Def. unit	FW vers.
	R&S CBT band pass filter with a bandwidth of	BP17	–	V4.25
BP02 |	6 Hz to 250 Hz			
BP03 |	50 Hz to 250 Hz			
BP05 |	6 Hz to 3000 Hz			
BP06 |	50 Hz to 3000 Hz			
BP07 |	300 Hz to 3000 Hz			
BP09 |	6 Hz to 4000 Hz			
BP10 |	50 Hz to 4000 Hz			
BP11 |	300 Hz to 4000 Hz			
BP13 |	6 Hz to 15000 Hz			
BP14 |	50 Hz to 15000 Hz			
BP15 |	300 Hz to 15000 Hz			
BP17 |	6 Hz to 21000 Hz			
BP18 |	50 Hz to 21000 Hz			
BP19	500 Hz to 5000 Hz			V4.30

Description of command

This command selects the band pass filter to be used if the AF path coupling is set to DC (see `CONFigure:AFANalyzer[:PRIMary]:COUPling` command).

CONFigure:MULTitone:AF1Channel:FILTer:BPASs:ACCoupling Band Pass, AC Coupling
CONFigure:MULTitone:AF2Channel:FILTer:BPASs:ACCoupling
<Bandpass>

<Bandpass>	Description of parameters	Def. value	Def. unit	FW vers.
	R&S CBT band pass filter with a bandwidth of	BP16	–	V4.25
BP01 |	0 Hz to 250 Hz			
BP02 |	6 Hz to 250 Hz			
BP03 |	50 Hz to 250 Hz			
BP04 |	0 Hz to 3000 Hz			
BP05 |	6 Hz to 3000 Hz			
BP06 |	50 Hz to 3000 Hz			
BP07 |	300 Hz to 3000 Hz			
BP08 |	0 Hz to 4000 Hz			
BP09 |	6 Hz to 4000 Hz			
BP10 |	50 Hz to 4000 Hz			
BP11 |	300 Hz to 4000 Hz			
BP12 |	0 Hz to 15000 Hz			
BP13 |	6 Hz to 15000 Hz			
BP14 |	50 Hz to 15000 Hz			
BP15 |	300 Hz to 15000 Hz			
BP16 |	0 Hz to 21000 Hz			
BP17 |	6 Hz to 21000 Hz			
BP 18 |	50 Hz to 21000 Hz			
BP19	500 Hz to 5000 Hz			V4.30

Description of command

This command selects the band pass filter to be used if the AF path coupling is set to AC (see `CONFigure:AFANalyzer[:PRIMary]:COUPling` command).

CONFigure:MULTitone:AF1Channel:FILTer:WEIGhting *<Weighting>* CONFigure:MULTitone:AF2Channel:FILTer:WEIGhting *<Weighting>*				Weighting
<Weighting>	Description of parameters	Def. value	Def. unit	FW vers.
A | **CME** | **CCI** | **OFF**	Switch on A-weighted filter Switch on C-message weighted filter Switch on CCITT weighting filter No weighting filter	OFF	–	V4.30 V4.25
Description of command				
This command selects the weighting filter to be included in the AF input signal path.				

DEFault:MULTitone:AF1Channel:FILTer *<Enable>* DEFault:MULTitone:AF2Channel:FILTer *<Enable>*				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V4.25
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting OFF results in an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				

DEFault:MULTitone:FILTer *<Enable>*				Default Settings
<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V4.25
Description of command				
If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem (including `AF1Channel` and `AF2Channel`) to their default values (the setting OFF results in an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.				

Results – Subsystem MULTitone:...?

The subsystem *MULTitone:...?* measures the AF input level, returns the results and compares them with the tolerance values. The subsystem corresponds to the various output elements in the measurement menu *Multitone.*

READ[:SCALar]:MULTitone:AF1Channel:TONE<nr>? READ[:SCALar]:MULTitone:AF2Channel:TONE<nr>? Start single shot measurement and return results ⇒ *RUN* **FETCh[:SCALar]:MULTitone:AF1Channel:TONE<nr>? FETCh[:SCALar]:MULTitone:AF2Channel:TONE<nr>?** Read results (unsynchronized) ⇒ *RUN*				Multitone Results
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dB to +20.0 dB	AF response at point <nr>	NAN	dB	V4.25
Description of command				
These commands are always queries. They return the audio level at test tones <nr> (<nr> = 1 to 20) defined via `CONFigure:MULTitone:AF1Channel:TONE<nr>`.				

Multitone Results

READ:ARRay:MULTitone:AF1Channel? Start single shot measurement and return results ⇒ *RUN*
READ:ARRay:MULTitone:AF2Channel?
FETCh:ARRay:MULTitone:AF1Channel? Read meas. results (unsynchronized) ⇒ *RUN*
FETCh:ARRay:MULTitone:AF2Channel?

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dB to +20.0 dB,	FreqResp[1], 1st value for AF response	NAN	dB	V4.25
...	...	...	...	
–100.0 dB to +20.0 dB	FreqResp[20], 20th value for AF resp.	NAN	dB	

Description of command

These commands are always queries. They return the audio level at the 20 test tones defined via `CONFigure:MULTitone:AF1Channel:TONE<nr>`.

READ:SUBarrays:MULTitone:AF1Channel? Subarray Results
Start single shot measurement and return results ⇒ *RUN*
READ:SUBarrays:MULTitone:AF2Channel?
FETCh:SUBarrays:MULTitone:AF1Channel? Read meas. results (unsynchronized) ⇒ *RUN*
FETCh:SUBarrays:MULTitone:AF2Channel?

Ret. values per subrange	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dB to +20.0 dB,	FreqResp[1], 1st value for AF response	NAN	dB	V4.25
...	...	...	...	
–100.0 dB to +20.0 dB	FreqResp[n], nth value for AF response	NAN	dB	

Description of command

These commands are always queries. They return the audio level in the subranges defined by means of the `CONFigure:SUBarrays:MULTitone:AF1Channel` command. In the default setting of the configuration command the `READ:SUBarrays...` and `FETCh:SUBarrays...` command group is equivalent to the `READ:ARRay...` and `FETCh:ARRay...` command group described above.

The `CONFigure:SUBarrays:MULTitone:AF1Channel` command defines a maximum of 32 subranges. If one of the statistical modes (`ARIThmetical, MINimum, MAXimum…`) or `IVAL` is set, only one value is returned by subrange.

CALCulate[:SCALar]:MULTitone:AF1Channel:TONE<nr>:MATChing:LIMit? Limit Matching
CALCulate[:SCALar]:MULTitone:AF2Channel:TONE<nr>:MATChing:LIMit?

Returned result	Value range	Def. value	Def. unit	FW vers.
Limit matching at tone <nr>	NMAU | NMAL | INV | OK	INV	–	V4.25

Description of command

This command is always a query. It indicates whether and in which way the error limits at tone <nr> (<nr> = 1 to 20) have been exceeded.

The following messages may be returned for test tone <nr>:

NMAU	Underflow of tolerance value	*not matching, underflow*
NMAL	Tolerance value exceeded	*not matching, overflow*
INV	Measurement invalid	*invalid*
OK	all tolerances matched	

CALCulate[:SCALar]:MULTitone:AF1Channel:MATChing:LIMit?
CALCulate[:SCALar]:MULTitone:AF2Channel:MATChing:LIMit?
Limit Matching, Overall

Returned result	Value range	Def. value	Def. unit	FW vers.
Limit matching at tone 1, **...,** **Limit matching at tone 20**	For tones 1 to 20: NMAU | NMAL | INV | OK	INV	–	V4.25

Description of command

This command is always a query. It indicates whether and in which way the error limits at all test tones 1 to 20 have been exceeded. The output string contains 20 values separated by commas.

CALCulate:ARRay:MULTitone:AF1Channel:MATChing:LIMit?
CALCulate:ARRay:MULTitone:AF2Channel:MATChing:LIMit?
Limit Matching, Overall

Returned result	Value range	Def. value	Def. unit	FW vers.
20 bit field,	Indicator for upper limit matching at tone 1 to 20	NAN	–	V4.25
20 bit field	Indicator for lower limit matching at tone 1 to 20	NAN	–	

Description of command

This command is always a query. Any bit of the two returned fields that is set indicates that the limits at the corresponding point are exceeded.

MULTitone:STEReo Subsystem

The commands in the …`MULTitone:STEReo`… subsystem control the *Stereo* application of the *Multitone* measurement.

Measurement Control – Subsystem MULTitone

The subsystem *MULTitone* corresponds to the measurement control softkey in the measurement menu *Multitone* and some of the associated hotkeys.

INITiate:MULTitone:STEReo	Start new measurement	⇒ *RUN*
ABORt:MULTitone:STEReo	Abort running measurement and switch off	⇒ *OFF*
STOP:MULTitone:STEReo	Stop measurement after current stat. cycle	⇒ *STOP*
CONTinue:MULTitone:STEReo	Next measurement step (only *stepping mode*)	⇒ *RUN*

Description of command	FW vers.
These commands have no query form. They start and stop the measurement, setting it to the status indicated in the top right column. **Note:** *The single tone AF generator must be switched off before a multitone measurement is started. See note in section* Audio Generator and Analyzer *in the operating manual.*	V4.60

CONFigure:MULTitone:STEReo:EREPorting *<Mode>*
Event Reporting>

<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ |	Service request	OFF	–	V4.60
SOPC |	Single operation complete			
SRSQ |	SRQ and SOPC			
OFF	No reporting			

Description of command

This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of the operating manual).

FETCh:MULTitone:STEReo:STATus?				Measurement Status
Ret. values	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN |** **STOP |** **ERR |** **STEP |** **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode and stop condition	OFF	–	V4.60
1 to 10000 | **NONE**	Counter for current statistics cycle No counting mode set	NONE	–	
Description of command				
This command is always a query. It returns the status of the measurement (see chapters 3 and 5 of the operating manual).				

Test Configuration

The commands of the following subsystems configure the *Multitone* measurement. They correspond to the *Multitone Configuration* menu.

Subsystem MULTitone:...CONTrol

The subsystem *MULTitone:...CONTrol* defines the scope of the measurement. It corresponds to the *Control* tab in the popup menu *Multitone Configuration.*

CONFigure:MULTitone:STEReo:CONTrol:REPetition ***<Repetition>, <StopCond>, <Stepmode>***				Test Cycles
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot |** **1 to 10000,**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCond>	Description of parameters	Def. value	Def. unit	
SONerror | **NONE,**	Stop measurement in case of error *(stop on error)* Continue measurement even in case of error	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V4.60
Description of command				
This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement. ***Note:*** *For READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*				

CONFigure:MULTitone:STEReo:COUPling *<Coupling_1>, <Coupling_2>*				Path Coupling (AF IN)
<Coupling_1>	Description of parameters	Def. value	Def. unit	FW vers.
AC | DC	AC or DC coupling for the AF channel 1 signal (measured at AF 1 IN)	AC	–	V4.60
<Coupling_2>	Description of parameters	Def. value	Def. unit	FW vers.
AC | DC	AC or DC coupling for the AF channel 2 signal (measured at AF 2 IN)	DC	–	V4.60
Description of command				
This command determines the AF path coupling for multitone measurements.				

CONFigure:MULTitone:STEReo:RLEVel *<Voltage_1>, <Voltage_2>*				AF Reference Level
<Voltage_1>	Description of parameters	Def. value	Def. unit	FW vers.
0.001 V to 5.000 V	Reference Level for AF channel 1	0.010	V	V4.60
<Voltage_2>	Description of parameters	Def. value	Def. unit	FW vers.
0.001 V to 5.000 V	Reference Level for AF channel 2	0.010	V	V4.60
Description of command				
This command defines the AF reference level, i.e. the 0-dB line in the test diagram.				

CONFigure:MULTitone:AF1CHannel:FSCale:RLEVel *<Voltage_1>, <Voltage_2>*				AF Reference Level, digital analyzer
<Voltage_1>	Description of parameters	Def. value	Def. unit	FW vers.
0.00000 FS to 1.0000 FS	Reference Level for AF channel 1	1.0000	FS	V4.60
<Voltage_2>	Description of parameters	Def. value	Def. unit	FW vers.
0.00000 FS to 1.0000 FS	Reference Level for AF channel 2	1.0000	FS	V4.60
Description of command				
This command defines the AF reference level, i.e. the 0-dB line in the test diagram for test scenarios where a digital analyzer is used.				

CONFigure:MULTitone:STEReo:RMODe *<Reference_1>, <Reference_2>*				Result
<Reference_1>	Description of parameters	Def. value	Def. unit	FW vers.
RLEV | TON<nr>	Results relative to the reference level Results relative to level at test tone <nr>, where <nr> = 1 to 20	TON4	–	V4.60
<Reference_2>	Description of parameters	Def. value	Def. unit	FW vers.
RLEV | TON<nr>	Results relative to the reference level Results relative to level at test tone <nr>, where <nr> = 1 to 20	TON4	–	V4.60
Description of command				
This command defines the reference value for the results of the *Multitone* measurement. The reference level is defined via `CONFigure:MULTitone:STEReo:RLEVel`. To choose one of the test tones no. 1 to 20, it must be enabled via the `CONFigure:MULTitone:STEReo:TDEFinition:TONE<nr>` command.				

CONFigure:MULTitone:STEReo:AFGLead *<Time_1>, <Time_2>*				AF Generator Lead
<Time_1>	Description of parameters	Def. value	Def. unit	FW vers.
0 s to 0.1 s,	Hold off time for AF channel 1	0.014	s	V4.60
<Time_2>	Description of parameters	Def. value	Def. unit	FW vers.
0 s to 0.1 s	Hold off time for AF channel 2	0.014	s	V4.60
Description of command				
This command defines a hold off time for the AF generator.				

Tolerance values – Subsystem MULTitone:...LIMit

The subsystem *MULTitone:...LIMit* defines tolerance values for the *Multitone* measurement. The subsystem corresponds to the *Limits* tab of the popup menu *Multitone Configuration.*

CONFigure:MULTitone:STEReo:LIMit:LINE:ASYMmetric:UPPer *<Limit_1_1>, <Enable_1_1>, ... <Limit_20_1>, <Enable_20_1>* , *<Limit_1_2>, <Enable_1_2>, ... <Limit_20_2>, <Enable_20_2>*				Upper Limit, Overall
<Limit_nr_ch>	Description of parameters	Def. value	Def. unit	
–80 dB to +80 dB,	Upper limit line at tone <nr> and audio channel <ch>	See below	dB	
<Enable_nr_ch>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Enable upper limit line at tone <nr> and audio channel <ch>	ON	–	V4.60
Description of command				

This command configures the upper limit lines and enables the limit check at the 20 test tones that can be defined via `CONFigure:MULTitone:STEReo:TONE<nr>`.

By default, the limit check is switched on at all tones and the following limit lines apply to both audio channels:

Tone <nr>	**Limit Line/[dB]**	**Enable**	**Tone <nr>**	**Limit Line/[dB]**	**Enable**
1	–9.5	ON	11	+5.6	ON
2	–6.2	ON	12	+6.3	ON
3	–3.8	ON	13	+6.9	ON
4	–1.9	ON	14	+7.5	ON
5	–0.3	ON	15	+8.0	ON
6	+1.0	ON	16	+8.6	ON
7	+2.1	ON	17	+9.1	ON
8	+3.1	ON	18	+9.6	ON
9	+4.0	ON	19	+10.0	ON
10	+4.8	ON	20	+10.5	ON

CONFigure:MULTitone:STEReo:TONE<nr>:LIMit:LINE:ASYMmetric:UPPer
<Limit_1>, <Enable_1>, <Limit_2>, <Enable_2> Upper Limit, Single Point

<Limit_ch>	Description of parameters	Def. value	Def. unit	
–80 dB to +80 dB,	Upper limit line at tone <nr> and audio channel <ch>	See below	dB	
<Enable_ch>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Enable upper limit line at tone <nr>> and audio channel <ch>	ON	–	V4.60

Description of command

This command configures the upper limit and enables the limit check at one of 20 test tones that can be defined via `CONFigure:MULTitone:STEReo:TONE<nr>`. The test tones are numbered by <nr> = 1 to 20. The default limits at all test points are quoted in the previous command.

CONFigure:MULTitone:STEReo:LIMit:LINE:ASYMmetric:LOWer Lower Limits, Overall
<Limit_1_1>, <Enable_1_1>, ... <Limit_20_1>, <Enable_20_1> ,
<Limit_1_2>, <Enable_1_2>, ... <Limit_20_2>, <Enable_20_2>

<Limit_nr_ch>	Description of parameters	Def. value	Def. unit	
–80 dB to +80 dB,	Lower limit line at tone <nr> and audio channel <ch>	See below	dB	
<Enable_nr_ch>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Enable lower limit line at tone <nr> and audio channel <ch>	ON	–	V4.60

Description of command

This command configures the lower limit lines and enables the limit check at the 20 test tones that can be defined via `CONFigure:MULTitone:STEReo:TONE<nr>.`

By default, the limit check is switched on at all tones and the following limit lines apply to both audio channels:

Tone <nr>	**Limit Line/[dB]**	**Enable**	**Tone <nr>**	**Limit Line/[dB]**	**Enable**
1	–13.5	ON	11	+1.6	ON
2	–10.2	ON	12	+2.3	ON
3	–7.8	ON	13	+2.9	ON
4	–5.9	ON	14	+3.5	ON
5	–4.3	ON	15	+4.0	ON
6	–3.0	ON	16	+4.6	ON
7	–1.9	ON	17	+5.0	ON
8	–0.9	ON	18	+5.0	ON
9	0.0	ON	19	+5.0	ON
10	+0.8	ON	20	+5.0	ON

CONFigure:MULTitone:STEReo:TONE<nr>:LIMit:LINE:ASYMmetric:LOWer ***<Limit_1>, <Enable_1>, <Limit_2>, <Enable_2>*** — Lower Limit, Single Point

<Limit_ch>	Description of parameters	Def. value	Def. unit	
–80 dB to +80 dB,	Lower limit line at tone <nr> and audio channel <ch>	See below	dB	
<Enable_ch>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Enable lower limit line at tone <nr> and audio channel <ch>	ON	–	V4.60

Description of command

This command configures the lower limit and enables the limit check at one of 20 test tones that can be defined via `CONFigure:MULTitone:STEReo:TONE<nr>`. The test tones are numbered by <nr> = 1 to 20. The default limits at all test points are quoted in the previous command.

DEFault:MULTitone:STEReo:LIMit:LINE ***<Enable>*** — Default Settings

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V4.60

Description of command

If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting OFF results in an error message).

If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.

Test Tones – Subsystem MULTitone:...TDEFinition

The subsystem *MULTitone:...TDEFinition* configures the audio test signal used for the *Multitone* measurement. The subsystem corresponds to the *Tone Def.* tab of the popup menu *Multitone Configuration.*

CONFigure:MULTitone:STEReo:TDEFinition Test Tones, analog generators

<Freq_1_1>, <Lev_1_1>, <Enable_1_1>, ... <Freq_20_1>, <Lev_20_1>, <Enable_20_1>
<Freq_1_2>, <Lev_1_2>, <Enable_1_2>, ... <Freq_20_2>, <Lev_20_2>, <Enable_20_2>

<Freq_nr_ch>	Description of parameters	Def. value	Def. unit	
10 Hz to 16000 Hz,	Frequency of test tone <nr> and audio channel <ch>	See below	Hz	
<Lev_nr_ch >	Description of parameters	Def. value	Def. unit	
0.0 V to 5.0 V*),	Level at test tone <nr> and audio channel <ch>	See below	V	
<Enable_nr_ch >	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Switch on / off test tone <nr> and audio channel <ch>	See below	–	V4.60

Description of command

This command enables and configures up to 20 test tones for test scenarios where an analog generator is used. The minimum frequency spacing between two tones is 1 Hz. The sum of all test tones must not exceed the maximum AF generator level quoted in the data sheet.

*) The sum of the levels of all enabled tones must not exceed 5.0 V.

The following default test tones are provided for both audio channels:

Tone <nr>	Frequency/[Hz]	Level/[V]	Enable	Tone <nr>	Frequency/[Hz]	Level/[V]	Enable
1	300	0.01	ON	11	1700	0.01	ON
2	440	0.01	ON	12	1840	0.01	ON
3	580	0.01	ON	13	1980	0.01	ON
4	720	0.01	ON	14	2120	0.01	ON
5	860	0.01	ON	15	2260	0.01	ON
6	1004	0.01	ON	16	2400	0.01	ON
7	1140	0.01	ON	17	2540	0.01	ON
8	1280	0.01	ON	18	2680	0.01	ON
9	1420	0.01	ON	19	2820	0.01	ON
10	1560	0.01	ON	20	3000	0.01	ON

Note: *If the level of all test tones is derived from a total level (TLEVel setting in the CONFigure:MULTitone:AF1Channel:TDEFinition:MODE command), the individual level settings are ignored. The* <Frequency> *and* <Enable> *parameter settings are still effective.*

CONFigure:MULTitone:STEReo:FSCale:TDEFinition Test Tones, digital generators

<Freq_1_1>, <Lev_1_1>, <Enable_1_1>, ... <Freq_20_1>, <Lev_20_1>, <Enable_20_1>
<Freq_1_2>, <Lev_1_2>, <Enable_1_2>, ... <Freq_20_2>, <Lev_20_2>, <Enable_20_2>

<Freq_nr_ch>	Description of parameters	Def. value	Def. unit	
10 Hz to 16000 Hz,	Frequency of test tone <nr> and audio channel <ch>	See below	Hz	
<Lev_nr_ch >	Description of parameters	Def. value	Def. unit	
0.0000 FS to 1..0000 FS*),	Level at test tone <nr> and audio channel <ch>	See below	FS	
<Enable_nr_ch >	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Switch on / off test tone <nr> and audio channel <ch>	See below	–	V4.60

Description of command

This command enables and configures up to 20 test tones for test scenarios where a digital generator is used. The minimum frequency spacing between two tones is 1 Hz. The sum of all test tones must not exceed the maximum AF generator level quoted in the data sheet.

*) The sum of the levels of all enabled tones must not exceed 1.0000 FS.

The following default test tones are provided for both audio channels:

Tone <nr>	**Frequency/[Hz]**	**Level/[FS]**	**Enable**	**Tone <nr>**	**Frequency/[Hz]**	**Level/[FS]**	**Enable**
1	300	0.0500	ON	11	1700	0.0500	ON
2	440	0.0500	ON	12	1840	0.0500	ON
3	580	0.0500	ON	13	1980	0.0500	ON
4	720	0.0500	ON	14	2120	0.0500	ON
5	860	0.0500	ON	15	2260	0.0500	ON
6	1004	0.0500	ON	16	2400	0.0500	ON
7	1140	0.0500	ON	17	2540	0.0500	ON
8	1280	0.0500	ON	18	2680	0.0500	ON
9	1420	0.0500	ON	19	2820	0.0500	ON
10	1560	0.0500	ON	20	3000	0.0500	ON

Note: *If the level of all test tones is derived from a total level (TLEVel setting in the CONFigure:MULTitone:AF1Channel:TDEFinition:MODE command), the individual level settings are ignored. The* <Frequency> *and* <Enable> *parameter settings are still effective.*

CONFigure:MULTitone:STEReo:TDEFinition:TONE<nr> Test Tones, analog generators

<Frequency_1>, <Level_1>, <Enable_1>, <Frequency_2>, <Level_2>, <Enable_2>

<Frequency_ch>	Description of parameters	Def. value	Def. unit	
10 Hz to 16000 Hz,	Frequency of test tone <nr> and audio channel <ch>	See below	Hz	
<Level_ch>	Description of parameters	Def. value	Def. unit	
0.0 V to 5.0 V*),	AF level test tone <nr> and audio channel <ch>	See below	V	
<Enable_ch>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Switch on / off test tone <nr> and audio channel <ch>	See below	–	V4.60

Description of command

This command enables and configures one of up to 20 test tones (<nr> = 1 to 20) for test scenarios where an analog generator is used. The default values for all test tones are given in the previous commands.

*) The sum of the levels of all enabled tones must not exceed 5.0 V.

Note: *If the level of all test tones is derived from a total level (TLEVel setting in the CONFigure:MULTitone:AF1Channel:TDEFinition:MODE command), the* <Level> *setting is ignored. The* <Frequency> *and* <Enable> *parameter setting is still effective.*

CONFigure:MULTitone:STEReo:TDEFinition:FSCale:TONE<nr> Test Tones, digital generators

<Frequency_1>, <Level_1>, <Enable_1>, <Frequency_2>, <Level_2>, <Enable_2>

<Frequency_ch>	Description of parameters	Def. value	Def. unit	
10 Hz to 16000 Hz,	Frequency of test tone <nr> and audio channel <ch>	See below	Hz	
<Level_ch>	Description of parameters	Def. value	Def. unit	
0.0000 FS to 1..0000 FS *),	AF level test tone <nr> and audio channel <ch>	See below	FS	
<Enable_ch>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Switch on / off test tone <nr> and audio channel <ch>	See below	–	V4.60

Description of command

This command enables and configures one of up to 20 test tones (<nr> = 1 to 20) for test scenarios where a digital generator is used. The default values for all test tones are given in the previous commands.

*) The sum of the levels of all enabled tones must not exceed 1.0000 FS.

Note: *If the level of all test tones is derived from a total level (TLEVel setting in the CONFigure:MULTitone:AF1Channel:TDEFinition:MODE command), the* <Level> *setting is ignored. The* <Frequency> *and* <Enable> *parameter setting is still effective.*

CONFigure:MULTitone:STEReo:TDEFinition:MODE *<Mode_1>, <Mode_2>* Level Selection

<Mode_ch>	Description of parameters	Def. value	Def. unit	FW vers.
SEParate | **TLEVel**	Use separate levels for each tone in audio channel <ch> Use total level	SEParate	–	V4.60

Description of command

This command defines how the voltage of each of the test tones is determined.

- In the default setting SEParate, the levels of all tones are defined separately and may differ from each other (see command CONFigure:MULTitone:...:TDEFinition above).
- In the setting TLEV, the total AF generator level set via CONFigure:MULTitone: ...:TDEFinition:TLEVel is evenly distributed among all enabled test tones. Test tones can still be enabled or disabled and their frequency can be changed (see CONF:MULT:...TDEF... commands above), but level settings will be ignored as long as TLEV remains effective.

Total Level, analog generators

CONFigure:MULTitone:STEReo:TDEFinition:TLEVel *<Total_Level_1>, <Total_Level_2>*

<Total_Level_ch>	Description of parameters	Def. value	Def. unit	FW vers.
0.010 mV to 5.0 V	Total level/voltage (sum of all test tones) in audio channel <ch>	0.200	V	V4.60

Description of command

This command defines the total AF generator level for test scenarios where an analog generator is used. The total level is evenly distributed among all enabled test tones. This level setting comes into effect after the level selection mode is set to `TLEV` (see `CONFigure:MULTitone:...TDEFinition:MODe` command above). The total level must not exceed the maximum AF generator level quoted in the data sheet.

Total Level, digital generators

CONFigure:MULTitone:STEReo:FSCale:TDEFinition:TLEVel *<Total_Level_1>, <Total_Level_2>*

<Total_Level_ch>	Description of parameters	Def. value	Def. unit	FW vers.
0.00000 FS to 1.00000 FS	Total level/voltage (sum of all test tones) in audio channel <ch>	1.00000	FS	V4.60

Description of command

This command defines the total AF generator level for test scenarios where a digital generator is used. The total level is evenly distributed among all enabled test tones. This level setting comes into effect after the level selection mode is set to `TLEV` (see `CONFigure:MULTitone:...TDEFinition:MODe` command above). The total level must not exceed the maximum AF generator level quoted in the data sheet.

DEFault:MULTitone:STEReo:TDEFinition *<Enable>* Default Settings

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	The parameters are set to their default values Some or all parameters differ from the default values	ON	–	V4.60

Description of command

If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting OFF results in an error message). If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF).*

Path Configuration – Subsystem MULTitone:STEReo:FILTer

The subsystem *MULTitone:STEReo:FILTer* configures the voice-processing equipment used for the *Multitone* measurement. The subsystem corresponds to the *Filters* tab of the popup menu *Multitone Configuration.*

CONFigure:MULTitone:STEReo:FILTer:BPASs:DCCoupling ***<Bandpass_1>, <Bandpass_2>*** Band Pass, DC Coupling

<Bandpass_ch>	Description of parameters	Def. value	Def. unit	FW vers.
	R&S CBT band pass filter for audio channel <ch> with a bandwidth of	BP17	–	V4.60
BP02 |	6 Hz to 250 Hz			
BP03 |	50 Hz to 250 Hz			
BP05 |	6 Hz to 3000 Hz			
BP06 |	50 Hz to 3000 Hz			
BP07 |	300 Hz to 3000 Hz			
BP09 |	6 Hz to 4000 Hz			
BP10 |	50 Hz to 4000 Hz			
BP11 |	300 Hz to 4000 Hz			
BP13 |	6 Hz to 15000 Hz			
BP14 |	50 Hz to 15000 Hz			
BP15 |	300 Hz to 15000 Hz			
BP17 |	6 Hz to 21000 Hz			
BP18 |	50 Hz to 21000 Hz			
BP19	500 Hz to 5000 Hz			

Description of command

This command selects the band pass filter to be used if the AF path coupling is set to DC (see `CONFigure:AFANalyzer[:PRIMary]:COUPling` command).

CONFigure:MULTitone:STEReo:FILTer:BPASs:ACCoupling *<<Bandpass_1>, <Bandpass_2>* — Band Pass, AC Coupling

<Bandpass_ch>	Description of parameters	Def. value	Def. unit	FW vers.
	R&S CBT band pass filter for audio channel <ch> with a bandwidth of	BP16	–	V4.60
BP01 |	0 Hz to 250 Hz			
BP02 |	6 Hz to 250 Hz			
BP03 |	50 Hz to 250 Hz			
BP04 |	0 Hz to 3000 Hz			
BP05 |	6 Hz to 3000 Hz			
BP06 |	50 Hz to 3000 Hz			
BP07 |	300 Hz to 3000 Hz			
BP08 |	0 Hz to 4000 Hz			
BP09 |	6 Hz to 4000 Hz			
BP10 |	50 Hz to 4000 Hz			
BP11 |	300 Hz to 4000 Hz			
BP12 |	0 Hz to 15000 Hz			
BP13 |	6 Hz to 15000 Hz			
BP14 |	50 Hz to 15000 Hz			
BP15 |	300 Hz to 15000 Hz			
BP16 |	0 Hz to 21000 Hz			
BP17 |	6 Hz to 21000 Hz			
BP 18 |	50 Hz to 21000 Hz			
BP19	500 Hz to 5000 Hz			

Description of command

This command selects the band pass filter to be used if the AF path coupling is set to AC (see `CONFigure:AFANalyzer[:PRIMary]:COUPling` command).

CONFigure:MULTitone:STEReo:FILTer:WEIGhting *<Weighting_1>, <Weighting_2>* — Weighting

<Weighting_ch>	Description of parameters	Def. value	Def. unit	FW vers.
A |	Switch on A-weighted filter for audio channel <ch>	OFF	–	V4.60
CME |	Switch on C-message weighted filter			
CCI |	Switch on CCITT weighting filter			
OFF	No weighting filter			

Description of command

This command selects the weighting filter to be included in the AF input signal path.

DEFault:MULTitone:STEReo:FILTer *<Enable>* — Default Settings

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON |	The parameters are set to their default values	ON	–	V4.60
OFF	Some or all parameters differ from the default values			

Description of command

If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting OFF results in an error message).

If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.

Results – Subsystem MULTitone:...?

The subsystem *MULTitone:...?* measures the AF input level, returns the results and compares them with the tolerance values. The subsystem corresponds to the various output elements in the measurement menu *Multitone.*

READ[:SCALar]:MULTitone:STEReo:AF1Channel:TONE<nr>? Multitone Results, single channels
READ[:SCALar]:MULTitone:STEReo:AF2Channel:TONE<nr>?
Start single shot measurement and return results ⇒ *RUN*
FETCh[:SCALar]:MULTitone:STEReo:AF1Channel:TONE<nr>?
FETCh[:SCALar]:MULTitone:STEReo:AF2Channel:TONE<nr>?
Read results (unsynchronized) ⇒ *RUN*

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dB to +20.0 dB	AF response at point <nr>	NAN	dB	V4.60

Description of command

These commands are always queries. They return the audio level at test tones <nr> (<nr> = 1 to 20) defined via CONFigure:MULTitone:STEReo:AF1Channel:TONE<nr>.

READ[:SCALar]:MULTitone:STEReo:TONE<nr>? Multitone Results, both channels
Start single shot measurement and return results ⇒ *RUN*
FETCh[:SCALar]:MULTitone:STEReo:TONE<nr>? Read results (unsynchronized) ⇒ *RUN*

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dB to +20.0 dB **–100.0 dB to +20.0 dB**	AF response at point <nr> and audio channel 1, AF response at point <nr> and audio channel 2	NAN NAN	dB dB	V4.60

Description of command

These commands are always queries. They return the audio level at test tones <nr> (<nr> = 1 to 20) defined via CONFigure:MULTitone:STEReo:TONE<nr>.

Multitone Results, single channels
READ:ARRay:MULTitone:STEReo:AF1Channel? Start single shot measurement and return results ⇒ *RUN*
READ:ARRay:MULTitone:STEReo:AF2Channel?
FETCh:ARRay:MULTitone:STEReo:AF1Channel? Read meas. results (unsynchronized) ⇒ *RUN*
FETCh:ARRay:MULTitone:STEReo:AF2Channel?

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dB to +20.0 dB, **...** **–100.0 dB to +20.0 dB**	FreqResp[1], 1st value for AF response ... FreqResp[20], 20th value for AF resp.	NAN ... NAN	dB ... dB	V4.60

Description of command

These commands are always queries. They return the audio level at the 20 test tones defined via CONFigure:MULTitone:STEReo:AF1Channel:TONE<nr>.

				Multitone Results, both channels
READ:ARRay:MULTitone:STEReo?	Start single shot measurement and return results			⇒ *RUN*
FETCh:ARRay:MULTitone:STEReo?	Read meas. results (unsynchronized)			⇒ *RUN*
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–100.0 dB to +20.0 dB, **...** **–100.0 dB to +20.0 dB,** **–100.0 dB to +20.0 dB,** **...** **–100.0 dB to +20.0 dB**	FreqResp[1], 1st value for AF response in ch. 1 ... FreqResp[20], 20th value for AF resp. in ch. 1 FreqResp[1], 1st value for AF response in ch. 2 ... FreqResp[20], 20th value for AF resp. in ch. 2	NAN ... NAN NAN ... NAN	dB ... dB dB ... dB	V4.60
Description of command				
These commands are always queries. They return the audio level at the 20 test tones defined via `CONFigure:MULTitone:STEReo:TONE<nr>`.				

				Limit Matching, single channels
CALCulate[:SCALar]:MULTitone:STEReo:AF1Channel:TONE<nr>:MATChing:LIMit? **CALCulate[:SCALar]:MULTitone:STEReo:AF2Channel:TONE<nr>:MATChing:LIMit?**				
Returned result	Value range	Def. value	Def. unit	FW vers.
Limit matching at tone <nr>	NMAU | NMAL | INV | OK	INV	–	V4.60
Description of command				
This command is always a query. It indicates whether and in which way the error limits at tone <nr> (<nr> = 1 to 20) have been exceeded. The following messages may be returned for test tone <nr>: NMAU Underflow of tolerance value *not matching, underflow* NMAL Tolerance value exceeded *not matching, overflow* INV Measurement invalid *invalid* OK all tolerances matched				

CALCulate[:SCALar]:MULTitone:STEReo:TONE<nr>:MATChing:LIMit?	Limit Matching, both channels			
Returned result	Value range	Def. value	Def. unit	FW vers.
Limit matching at tone <nr> and ch. 1, **Limit matching at tone <nr> and ch. 2**	NMAU | NMAL | INV | OK NMAU | NMAL | INV | OK	INV INV	– –	V4.60
Description of command				
This command is always a query. It indicates whether and in which way the error limits at tone <nr> (<nr> = 1 to 20) have been exceeded; see command above.				

				Limit Matching, Overall, single channels
CALCulate[:SCALar]:MULTitone:STEReo:AF1Channel:MATChing:LIMit? **CALCulate[:SCALar]:MULTitone:STEReo:AF2Channel:MATChing:LIMit?**				
Returned result	Value range	Def. value	Def. unit	FW vers.
Limit matching at tone 1, **...,** **Limit matching at tone 20**	For tones 1 to 20: NMAU | NMAL | INV | OK	INV	–	V4.60
Description of command				
This command is always a query. It indicates whether and in which way the error limits at all test tones 1 to 20 have been exceeded. The output string contains 20 values separated by commas.				

CALCulate[:SCALar]:MULTitone:STEReo:MATChing:LIMit? Limit Matching, Overall, both channels

Returned result	Value range	Def. value	Def. unit	FW vers.
Limit matching at tone 1 and ch. 1, **...,** **Limit matching at tone 20 and ch. 1,** **Limit matching at tone 1 and ch. 2,** **...,** **Limit matching at tone 20 and ch. 2**	For tones 1 to 20 and both channels: NMAU | NMAL | INV | OK	INV	–	V4.60

Description of command

This command is always a query. It indicates whether and in which way the error limits at all test tones 1 to 20 have been exceeded. The output string contains 40 values separated by commas.

Limit Matching, Overall, single channels
CALCulate:ARRay:MULTitone:STEReo:AF1Channel:MATChing:LIMit?
CALCulate:ARRay:MULTitone:STEReo:AF2Channel:MATChing:LIMit?

Returned result	Value range	Def. value	Def. unit	FW vers.
20 bit field,	Indicator for upper limit matching at tone 1 to 20	NAN	–	V4.60
20 bit field	Indicator for lower limit matching at tone 1 to 20	NAN	–	

Description of command

This command is always a query. Any bit of the two returned fields that is set indicates that the limits at the corresponding point are exceeded.

CALCulate:ARRay:MULTitone:STEReo:MATChing:LIMit? Limit Matching, Overall, both channels

Returned result	Value range	Def. value	Def. unit	FW vers.
20 bit field,	Indicator for upper limit matching at tone 1 to 20, ch. 1	NAN	–	V4.60
20 bit field,	Indicator for lower limit matching at tone 1 to 20, ch. 1	NAN	–	
20 bit field,	Indicator for upper limit matching at tone 1 to 20, ch. 2	NAN	–	
20 bit field	Indicator for lower limit matching at tone 1 to 20, ch. 2	NAN	–	

Description of command

This command is always a query. Any bit of the two returned fields that is set indicates that the limits at the corresponding point are exceeded.

Total Harmonic Noise Measurement (THD)

The subsystem *THD* provides a single-frequency audio test signal with selectable power and measures the power at the generator frequency (1^{st} harmonic labeled d1) and at the 2^{nd}, 3^{rd} … 9^{th} harmonics. The subsystem corresponds to the measurement menu *THD* and the associated popup menu *THD Configuration.*

The *THD* measurement provides two independent circuits:

- In the first audio channel (subsystem `THD:AF1Channel...`), the audio signals are applied to the connectors AF 1 OUT (output, AF generator signal) and AF 1 IN (input) on the R&S CBT front panel. The first audio channel corresponds to the THD menu, application *AF Chan. One*, and the associated sections in the configuration menu.
- In the second audio channel (subsystem `THD:AF2Channel...`), the audio signals are applied to the connectors AF 2 OUT (output, AF generator signal) and AF 2 IN (input) on the R&S CBT front panel. The second audio channel corresponds to the THD menu, application *AF Chan. Two*, and the associated sections in the configuration menu.

With the exception of the input and output connectors, the two audio circuits are identical. All remote control commands are analogous.

The *Stereo* application is a combination of the previous two applications, where the R&S generates and analyzes two audio signals at equal or different frequencies. The stereo commands are reported in section *THD:STEReo Subsystem* on p. 6.249.

Single-Tone THD (THD:AF<n>Channel)

The commands in the following sections control the THD measurement in the first and second audio channel.

Measurement Control

The following commands correspond to the softkeys *AF Chan. One / AF Chan. Two* in the measurement menu *THD* and some of the associated hotkeys.

INITiate:THD:AF1Channel **INITiate:THD:AF2Channel**	Start new measurement	⇒ *RUN*
ABORt:THD:AF1Channel **ABORt:THD:AF2Channel**	Abort running measurement and switch off	⇒ *OFF*
STOP:THD:AF1Channel **STOP:THD:AF2Channel**	Stop measurement after current stat. cycle	⇒ *STOP*
CONTinue:THD:AF1Channel **CONTinue:THD:AF2Channel**	Next measurement step (only *stepping mode*)	⇒ *RUN*

Description of command	FW vers.
These commands have no query form. They start and stop the measurement, setting it to the status indicated in the top right column.	V4.35

CONFigure:THD:AF1Channel:EREPorting *<Mode>* **CONFigure:THD:AF2Channel:EREPorting *<Mode>***				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC** | **SRSQ** | **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	V4.35
Description of command				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of the operating manual).				

FETCh:THD:AF1Channel:STATus? **FETCh:THD:AF2Channel:STATus?**				Measurement Status
Ret. values	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN** | **STOP** | **ERR** | **STEP** | **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode	OFF	–	V4.35
1 to 10000 | **NONE**	Counter for current statistics cycle No counting mode set	NONE	–	
Description of command				
This command is always a query. It returns the status of the measurement (see chapters 3 and 5).				

Test Configuration

The commands of the following subsystems configure the *THD* measurement. They correspond to the *THD Configuration* menu.

Measurement Scope

The following commands define the scope of the measurement. They correspond to the *Control* tab in the popup menu *THD Configuration.*

CONFigure:THD:AF1Channel:CONTrol:REPetition Test Cycles
CONFigure:THD:AF2Channel:CONTrol:REPetition
<Repetition>, <StopCond>, <Stepmode>

<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot** | **1 to 10000,**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCond>	Description of parameters	Def. value	Def. unit	
NONE,	No stop condition set (no limit check)	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V4.35

Description of command

This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement.

Note: *For READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*

CONFigure:THD:AF1Channel:COUPling *<Coupling>* Path Coupling (AF IN)
CONFigure:THD:AF2Channel:COUPling *<Coupling>*

<Coupling>	Description of parameters	Def. value	Def. unit	FW vers.
AC | **DC**	AC coupling of AF path DC coupling of AF path	AC (`:AF1Channel`) DC (`:AF2Channel`)	–	V4.60

Description of command

This command determines the AF path coupling for the THD measurement. The commands overwrite the `CONFigure:THD:STEReo:COUPling` settings.

CONFigure:THD:AF1Channel:HARMonics<nr> *<Enable>* Test Tones
CONFigure:THD:AF2Channel:HARMonics<nr> *<Enable>*

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON | **OFF**	Enable/disable harmonic <nr> = 2 … 9	ON	–	V4.35

Description of command

This command enables the harmonics no. 2 to 9 for the THD calculation. The audio levels are measured for all harmonics below 21 kHz. The first harmonic frequency is always enabled: A query returns 1 (ON), a setting command causes an SCPI error message *Invalid Suffix.*

The commands overwrite the `CONFigure:THD:STEReo:HARMonics<nr>` settings.

CONFigure:THD:AF1Channel:TDEFinition **CONFigure:THD:AF2Channel:TDEFinition** ***<Frequency>, <Level>***		Frequency d1, Analog Generator Level		
<Frequency>	Description of parameters	Def. value	Def. unit	FW Vers.
500 Hz to 3000 Hz,	Frequency of AF generator, d1 frequency	1000	Hz	V4.35
<Level>	Description of parameters	Def. value	Def. unit	
0.05 mV to 5.0 V	AF level	0.01	V	0
Description of command				
This command configures the generator signal for the THD measurement for test scenarios where an analog generator is used. The first harmonic d1 is measured at the generator signal frequency. The commands overwrite the `CONFigure:THD:STEReo:TDEFinition` settings.				

CONFigure:THD:AF1Channel:FSCale:TDEFinition **CONFigure:THD:AF2Channel:FSCale:TDEFinition** ***<Frequency>, <Level>***		Frequency d1, Digital Generator Level		
<Frequency>	Description of parameters	Def. value	Def. unit	FW Vers.
500 Hz to 3000 Hz,	Frequency of AF generator, d1 frequency	1000	Hz	V4.60
<Level>	Description of parameters	Def. value	Def. unit	
0.00000 FS to 1.0000 FS	AF level (full scale)	1.000	FS	0
Description of command				
This command configures the generator signal for the THD measurement for test scenarios where a digital generator is used. Digital generator levels are specified in full scale (FS) units, 1 FS corresponding to maximum generator level. The first harmonic d1 is measured at the generator signal frequency. The commands overwrite the `CONFigure:THD:STEReo:FSCale:TDEFinition` settings.				

Path Configuration – Subsystem THD:…:FILTer

The subsystem *THD:…:FILTer* configures the voice-processing equipment used for the *THD* measurement. The subsystem corresponds to the *Filters* tab of the popup menu *THD Configuration.*

CONFigure:THD:AF1Channel:FILTer:BPASs:DCCoupling **CONFigure:THD:AF2Channel:FILTer:BPASs:DCCoupling** ***<Bandpass>***				Band Pass, DC Coupling
<Bandpass>	Description of parameters	Def. value	Def. unit	FW vers.
	R&S CBT band pass filter with a bandwidth of	BP17	–	V4.60
BP02 |	6 Hz to 250 Hz			
BP03 |	50 Hz to 250 Hz			
BP05 |	6 Hz to 3000 Hz			
BP06 |	50 Hz to 3000 Hz			
BP07 |	300 Hz to 3000 Hz			
BP09 |	6 Hz to 4000 Hz			
BP10 |	50 Hz to 4000 Hz			
BP11 |	300 Hz to 4000 Hz			
BP13 |	6 Hz to 15000 Hz			
BP14 |	50 Hz to 15000 Hz			
BP15 |	300 Hz to 15000 Hz			
BP17 |	6 Hz to 21000 Hz			
BP18 |	50 Hz to 21000 Hz			
BP19	500 Hz to 5000 Hz			V4.60
Description of command				
This command selects the band pass filter to be used if the AF path coupling is set to DC (see `CONFigure:THD:AF<nr>Channel:COUPling` commands).				

CONFigure:THD:AF1Channel:FILTer:BPASs:ACCoupling **CONFigure:THD:AF2Channel:FILTer:BPASs:ACCoupling** ***<Bandpass>***				Band Pass, AC Coupling
<Bandpass>	Description of parameters	Def. value	Def. unit	FW vers.
	R&S CBT band pass filter with a bandwidth of	BP16	–	V4.60
BP01 |	0 Hz to 250 Hz			
BP02 |	6 Hz to 250 Hz			
BP03 |	50 Hz to 250 Hz			
BP04 |	0 Hz to 3000 Hz			
BP05 |	6 Hz to 3000 Hz			
BP06 |	50 Hz to 3000 Hz			
BP07 |	300 Hz to 3000 Hz			
BP08 |	0 Hz to 4000 Hz			
BP09 |	6 Hz to 4000 Hz			
BP10 |	50 Hz to 4000 Hz			
BP11 |	300 Hz to 4000 Hz			
BP12 |	0 Hz to 15000 Hz			
BP13 |	6 Hz to 15000 Hz			
BP14 |	50 Hz to 15000 Hz			
BP15 |	300 Hz to 15000 Hz			
BP16 |	0 Hz to 21000 Hz			
BP17 |	6 Hz to 21000 Hz			
BP 18 |	50 Hz to 21000 Hz			
BP19	500 Hz to 5000 Hz			V4.60
Description of command				
This command selects the band pass filter to be used if the AF path coupling is set to AC (see `CONFigure:THD:AF<nr>Channel:COUPling` commands).				

CONFigure:THD:AF1Channel:FILTer:WEIGhting ***<Weighting>*** — Weighting
CONFigure:THD:AF2Channel:FILTer:WEIGhting ***<Weighting>***

<Weighting>	Description of parameters	Def. value	Def. unit	FW vers.
A |	Switch on A-weighted filter	OFF	–	V4.60
CME |	Switch on C-message weighted filter			
CCI |	Switch on CCITT weighting filter			
OFF	No weighting filter			

Description of command

This command selects the weighting filter to be included in the AF input signal path.

DEFault:THD:AF1Channel:FILTer ***<Enable>*** — Default Settings
DEFault:THD:AF2Channel:FILTer ***<Enable>***

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON |	The parameters are set to their default values	ON	–	V4.60
OFF	Some or all parameters differ from the default values			

Description of command

If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem to their default values (the setting OFF results in an error message).

If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.

DEFault:THD:FILTer ***<Enable>*** — Default Settings

<Enable>	Description of parameters	Def. value	Def. unit	FW vers.
ON |	The parameters are set to their default values	ON	–	V4.60
OFF	Some or all parameters differ from the default values			

Description of command

If used as a setting command with the parameter *ON* this command sets all parameters of the subsystem (including `AF1Channel` and `AF2Channel`) to their default values (the setting OFF results in an error message).

If used as a query the command returns whether all parameters are set to their default values *(ON)* or not *(OFF)*.

Results – Subsystem THD:...?

The following commands start the THD measurement (`READ…`) and return the results. They correspond to the various output elements in the measurement menu *THD.*

READ[:SCALar]:THD:AF1Channel:HARMonic<nr>? — Harmonic levels, single
READ[:SCALar]:THD:AF2Channel:HARMonic<nr>?
Start single shot measurement and return results ⇒ *RUN*
FETCh[:SCALar]:THD:AF1Channel:HARMonic<nr>?
FETCh[:SCALar]:THD:AF2Channel:HARMonic<nr>? Read results (unsynchronized) ⇒ *RUN*

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–140.0 dB to +140.0 dB	AF level at harmonic <nr>	NAN	dB	V4.35

Description of command

These commands are always queries. They return the audio levels at the first harmonic frequency d1 (<nr> = 1) and at the harmonic frequencies <nr> = 2 to 9. All results are normalized to level of the first harmonic, so the first result is always 0 dB.

				Harmonics levels, all
READ:ARRay:THD:AF1Channel? **READ:ARRay:THD:AF2Channel?**	Start single shot measurement and return results			⇒ *RUN*
FETCh:ARRay:THD:AF1Channel? **FETCh:ARRay:THD:AF2Channel?**	Read meas. results (unsynchronized)			⇒ *RUN*
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–140.0 dB to +140.0 dB, **...** **–140.0 dB to +140.0 dB**	AF Level[1], 2nd harmonic level ... AF Level[[9], 9th harmonic level	NAN ... NAN	dB ... dB	V4.35
Description of command				
These commands are always queries. They return the audio level for all harmonics d2 to d9.				

READ[:SCALar]:THD:AF1Channel:THD? **READ[:SCALar]:THD:AF2Channel:THD?**				THD results
	Start single shot measurement and return results			⇒ *RUN*
FETCh[:SCALar]:THD:AF1Channel:THD? **FETCh[:SCALar]:THD:AF2Channel:THD?**	Read results (unsynchronized)			⇒ *RUN*
Returned values	Description of parameters	Def. value	Def. unit	FW vers.
0 % to 100 %, **–140.0 dB to +0.0 dB**	THD in percent THD in dB	NAN NAN	% dB	V4.35
Description of command				
These commands are always queries. They return the Total Harmonic Distortion (THD) as a percentage and as an equivalent dB-value.				

THD:STEReo Subsystem

The commands in the THD:STEReo subsystem control the *Stereo* application of the THD measurement.

Measurement Control

The following commands correspond to the softkey *AF Stereo* in the measurement menu *THD* and some of the associated hotkeys.

INITiate:THD:STEReo	Start new measurement	⇒ *RUN*
ABORt:THD:STEReo	Abort running measurement and switch off	⇒ *OFF*
STOP:THD:STEReo	Stop measurement after current stat. cycle	⇒ *STOP*
CONTinue:THD:STEReo	Next measurement step (only *stepping mode*)	⇒ *RUN*
Description of command		FW vers.
These commands have no query form. They start and stop the measurement, setting it to the status indicated in the top right column.		V4.60

CONFigure:THD:STEReo:EREPorting *<Mode>*				Event Reporting
<Mode>	Description of parameters	Def. value	Def. unit	FW vers.
SRQ | **SOPC** | **SRSQ** | **OFF**	Service request Single operation complete SRQ and SOPC No reporting	OFF	–	V4.60
Description of command				
This command defines the events generated when the measurement is terminated or stopped *(event reporting,* see chapter 5 of the operating manual).				

FETCh:THD:STEReo:STATus?				Measurement Status
Ret. values	Description of parameters	Def. value	Def. unit	FW vers.
OFF | **RUN** | **STOP** | **ERR** | **STEP** | **RDY,**	Measurement in the *OFF* state (`*RST` or `ABORt`) Running (after `INITiate, CONTinue` or `READ`) Stopped (`STOP`) *OFF* (could not be started) Stepping mode *(<stepmode>=STEP)* Stopped according to repetition mode	OFF	–	V4.60
1 to 10000 | **NONE**	Counter for current statistics cycle No counting mode set	NONE	–	
Description of command				
This command is always a query. It returns the status of the measurement (see chapters 3 and 5).				

Test Configuration

The following commands define the scope of the measurement. They correspond to the *Control* tab in the popup menu *THD Configuration.*

CONFigure:THD:STEReo:CONTrol:REPetition *<Repetition>, <StopCond>, <Stepmode>*				Test Cycles
<Repetition>	Description of parameters	Def. value	Def. unit	
CONTinuous | **SINGleshot** | **1 to 10000,**	Continuous measurement (until `STOP` or `ABORT`) Single shot measurement (until `Status = RDY`) Multiple measurement (*counting*, until `Status = STEP | RDY`)	SING	–	
<StopCond>	Description of parameters	Def. value	Def. unit	
NONE,	No stop condition set (no limit check)	NONE	–	
<Stepmode>	Description of parameters	Def. value	Def. unit	FW vers.
STEP | **NONE**	Interrupt measurement after each statistics cycle Continue measurement according to its rep. mode	NONE	–	V4.60
Description of command				
This command determines the number of statistics cycles, the stop condition and the stepping mode for the measurement. ***Note:*** *For READ commands (`READ:...`), the <Repetition> parameter has no effect; the measurement is always stopped after a single shot.*				

CONFigure:THD:STEReo:HARMonics<nr> *<Enable_1>, <Enable_2>*				Test Tones
<Enable_1>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Enable/disable harmonic <nr> = 2 … 9 for the AF channel 1 signal (measured at AF 1 IN)	ON	–	V4.60
<Enable_2>	Description of parameters	Def. value	Def. unit	FW vers.
ON | OFF	Enable/disable harmonic <nr> = 2 … 9 for the AF channel 2 signal (measured at AF 2 IN)	ON	–	V4.60
Description of command				
This command enables the harmonics no. 2 to 9 for the stereo THD calculation. The audio levels are measured for all harmonics below 21 kHz. The first harmonic frequency is always enabled: A query returns 1 (ON), a setting command causes an SCPI error message *Invalid Suffix.* The command overwrites the `CONFigure:THD:AF1Channel:HARMonics<nr>` and `CONFigure:THD:AF2Channel:HARMonics<nr>` settings.				

CONFigure:THD:STEReo:TDEFinition ***<Frequency_1>, <Level_1>, <Frequency_1>, <Level_1>***				Frequency d1, Analog Generator Level
<Frequency_1>	Description of parameters	Def. value	Def. unit	FW Vers.
500 Hz to 3000 Hz,	Frequency of AF generator for the AF channel 1 signal (routed to AF 1 OUT)	1000	Hz	V4.60
<Level_1>	Description of parameters	Def. value	Def. unit	
0.05 mV to 5.0 V	AF level for the AF channel 1 signal (routed to AF 1 OUT)	0.01	V	0
<Frequency_2>	Description of parameters	Def. value	Def. unit	FW Vers.
500 Hz to 3000 Hz,	Frequency of AF generator for the AF channel 2 signal (routed to AF 2 OUT)	1000	Hz	V4.60
<Level_2>	Description of parameters	Def. value	Def. unit	
0.05 mV to 5.0 V	AF level for the AF channel 2 signal (routed to AF 2 OUT)	0.01	V	0
Description of command				
This command configures the generator signals for the stereo THD measurement for test scenarios where an analog generator is used. Analog generator levels are specified in V. The first harmonic d1 is measured at the generator signal frequency. The command overwrites the `CONFigure:THD:AF1Channel:TDEFinition` and `CONFigure:THD:AF2Channel:TDEFinition` settings.				

CONFigure:THD:STEReo:FSCale:TDEFinition Frequency d1, Digital Generator Level
<Frequency_1>, <Level_1>, <Frequency_1>, <Level_1>

<Frequency_1>	Description of parameters	Def. value	Def. unit	FW Vers.
500 Hz to 3000 Hz,	Frequency of AF generator for the AF channel 1 signal (routed to AF 1 OUT)	1000	Hz	V4.60
<Level_1>	Description of parameters	Def. value	Def. unit	
0.00000 FS to 1.0000 FS	AF level for the AF channel 1 signal (routed to AF 1 OUT)	1.000	FS	0
<Frequency_2>	Description of parameters	Def. value	Def. unit	FW Vers.
500 Hz to 3000 Hz,	Frequency of AF generator for the AF channel 2 signal (routed to AF 2 OUT)	1000	Hz	V4.60
<Level_2>	Description of parameters	Def. value	Def. unit	
0.00000 FS to 1.0000 FS	AF level for the AF channel 1 signal (routed to AF 1 OUT)	1.000	FS	0

Description of command

This command configures the generator signals for the stereo THD measurement for test scenarios where a digital generator is used. Digital generator levels are specified in full scale (FS) units, 1 FS corresponding to maximum generator level. The first harmonic d1 is measured at the generator signal frequency.

The command overwrites the `CONFigure:THD:AF1Channel:FSCale:TDEFinition` and `CONFigure:THD:AF2Channel:FSCale:TDEFinition` settings.

Results – Subsystem THD:...?

The following commands start the THD measurement (`READ…`) and return the results. They correspond to the various output elements in the measurement menu *THD.*

READ[:SCALar]:THD:STEReo:AF1Channel:HARMonic<nr>? Harmonic levels, single
READ[:SCALar]:THD:STEReo:AF2Channel:HARMonic<nr>?
Start single shot measurement and return results ⇒ *RUN*
FETCh[:SCALar]:THD:STEReo:AF1Channel:HARMonic<nr>?
FETCh[:SCALar]:THD:STEReo:AF2Channel:HARMonic<nr>? Read results (unsynchronized) ⇒ *RUN*

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–140.0 dB to +140.0 dB	AF level at harmonic <nr>	NAN	dB	V4.60

Description of command

These commands are always queries. They return the audio levels at the first harmonic frequency d1 (<nr> = 1) and at the harmonic frequencies <nr> = 2 to 9. All results are normalized to level of the first harmonic, so the first result is always 0 dB.

Harmonics levels, single, both channels
READ[:SCALar]:THD:STEReo:HARMonic<nr>? Start single shot measurement and return results ⇒ *RUN*
FETCh[:SCALar]:THD:STEReo:HARMonic<nr>? Read results (unsynchronized) ⇒ *RUN*

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–140.0 dB to +140.0 dB, **–140.0 dB to +140.0 dB**	AF channel 1 level at harmonic <nr> AF channel 2 level at harmonic <nr>	NAN NAN	dB dB	V4.60

Description of command

These commands are always queries. They return the audio levels at the first harmonic frequency d1 (<nr> = 1) and at the harmonic frequencies <nr> = 2 to 9. All results are normalized to level of the first harmonic, so the first result is always 0 dB, 0 dB.

Harmonics levels, all

READ:ARRay:THD:STEReo:AF1Channel?
READ:ARRay:THD:STEReo:AF2Channel? Start single shot measurement and return results ⇒ *RUN*
FETCh:ARRay:THD:STEReo:AF1Channel?
FETCh:ARRay:THD:STEReo:AF2Channel? Read meas. results (unsynchronized) ⇒ *RUN*

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–140.0 dB to +140.0 dB,	AF Level[1], 2nd harmonic level	NAN	dB	V4.60
...	...	...	...	
–140.0 dB to +140.0 dB	AF Level[[9], 9th harmonic level	NAN	dB	

Description of command

These commands are always queries. They return the audio level for all harmonics d2 to d9.

Harmonics levels, all, both channels

READ:ARRay:THD:STEReo? Start single shot measurement and return results ⇒ *RUN*
FETCh:ARRay:THD:STEReo? Read meas. results (unsynchronized) ⇒ *RUN*

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
–140.0 dB to +140.0 dB,	AF Level[1], 2nd harmonic level in channel 1	NAN	dB	V4.60
...	...	...	...	
–140.0 dB to +140.0 dB,	AF Level[[9], 9th harmonic level in channel 1	NAN	dB	
–140.0 dB to +140.0 dB,	AF Level[1], 2nd harmonic level in channel 2	NAN	dB	
...	...	…		
–140.0 dB to +140.0 dB	AF Level[[9], 9th harmonic level in channel 2	NAN	dB	

Description of command

These commands are always queries. They return the audio level for all harmonics d2 to d9.

THD results

READ[:SCALar]:THD:STEReo:AF1Channel:THD?
READ[:SCALar]:THD:STEReo:AF2Channel:THD?
Start single shot measurement and return results ⇒ *RUN*
FETCh[:SCALar]:THD:STEReo:AF1Channel:THD?
FETCh[:SCALar]:THD:STEReo:AF2Channel:THD? Read results (unsynchronized) ⇒ *RUN*

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
0 % to 100 %,	THD in percent	NAN	%	V4.60
–140.0 dB to +0.0 dB	THD in dB	NAN	dB	

Description of command

These commands are always queries. They return the Total Harmonic Distortion (THD) as a percentage and as an equivalent dB-value.

THD results, both channels

READ[:SCALar]:THD:STEReo:THD? Start single shot measurement and return results ⇒ *RUN*
FETCh[:SCALar]:THD:STEReo:THD? Read results (unsynchronized) ⇒ *RUN*

Returned values	Description of parameters	Def. value	Def. unit	FW vers.
0 % to 100 %,	THD in percent, channel 1	NAN	%	V4.60
–140.0 dB to +0.0 dB,	THD in dB, channel 1	NAN	dB	
0 % to 100 %,	THD in percent, channel 2	NAN	%	
–140.0 dB to +0.0 dB	THD in dB, channel 2	NAN	dB	

Description of command

These commands are always queries. They return the Total Harmonic Distortion (THD) as a percentage and as an equivalent dB-value.

List of Commands

In the following, all remote-control commands implemented in the R&S® CBT will be listed with their parameters and page numbers. Generally, they are arranged alphabetically according to the **second** keyword of the command so that related commands belong to the same group. For a list of common commands see Table 6-1 in section *Common Commands.*

Table 6-1 List of remote-control commands: R&S® CBT base system

Command	Parameters	Remarks	Page
Subsystem COMMunicate (interface parameters)			
SYSTem:COMMunicate:GPIB[:SELF]:ADDRess	0 to 30	with query	6.13
SYSTem:COMMunicate:SERial1:APPLication	–	query only	6.13
SYSTem:COMMunicate:SERial1:TRANsmit:PACE	XON|ACK|NONE	with query	6.14
SYSTem:COMMunicate:SERial1[:RECeive]:BAUD	110 to 115200	with query	6.13
SYSTem:COMMunicate:SERial1[:RECeive]:BITS	7|8	with query	6.14
SYSTem:COMMunicate:SERial1[:RECeive]:PARity[:TYPE]	NONE|ODD|EVEN	with query	6.14
SYSTem:COMMunicate:SERial1[:RECeive]:STOP	1|2	with query	6.14
***GTL (Go to Local)**			
*GTL	–	no query	6.18
Subsystem GTRMode (local to remote switchover)			
SYSTem:GTRMode:COMPatible	ON|OFF	with query	6.17
***LLO (local lockout)**			
*LLO	TRUE | FALSe	no query	6.19
Subsystem MISC (keyboard settings)			
SYSTem:MISC:KBEep	ON|OFF	with query	6.16
SYSTem:MISC:KEYBoard	US|GR	with query	6.17
Subsystem MMEMory (mass memory)			
MMEMory:CDIRectory	<DirectoryName>	no query	6.22
MMEMory:COMMent	<Comment>	with query	6.21
MMEMory:COPY	<FileSource>, <msus1>, <FileDest>, <msus2> | <FileSource>, <FileDest>	no query	6.22
MMEMory:DATA?	<FileName> ,<Data>	with query	6.24
MMEMory:DELete	<FileName> [,<msus>]	no query	6.22
MMEMory:DIRectory[:CURRent]?	<DirectoryName>	query only	6.21
MMEMory:INFO?	<FileName> [,<msus>]	query only	6.21
MMEMory:MKDir	<DirName> [,<msus>]	no query	6.22
MMEMory:MOVE	<FileSource>, <msus1>, <FileDest>, <msus2> | <FileSource>, <FileDest>	no query	6.23
MMEMory:RECall:CURRent	<FileName> [,<msus>]	no query	6.25

Command	Parameters	Remarks	Page
MMEMory:RECall[:ALL]	<FileName> [,<msus>]	no query	6.25
MMEMory:REName	<FileSource>[,<msus1>], <FileDest> [,<msus2>]	no query	6.23
MMEMory:RMDir	<DirName> [,<msus>]	no query	6.22
MMEMory:SAVE:CURRent	<FileName> [,<msus>]	no query	6.24
MMEMory:SAVE[:ALL]	<FileName> [,<msus>]	no query	6.24
MMEMory:SCAN?	INT | EXT, D , <DirectoryName1>,<DirectoryName2>,... ,F , <FileName1>,<FileName2>,.. . ,	query only	6.23
Subsystem MQUeue (measurement queue)			
SYSTem:MQUeue[:COMPlete]:ITEM?	US|GR	query only	6.18
SYSTem:MQUeue[:COMPlete][:LIST]?	<Meas_Queue>	query only	6.18
Subsystem OPTions (options)			
SYSTem:OPTion:ACTivation	'<Key code>'	with query	6.15
SYSTem:OPTions:INFO?		query only	6.15
SYSTem:OPTions?		query only	6.15
Subsystem PRESet (general reset)			
SYSTem:PRESet[:ALL]		no query	6.19
SYSTem:RESet:CURRent		no query	6.18
SYSTem:RESet[:ALL]		no query	6.18
Subsystem REBoot (reboot instrument)			
SYSTem:REBoot	–	no query	6.6
SYSTem:RESet:CURRent		no query	6.19
Subsystem REMote (remote control)			
SYSTem:REMote:ADDRess:PRIMary	0 to 30	with query	6.11
SYSTem:REMote:ADDRess:SECondary	1 to 29,<Remote-FGrp-Name> | NONe	with query	6.11
SYSTem:REMote:ADDRess:SECondary:UNMap	–	no query	6.12
SYSTem:REMote:FORMat:NUMeric	IEEE754 | SCPI	with query	6.12
TRACe:REMote:MODE:DISPlay:FILTer	ON | OFF	with query	6.19
SYSTem:REMote:RDMode	ON|OFF	with query	6.12
SYSTem:REMote:TPManagement	ON|OFF	with query	6.12
*SEC	1 to 29	no query	6.12
System STATus (status reporting system)			
STATus:OPERation:CMU:ALL	0 to 32767, ... , 0 to 32767	query only	6.8
STATus:OPERation:CMU:CLEar	–	no query	6.8
STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>:ENABle	0 to 32767	with query	6.8
STATus:OPERation:CMU:SUM<nr>:CMU<nr_event>[EVENt]?		query only	6.8
STATus:OPERation:CMU:SUM<nr>:ENABle	0 to 32767	with query	6.8

Command	Parameters	Remarks	Page
STATus:OPERation:CMU:SUM<nr>[EVENt]?		query only	6.7
STATus:OPERation:ENABle	0 to 32767	with query	6.7
STATus:OPERation:EVENt:SADDress?	<SecAddr>,<Fgrp>	query only	6.10
STATus:OPERation:SYMBolic:ENABle	<Event>{,<Event>}	with query	6.10
STATus:OPERation:SYMBolic[:EVENt]?	NONE | <Event>{,<Event>}	query only	6.10
STATus:OPERation[EVENt]?		query only	6.7
STATus:QUEStionable:ENABle	0 to 32767	with query	6.9
STATus:QUEStionable[EVENt]?		query only	6.8
Subsystem SYNChronize (reference frequency)			
[SENSe:]SYNChronize:FREQuency:REFerence:LOCKed?	ON | OFF	query only	6.26
CONFigure:SYNChronize:FREQuency:REFerence:MODE	INTernal | EXTernal	with query	6.25
SYSTem (system parameters)			
SYSTem:ERRor?		query only	6.6
SYSTem:NONVolatile:DISable		no query	6.6
SYSTem:VERSion?		query only	6.6
System TIME (status reporting system)			
SYSTem:[TIME:]DATE	YYYY,MM,DD	with query	6.16
SYSTem:[TIME:]TZONe	-12 to +12,-59 to +59	with query	6.16
SYSTem:[TIME]:TIME	0 to 23,0 to 59,0 to 59	with query	6.16
TRACe (remote report)			
TRACe:REMote:MODE:DISPlay	ON | OFF	-	6.19
TRACe:REMote:MODE:ERRor	ON | OFF	-	6.20
TRACe:REMote:MODE:FILE	ON | OFF	-	6.19
TRACe:REMote:MODE:OUTLines	1 to 4	-	6.20
TRACe:REMote:MODE:SRQ	ON | OFF	-	6.20
WINDows (screensaver)			
DISPlay[:WINDow][:STATe]?	ON | OFF	with query	6.26

Table 6-2 List of remote-control commands: RF measurements

Command	Parameters	Remarks	Page
Subsystem CORRection:LOSS (Ext. Attenuation)			
[SENSe:]CORRection:LOSS[:MAGNitude]	–50 dB to 90 dB	with query	6.35
SOURce:CORRection:LOSS[:MAGNitude]	–50 dB to 90 dB	with query	6.35
Subsystem LEVel (Input Level)			
[SENSe:]LEVel:MAXimum	–40 dBm to +26 dBm	with query	6.30

Command	Parameters	Remarks	Page
Save/Recall of settings			
MMEMory:RECall:CURRent	<FileName> [,<msus>]	no query	6.28
MMEMory:SAVE:CURRent	<FileName> [,<msus>]	no query	6.27
Subsystem OPTions (options)			
SYSTem:OPTions:INFO:CURRent?		query only	6.27
Narrow-band power			
INITiate:NPOWer	–	no query	6.36
ABORt:NPOWer	–	no query	6.36
STOP:NPOWer	–	no query	6.36
CONTinue:NPOWer	–	no query	6.36
[SENSe:]NPOWer:BWIDth[:RESolution]	10 Hz to 1 MHz	with query	6.38
CONFigure:NPOWer:CONTrol	1 to 1000 | NONE,CONTinuous | SINGleshot | 1 ... 10000, SONerror | NONE,STEP | NONE	with query	6.37
CONFigure:NPOWer:CONTrol:REPetition	CONTinuous | SINGleshot | 1 ... 10000, SONerror | NONE,STEP | NONE	with query	6.38
CONFigure:NPOWer:CONTrol:STATistics	1 to 1000 | NONE	with query	6.38
CONFigure:NPOWer:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.36
FETCh:NPOWer:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE, 1 to 1000 | NONE	query only	6.37
READ[:SCALar]:NPOWer?	–30 dBm to +30 dBm	query only	6.39
FETCh[:SCALar]:NPOWer?	–30 dBm to +30 dBm	query only	6.39
Partial reset			
SYSTem:RESet:CURRent		no query	6.28
Test object RFANalyzer (Power)			
INITiate:RFANalyzer	–	no query	6.32
ABORt:RFANalyzer	–	no query	6.32
STOP:RFANalyzer	–	no query	6.32
CONTinue:RFANalyzer	–	no query	6.32
[SENSe:]RFANalyzer:BANDwidth[:RESolution]	10 Hz to 1 MHz | WIDE	with query	6.31
[SENSe:]RFANalyzer:BWIDth[:RESolution]	10 Hz to 1MHz	with query	6.31
CONFigure:RFANalyzer:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, NONE,STEP | NONE	with query	6.33
CONFigure:RFANalyzer:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.32
[SENSe:]RFANalyzer:FREQuency	2398 MHz to 2499 MHz	with query	6.31
READ[:SCALar]:RFANalyzer:POWer?	–110.0 dBm to +26 dBm	query only	6.33
FETCh[:SCALar]:RFANalyzer:POWer?	–110.0 dBm to +26 dBm	query only	6.33
FETCh:RFANalyzer:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 0 to 10000 |	query only	6.32

Command	Parameters	Remarks	Page
	NONE , 0 to 1000 | NONE		
Generator object RFGenerator			
DEFault:RFGenerator	ON | OFF	with query	6.33
INITiate:RFGenerator	–	no query	6.34
ABORt:RFGenerator	–	no query	6.34
SOURce:RFGenerator:FOFFset	–250.0 kHz to +250.0 kHz	with query	6.34
SOURce:RFGenerator:MODulation	OFF | TEST	with query	6.35
SOURce:RFGenerator[:TX]:FREQuency	2398 MHz to 2499 MHz	with query	6.34
SOURce:RFGenerator[:TX]:LEVel	–90.0 dBm to +0.0 dBm	with query	6.34
FETCh:RFGenerator[:TX]:STATus?	OFF | RUN | ERR	query only	6.34
System STATus (status reporting system)			
STATus:OPERation:SYMBolic:ENABle	<Event>{,<Event>}	with query	6.28
STATus:OPERation:SYMBolic[:EVENt]?	NONE | <Event>{,<Event>}	query only	6.29
Subsystem TRIGger			
TRIGger[:SEQuence]:DEFault	ON | OFF	with query	6.31
TRIGger[:SEQuence]:SOURce	IMMediate | POWer	with query	6.30
TRIGger[:SEQuence]:THReshold:POWer	LOW | HIGH	with query	6.31

Table 6-3 List of remote-control commands: Bluetooth Non Signalling

Command	Parameters	Remarks	Page
Inputs and outputs			
[SENSe:]CORRection:LOSS[:MAGNitude]	–50 dB to +90 dB	with query	6.45
SOURce:CORRection:LOSS[:MAGNitude]	–50 dB to +90 dB	with query	6.45
Save/Recall of settings			
MMEMory:RECall:CURRent	<FileName> [,<msus>]	no query	6.28
MMEMory:SAVE:CURRent	<FileName> [,<msus>]	no query	6.27
Subsystem OPTions (options)			
SYSTem:OPTions:INFO:CURRent?		query only	6.27
Partial reset			
SYSTem:RESet:CURRent		no query	6.28
RF Generator			
INITiate:RFGenerator	–	no query	6.40
ABORt:RFGenerator	–	no query	6.40
SOURce:RFGenerator:BDADdress	"<BD address>"	with query	6.42
SOURce:RFGenerator:BMODulation	PRBS | ALL0 | ALL1 | P44 |	with query	6.43

Command	Parameters	Remarks	Page
	P22 | P11		
SOURce:RFGenerator:DTX	ON | OFF	with query	6.43
SOURce:RFGenerator:ESDTx:FDRift	ON | OFF	with query	6.44
SOURce:RFGenerator:ESDTx:FOFFset	–250 kHz to 250 kHz | OFF	with query	6.44
SOURce:RFGenerator:ESDTx:STERror	–250 kHz to 250 kHz | OFF	with query	6.44
SOURce:RFGenerator:FOFFset	–500 kHz to 500 kHz	with query	6.41
SOURce:RFGenerator:FREQuency	2398 MHz to 2499 MHz	with query	6.41
SOURce:RFGenerator:FREQuency:UNIT	HZ | KHZ | MHZ | GHZ | CH	with query	6.41
SOURce:RFGenerator:LEVel	–90.0 dBm to +0.0 dBm	with query	6.40
SOURce:RFGenerator:MINDex	0.20 to 0.44 | OFF	with query	6.41
SOURce:RFGenerator:PLENgth	<dep. on packet type>	with query	6.42
SOURce:RFGenerator:PTBZero	LONG | SHORt	with query	6.40
SOURce:RFGenerator:PTYPe	DH1 | DH3 | DH5 | E21P | E23P | E25P | E31P | E33P | E35	with query	6.42
SOURce:RFGenerator:SDTX:FDRift	ON | OFF	with query	6.44
SOURce:RFGenerator:SDTX:FOFFset	–250 kHz to 250 kHz | OFF	with query	6.43
SOURce:RFGenerator:SDTX:MINDex	0.20 to 0.44 | OFF	with query	6.43
SOURce:RFGenerator:SDTX:STERror	–250 kHz to 250 kHz | OFF	with query	6.44
FETCh:RFGenerator:STATus?	OFF | RUN | ERR	query only	6.40
System STATus (status reporting system)			
STATus:OPERation:SYMBolic:ENABle	<Event>{,<Event>}	with query	6.28
STATus:OPERation:SYMBolic[:EVENt]?	NONE | <Event>{,<Event>}	query only	6.29

Table 6-4 Remote-control commands: Bluetooth Signalling

Command	Parameter	Remark	Page
ACL Data			
SOURce:ACLData	”<string>”	with query	6.81
SOURce:ACLData:ENABle	”<string>”	with query	6.80
[SENSe:]ACLData?	”<string>”	query only	6.81
Connector Configuration			
CONFigure:AFRFsync:CCONfig	MONO | ASTereo | DSTereo | MTESt | STESt | ALTest	with query	6.69
Inputs and outputs			
[SENSe:]CORRection:LOSS[:MAGNitude]	–50 dB to 90 dB	with query	6.68
SOURce:CORRection:LOSS[:MAGNitude]	–50 dB to 90 dB	with query	6.69
Authentication			
CONFigure:DUT:AUTHentic:ENABle	ON | OFF	with query	6.57
CONFigure:DUT:PINCode	’<12-digit hex>	with query	6.57

Command	Parameter	Remark	Page
CONFigure:DUT:STORe:LINK:KEYS	ON | OFF	with query	6.58
Input level			
DEFault:LEVel	ON | OFF	with query	6.70
[SENSe:]LEVel:MAXimum	–40 dBm to +26 dBm	with query	6.69
[SENSe:]LEVel:MODE	MANual | AUTomatic	with query	6.69
Modulation measurements			
INITiate:MODulation:DEViation	–	no query	6.117
ABORt:MODulation:DEViation	–	no query	6.117
STOP:MODulation:DEViation	–	no query	6.117
CONTinue:MODulation:DEViation	–	no query	6.117
CONFigure:SUBarrays:MODulation:DEViation	ALL | ARITHmetical | MINimum | MAXimum | IVAL | XMINimum | XMAXimum | PAVG,<Start>,<Samples>{,< Start>,<Samples>}	with query	6.126
CONFigure:MODulation:DEViation:AVERage:LIMit:SCALar:ASYMmetric:LOWer:ENABle	ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF	with query	6.124
CONFigure:MODulation:DEViation:AVERage:LIMit:SCALar:ASYMmetric:LOWer:VALue	<Freq_Acc>, <Freq_Drift>, <Max_Drift_Rate>, <Freq_Dev_Aver>, <Freq_Dev_Max>, <Freq_Dev_Min>	with query	6.123
CONFigure:MODulation:DEViation:AVERage:LIMit:SCALar:ASYMmetric:UPPer:ENABle	ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF	with query	6.123
CONFigure:MODulation:DEViation:AVERage:LIMit:SCALar:ASYMmetric:UPPer:VALue	<Freq_Acc>, <Freq_Drift>, <Max_Drift_Rate>, <Freq_Dev_Aver>, <Freq_Dev_Max>, <Freq_Dev_Min>	with query	6.122
CONFigure:MODulation:DEViation:AVERage:LIMit:SCALar:ASYMmetric[:COMBined]:ENABle	ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF	with query	6.125
CONFigure:MODulation:DEViation:AVERage:LIMit:SCALar:ASYMmetric[:COMBined]:VALue	<Freq_Acc_Upp>, <Freq_Acc_Low>, <Freq_Drift_Upp>, <Freq_Drift_Low>, <Max_Drift_Rate_Upp>, <Max_Drift_Rate_Low>, <Freq_Dev_Upp_Aver>, <Freq_Dev_Low_Aver> <Freq_Dev_Upp_Max>, <Freq_Dev_Low_Max> <Freq_Dev_Upp_Min>, <Freq_Dev_Low_Min>	with query	6.124
READ:ARRAy:MODulation:DEViation:AVERage?	–200.0 kHz to +200.0 kHz	query only	6.130
FETCh:ARRAy:MODulation:DEViation:AVERage?	–200.0 kHz to +200.0 kHz	query only	6.130
READ:SUBarrays:MODulation:DEViation:AVERage?	–200.0 kHz to +200.0 kHz	query only	6.131
FETCh:SUBarrays:MODulation:DEViation:AVERage?	–200.0 kHz to +200.0 kHz	query only	6.131
CONFigure:MODulation:DEViation:BATHreshold:CLIMit:ENABle	<Enable>	with query	6.125
CONFigure:MODulation:DEViation:BATHreshold:CLIMit[:VALue]	<Percentage>	with query	6.125

Command	Parameter	Remark	Page
CONFigure:MODulation:DEViation:BATHreshold:THReshold [:VALue]	<Freq_Dev>	with query	6.125
FETCh[:SCALar]:MODulation:DEViation:BATHreshold?	<Result>	query only	6.128
CONFigure:MODulation:DEViation:CONTrol	SCALar | ARRay, 1 to 1000 | NONE, CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.120
DEFault:MODulation:DEViation:CONTrol	ON | OFF	with query	6.122
CONFigure:MODulation:DEViation:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE,STEP | NONE	with query	6.121
CONFigure:MODulation:DEViation:CONTrol:RMODe	SCALar | ARRay	with query	6.121
CONFigure:MODulation:DEViation:CONTrol:STATistics	1 to 1000 | NONE	with query	6.121
CONFigure:MODulation:DEViation:CURRent:LIMit:SCALar :ASYMmetric:LOWer:ENABle	ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF	with query	6.124
CONFigure:MODulation:DEViation:CURRent:LIMit:SCALar :ASYMmetric:LOWer:VALue	<Freq_Acc>, <Freq_Drift>, <Max_Drift_Rate>, <Freq_Dev_Aver>, <Freq_Dev_Max>, <Freq_Dev_Min>	with query	6.123
CONFigure:MODulation:DEViation:CURRent:LIMit:SCALar :ASYMmetric:UPPer:ENABle	ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF	with query	6.123
CONFigure:MODulation:DEViation:CURRent:LIMit:SCALar :ASYMmetric:UPPer:VALue	<Freq_Acc>, <Freq_Drift>, <Max_Drift_Rate>, <Freq_Dev_Aver>, <Freq_Dev_Max>, <Freq_Dev_Min>	with query	6.122
CONFigure:MODulation:DEViation:CURRent:LIMit:SCALar :ASYMmetric[:COMBined]:ENABle	ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF	with query	6.125
CONFigure:MODulation:DEViation:CURRent:LIMit:SCALar :ASYMmetric[:COMBined]:VALue	<Freq_Acc_Upp>, <Freq_Acc_Low>, <Freq_Drift_Upp>, <Freq_Drift_Low>, <Max_Drift_Rate_Upp>, <Max_Drift_Rate_Low>, <Freq_Dev_Upp_Aver>, <Freq_Dev_Low_Aver> <Freq_Dev_Upp_Max>, <Freq_Dev_Low_Max> <Freq_Dev_Upp_Min>, <Freq_Dev_Low_Min>	with query	6.124
READ:ARRAy:MODulation:DEViation:CURRent?	–200.0 kHz to +200.0 kHz	query only	6.130
FETCh:ARRAy:MODulation:DEViation:CURRent?	–200.0 kHz to +200.0 kHz	query only	6.130
READ:SUBarrays:MODulation:DEViation:CURRent?	–200.0 kHz to +200.0 kHz	query only	6.131
FETCh:SUBarrays:MODulation:DEViation:CURRent?	–200.0 kHz to +200.0 kHz	query only	6.131
CONFigure:MODulation:DEViation:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.117
READ[:SCALar]:MODulation:DEViation:EXTended?	<Result>	query only	6.128
FETCh[:SCALar]:MODulation:DEViation:EXTended?	<Result>	query only	6.128
CONFigure:MODulation:DEViation:FDALgorithm	BCAV | IAV	with query	6.120
DEFault:MODulation:DEViation:LIMit	ON | OFF	with query	6.126
CALCulate:MODulation:DEViation:MATChing:LIMit?	<Result>	query only	6.129

Command	Parameter	Remark	Page
CONFigure:MODulation:DEViation:MAXimum:LIMit:SCALar :ASYMmetric:LOWer:ENABle	ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF	with query	6.124
CONFigure:MODulation:DEViation:MAXimum:LIMit:SCALar :ASYMmetric:LOWer:VALue	<Freq_Acc>, <Freq_Drift>, <Max_Drift_Rate>, <Freq_Dev_Aver>, <Freq_Dev_Max>, <Freq_Dev_Min>	with query	6.123
CONFigure:MODulation:DEViation:MAXimum:LIMit:SCALar :ASYMmetric:UPPer:ENABle	ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF	with query	6.123
CONFigure:MODulation:DEViation:MAXimum:LIMit:SCALar :ASYMmetric:UPPer:VALue	<Freq_Acc>, <Freq_Drift>, <Max_Drift_Rate>, <Freq_Dev_Aver>, <Freq_Dev_Max>, <Freq_Dev_Min>	with query	6.122
CONFigure:MODulation:DEViation:MAXimum:LIMit:SCALar :ASYMmetric[:COMBined]:ENABle	ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF	with query	6.125
CONFigure:MODulation:DEViation:MAXimum:LIMit:SCALar :ASYMmetric[:COMBined]:VALue	<Freq_Acc_Upp>, <Freq_Acc_Low>, <Freq_Drift_Upp>, <Freq_Drift_Low>, <Max_Drift_Rate_Upp>, <Max_Drift_Rate_Low>, <Freq_Dev_Upp_Aver>, <Freq_Dev_Low_Aver> <Freq_Dev_Upp_Max>, <Freq_Dev_Low_Max> <Freq_Dev_Upp_Min>, <Freq_Dev_Low_Min>	with query	6.124
READ:ARRAy:MODulation:DEViation:MAXimum?	–200.0 kHz to +200.0 kHz	query only	6.130
FETCh:ARRAy:MODulation:DEViation:MAXimum?	–200.0 kHz to +200.0 kHz	query only	6.130
READ:SUBarrays:MODulation:DEViation:MAXimum?	–200.0 kHz to +200.0 kHz	query only	6.131
FETCh:SUBarrays:MODulation:DEViation:MAXimum?	–200.0 kHz to +200.0 kHz	query only	6.131
CONFigure:MODulation:DEViation:MFRequency	2402 MHz to 2495 MHz	with query	6.119
CONFigure:MODulation:DEViation:MFRequency:SIMultaneous	2402 MHz to 2495 MHz	with query	6.118
CONFigure:MODulation:DEViation:MFRequency:UNIT	HZ | KHZ | MHZ | GHZ | CH	with query	6.119
CONFigure:MODulation:DEViation:MINimum:LIMit:SCALar :ASYMmetric:LOWer:ENABle	ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF	with query	6.124
CONFigure:MODulation:DEViation:MINimum:LIMit:SCALar :ASYMmetric:LOWer:VALue	<Freq_Acc>, <Freq_Drift>, <Max_Drift_Rate>, <Freq_Dev_Aver>, <Freq_Dev_Max>, <Freq_Dev_Min>	with query	6.123
CONFigure:MODulation:DEViation:MINimum:LIMit:SCALar :ASYMmetric:UPPer:ENABle	ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF	with query	6.123
CONFigure:MODulation:DEViation:MINimum:LIMit:SCALar :ASYMmetric:UPPer:VALue	<Freq_Acc>, <Freq_Drift>, <Max_Drift_Rate>, <Freq_Dev_Aver>, <Freq_Dev_Max>, <Freq_Dev_Min>	with query	6.122
CONFigure:MODulation:DEViation:MINimum:LIMit:SCALar :ASYMmetric[:COMBined]:ENABle	ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF,	with query	6.125

Command	Parameter	Remark	Page
	ON | OFF, ON | OFF		
CONFigure:MODulation:DEViation:MINimum:LIMit:SCALar :ASYMmetric[:COMBined]:VALue	<Freq_Acc_Upp>, <Freq_Acc_Low>, <Freq_Drift_Upp>, <Freq_Drift_Low>, <Max_Drift_Rate_Upp>, <Max_Drift_Rate_Low>, <Freq_Dev_Upp_Aver>, <Freq_Dev_Low_Aver> <Freq_Dev_Upp_Max>, <Freq_Dev_Low_Max> <Freq_Dev_Upp_Min>, <Freq_Dev_Low_Min>	with query	6.124
READ:ARRAy:MODulation:DEViation:MINimum?	–200.0 kHz to +200.0 kHz	query only	6.130
FETCh:ARRAy:MODulation:DEViation:MINimum?	–200.0 kHz to +200.0 kHz	query only	6.130
READ:SUBarrays:MODulation:DEViation:MINimum?	–200.0 kHz to +200.0 kHz	query only	6.131
FETCh:SUBarrays:MODulation:DEViation:MINimum?	–200.0 kHz to +200.0 kHz	query only	6.131
CONFigure:MODulation:DEViation:MMODe	ALL | SINGle | SIMultaneous	with query	6.118
CONFigure:MODulation:DEViation:MRANge	<Start>, <Span>	with query	6.119
FETCh:MODulation:DEViation:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.118
READ[:SCALar]:MODulation:DEViation?	<Result>	query only	6.127
FETCh[:SCALar]:MODulation:DEViation?	<Result>	query only	6.127
INITiate:MODulation:DPSKeying	–	no query	6.132
ABORt:MODulation:DPSKeying	–	no query	6.132
STOP:MODulation:DPSKeying	–	no query	6.132
CONTinue:MODulation:DPSKeying	–	no query	6.132
CONFigure:SUBarrays:MODulation:DPSKeying	ALL | ARITHmetical | MINimum | MAXimum | IVAL | XMINimum | XMAXimum | PAVG,<Start>,<Samples>{,< Start>,<Samples>}	with query	6.141
CONFigure:MODulation:DPSKeying:AVERage:LIMit:SCALar :ASYMmetric:LOWer:ENABle	<ωi>, <ωi + ωo max>, <ωo max>	with query	6.138
CONFigure:MODulation:DPSKeying:AVERage:LIMit:SCALar :ASYMmetric:LOWer:VALue	<ωi>, <ωi + ωo max>, <ωo max>	with query	6.138
CONFigure:MODulation:DPSKeying:AVERage:LIMit:SCALar :ASYMmetric:UPPer:ENABle	<ωi>, <ωi + ωo max>, <ωo max>, <RMS DEVM π/4 DQPSK>, <RMS DEVM 8DPSK>, <Peak DEVM π/4 DQPSK>, <Peak DEVM 8DPSK>	with query	6.137
CONFigure:MODulation:DPSKeying:AVERage:LIMit:SCALar :ASYMmetric:UPPer:VALue	<ωi>, <ωi + ωo max>, <ωo max>, <RMS DEVM π/4 DQPSK>, <RMS DEVM 8DPSK>, <Peak DEVM π/4 DQPSK>, <Peak DEVM 8DPSK>	with query	6.137
CONFigure:MODulation:DPSKeying:AVERage:LIMit:SCALar :ASYMmetric[:COMBined]:ENABle	ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF	with query	6.139
CONFigure:MODulation:DPSKeying:AVERage:LIMit:SCALar :ASYMmetric[:COMBined]:VALue	<ωi _Upp>, <ωi _Low> … <Peak_DEVM_8DPSK_Upp>	with query	6.139
READ:ARRAy:MODulation:DPSKeying:AVERage?	0 to 1	query only	6.144
FETCh:ARRAy:MODulation:DPSKeying:AVERage?	0 to 1	query only	6.144

Command	Parameter	Remark	Page
READ:SUBarrays:MODulation:DPSKeying:AVERage?	0 to 1	query only	6.145
FETCh:SUBarrays:MODulation:DPSKeying:AVERage?	0 to 1	query only	6.145
CONFigure:MODulation:DPSKeying:CONTrol	SCALar | ARRay, 1 to 1000 | NONE, CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.135
DEFault:MODulation:DPSKeying:CONTrol	ON | OFF	with query	6.136
CONFigure:MODulation:DPSKeying:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE,STEP | NONE	with query	6.136
CONFigure:MODulation:DPSKeying:CONTrol:RMODe	SCALar | ARRay	with query	6.135
CONFigure:MODulation:DPSKeying:CONTrol:STATistics	1 to 1000 | NONE	with query	6.135
CONFigure:MODulation:DPSKeying:CURRent:LIMit:SCALar :ASYMmetric:LOWer:ENABle	<ωi>, <ωi + ωo max>, <ωo max>	with query	6.138
CONFigure:MODulation:DPSKeying:CURRent:LIMit:SCALar :ASYMmetric:LOWer:VALue	<ωi>, <ωi + ωo max>, <ωo max>	with query	6.138
CONFigure:MODulation:DPSKeying:CURRent:LIMit:SCALar :ASYMmetric:UPPer:ENABle	<ωi>, <ωi + ωo max>, <ωo max>, <RMS DEVM π/4 DQPSK>, <RMS DEVM 8DPSK>, <Peak DEVM π/4 DQPSK>, <Peak DEVM 8DPSK>	with query	6.137
CONFigure:MODulation:DPSKeying:CURRent:LIMit:SCALar :ASYMmetric:UPPer:VALue	<ωi>, <ωi + ωo max>, <ωo max>, <RMS DEVM π/4 DQPSK>, <RMS DEVM 8DPSK>, <Peak DEVM π/4 DQPSK>, <Peak DEVM 8DPSK>	with query	6.137
CONFigure:MODulation:DPSKeying:CURRent:LIMit:SCALar :ASYMmetric[:COMBined]:ENABle	ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF	with query	6.139
CONFigure:MODulation:DPSKeying:CURRent:LIMit:SCALar :ASYMmetric[:COMBined]:VALue	<ωi _Upp>, <ωi _Low> … <Peak_DEVM_8DPSK_Upp>	with query	6.139
READ:ARRAy:MODulation:DPSKeying:CURRent?	0 to 1	query only	6.144
FETCh:ARRAy:MODulation:DPSKeying:CURRent?	0 to 1	query only	6.144
READ:SUBarrays:MODulation:DPSKeying:CURRent?	0 to 1	query only	6.145
FETCh:SUBarrays:MODulation:DPSKeying:CURRent?	0 to 1	query only	6.145
CONFigure:MODulation:DPSKeying:DEVMagnitude:CLIMit :ENABle	<Enable_1>, <Enable_2>	with query	6.140
CONFigure:MODulation:DPSKeying:DEVMagnitude:CLIMit [:VALue]	<π/4DQPSK_DEVM_CLimit>, <8DPSK_DEVM_CLimit>	with query	6.140
CONFigure:MODulation:DPSKeying:DEVMagnitude:THReshold [:VALue]	<π/4_DQPSK_DEVM_Threshold>, <8DPSK_DEVM_Threshold>	with query	6.140
CONFigure:MODulation:DPSKeying:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.132
DEFault:MODulation:DPSKeying:LIMit	ON | OFF	with query	6.140
CALCulate:MODulation:DPSKeying:MATChing:LIMit?	<Result>	query only	6.143
CONFigure:MODulation:DPSKeying:MAXimum:LIMit:SCALar :ASYMmetric:LOWer:ENABle	<ωi>, <ωi + ωo max>, <ωo max>	with query	6.138
CONFigure:MODulation:DPSKeying:MAXimum:LIMit:SCALar :ASYMmetric:LOWer:VALue	<ωi>, <ωi + ωo max>, <ωo max>	with query	6.138
CONFigure:MODulation:DPSKeying:MAXimum:LIMit:SCALar :ASYMmetric:UPPer:ENABle	<ωi>, <ωi + ωo max>, <ωo max>, <RMS DEVM π/4 DQPSK>, <RMS DEVM 8DPSK>,	with query	6.137

Command	Parameter	Remark	Page
	<Peak DEVM π/4 DQPSK>, <Peak DEVM 8DPSK>		
CONFigure:MODulation:DPSKeying:MAXimum:LIMit:SCALar :ASYMmetric:UPPer:VALue	<ωi>, <ωi + ωo $_{max}$>, <ωo $_{max}$>, <RMS DEVM π/4 DQPSK>, <RMS DEVM 8DPSK>, <Peak DEVM π/4 DQPSK>, <Peak DEVM 8DPSK>	with query	6.137
CONFigure:MODulation:DPSKeying:MAXimum:LIMit:SCALar :ASYMmetric[:COMBined]:ENABle	ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF	with query	6.139
CONFigure:MODulation:DPSKeying:MAXimum:LIMit:SCALar :ASYMmetric[:COMBined]:VALue	<ωi _Upp>, <ωi _Low> … <Peak_DEVM_8DPSK_Upp>	with query	6.139
READ:ARRAy:MODulation:DPSKeying:MAXimum?	0 to 1	query only	6.144
FETCh:ARRAy:MODulation:DPSKeying:MAXimum?	0 to 1	query only	6.144
READ:SUBarrays:MODulation:DPSKeying:MAXimum?	0 to 1	query only	6.145
FETCh:SUBarrays:MODulation:DPSKeying:MAXimum?	0 to 1	query only	6.145
CONFigure:MODulation:DPSKeying:MFRequency	2402 MHz to 2495 MHz	with query	6.133
CONFigure:MODulation:DPSKeying:MFRequency:SIMultaneous	2402 MHz to 2495 MHz	with query	6.133
CONFigure:MODulation:DPSKeying:MFRequency:UNIT	HZ | KHZ | MHZ | GHZ | CH	with query	6.133
CONFigure:MODulation:DPSKeying:MINimum:LIMit:SCALar :ASYMmetric:LOWer:ENABle	<ωi>, <ωi + ωo $_{max}$>, <ωo $_{max}$>	with query	6.138
CONFigure:MODulation:DPSKeying:MINimum:LIMit:SCALar :ASYMmetric:LOWer:VALue	<ωi>, <ωi + ωo $_{max}$>, <ωo $_{max}$>	with query	6.138
CONFigure:MODulation:DPSKeying:MINimum:LIMit:SCALar :ASYMmetric:UPPer:ENABle	<ωi>, <ωi + ωo $_{max}$>, <ωo $_{max}$>, <RMS DEVM π/4 DQPSK>, <RMS DEVM 8DPSK>, <Peak DEVM π/4 DQPSK>, <Peak DEVM 8DPSK>	with query	6.137
CONFigure:MODulation:DPSKeying:MINimum:LIMit:SCALar :ASYMmetric:UPPer:VALue	<ωi>, <ωi + ωo $_{max}$>, <ωo $_{max}$>, <RMS DEVM π/4 DQPSK>, <RMS DEVM 8DPSK>, <Peak DEVM π/4 DQPSK>, <Peak DEVM 8DPSK>	with query	6.137
CONFigure:MODulation:DPSKeying:MINimum:LIMit:SCALar :ASYMmetric[:COMBined]:ENABle	ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF	with query	6.139
CONFigure:MODulation:DPSKeying:MINimum:LIMit:SCALar :ASYMmetric[:COMBined]:VALue	<ωi _Upp>, <ωi _Low> … <Peak_DEVM_8DPSK_Upp>	with query	6.139
READ:ARRAy:MODulation:DPSKeying:MINimum?	0 to 1	query only	6.144
FETCh:ARRAy:MODulation:DPSKeying:MINimum?	0 to 1	query only	6.144
READ:SUBarrays:MODulation:DPSKeying:MINimum?	0 to 1	query only	6.145
FETCh:SUBarrays:MODulation:DPSKeying:MINimum?	0 to 1	query only	6.145
CONFigure:MODulation:DPSKeying:MMODe	ALL | SINGle | SIMultaneous	with query	6.133
CONFigure:MODulation:DPSKeying:MRANge	<Start>, <Span>	with query	6.134
FETCh:MODulation:DPSKeying:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.132
READ[:SCALar]:MODulation:DPSKeying?	<Result>	query only	6.142
FETCh[:SCALar]:MODulation:DPSKeying?	<Result>	query only	6.142
INITiate:MODulation:ENCoding	–	no query	6.146

Command	Parameter	Remark	Page
ABORt:MODulation:ENCoding	–	no query	6.146
STOP:MODulation:ENCoding	–	no query	6.146
CONTinue:MODulation:ENCoding	–	no query	6.146
CONFigure:MODulation:ENCoding:CONTrol	SCALar | ARRay, 1 to 1000 | NONE, CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.147
DEFault:MODulation:ENCoding:CONTrol	ON | OFF	with query	6.148
CONFigure:MODulation:ENCoding:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE,STEP | NONE	with query	6.148
CONFigure:MODulation:ENCoding:CONTrol:STATistics	1 to 1000 | NONE	with query	6.147
CONFigure:MODulation:ENCoding:CURRent:LIMit:SCALar :ASYMmetric:LOWer:ENABle	ON | OFF	with query	6.149
CONFigure:MODulation:ENCoding:CURRent:LIMit:SCALar :ASYMmetric:LOWer:VALue	<Zero_Errors_Limit>	with query	6.149
CONFigure:MODulation:ENCoding:CURRent:LIMit:SCALar :ASYMmetric:UPPer:ENABle	ON | OFF	with query	6.149
CONFigure:MODulation:ENCoding:CURRent:LIMit:SCALar :ASYMmetric:UPPer:VALue	<BER_Limit>	with query	6.149
CONFigure:MODulation:ENCoding:CURRent:LIMit:SCALar :ASYMmetric[:COMBined]:ENABle	ON | OFF, ON | OFF	with query	6.150
CONFigure:MODulation:ENCoding:CURRent:LIMit:SCALar :ASYMmetric[:COMBined]:VALue	<BER_Limit>, <Zero_Errors_Limit>	with query	6.150
CONFigure:MODulation:ENCoding:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.146
DEFault:MODulation:ENCoding:LIMit	ON | OFF	with query	6.150
CALCulate:MODulation:ENCoding:MATChing:LIMit?	<Result>	query only	6.151
FETCh:MODulation:ENCoding:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.146
READ[:SCALar]:MODulation:ENCoding?	<Result>	query only	6.150
FETCh[:SCALar]:MODulation:ENCoding?	<Result>	query only	6.150
INITiate:MODulation:IQANalyzer:DPSKeying	–	no query	6.152
ABORt:MODulation:IQANalyzer:DPSKeying	–	no query	6.152
STOP:MODulation:IQANalyzer:DPSKeying	–	no query	6.152
CONTinue:MODulation:IQANalyzer:DPSKeying	–	no query	6.152
CONFigure:MODulation:IQANalyzer:DPSKeying:CONTrol	SCALar | ARRay, 1 to 1000 | NONE, CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.154
DEFault:MODulation:IQANalyzer:DPSKeying:CONTrol	ON | OFF	with query	6.155
CONFigure:MODulation:IQANalyzer:DPSKeying:CONTrol :REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE,STEP | NONE	with query	6.155
CONFigure:MODulation:IQANalyzer:DPSKeying:CONTrol :RMODe	SCALar | ARRay	with query	6.154
CONFigure:MODulation:IQANalyzer:DPSKeying:CONTrol :STATistics	1 to 1000 | NONE	with query	6.155
CONFigure:MODulation:IQANalyzer:DPSKeying:CURRent :LIMit:SCALar :ASYMmetric:LOWer:VALue	<Freq_Stab_ω_i>,<Freq_Stab_ $\omega_i + \omega_{o\ max}$>, <Freq_Stab_ $\omega_{o\ max}$>	with query	6.157

Command	Parameter	Remark	Page
CONFigure:MODulation:IQANalyzer:DPSKeying:CURRent:LIMit:SCALar:ASYMmetric:LOWer:ENABle	ON | OFF, ON | OFF, ON | OFF	with query	6.157
CONFigure:MODulation:IQANalyzer:DPSKeying:CURRent:LIMit:SCALar:ASYMmetric:UPPer:VALue	<Freq_Stability_ω_i>, <Freq_Stability_ $\omega_i + \omega_{o\,max}$>, <Freq_Stability_ $\omega_{o\,max}$>, <RMS_DEVM_π/4_DQPSK>, <RMS_DEVM_8DPSK>, <Peak_DEVM_π/4_DQPSK>, <Peak_DEVM_8DPSK>	with query	6.156
CONFigure:MODulation:IQANalyzer:DPSKeying:CURRent:LIMit:SCALar:ASYMmetric:UPPer:ENABle	ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF	with query	6.157
CONFigure:MODulation:IQANalyzer:DPSKeying:CURRent:LIMit:SCALar:ASYMmetric[:COMBined]:VALue	<Freq_Stab_ω_i_Upp>, <Freq_Stab_ω_i_Low>, <Freq_Stab_ $\omega_i + \omega_{o\,max}$_Upp>, <Freq_Stab_ $\omega_i + \omega_{o\,max}$_Low>, <Freq_Stab_ $\omega_{o\,max}$_Upp>, <Freq_Stab_ $\omega_{o\,max}$_Low>, <RMS_DEVM_π/4_DQPSK_ Upp>, <RMS_DEVM_8DPSK_Upp>, <Peak_DEVM_π/4_DQPSK_ Upp>, <Peak_DEVM_8DPSK_Upp>	with query	6.158
CONFigure:MODulation:IQANalyzer:DPSKeying:CURRent:LIMit:SCALar:ASYMmetric[:COMBined]:ENABle	ON | OFF,…	with query	6.158
READ:ARRAy:MODulation:IQANalyzer:DPSKeying:CURRent?	–200.0 kHz to +200.0 kHz	query only	6.162
FETCh:ARRAy:MODulation:IQANalyzer:DPSKeying:CURRent?	–200.0 kHz to +200.0 kHz	query only	6.162
READ:ARRAy:MODulation:IQANalyzer:DPSKeying:CURRent?	–200.0 kHz to +200.0 kHz	query only	6.163
FETCh:ARRAy:MODulation:IQANalyzer:DPSKeying:CURRent?	–200.0 kHz to +200.0 kHz	query only	6.163
CONFigure:MODulation:IQANalyzer:DPSKeying:DEVMagnitude:CLIMit:ENABle	ON | OFF, ON | OFF	with query	6.159
CONFigure:MODulation:IQANalyzer:DPSKeying:DEVMagnitude:CLIMit[:VALue]	<π/4DQPSK_DEVM_CLimit>, <8DPSK_DEVM_CLimit>	with query	6.159
CONFigure:MODulation:IQANalyzer:DPSKeying:DEVMagnitude:THReshold[:VALue]	<π/4_DQPSK_DEVM_Threshold>, <8DPSK_DEVM_Threshold>	with query	6.158
CONFigure:MODulation:IQANalyzer:DPSKeying:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.152
CONFigure:MODulation:IQANalyzer:DPSKeying:FILTer:BWIDth	WIDE | NARRow	with query	6.156
DEFault:MODulation:IQANalyzer:DPSKeying:LIMit	ON | OFF	with query	6.159
CALCulate:MODulation:IQANalyzer:DPSKeying:MATChing:LIMit?	<Result>	query only	6.161
CONFigure:MODulation:IQANalyzer:DPSKeying:MFRequency	2402 MHz to 2495 MHz	with query	6.153
CONFigure:MODulation:IQANalyzer:DPSKeying:MFRequency:SIMultaneous	2402 MHz to 2495 MHz	with query	6.153
CONFigure:MODulation:IQANalyzer:DPSKeying:MFRequency:UNIT	HZ | KHZ | MHZ | GHZ | CH	with query	6.153
CONFigure:MODulation:IQANalyzer:DPSKeying:MMODe	ALL | SINGle | SIMultaneous	with query	6.153
FETCh:MODulation:IQANalyzer:DPSKeying:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.152
CONFigure:MODulation:IQANalyzer:DPSKeying:SYMBol:MODE	ABS | DIFF | ERR	with query	6.152
READ[:SCALar]:MODulation:IQANalyzer:DPSKeying?	<Result>	query only	6.160
FETCh[:SCALar]:MODulation:IQANalyzer:DPSKeying?	<Result>	query only	6.160

Command	Parameter	Remark	Page
INITiate:MODulation:PDIFference	–	no query	6.164
ABORt:MODulation:PDIFference	–	no query	6.164
STOP:MODulation:PDIFference	–	no query	6.164
CONTinue:MODulation:PDIFference	–	no query	6.164
CONFigure:SUBarrays:MODulation:PDIFference	ALL | ARITHmetical | MINimum | MAXimum | IVAL | XMINimum | XMAXimum | PAVG,<Start>,<Samples>{,< Start>,<Samples>}	with query	6.169
READ:ARRAy:MODulation:PDIFference:AVERage?	–200.0 kHz to +200.0 kHz	query only	6.170
FETCh:ARRAy:MODulation:PDIFference:AVERage?	–200.0 kHz to +200.0 kHz	query only	6.170
READ:SUBarrays:MODulation:PDIFference:AVERage?	–200.0 kHz to +200.0 kHz	query only	6.171
FETCh:SUBarrays:MODulation:PDIFference:AVERage?	–200.0 kHz to +200.0 kHz	query only	6.171
CONFigure:MODulation:PDIFference:CONTrol	SCALar | ARRay, 1 to 1000 | NONE, CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.167
DEFault:MODulation:PDIFference:CONTrol	ON | OFF	with query	6.168
CONFigure:MODulation:PDIFference:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE,STEP | NONE	with query	6.168
CONFigure:MODulation:PDIFference:CONTrol:RMODe	SCALar | ARRay	with query	6.167
CONFigure:MODulation:PDIFference:CONTrol:STATistics	1 to 1000 | NONE	with query	6.168
READ:ARRAy:MODulation:PDIFference:CURRent?	–200.0 kHz to +200.0 kHz	query only	6.170
FETCh:ARRAy:MODulation:PDIFference:CURRent?	–200.0 kHz to +200.0 kHz	query only	6.170
READ:SUBarrays:MODulation:PDIFference:CURRent?	–200.0 kHz to +200.0 kHz	query only	6.171
FETCh:SUBarrays:MODulation:PDIFference:CURRent?	–200.0 kHz to +200.0 kHz	query only	6.171
CONFigure:MODulation:PDIFference:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.164
CONFigure:MODulation:PDIFference:FILTer:BWIDth	WIDE | NARRow	with query	6.166
READ:ARRAy:MODulation:PDIFference:MAXimum?	–200.0 kHz to +200.0 kHz	query only	6.170
FETCh:ARRAy:MODulation:PDIFference:MAXimum?	–200.0 kHz to +200.0 kHz	query only	6.170
READ:SUBarrays:MODulation:PDIFference:MAXimum?	–200.0 kHz to +200.0 kHz	query only	6.171
FETCh:SUBarrays:MODulation:PDIFference:MAXimum?	–200.0 kHz to +200.0 kHz	query only	6.171
CONFigure:MODulation:PDIFference:MFRequency	2402 MHz to 2495 MHz	with query	6.165
CONFigure:MODulation:PDIFference:MFRequency:SIMultaneous	2402 MHz to 2495 MHz	with query	6.165
CONFigure:MODulation:PDIFference:MFRequency:UNIT	HZ | KHZ | MHZ | GHZ | CH	with query	6.165
READ:ARRAy:MODulation:PDIFference:MINimum?	–200.0 kHz to +200.0 kHz	query only	6.170
FETCh:ARRAy:MODulation:PDIFference:MINimum?	–200.0 kHz to +200.0 kHz	query only	6.170
READ:SUBarrays:MODulation:PDIFference:MINimum?	–200.0 kHz to +200.0 kHz	query only	6.171
FETCh:SUBarrays:MODulation:PDIFference:MINimum?	–200.0 kHz to +200.0 kHz	query only	6.171
CONFigure:MODulation:PDIFference:MMODe	ALL | SINGle | SIMultaneous	with query	6.165
CONFigure:MODulation:PDIFference:MRANge	<Start>, <Span>	with query	6.166
FETCh:MODulation:PDIFference:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.164
Master Signal Parameters			
DEFault:MSIGnal	ON | OFF	with query	6.53

Command	Parameter	Remark	Page
CONFigure:MSIGnal:BDADdress	"<BD address>"	with query	6.51
CONFigure:MSIGnal:DTX	ON | OFF	with query	6.53
CONFigure:MSIGnal:DTX:SCOPex	GLOBal | RXQuality	with query	6.54
CONFigure:MSIGnal:ESDTx:FDRift	ON | OFF	with query	6.55
CONFigure:MSIGnal:ESDTx:FOFFset	–250 kHz to 250 kHz | OFF	with query	6.54
CONFigure:MSIGnal:ESDTx:STERror	–250 kHz to 250 kHz | OFF	with query	6.54
CONFigure:MSIGnal:EUTDtx:SET<nr>:FOFFset	–250 kHz to 250 kHz | OFF	with query	6.56
CONFigure:MSIGnal:EUTDtx:SET<nr>:STERror	–20 ppm to +20 ppm | OFF	with query	6.57
CONFigure:MSIGnal:HSCHeme	EUSA | FRANce	with query	6.51
CONFigure:MSIGnal:INQuiry:ILENgth	1 to 24	with query	6.52
CONFigure:MSIGnal:INQuiry:NOResponses	1 to 12	with query	6.52
DEFault:MSIGnal:PAGing	ON | OFF	with query	6.53
CONFigure:MSIGnal:PAGing:PSRMode	R0 | R1 | R2	with query	6.52
CONFigure:MSIGnal:PAGing:RSINfo	ON | OFF	with query	6.53
CONFigure:MSIGnal:PAGing:TARGet	"<BD_Address>"	with query	6.52
CONFigure:MSIGnal:PAGing:TOUT	1 to 65535	with query	6.52
CONFigure:MSIGnal:SDTX:FDRift	ON | OFF	with query	6.55
CONFigure:MSIGnal:SDTX:FOFFset	–250 kHz to 250 kHz | OFF	with query	6.54
CONFigure:MSIGnal:SDTX:MINDex	0.20 to 0.44 | OFF	with query	6.54
CONFigure:MSIGnal:SDTX:STERror	–250 kHz to 250 kHz | OFF	with query	6.54
CONFigure:MSIGnal:SVTout	0 to 65535	with query	6.51
CONFigure:MSIGnal:TXLevel	–90.0 dBm to +0.0 dBm	with query	6.51
CONFigure:MSIGnal:UTDTX:FDRift	ON | OFF	with query	6.55
CONFigure:MSIGnal:UTDTX:SET<nr>	<Offset>, <Index>, <Error>	with query	6.55
CONFigure:MSIGnal:UTDTx:SET<nr>:FOFFset	–250 kHz to 250 kHz | OFF	with query	6.56
CONFigure:MSIGnal:UTDTX:SET<nr>:MINDex	0.20 to 0.44 | OFF	with query	6.56
CONFigure:MSIGnal:UTDTx:SET<nr>:STERror	–20 ppm to +20 ppm | OFF	with query	6.57
Substate parameters (Network)			
DEFault:NETWork	ON | OFF	with query	6.64
CONFigure:NETWork:AUDio:A2DP:CTYPe?	SBC	query only	6.67
CONFigure:NETWork:AUDio:A2DP:SBC:AMEThod	SNR | LOUD	query only	6.68
CONFigure:NETWork:AUDio:A2DP:SBC:BITPool:MAXimum	2 to 128	query only	6.68
CONFigure:NETWork:AUDio:A2DP:SBC:BITPool:MINimum	2 to 18	query only	6.68
CONFigure:NETWork:AUDio:A2DP:SBC:BLENgth	BL4 | BL8 | BL12 | BL16	query only	6.67
CONFigure:NETWork:AUDio:A2DP:SBC:CMODe	MONO | DUAL | STER | JOIN	query only	6.67
CONFigure:NETWork:AUDio:A2DP:SBC:SBANds	SB4 | SB8	query only	6.67
CONFigure:NETWork:AUDio:A2DP:SBC:SFRequency?	SF48	query only	6.67
CONFigure:NETWork:AUDio:AIRCoding	CVSD | ULAW | ALAW	with query	6.64
CONFigure:NETWork:AUDio:BITStream	AIO | ECHO	with query	6.64
CONFigure:NETWork:AUDio:DELTime	AIO | ECHO	with query	6.64
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CONFigure:NETWork:HOLD:INTerval	1 slots to 65535 slots	with query	6.66
CONFigure:NETWork:HOLD:INTerval	1 slots to 65535 slots	with query	6.66
CONFigure:NETWork:SNIFf:ATTempt	1 to 65535	with query	6.65
CONFigure:NETWork:SNIFf:INTerval	2 slots to 65534 slots	with query	6.65

Command	Parameter	Remark	Page
CONFigure:NETWork:SNIFf:TOUT	1 to 65535	with query	6.65
CONFigure:NETWork:TEST:RLSettling	0 ms to 200 ms	with query	6.66
CONFigure:NETWork:TEST:SNBehaviour	NORM | TEST	with query	6.66
CONFigure:NETWork:TEST:TCPChange	ON | OFF	with query	6.66
Power control			
PROCedure:PCONTrol:STEP	UP | DOWN	no query	6.50
Power measurements			
INITiate:POWer:MPE	–	no query	6.112
ABORt:POWer:MPE	–	no query	6.112
STOP:POWer:MPE	–	no query	6.112
CONTinue:POWer:MPE	–	no query	6.112
CONFigure:POWer:MPE:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.113
CALCulate[:SCALar]:POWer:MPE:MATChing:LIMit?	<Result>	query only	6.116
CONFigure:POWer:MPE:MFRequency	2402 MHz to 2495 MHz	with query	6.113
CONFigure:POWer:MPE:MFRequency:SIMultaneous	2402 MHz to 2495 MHz	with query	6.113
CONFigure:POWer:MPE:MFRequency:UNIT	HZ | KHZ | MHZ | GHZ | CH	with query	6.113
CONFigure:POWer:MPE:MMODe	ALL | SINGle | SIMultaneous	with query	6.114
FETCh[:SCALar]:POWer:MPE:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.114
READ[:SCALar]:POWer:MPE?	<Result>	query only	6.115
FETCh[:SCALar]:POWer:MPE?	<Result>	query only	6.115
INITiate:POWer:MPR	–	no query	6.96
ABORt:POWer:MPR	–	no query	6.96
STOP:POWer:MPR	–	no query	6.96
CONTinue:POWer:MPR	–	no query	6.96
DEFault:POWer:MPR:CONTrol	ON | OFF	with query	6.98
CONFigure:POWer:MPR:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE,STEP | NONE	with query	6.98
CONFigure:POWer:MPR:CONTrol:STATistics	1 to 1000 | NONE	with query	6.98
CONFigure:POWer:MPR:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.96
CALCulate:POWer:MPR:MATChing:LIMit?	<Result>	query only	6.100
CONFigure:POWer:MPR:MFRequency	2402 MHz to 2495 MHz	with query	6.97
CONFigure:POWer:MPR:MFRequency:SIMultaneous	2402 MHz to 2495 MHz	with query	6.97
CONFigure:POWer:MPR:MFRequency:UNIT	Hz | KHZ | MHZ | GHZ | CH	with query	6.97
CONFigure:POWer:MPR:MMODe	ALL | SINGle | SIMultaneous	with query	6.97
FETCh:POWer:MPR:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.96
READ[:SCALar]:POWer:MPR?	<Result>	query only	6.99
FETCh[:SCALar]:POWer:MPR?	<Result>	query only	6.99
INITiate:POWer:RELative	–	no query	6.101
ABORt:POWer:RELative	–	no query	6.101
STOP:POWer:RELative	–	no query	6.101
CONTinue:POWer:RELative	–	no query	6.101
CONFigure:SUBarrays:POWer:RELative	ALL | ARITHmetical |	with query	6.109

Command	Parameter	Remark	Page
	MINimum | MAXimum | IVAL | XMINimum | XMAXimum | PAVG,<Start>,<Samples>{,< Start>,<Samples>}		
CONFigure:POWer:RELative:AVERage:LIMit:SCALar :ASYMmetric:LOWer:ENABle	ON | OFF, ON | OFF, ON | OFF	with query	6.107
CONFigure:POWer:RELative:AVERage:LIMit:SCALar :ASYMmetric:LOWer:VALue	–10 dBm to +30 dBm, –10 dBm to +30 dBm,–10 dBm to +30 dBm	with query	6.106
CONFigure:POWer:RELative:AVERage:LIMit:SCALar :ASYMmetric:UPPer:ENABle	ON | OFF, ON | OFF, ON | OFF	with query	6.106
CONFigure:POWer:RELative:AVERage:LIMit:SCALar :ASYMmetric:UPPer:VALue	–10 dBm to +30 dBm, –120 dBm to 0 dBm,–10 dBm to +30 dBm	with query	6.106
CONFigure:POWer:RELative:AVERage:LIMit:SCALar :ASYMmetric[:COMBined]:ENABle	ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF	with query	6.108
CONFigure:POWer:RELative:AVERage:LIMit:SCALar :ASYMmetric[:COMBined]:VALue	–10 dBm to +30 dBm, –10 dBm to +30 dBm,–10 dBm to +30 dBm, –10 dBm to +30 dBm, –10 dBm to +30 dBm,–10 dBm to +30 dBm	with query	6.107
READ:ARRAy:POWer:RELative:AVERage?	–100.0 to +30.0	query only	6.111
FETCh:ARRAy:POWer:RELative:AVERage?	–100.0 to +30.0	query only	6.111
READ:ARRAy:POWer:RELative:AVERage?	–100.0 dB to +30.0 dB	query only	6.112
FETCh:ARRAy:POWer:RELative:AVERage?	–100.0 dB to +30.0 dB	query only	6.112
CONFigure:POWer:RELative:CONTrol	SCALar | ARRay, 1 to 1000 | NONE, CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.104
DEFault:POWer:RELative:CONTrol	ON | OFF	with query	6.105
CONFigure:POWer:RELative:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE,STEP | NONE	with query	6.105
CONFigure:POWer:RELative:CONTrol:RMODe	SCALar | ARRay	with query	6.104
CONFigure:POWer:RELative:CONTrol:STATistics	1 to 1000 | NONE	with query	6.105
CONFigure:POWer:RELative:CURRent:LIMit:SCALar :ASYMmetric:LOWer:ENABle	ON | OFF, ON | OFF, ON | OFF	with query	6.107
CONFigure:POWer:RELative:CURRent:LIMit:SCALar :ASYMmetric:LOWer:VALue	–10 dBm to +30 dBm, –10 dBm to +30 dBm,–10 dBm to +30 dBm	with query	6.106
CONFigure:POWer:RELative:CURRent:LIMit:SCALar :ASYMmetric:UPPer:ENABle	ON | OFF, ON | OFF, ON | OFF	with query	6.106
CONFigure:POWer:RELative:CURRent:LIMit:SCALar :ASYMmetric:UPPer:VALue	–10 dBm to +30 dBm, –120 dBm to 0 dBm,–10 dBm to +30 dBm	with query	6.106
CONFigure:POWer:RELative:CURRent:LIMit:SCALar :ASYMmetric[:COMBined]:ENABle	ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF	with query	6.108
CONFigure:POWer:RELative:CURRent:LIMit:SCALar :ASYMmetric[:COMBined]:VALue	–10 dBm to +30 dBm, –10 dBm to +30 dBm,–10 dBm to +30 dBm, –10 dBm to +30 dBm, –10 dBm to +30 dBm,–10 dBm to +30 dBm	with query	6.107
READ:ARRAy:POWer:RELative:CURRent?	–100.0 to +30.0	query only	6.111
FETCh:ARRAy:POWer:RELative:CURRent?	–100.0 to +30.0	query only	6.111

Command	Parameter	Remark	Page
READ:ARRAy:POWer:RELative:CURRent?	–100.0 dB to +30.0 dB	query only	6.112
FETCh:ARRAy:POWer:RELative:CURRent?	–100.0 dB to +30.0 dB	query only	6.112
CONFigure:POWer:RELative:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.101
DEFault:POWer:RELative:LIMit	ON | OFF	with query	6.108
CALCulate[:SCALar]:POWer:RELative:MATChing:LIMit?	<Result>	query only	6.111
CONFigure:POWer:RELative:MAXimum:LIMit:SCALar :ASYMmetric:LOWer:ENABle	ON | OFF, ON | OFF, ON | OFF	with query	6.107
CONFigure:POWer:RELative:MAXimum:LIMit:SCALar :ASYMmetric:LOWer:VALue	–10 dBm to +30 dBm, –10 dBm to +30 dBm,–10 dBm to +30 dBm	with query	6.106
CONFigure:POWer:RELative:MAXimum:LIMit:SCALar :ASYMmetric:UPPer:ENABle	ON | OFF, ON | OFF, ON | OFF	with query	6.106
CONFigure:POWer:RELative:MAXimum:LIMit:SCALar :ASYMmetric:UPPer:VALue	–10 dBm to +30 dBm, –120 dBm to 0 dBm,–10 dBm to +30 dBm	with query	6.106
CONFigure:POWer:RELative:MAXimum:LIMit:SCALar :ASYMmetric[:COMBined]:ENABle	ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF	with query	6.108
CONFigure:POWer:RELative:MAXimum:LIMit:SCALar :ASYMmetric[:COMBined]:VALue	–10 dBm to +30 dBm, –10 dBm to +30 dBm,–10 dBm to +30 dBm, –10 dBm to +30 dBm, –10 dBm to +30 dBm,–10 dBm to +30 dBm	with query	6.107
READ:ARRAy:POWer:RELative:MAXimum?	–100.0 to +30.0	query only	6.111
FETCh:ARRAy:POWer:RELative:MAXimum?	–100.0 to +30.0	query only	6.111
READ:ARRAy:POWer:RELative:MAXimum?	–100.0 dB to +30.0 dB	query only	6.112
FETCh:ARRAy:POWer:RELative:MAXimum?	–100.0 dB to +30.0 dB	query only	6.112
CONFigure:POWer:RELative:MFRequency	2402 MHz to 2495 MHz	with query	6.102
CONFigure:POWer:RELative:MFRequency:SIMultaneous	2402 MHz to 2495 MHz	with query	6.102
CONFigure:POWer:RELative:MFRequency:UNIT	HZ | KHZ | MHZ | GHZ | CH	with query	6.102
CONFigure:POWer:RELative:MINimum:LIMit:SCALar :ASYMmetric:LOWer:ENABle	ON | OFF, ON | OFF, ON | OFF	with query	6.107
CONFigure:POWer:RELative:MINimum:LIMit:SCALar :ASYMmetric:LOWer:VALue	–10 dBm to +30 dBm, –10 dBm to +30 dBm,–10 dBm to +30 dBm	with query	6.106
CONFigure:POWer:RELative:MINimum:LIMit:SCALar :ASYMmetric:UPPer:ENABle	ON | OFF, ON | OFF, ON | OFF	with query	6.106
CONFigure:POWer:RELative:MINimum:LIMit:SCALar :ASYMmetric:UPPer:VALue	–10 dBm to +30 dBm, –120 dBm to 0 dBm,–10 dBm to +30 dBm	with query	6.106
CONFigure:POWer:RELative:MINimum:LIMit:SCALar :ASYMmetric[:COMBined]:ENABle	ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF, ON | OFF	with query	6.108
CONFigure:POWer:RELative:MINimum:LIMit:SCALar :ASYMmetric[:COMBined]:VALue	–10 dBm to +30 dBm, –10 dBm to +30 dBm,–10 dBm to +30 dBm, –10 dBm to +30 dBm, –10 dBm to +30 dBm,–10 dBm to +30 dBm	with query	6.107
READ:ARRAy:POWer:RELative:MINimum?	–100.0 to +30.0	query only	6.111
READ:ARRAy:POWer:RELative:MINimum?	–100.0 dB to +30.0 dB	query only	6.112
FETCh:ARRAy:POWer:RELative:MINimum?	–100.0 dB to +30.0 dB	query only	6.112
CONFigure:POWer:RELative:MMODe	ALL | SINGle | SIMultaneous	with query	6.102
FETCh[:SCALar]:POWer:RELative:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 |	query only	6.101

Command	Parameter	Remark	Page
	NONE , 1 to 1000 | NONE		
READ[:SCALar]:POWer:RELative?	<Result>	query only	6.110
FETCh[:SCALar]:POWer:RELative?	<Result>	query only	6.110
INITiate:POWer:TIME	–	no query	6.82
ABORt:POWer:TIME	–	no query	6.82
STOP:POWer:TIME	–	no query	6.82
CONTinue:POWer:TIME	–	no query	6.82
CONFigure:SUBarrays:POWer:TIME	ALL | ARITHmetical | MINimum | MAXimum | IVAL | XMINimum | XMAXimum | PAVG,<Start>,<Samples>{,< Start>,<Samples>}	with query	6.92
CONFigure:POWer:TIME:AVERage:LIMit:SCALar :ASYMmetric:LOWer:ENABle	ON | OFF, ON | OFF, ON | OFF	with query	6.89
CONFigure:POWer:TIME:AVERage:LIMit:SCALar :ASYMmetric:LOWer:VALue	–10 dBm to +30 dBm, –10 dBm to +30 dBm,–10 dBm to +30 dBm	with query	6.88
CONFigure:POWer:TIME:AVERage:LIMit:SCALar :ASYMmetric:UPPer:ENABle	ON | OFF, ON | OFF, ON | OFF	with query	6.88
CONFigure:POWer:TIME:AVERage:LIMit:SCALar :ASYMmetric:UPPer:VALue	–10 dBm to +30 dBm, –120 dBm to 0 dBm,–10 dBm to +30 dBm	with query	6.88
CONFigure:POWer:TIME:AVERage:LIMit:SCALar :ASYMmetric[:COMBined]:ENABle	ON | OFF, ON | OFF, ON | OFF	with query	6.89
CONFigure:POWer:TIME:AVERage:LIMit:SCALar :ASYMmetric[:COMBined]:VALue	–10 dBm to +30 dBm, –10 dBm to +30 dBm,–10 dBm to +30 dBm, –10 dBm to +30 dBm, –10 dBm to +30 dBm,–10 dBm to +30 dBm	with query	6.89
READ:ARRAy:POWer:TIME:AVERage?	–100.0 to +30.0	query only	6.94
FETCh:ARRAy:POWer:TIME:AVERage?	–100.0 to +30.0	query only	6.94
READ:ARRAy:POWer:TIME:AVERage?	–100.0 to +30.0	query only	6.95
FETCh:ARRAy:POWer:TIME:AVERage?	–100.0 to +30.0	query only	6.95
CONFigure:POWer:TIME:CONTrol	SCALar | ARRay, 1 to 1000 | NONE, CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.86
DEFault:POWer:TIME:CONTrol	ON | OFF	with query	6.87
CONFigure:POWer:TIME:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE,STEP | NONE	with query	6.87
CONFigure:POWer:TIME:CONTrol:RMODe	SCALar | ARRay	with query	6.86
CONFigure:POWer:TIME:CONTrol:STATistics	1 to 1000 | NONE	with query	6.87
CONFigure:POWer:TIME:CURRent:LIMit:SCALar :ASYMmetric:LOWer:ENABle	ON | OFF, ON | OFF, ON | OFF	with query	6.89
CONFigure:POWer:TIME:CURRent:LIMit:SCALar :ASYMmetric:LOWer:VALue	–10 dBm to +30 dBm, –10 dBm to +30 dBm,–10 dBm to +30 dBm	with query	6.88
CONFigure:POWer:TIME:CURRent:LIMit:SCALar :ASYMmetric:UPPer:ENABle	ON | OFF, ON | OFF, ON | OFF	with query	6.88
CONFigure:POWer:TIME:CURRent:LIMit:SCALar :ASYMmetric:UPPer:VALue	–10 dBm to +30 dBm, –120 dBm to 0 dBm,–10 dBm to +30 dBm	with query	6.88

Command	Parameter	Remark	Page
CONFigure:POWer:TIME:CURRent:LIMit:SCALar :ASYMmetric[:COMBined]:ENABle	ON | OFF, ON | OFF, ON | OFF	with query	6.89
CONFigure:POWer:TIME:CURRent:LIMit:SCALar :ASYMmetric[:COMBined]:VALue	–10 dBm to +30 dBm, –10 dBm to +30 dBm,–10 dBm to +30 dBm, –10 dBm to +30 dBm, –10 dBm to +30 dBm,–10 dBm to +30 dBm	with query	6.89
READ:ARRAy:POWer:TIME:CURRent?	–100.0 to +30.0	query only	6.94
FETCh:ARRAy:POWer:TIME:CURRent?	–100.0 to +30.0	query only	6.94
READ:ARRAy:POWer:TIME:CURRent?	–100.0 to +30.0	query only	6.95
FETCh:ARRAy:POWer:TIME:CURRent?	–100.0 to +30.0	query only	6.95
CONFigure:POWer:TIME:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.83
DEFault:POWer:TIME:LIMit	ON | OFF	with query	6.91
CALCulate[:SCALar]:POWer:TIME:MATChing:LIMit?	<Result>	query only	6.94
CONFigure:POWer:TIME:MAXimum:LIMit:SCALar :ASYMmetric:LOWer:ENABle	ON | OFF, ON | OFF, ON | OFF	with query	6.89
CONFigure:POWer:TIME:MAXimum:LIMit:SCALar :ASYMmetric:LOWer:VALue	–10 dBm to +30 dBm, –10 dBm to +30 dBm,–10 dBm to +30 dBm	with query	6.88
CONFigure:POWer:TIME:MAXimum:LIMit:SCALar :ASYMmetric:UPPer:ENABle	ON | OFF, ON | OFF, ON | OFF	with query	6.88
CONFigure:POWer:TIME:MAXimum:LIMit:SCALar :ASYMmetric:UPPer:VALue	–10 dBm to +30 dBm, –120 dBm to 0 dBm,–10 dBm to +30 dBm	with query	6.88
CONFigure:POWer:TIME:MAXimum:LIMit:SCALar :ASYMmetric[:COMBined]:ENABle	ON | OFF, ON | OFF, ON | OFF	with query	6.89
CONFigure:POWer:TIME:MAXimum:LIMit:SCALar :ASYMmetric[:COMBined]:VALue	–10 dBm to +30 dBm, –10 dBm to +30 dBm,–10 dBm to +30 dBm, –10 dBm to +30 dBm, –10 dBm to +30 dBm,–10 dBm to +30 dBm	with query	6.89
READ:ARRAy:POWer:TIME:MAXimum?	–100.0 to +30.0	query only	6.94
FETCh:ARRAy:POWer:TIME:MAXimum?	–100.0 to +30.0	query only	6.94
READ:ARRAy:POWer:TIME:MAXimum?	–100.0 to +30.0	query only	6.95
FETCh:ARRAy:POWer:TIME:MAXimum?	–100.0 to +30.0	query only	6.95
CONFigure:POWer:TIME:MFRequency	2402 MHz to 2495 MHz	with query	6.84
CONFigure:POWer:TIME:MFRequency:SIMultaneous	2402 MHz to 2495 MHz	with query	6.84
CONFigure:POWer:TIME:MFRequency:UNIT	HZ | KHZ | MHZ | GHZ | CH	with query	6.84
CONFigure:POWer:TIME:MINimum:LIMit:SCALar :ASYMmetric:LOWer:ENABle	ON | OFF, ON | OFF, ON | OFF	with query	6.89
CONFigure:POWer:TIME:MINimum:LIMit:SCALar :ASYMmetric:LOWer:VALue	–10 dBm to +30 dBm, –10 dBm to +30 dBm,–10 dBm to +30 dBm	with query	6.88
CONFigure:POWer:TIME:MINimum:LIMit:SCALar :ASYMmetric:UPPer:ENABle	ON | OFF, ON | OFF, ON | OFF	with query	6.88
CONFigure:POWer:TIME:MINimum:LIMit:SCALar :ASYMmetric:UPPer:VALue	–10 dBm to +30 dBm, –120 dBm to 0 dBm,–10 dBm to +30 dBm	with query	6.88
CONFigure:POWer:TIME:MINimum:LIMit:SCALar :ASYMmetric[:COMBined]:ENABle	ON | OFF, ON | OFF, ON | OFF	with query	6.89
CONFigure:POWer:TIME:MINimum:LIMit:SCALar :ASYMmetric[:COMBined]:VALue	–10 dBm to +30 dBm, –10 dBm to +30 dBm,–10 dBm to +30 dBm, –10 dBm to +30 dBm, –10 dBm to +30 dBm,–	with query	6.89

Command	Parameter	Remark	Page
	10 dBm to +30 dBm		
READ:ARRAy:POWer:TIME:MINimum?	–100.0 to +30.0	query only	6.94
FETCh:ARRAy:POWer:TIME:MINimum?	–100.0 to +30.0	query only	6.94
READ:ARRAy:POWer:TIME:MINimum?	–100.0 to +30.0	query only	6.95
FETCh:ARRAy:POWer:TIME:MINimum?	–100.0 to +30.0	query only	6.95
CONFigure:POWer:TIME:MMODe	ALL | SINGle | SIMultaneous	with query	6.83
CONFigure:POWer:TIME:MRANge	<Start>, <Span>	with query	6.85
CONFigure:POWer:TIME:MRANge	<Start>, <Span>	with query	6.103
CONFigure:POWer:TIME:PTIMing:AVERage:LIMit:SCALar :ASYMmetric:LOWer:ENABle	ON | OFF	with query	6.90
CONFigure:POWer:TIME:PTIMing:AVERage:LIMit:SCALar :ASYMmetric:LOWer:VALue	–15 µs to 15 µs	with query	6.90
CONFigure:POWer:TIME:PTIMing:AVERage:LIMit:SCALar :ASYMmetric:UPPer:ENABle	ON | OFF	with query	6.90
CONFigure:POWer:TIME:PTIMing:AVERage:LIMit:SCALar :ASYMmetric:UPPer:VALue	–15 µs to 15 µs	with query	6.90
CONFigure:POWer:TIME:PTIMing:AVERage:LIMit:SCALar :ASYMmetric[:COMBined]:ENABle	ON | OFF	with query	6.91
CONFigure:POWer:TIME:PTIMing:AVERage:LIMit:SCALar :ASYMmetric[:COMBined]:VALue	–15 µs to 15 µs	with query	6.91
CONFigure:POWer:TIME:PTIMing:CURRent:LIMit:SCALar :ASYMmetric:LOWer:ENABle	ON | OFF	with query	6.90
CONFigure:POWer:TIME:PTIMing:CURRent:LIMit:SCALar :ASYMmetric:LOWer:VALue	–15 µs to 15 µs	with query	6.90
CONFigure:POWer:TIME:PTIMing:CURRent:LIMit:SCALar :ASYMmetric:UPPer:ENABle	ON | OFF	with query	6.90
CONFigure:POWer:TIME:PTIMing:CURRent:LIMit:SCALar :ASYMmetric:UPPer:VALue	–15 µs to 15 µs	with query	6.90
CONFigure:POWer:TIME:PTIMing:CURRent:LIMit:SCALar :ASYMmetric[:COMBined]:ENABle	ON | OFF	with query	6.91
CONFigure:POWer:TIME:PTIMing:CURRent:LIMit:SCALar :ASYMmetric[:COMBined]:VALue	–15 µs to 15 µs	with query	6.91
CONFigure:POWer:TIME:PTIMing:MAXimum:LIMit:SCALar :ASYMmetric:LOWer:ENABle	ON | OFF	with query	6.90
CONFigure:POWer:TIME:PTIMing:MAXimum:LIMit:SCALar :ASYMmetric:LOWer:VALue	–15 µs to 15 µs	with query	6.90
CONFigure:POWer:TIME:PTIMing:MAXimum:LIMit:SCALar :ASYMmetric:UPPer:ENABle	ON | OFF	with query	6.90
CONFigure:POWer:TIME:PTIMing:MAXimum:LIMit:SCALar :ASYMmetric:UPPer:VALue	–15 µs to 15 µs	with query	6.90
CONFigure:POWer:TIME:PTIMing:MAXimum:LIMit:SCALar :ASYMmetric[:COMBined]:ENABle	ON | OFF	with query	6.91
CONFigure:POWer:TIME:PTIMing:MAXimum:LIMit:SCALar :ASYMmetric[:COMBined]:VALue	–15 µs to 15 µs	with query	6.91
CONFigure:POWer:TIME:PTIMing:MINimum:LIMit:SCALar :ASYMmetric:LOWer:ENABle	ON | OFF	with query	6.90
CONFigure:POWer:TIME:PTIMing:MINimum:LIMit:SCALar :ASYMmetric:LOWer:VALue	–15 µs to 15 µs	with query	6.90
CONFigure:POWer:TIME:PTIMing:MINimum:LIMit:SCALar :ASYMmetric:UPPer:ENABle	ON | OFF	with query	6.90
CONFigure:POWer:TIME:PTIMing:MINimum:LIMit:SCALar :ASYMmetric:UPPer:VALue	–15 µs to 15 µs	with query	6.90
CONFigure:POWer:TIME:PTIMing:MINimum:LIMit:SCALar	ON | OFF	with query	6.91

Command	Parameter	Remark	Page
:ASYMmetric[:COMBined]:ENABle			
CONFigure:POWer:TIME:PTIMing:MINimum:LIMit:SCALar :ASYMmetric[:COMBined]:VALue	–15 µs to 15 µs	with query	6.91
FETCh[:SCALar]:POWer:TIME:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.83
READ[:SCALar]:POWer:TIME?	<Result>	query only	6.93
FETCh[:SCALar]:POWer:TIME?	<Result>	query only	6.93
Profile information			
[SENSe:]PROFile:A2DP:ALDS?	ON | OFF	query only	6.79
[SENSe:]PROFile:A2DP:ASNR?	ON | OFF	query only	6.79
[SENSe:]PROFile:A2DP:B04B?	ON | OFF	query only	6.79
[SENSe:]PROFile:A2DP:B08B?	ON | OFF	query only	6.79
[SENSe:]PROFile:A2DP:B12B?	ON | OFF	query only	6.79
[SENSe:]PROFile:A2DP:B16B?	ON | OFF	query only	6.79
[SENSe:]PROFile:A2DP:BITPool:MAXimum?	2 to 128	query only	6.80
[SENSe:]PROFile:A2DP:BITPool:MINimum?	2 to 18	query only	6.80
[SENSe:]PROFile:A2DP:CMDL?	ON | OFF	query only	6.79
[SENSe:]PROFile:A2DP:CMJS?	ON | OFF	query only	6.79
[SENSe:]PROFile:A2DP:CMMN?	ON | OFF	query only	6.79
[SENSe:]PROFile:A2DP:CMST?	ON | OFF	query only	6.79
[SENSe:]PROFile:A2DP:S16K?	ON | OFF	query only	6.79
[SENSe:]PROFile:A2DP:S44K?	ON | OFF	query only	6.79
[SENSe:]PROFile:A2DP:SB4B?	ON | OFF	query only	6.79
[SENSe:]PROFile:A2DP:SB8B?	ON | OFF	query only	6.79
[SENSe:]PROFile:A2DP:S32K?	ON | OFF	query only	6.79
[SENSe:]PROFile:A2DP:S48K?	ON | OFF	query only	6.79
Receiver quality measurements			
INITiate:RXQuality:BER	–	no query	6.190
ABORt:RXQuality:BER	–	no query	6.190
STOP:RXQuality:BER	–	no query	6.190
CONTinue:RXQuality:BER	–	no query	6.190
FETCh[:SCALar]:RXQuality:BER:DETail?	<Result>	query only	6.198
CONFigure:RXQuality:BER:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.190
CALCulate:RXQuality:BER:MATChing:LIMit?	<Result>	query only	6.198
FETCh:RXQuality:BER:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 10000 | NONE	query only	6.191
CONFigure:RXQuality:BER:TSETup	T1 | T2 | T3 | T4 | T5	with query	6.191
DEFault:RXQuality:BER:TSETup<nr>	ON | OFF	with query	6.196
CONFigure:RXQuality:BER:TSETup<nr>:CONTrol	1 to 40000, 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.192
CONFigure:RXQuality:BER:TSETup<nr>:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000 , SONerror | NONE, STEP | NONE	with query	6.193

Command	Parameter	Remark	Page
CONFigure:RXQuality:BER:TSETup<nr>:CONTrol:STATistics	1 to 40000	with query	6.192
CONFigure:RXQuality:BER:TSETup<nr>:DELay	ON | OFF	with query	6.196
CONFigure:RXQuality:BER:TSETup<nr>:FREQuency	2402 MHz to 2495 MHz, 2402 MHz to 2495 MHz	with query	6.194
CONFigure:RXQuality:BER:TSETup<nr>:HSCHeme	RXTX | EUSA | JAPan | FRANce | SPAin | RHOP	with query	6.194
CONFigure:RXQuality:BER:TSETup<nr>:LEVel	<Level>	with query	6.193
CONFigure:RXQuality:BER:TSETup<nr>:LIMit	ON | OFF	with query	6.197
CONFigure:RXQuality:BER:TSETup<nr>:LIMit:SCALar :ASYMmetric[:COMBined]	0% to 100%, ON | OFF, 0% to 100%, ON | OFF	with query	6.197
CONFigure:RXQuality:BER:TSETup<nr>:LIMit:SCALar :ASYMmetric[:COMBined]:ENABle	ON | OFF, ON | OFF	with query	6.197
CONFigure:RXQuality:BER:TSETup<nr>:LIMit:SCALar :ASYMmetric[:COMBined]:VALue	0% to 100%, 0% to 100%	with query	6.197
CONFigure:RXQuality:BER:TSETup<nr>:LOTSequence :DH1Packet	1 to 27	with query	6.195
CONFigure:RXQuality:BER:TSETup<nr>:LOTSequence :DH3Packet	1 to 183	with query	6.195
CONFigure:RXQuality:BER:TSETup<nr>:LOTSequence :DH5Packet	1 to 339	with query	6.195
CONFigure:RXQuality:BER:TSETup<nr>:PATType	DPRS | SPRS | ALL1 | ALL0 | P11 | P44 | USER	with query	6.194
CONFigure:RXQuality:BER:TSETup<nr>:PTYPe	DH1 | DH3 | DH5 | E21P | E23P | E25P | E31P | E33P | E35P	with query	6.195
CONFigure:RXQuality:BER:TSETup<nr>:UDData	<hex data>	with query	6.196
CONFigure:RXQuality:BER:TSETup<nr>:UDLength	3 to 64	with query	6.196
CONFigure:RXQuality:BER:TSETup<nr>:WHITening	ON | OFF	with query	6.196
READ[:SCALar]:RXQuality:BER?	<Result>	query only	6.198
FETCh[:SCALar]:RXQuality:BER?	<Result>	query only	6.198
INITiate:RXQuality:SBER	–	no query	6.199
ABORt:RXQuality:SBER	–	no query	6.199
STOP:RXQuality:SBER	–	no query	6.199
CONTinue:RXQuality:SBER	–	no query	6.199
DEFault:RXQuality:SBER	ON | OFF	with query	6.203
CONFigure:RXQuality:SBER:CONTrol:STATistics	1 to 10000, 0% to 100%, 1 to 100	with query	6.200
CONFigure:RXQuality:SBER:DELay	ON | OFF	with query	6.203
CONFigure:RXQuality:SBER:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.199
CONFigure:RXQuality:SBER:FREQuency	2402 MHz to 2495 MHz, 2402 MHz to 2495 MHz	with query	6.201
CONFigure:RXQuality:SBER:LEVel	<Low_Lev>, <Upp_Lev>	with query	6.200
CONFigure:RXQuality:SBER:LOTSequence:DH1Packet	1 to 27	with query	6.202
CONFigure:RXQuality:SBER:LOTSequence:DH3Packet	1 to 183	with query	6.202
CONFigure:RXQuality:SBER:LOTSequence:DH5Packet	1 to 339	with query	6.202
CONFigure:RXQuality:SBER:PATType	DPRS | SPRS | ALL1 | ALL0 | P11 | P44 | USER	with query	6.201
CONFigure:RXQuality:SBER:PTYPe	DH1 | DH3 | DH5 | E21P | E23P | E25P | E31P | E33P | E35P	with query	6.202

Command	Parameter	Remark	Page
FETCh:RXQuality:SBER:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 500 | NONE	query only	6.199
CONFigure:RXQuality:SBER:UDData	<hex data>	with query	6.203
CONFigure:RXQuality:SBER:UDLength	3 to 64	with query	6.203
CONFigure:RXQuality:SBER:WHITening	ON | OFF	with query	6.203
READ[:SCALar]:RXQuality:SBER?	<Result>	query only	6.204
FETCh[:SCALar]:RXQuality:SBER?	<Result>	query only	6.204
CONFigure:RXQuality:SBER[:LBACk]:HSCHeme	RXTX | EUSA | JAPan | FRANce | SPAin | RHOP	with query	6.201
CONFigure:RXQuality:SBER:LOTSequence:DH1Packet	1 to 1021	with query	6.198
CONFigure:RXQuality:SBER:LOTSequence:DH3Packet	1 to 183	with query	6.198
CONFigure:RXQuality:SBER:LOTSequence:DH5Packet	1 to 339	with query	6.198
CONFigure:RXQuality:SBER:PATType	DPRS | SPRS | ALL1 | ALL0 | P11 | P44 | USER	with query	6.197
CONFigure:RXQuality:SBER:PTYPe	DH1 | DH3 | DH5 | E21P | E23P | E25P | E31P | E33P | E35P	with query	6.198
FETCh:RXQuality:SBER:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 500 | NONE	query only	6.195
CONFigure:RXQuality:SBER:UDData	<hex data>	with query	6.199
CONFigure:RXQuality:SBER:UDLength	3 to 64	with query	6.199
CONFigure:RXQuality:SBER:WHITening	ON | OFF	with query	6.199
READ[:SCALar]:RXQuality:SBER?	<Result>	query only	6.200
FETCh[:SCALar]:RXQuality:SBER?	<Result>	query only	6.200
CONFigure:RXQuality:SBER[:LBACk]:HSCHeme	RXTX | EUSA | JAPan | FRANce | SPAin | RHOP	with query	6.197
Signalling			
PROCedure:SIGNalling:ACTion	INQuiry | SINQuiry | PAGE | SPAGe | CONNect | SCONnect | TEST | STESt | DETach | SNIFf | SSNiff | PARK | SPARk | HOLD | AUDio | SAUDio | FSTY	with query	6.47
CONFigure:SIGNalling:PTARget	"BD00" to "BD11"	with query	6.50
FETCh:SIGNalling:PTARgets?	0 to 12, "BD00", "BD_address_00" {,"BDxx", "BD_address_xx"}	query only	6.50
PROCedure:SIGNalling:PTBZero	LONG | SHORT	with query	6.50
[SENSe:]SIGNalling:STATe?	SBY | INQ | PAG | CONN	query only	6.49
[SENSe:]SIGNalling:XSTate?	SBY | INQ | PAG | CONN | TEST | HOLD | SNIF | AUD | PARK | DET	query only	6.49
Signalling info			
[SENSe:]SINFo:BDADdress?	<BD address>	query only	6.71
[SENSe:]SINFo:CLASs:SERVice?	"<Service_Class1>" | "", "<Service_Class2>" | "", ...	query only	6.72
[SENSe:]SINFo:CLASs?	<MajorDC><MinorDC>	query only	6.72

Command	Parameter	Remark	Page
[SENSe:]SINFo:COMPany?	”<Company_Name>”	query only	6.71
[SENSe:]SINFo:FEATure:ALAW?	ON | OFF	query only	6.76
[SENSe:]SINFo:FEATure:CQDD?	ON | OFF	query only	6.75
[SENSe:]SINFo:FEATure:CVSD?	ON | OFF	query only	6.76
[SENSe:]SINFo:FEATure:EA2Mbps?	ON | OFF	query only	6.77
[SENSe:]SINFo:FEATure:EA2Mbps?	ON | OFF	query only	6.78
[SENSe:]SINFo:FEATure:EA3Mbps?	ON | OFF	query only	6.77
[SENSe:]SINFo:FEATure:EA3Mbps?	ON | OFF	query only	6.78
[SENSe:]SINFo:FEATure:EA3Slot?	ON | OFF	query only	6.77
[SENSe:]SINFo:FEATure:EA3Slot?	ON | OFF	query only	6.78
[SENSe:]SINFo:FEATure:EA5Slot?	ON | OFF	query only	6.77
[SENSe:]SINFo:FEATure:EA5Slot?	ON | OFF	query only	6.78
[SENSe:]SINFo:FEATure:ENCRyption?	ON | OFF	query only	6.73
[SENSe:]SINFo:FEATure:FCLag?	ON | OFF	query only	6.76
[SENSe:]SINFo:FEATure:HOLD?	ON | OFF	query only	6.74
[SENSe:]SINFo:FEATure:HV2P?	ON | OFF	query only	6.75
[SENSe:]SINFo:FEATure:HV3P?	ON | OFF	query only	6.75
[SENSe:]SINFo:FEATure:LFRequest?	8 feature bytes	query only	6.77
[SENSe:]SINFo:FEATure:MS3S?	ON | OFF	query only	6.73
[SENSe:]SINFo:FEATure:MS5S?	ON | OFF	query only	6.73
[SENSe:]SINFo:FEATure:PARK?	ON | OFF	query only	6.74
[SENSe:]SINFo:FEATure:PCONtrol?	ON | OFF	query only	6.75
[SENSe:]SINFo:FEATure:PSCHeme?	ON | OFF	query only	6.76
[SENSe:]SINFo:FEATure:PSCHeme?	ON | OFF	query only	6.76
[SENSe:]SINFo:FEATure:RSSI?	ON | OFF	query only	6.74
[SENSe:]SINFo:FEATure:SCOL?	ON | OFF	query only	6.75
[SENSe:]SINFo:FEATure:SNIFf?	ON | OFF	query only	6.74
[SENSe:]SINFo:FEATure:SOFF?	ON | OFF	query only	6.73
[SENSe:]SINFo:FEATure:SWITch?	ON | OFF	query only	6.74
[SENSe:]SINFo:FEATure:TACCuracy?	ON | OFF	query only	6.74
[SENSe:]SINFo:FEATure:TSData?	ON | OFF	query only	6.76
[SENSe:]SINFo:FEATure:ULAW?	ON | OFF	query only	6.75
[SENSe:]SINFo:NAME?	<string>	query only	6.71
[SENSe:]SINFo:PAGing?	MAND | OPT1 | OPT2 | OPT3, P0 | P1 | P2, R0 | R1 | R2	query only	6.73
[SENSe:]SINFo:VERSion?	0 | 1, 0 to 65535, 0 to 65535	query only	6.71
Spectrum Measurement			
INITiate:SPECtrum:ACPower	–	no query	6.172
ABORt:SPECtrum:ACPower	–	no query	6.172
STOP:SPECtrum:ACPower	–	no query	6.172
CONTinue:SPECtrum:ACPower	–	no query	6.172
CONFigure:SPECtrum:ACPower:AVERage:LIMit:SCALar :ASYMmetric:LCHannel:ENABle	ON | OFF	with query	6.177
CONFigure:SPECtrum:ACPower:AVERage:LIMit:SCALar	–40 dBm to 0 dBm	with query	6.176

Command	Parameter	Remark	Page
:ASYMmetric:LCHannel:VALue			
CONFigure:SPECtrum:ACPower:AVERage:LIMit:SCALar :ASYMmetric:PDELta:ENABle	ON | OFF, ON | OFF	with query	6.177
CONFigure:SPECtrum:ACPower:AVERage:LIMit:SCALar :ASYMmetric:PDELta:VALue	–60 dB to 0 dB, –60 dB to 0 dB	with query	6.177
CONFigure:SPECtrum:ACPower:AVERage:LIMit:SCALar :ASYMmetric:UCHannel:ENABle	ON | OFF	with query	6.176
CONFigure:SPECtrum:ACPower:AVERage:LIMit:SCALar :ASYMmetric:UCHannel:VALue	–40 dBm to 0 dBm	with query	6.176
CONFigure:SPECtrum:ACPower:CCHannel	0 to 78	with query	6.175
CONFigure:SPECtrum:ACPower:CONTrol	SCALar | ARRay, 1 to 1000 | NONE, CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.173
CONFigure:SPECtrum:ACPower:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE,STEP | NONE	with query	6.174
CONFigure:SPECtrum:ACPower:CONTrol:STATistics	1 to 1000 | NONE	with query	6.174
CONFigure:SPECtrum:ACPower:DMODe	AVG | RMS | PEAK	with query	6.175
CONFigure:SPECtrum:ACPower:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.172
READ[:SCALar]:SPECtrum:ACPower:EXTended?	<Result>	query only	6.179
FETCh[:SCALar]:SPECtrum:ACPower:EXTended?	<Result>	query only	6.179
CONFigure:SPECtrum:ACPower:GATing	ON | OFF	with query	6.174
CONFigure:SPECtrum:ACPower:LUNit	ABS | REL	with query	6.175
CALCulate[:SCALar]:SPECtrum:ACPower:MATChing:LIMit?	NMAU | INV | OK	query only	6.179
CONFigure:SPECtrum:ACPower:MCHannel:RELative	–97 to 0, …, 0 to 97	with query	6.175
CONFigure:SPECtrum:ACPower:PEAK:LIMit:SCALar :ASYMmetric:LCHannel:ENABle	ON | OFF	with query	6.177
CONFigure:SPECtrum:ACPower:PEAK:LIMit:SCALar :ASYMmetric:LCHannel:VALue	–40 dBm to 0 dBm	with query	6.176
CONFigure:SPECtrum:ACPower:PEAK:LIMit:SCALar :ASYMmetric:PDELta:ENABle	ON | OFF, ON | OFF	with query	6.177
CONFigure:SPECtrum:ACPower:PEAK:LIMit:SCALar :ASYMmetric:PDELta:VALue	–60 dB to 0 dB, –60 dB to 0 dB	with query	6.177
CONFigure:SPECtrum:ACPower:PEAK:LIMit:SCALar :ASYMmetric:UCHannel:ENABle	ON | OFF	with query	6.176
CONFigure:SPECtrum:ACPower:PEAK:LIMit:SCALar :ASYMmetric:UCHannel:VALue	–40 dBm to 0 dBm	with query	6.176
CONFigure:SPECtrum:ACPower:RMS:LIMit:SCALar :ASYMmetric:LCHannel:ENABle	ON | OFF	with query	6.177
CONFigure:SPECtrum:ACPower:RMS:LIMit:SCALar :ASYMmetric:LCHannel:VALue	–40 dBm to 0 dBm	with query	6.176
CONFigure:SPECtrum:ACPower:RMS:LIMit:SCALar :ASYMmetric:PDELta:ENABle	ON | OFF, ON | OFF	with query	6.177
CONFigure:SPECtrum:ACPower:RMS:LIMit:SCALar :ASYMmetric:PDELta:VALue	–60 dB to 0 dB, –60 dB to 0 dB	with query	6.177
CONFigure:SPECtrum:ACPower:RMS:LIMit:SCALar :ASYMmetric:UCHannel:ENABle	ON | OFF	with query	6.176
CONFigure:SPECtrum:ACPower:RMS:LIMit:SCALar :ASYMmetric:UCHannel:VALue	–40 dBm to 0 dBm	with query	6.176
FETCh[:SCALar]:SPECtrum:ACPower:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 |	query only	6.173

Command	Parameter	Remark	Page
	NONE , 1 to 1000 | NONE		
READ[:SCALar]:SPECtrum:ACPower?	<Result>	query only	6.178
FETCh[:SCALar]:SPECtrum:ACPower?	<Result>	query only	6.178
INITiate:SPECtrum:BWIDth	–	no query	6.180
ABORt:SPECtrum:BWIDth	–	no query	6.180
STOP:SPECtrum:BWIDth	–	no query	6.180
CONTinue:SPECtrum:BWIDth	–	no query	6.180
CONFigure:SPECtrum:BWIDth:AVERage:LIMit:SCALar :ASYMmetric:UPPer:ENABle	ON | OFF	with query	6.184
CONFigure:SPECtrum:BWIDth:AVERage:LIMit:SCALar :ASYMmetric:UPPer:VALue	0.05 MHz to 3.30 MHz	with query	6.183
READ:ARRAy:SPECtrum:BWIDth:AVERage?	–100.0 to 0.0	query only	6.185
FETCh:ARRAy:SPECtrum:BWIDth:AVERage?	–100.0 to 0.0	query only	6.185
CONFigure:SPECtrum:BWIDth:CONTrol	SCALar | ARRay, 1 to 1000 | NONE, CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.181
CONFigure:SPECtrum:BWIDth:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE,STEP | NONE	with query	6.182
CONFigure:SPECtrum:BWIDth:CONTrol:RMODe	SCALar | ARRay	with query	6.181
CONFigure:SPECtrum:BWIDth:CONTrol:STATistics	1 to 1000 | NONE	with query	6.182
CONFigure:SPECtrum:BWIDth:CURRent:LIMit:SCALar :ASYMmetric:UPPer:ENABle	ON | OFF	with query	6.184
CONFigure:SPECtrum:BWIDth:CURRent:LIMit:SCALar :ASYMmetric:UPPer:VALue	0.05 MHz to 3.30 MHz	with query	6.183
READ:ARRAy:SPECtrum:BWIDth:CURRent?	–100.0 to 0.0	query only	6.185
FETCh:ARRAy:SPECtrum:BWIDth:CURRent?	–100.0 to 0.0	query only	6.185
CONFigure:SPECtrum:BWIDth:DLEVel	–0.1 dB to –50.0 dB	with query	6.183
CONFigure:SPECtrum:BWIDth:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.180
CALCulate[:SCALar]:SPECtrum:BWIDth:MATChing:LIMit?	NMAU | INV | OK	query only	6.185
CONFigure:SPECtrum:BWIDth:MAXimum:LIMit:SCALar :ASYMmetric:UPPer:ENABle	ON | OFF	with query	6.184
CONFigure:SPECtrum:BWIDth:MAXimum:LIMit:SCALar :ASYMmetric:UPPer:VALue	0.05 MHz to 3.30 MHz	with query	6.183
READ:ARRAy:SPECtrum:BWIDth:MAXimum?	–100.0 to 0.0	query only	6.185
FETCh:ARRAy:SPECtrum:BWIDth:MAXimum?	–100.0 to 0.0	query only	6.185
CONFigure:SPECtrum:BWIDth:MFRequency:SIMultaneous	2402 MHz to 2495 MHz	with query	6.183
CONFigure:SPECtrum:BWIDth:MFRequency:UNIT	HZ | KHZ | MHZ | GHZ | CH	with query	6.183
CONFigure:SPECtrum:BWIDth:MMODe	ALL | SINGle	with query	6.182
FETCh[:SCALar]:SPECtrum:BWIDth:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.180
READ[:SCALar]:SPECtrum:BWIDth?	<Result>	query only	6.184
FETCh[:SCALar]:SPECtrum:BWIDth?	<Result>	query only	6.184
INITiate:SPECtrum:FRANge	–	no query	6.186
ABORt:SPECtrum:FRANge	–	no query	6.186
STOP:SPECtrum:FRANge	–	no query	6.186
CONTinue:SPECtrum:FRANge	–	no query	6.186

Command	Parameter	Remark	Page
CONFigure:SPECtrum:FRANge:CONTrol:STATistics	1 to 1000 | NONE	with query	6.187
CONFigure:SPECtrum:FRANge:CURRent:LIMit:SCALar :ASYMmetric[:COMBined]:ENABle	ON | OFF, ON | OFF	with query	6.188
CONFigure:SPECtrum:FRANge:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.186
READ[:SCALar]:SPECtrum:FRANge:LFRequency?	–140.0 dBm to +0.0 dBm	query only	6.189
READ[:SCALar]:SPECtrum:FRANge:LFRequency?	–140.0 dBm to +0.0 dBm	query only	6.189
FETCh[:SCALar]:SPECtrum:FRANge:LFRequency?	–140.0 dBm to +0.0 dBm	query only	6.189
FETCh[:SCALar]:SPECtrum:FRANge:LFRequency?	–140.0 dBm to +0.0 dBm	query only	6.189
CONFigure:SPECtrum:FRANge:LIMit:SCALar :ASYMmetric[:COMBined]:VALue	2397.55 MHz to 2485.45 MHz, 2397.55 MHz to 2485.45 MHz	with query	6.188
CALCulate[:SCALar]:SPECtrum:FRANge:MATChing:LIMit?	Fl limit check, Fh limit check	query only	6.189
CONFigure:SPECtrum:FRANge:MWINdow	–4 to 73, 1 to 11	with query	6.187
FETCh:SPECtrum:FRANge:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE , 1 to 1000 | NONE	query only	6.187
CONFigure:SPECtrum:FRANge:THReshold	–100 dBm to 0 dBm	with query	6.187
READ:ARRAy:SPECtrum:FRANge?	<Result>	query only	6.188
FETCh:ARRAy:SPECtrum:FRANge?	<Result>	query only	6.188
Slave Signal			
CONFigure:SSIGnal:PCTR	ADAPtive | FIXed	with query	6.58
DEFault:SSIGnal:TMODe	ON | OFF	with query	6.63
CONFigure:SSIGnal:TMODe:FREQuency:UNIT	HZ | KHZ | MHZ | GHZ | CH	with query	6.59
CONFigure:SSIGnal:TMODe:HSCHeme	RXTX | EUSA | JAPan | FRANce | SPAin | RHOP	with query	6.59
CONFigure:SSIGnal:TMODe:LBTests:FREQuency	2402 MHz to 2495 MHz, 2402 MHz to 2495 MHz	with query	6.61
CONFigure:SSIGnal:TMODe:LBTests:LOTSequence:DH1Packet	0 to 27	with query	6.63
CONFigure:SSIGnal:TMODe:LBTests:LOTSequence:DH3Packet	0 to 183	with query	6.63
CONFigure:SSIGnal:TMODe:LBTests:LOTSequence:DH5Packet	0 to 339	with query	6.63
CONFigure:SSIGnal:TMODe:LBTests:PATType	DPRS | SPRS | ALL1 | ALL0 | P11 | P44 | USER	with query	6.61
CONFigure:SSIGnal:TMODe:LBTests:PTYPe	DH1 | DH3 | DH5 | E21P | E23P | E25P | E31P | E33P | E35P	with query	6.62
CONFigure:SSIGnal:TMODe:LBTests:UDData	<hex data>	with query	6.62
CONFigure:SSIGnal:TMODe:LBTests:UDLength	3 to 64	with query	6.61
CONFigure:SSIGnal:TMODe:LBTests:WHITening	ON | OFF	with query	6.63
CONFigure:SSIGnal:TMODe:TMTYpe	LBT | TXT	with query	6.58
CONFigure:SSIGnal:TMODe:TXTests:FREQuency	2402 MHz to 2495 MHz, 2402 MHz to 2495 MHz	with query	6.59
CONFigure:SSIGnal:TMODe:TXTests:LOTSequence:DH1Packet	0 to 27	with query	6.60
CONFigure:SSIGnal:TMODe:TXTests:LOTSequence:DH3Packet	0 to 183	with query	6.60
CONFigure:SSIGnal:TMODe:TXTests:LOTSequence:DH5Packet	0 to 339	with query	6.60
CONFigure:SSIGnal:TMODe:TXTests:PATType	DPRS | SPRS | ALL1 | ALL0 | P11 | P44	with query	6.59
CONFigure:SSIGnal:TMODe:TXTests:PPERiod	2 to 254	with query	6.61
CONFigure:SSIGnal:TMODe:TXTests:PTYPe	DH1 | DH3 | DH5 | E21P |	with query	6.60

Command	Parameter	Remark	Page
	E23P | E25P | E31P | E33P | E35P		
CONFigure:SSIGnal:TMODe:TXTests:LOTSequence:DH1Packet	0 to 27	with query	6.61
CONFigure:SSIGnal:TMODe:TXTests:LOTSequence:DH3Packet	0 to 183	with query	6.61
CONFigure:SSIGnal:TMODe:TXTests:LOTSequence:DH5Packet	0 to 339	with query	6.61
CONFigure:SSIGnal:TMODe:TXTests:LOTSequence:E121Packet	0 to 54	with query	6.61
CONFigure:SSIGnal:TMODe:TXTests:LOTSequence:E23Packet	0 to 367	with query	6.61
CONFigure:SSIGnal:TMODe:TXTests:LOTSequence:E25Packet	0 to 679	with query	6.61
CONFigure:SSIGnal:TMODe:TXTests:LOTSequence:E31Packet	0 to 83	with query	6.61
CONFigure:SSIGnal:TMODe:TXTests:LOTSequence:E33Packet	0 to 552	with query	6.61
CONFigure:SSIGnal:TMODe:TXTests:LOTSequence:E35Packet	0 to 1021	with query	6.61
CONFigure:SSIGnal:TMODe:TXTests:PATType	DPRS | SPRS | ALL1 | ALL0 | P11 | P44	with query	6.60
CONFigure:SSIGnal:TMODe:TXTests:PPERiod	2 to 254	with query	6.62
CONFigure:SSIGnal:TMODe:TXTests:PTYPe	DH1 | DH3 | DH5 | E21P | E23P | E25P | E31P | E33P | E35P	with query	6.61
Trigger			
DEFault:TRIGger[:SEQuence]	ON | OFF	with query	6.70
TRIGger[:SEQuence]:SOURce	SIGNalling | POWer	with query	6.70
TRIGger[:SEQuence]:THReshold	LOW | HIGH	with query	6.70

Table 6-5 Remote-control commands: Audio generator and analyzer

Command	Parameters	Remarks	Page
Subsystem AFANalyzer (audio analyzer)			
INITiate:AFANalyzer:SECondary	–	no query	6.207
STOP:AFANalyzer:SECondary	–	no query	6.207
STOP:AFANalyzer:SECondary	–	no query	6.207
ABORt:AFANalyzer:SECondary	–	no query	6.207
CONTinue:AFANalyzer:SECondary	–	no query	6.207
CONFigure:AFANalyzer:SECondary:CONTrol:COUPling	AC | DC	with query	6.209
CONFigure:AFANalyzer:SECondary:CONTrol:DISTortion[:FREQuency]	100 Hz to 21000 Hz	with query	6.209
CONFigure:AFANalyzer:SECondary:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.209
CONFigure:AFANalyzer:SECondary:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.208
CONFigure:AFANalyzer:SECondary:FILTer:BPASs:ACCoupling	BP01 to BP19	with query	6.211
CONFigure:AFANalyzer:SECondary:FILTer:BPASs:DCCoupling	BP01 to BP19	with query	6.211
CONFigure:AFANalyzer:SECondary:FILTer:VBPass:BWIDth	10 Hz to 1000 Hz	with query	6.210
CONFigure:AFANalyzer:SECondary:FILTer:VBPass:CFRequency	20 Hz to 21000 Hz	with query	6.210
CONFigure:AFANalyzer:SECondary:FILTer:WEIGhting	A | CME | CCI | OFF	with query	6.210

Command	Parameters	Remarks	Page
CONFigure:AFANalyzer:SECondary:MTReduce	LOWF | EXPF, <Frequency>	with query	6.208
FETCh:AFANalyzer:SECondary:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE	query only	6.208
READ[:SCALar]:AFANalyzer:SECondary?	<Result>	query only	6.212
FETCh[:SCALar]:AFANalyzer:SECondary?	<Result>	query only	6.212
INITiate:AFANalyzer[:PRIMary]	–	no query	6.207
ABORt:AFANalyzer[:PRIMary]	–	no query	6.207
CONTinue:AFANalyzer[:PRIMary]	–	no query	6.207
CONFigure:AFANalyzer[:PRIMary]:CONTrol:COUPling	AC | DC	with query	6.209
CONFigure:AFANalyzer[:PRIMary]:CONTrol:DISTortion[:FREQuency]	100 Hz to 21000 Hz	with query	6.209
CONFigure:AFANalyzer[:PRIMary]:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.209
CONFigure:AFANalyzer[:PRIMary]:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.208
CONFigure:AFANalyzer[:PRIMary]:FILTer:BPASs:ACCoupling	BP01 to BP19	with query	6.211
CONFigure:AFANalyzer[:PRIMary]:FILTer:BPASs:DCCoupling	BP01 to BP19	with query	6.211
CONFigure:AFANalyzer[:PRIMary]:FILTer:VBPass:BWIDth	10 Hz to 1000 Hz	with query	6.210
CONFigure:AFANalyzer[:PRIMary]:FILTer:VBPass:CFRequency	20 Hz to 21000 Hz	with query	6.210
CONFigure:AFANalyzer[:PRIMary]:FILTer:WEIGhting	A | CME | CCI | OFF	with query	6.210
CONFigure:AFANalyzer[:PRIMary]:MTReduce	LOWF | EXPF, <Frequency>	query only	6.208
FETCh:AFANalyzer[:PRIMary]:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE	query only	6.208
READ[:SCALar]:AFANalyzer[:PRIMary]?	<Result>	query only	6.212
FETCh[:SCALar]:AFANalyzer[:PRIMary]?	<Result>	query only	6.212
AFGenerator (AF generator)			
INITiate:AFGenerator:SECondary	–	no query	6.212
ABORt:AFGenerator:SECondary	–	no query	6.212
SOURce:AFGenerator:SECondary:FREQuency	20 Hz to 21 kHz	with query	6.213
SOURce:AFGenerator:SECondary:FSCale:LEVel	0 μV to 5 V	with query	6.213
SOURce:AFGenerator:SECondary:LEVel	0 μV to 5 V	with query	6.213
SOURce:AFGenerator:SECondary:SMODe	AC | DC	with query	6.213
FETCh:AFGenerator:SECondary:STATus?	OFF | RUN | ERR	query only	6.213
INITiate:AFGenerator[:PRIMary]	–	no query	6.212
ABORt:AFGenerator[:PRIMary]	–	no query	6.212
SOURce:AFGenerator[:PRIMary]:FREQuency	20 Hz to 21 kHz	with query	6.213
SOURce:AFGenerator[:PRIMary]:FSCale:LEVel	0 μV to 5 V	with query	6.213
SOURce:AFGenerator[:PRIMary]:LEVel	0 μV to 5 V	with query	6.213
SOURce:AFGenerator[:PRIMary]:SMODe	AC | DC	with query	6.213
FETCh:AFGenerator[:PRIMary]:STATus?	OFF | RUN | ERR	query only	6.213
Subsystem AFLevel (AF input level)			
[SENSe:]AFLevel:DEFault	ON | OFF	with query	6.207
[SENSe:]AFLevel:SECondary:FSCale:MAXimum	<Level>	with query	6.207

Command	Parameters	Remarks	Page
[SENSe:]AFLevel:SECondary:MAXimum	<Level>	with query	6.206
[SENSe:]AFLevel:SECondary:MODE	MANual | AUTO	with query	6.206
[SENSe:]AFLevel[:PRIMary]:FSCale:MAXimum	<Level>	with query	6.207
[SENSe:]AFLevel[:PRIMary]:MAXimum	<Level>	with query	6.206
[SENSe:]AFLevel[:PRIMary]:MODE	MANual | AUTO	with query	6.206
Subsystem MULTitone (multitone measurements)			
INITiate:MULTitone:AF1Channel	–	no query	6.214
ABORt:MULTitone:AF1Channel	–	no query	6.214
STOP:MULTitone:AF1Channel	–	no query	6.214
CONTinue:MULTitone:AF1Channel	–	no query	6.214
CONFigure:SUBarrays:MULTitone:AF1Channel	ALL | ARITHmetical | MINimum | MAXimum | IVAL,<Range>{,<Range>}	with query	6.218
CONFigure:MULTitone:AF1Channel:AFGLead	0 s to 0.1 s	with query	6.216
CONFigure:MULTitone:AF1Channel:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 1000, SONerror | NONE, STEP | NONE	with query	6.217
CONFigure:MULTitone:AF1Channel:COUPling	AC | DC	with query	6.215
CONFigure:MULTitone:AF1Channel:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.215
DEFault:MULTitone:AF1Channel:FILTer	ON | OFF	with query	6.226
CONFigure:MULTitone:AF1Channel:FILTer:BPASs:ACCoupling	BP01 to BP19	with query	6.225
CONFigure:MULTitone:AF1Channel:FILTer:BPASs:DCCoupling	BP01 to BP19	with query	6.225
CONFigure:MULTitone:AF1Channel:FILTer:WEIGhting	<Weighting>	with query	6.226
CONFigure:MULTitone:AF1CHannel:FSCale:RLEVel	0.001 V to 5.000 V	with query	6.216
CONFigure:MULTitone:AF1CHannel:FSCale:RLEVel	0.001 V to 5.000 V	with query	6.230
CONFigure:MULTitone:AF1CHannel:FSCale:TDEFinition	<Freq_1>, <Lev_1>, <Enable_1>, ... <Freq_20>, <Lev_20>, <Enable_20>	with query	6.222
CONFigure:MULTitone:AF1CHannel:FSCale:TDEFinition:TLEVel	<Total_Level>	with query	6.224
CONFigure:MULTitone:AF1CHannel:FSCale:TDEFinition:TONE<nr>	<Frequency>, <Level>, ON | OFF	with query	6.223
DISPlay:MULTitone:AF1Channel:GRID	ON | OFF	with query	6.215
DEFault:MULTitone:AF1Channel:LIMit:LINE	ON | OFF	with query	6.220
CONFigure:MULTitone:AF1Channel:LIMit:LINE:ASYMmetric:LOWer	<Limit_1>, <Enable_1>, ... <Limit_20>, <Enable_20>	with query	6.220
CONFigure:MULTitone:AF1Channel:LIMit:LINE:ASYMmetric:UPPer	<Limit_1>, <Enable_1>, ... <Limit_20>, <Enable_20>	with query	6.219
CALCulate[:SCALar]:MULTitone:AF1Channel:MATChing:LIMit?	<Result>	query only	6.228
CALCulate:ARRay:MULTitone:AF1Channel:MATChing:LIMit?	<Result>	query only	6.228
CONFigure:MULTitone:AF1Channel:RLEVel	0.001 V to 5.000 V	with query	6.215
CONFigure:MULTitone:AF1Channel:RMODe	RLEV | TON1 | ... | TON20	with query	6.216
FETCh:MULTitone:AF1Channel:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE	query only	6.215
CONFigure:MULTitone:AF1Channel:TDEFinition	<Freq_1>, <Lev_1>, <Enable_1>, ... <Freq_20>, <Lev_20>, <Enable_20>	with query	6.221
DEFault:MULTitone:AF1Channel:TDEFinition	ON | OFF	with query	6.224

Command	Parameters	Remarks	Page
CONFigure:MULTitone:AF1Channel:TDEFinition:MODE	<Total_Level>	with query	6.223
CONFigure:MULTitone:AF1Channel:TDEFinition:TLEVel	<Total_Level>	with query	6.223
CONFigure:MULTitone:AF1Channel:TDEFinition:TONE<nr>	<Frequency>, <Level>, ON | OFF	with query	6.222
CONFigure:MULTitone:AF1Channel:TONE<nr>:LIMit:LINE:ASYMmetric:LOWer	<Limit>, <Enable>	with query	6.220
CONFigure:MULTitone:AF1Channel:TONE<nr>:LIMit:LINE:ASYMmetric:UPPer	<Limit>, <Enable>	with query	6.219
CALCulate[:SCALar]:MULTitone:AF1Channel:TONE<nr>:MATChing:LIMit?	<Result>	query only	6.227
READ[:SCALar]:MULTitone:AF1Channel:TONE<nr>?	–100.0 dB to +20.0 dB	query only	6.226
FETCh[:SCALar]:MULTitone:AF1Channel:TONE<nr>?	–100.0 dB to +20.0 dB	query only	6.226
READ:ARRay:MULTitone:AF1Channel?	–100.0 dB to +20.0 dB	query only	6.227
FETCh:ARRay:MULTitone:AF1Channel?	–100.0 dB to +20.0 dB	query only	6.227
READ:SUBarrays:MULTitone:AF1Channel?	–100.0 dB to +20.0 dB	query only	6.227
FETCh:SUBarrays:MULTitone:AF1Channel?	–100.0 dB to +20.0 dB	query only	6.227
INITiate:MULTitone:AF2Channel	–	no query	6.214
ABORt:MULTitone:AF2Channel	–	no query	6.214
STOP:MULTitone:AF2Channel	–	no query	6.214
CONTinue:MULTitone:AF2Channel	–	no query	6.214
CONFigure:SUBarrays:MULTitone:AF2Channel	ALL | ARITHmetical | MINimum | MAXimum | IVAL | XMINimum | XMAXimum | PAVG,<Range>{,<Range>}	with query	6.218
CONFigure:MULTitone:AF2Channel:AFGLead	0 s to 0.1 s	with query	6.216
CONFigure:MULTitone:AF2Channel:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 1000, SONerror | NONE, STEP | NONE	with query	6.217
CONFigure:MULTitone:AF2Channel:COUPling	AC | DC	with query	6.215
CONFigure:MULTitone:AF2Channel:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.215
DEFault:MULTitone:AF2Channel:FILTer	ON | OFF	with query	6.226
CONFigure:MULTitone:AF2Channel:FILTer:BPASs:ACCoupling	BP01 to BP19	with query	6.225
CONFigure:MULTitone:AF2Channel:FILTer:BPASs:ACCoupling	BP01 to BP19	with query	6.239
CONFigure:MULTitone:AF2Channel:FILTer:BPASs:DCCoupling	BP01 to BP19	with query	6.225
CONFigure:MULTitone:AF2Channel:FILTer:WEIGhting	<Weighting>	with query	6.226
CONFigure:MULTitone:AF2CHannel:FSCale:RLEVel	0.001 V to 5.000 V	with query	6.216
CONFigure:MULTitone:AF2CHannel:FSCale:TDEFinition	<Freq_1>, <Lev_1>, <Enable_1>, ... <Freq_20>, <Lev_20>, <Enable_20>	with query	6.222
CONFigure:MULTitone:AF2CHannel:FSCale:TDEFinition:TLEVel	<Total_Level>	with query	6.224
CONFigure:MULTitone:AF2CHannel:FSCale:TDEFinition:TONE<nr>	<Frequency>, <Level>, ON | OFF	with query	6.223
DISPlay:MULTitone:AF2Channel:GRID	ON | OFF	with query	6.215
DEFault:MULTitone:AF2Channel:LIMit:LINE	ON | OFF	with query	6.220
CONFigure:MULTitone:AF2Channel:LIMit:LINE:ASYMmetric:LOWer	<Limit_1>, <Enable_1>, ... <Limit_20>, <Enable_20>	with query	6.220
CONFigure:MULTitone:AF2Channel:LIMit:LINE:ASYMmetric:UPPer	<Limit_1>, <Enable_1>, ... <Limit_20>, <Enable_20>	with query	6.219
CALCulate[:SCALar]:MULTitone:AF2Channel:MATChing:LIMit?	<Result>	query only	6.228

Command	Parameters	Remarks	Page
CALCulate:ARRay:MULTitone:AF2Channel:MATChing:LIMit?	<Result>	query only	6.228
CONFigure:MULTitone:AF2Channel:RLEVel	0.001 V to 5.000 V	with query	6.215
CONFigure:MULTitone:AF2Channel:RMODe	RLEV | TON1 | ... | TON20	with query	6.216
FETCh:MULTitone:AF2Channel:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE	query only	6.215
CONFigure:MULTitone:AF2Channel:TDEFinition	<Freq_1>, <Lev_1>, <Enable_1>, ... <Freq_20>, <Lev_20>, <Enable_20>	with query	6.221
DEFault:MULTitone:AF2Channel:TDEFinition	ON | OFF	with query	6.224
CONFigure:MULTitone:AF2Channel:TDEFinition:MODE	<Total_Level>	with query	6.223
CONFigure:MULTitone:AF2Channel:TDEFinition:TLEVel	<Total_Level>	with query	6.223
CONFigure:MULTitone:AF2Channel:TDEFinition:TONE<nr>	<Frequency>, <Level>, ON | OFF	with query	6.222
CONFigure:MULTitone:AF2Channel:TONE<nr>:LIMit:LINE:ASYMmetric:LOWer	<Limit>, <Enable>	with query	6.220
CONFigure:MULTitone:AF2Channel:TONE<nr>:LIMit:LINE:ASYMmetric:UPPer	<Limit>, <Enable>	with query	6.219
CALCulate[:SCALar]:MULTitone:AF2Channel:TONE<nr>:MATChing:LIMit?	<Result>	query only	6.227
READ[:SCALar]:MULTitone:AF2Channel:TONE<nr>?	–100.0 dB to +20.0 dB	query only	6.226
FETCh[:SCALar]:MULTitone:AF2Channel:TONE<nr>?	–100.0 dB to +20.0 dB	query only	6.226
READ:ARRay:MULTitone:AF2Channel?	–100.0 dB to +20.0 dB	query only	6.227
FETCh:ARRay:MULTitone:AF2Channel?	–100.0 dB to +20.0 dB	query only	6.227
READ:SUBarrays:MULTitone:AF2Channel?	–100.0 dB to +20.0 dB	query only	6.227
FETCh:SUBarrays:MULTitone:AF2Channel?	–100.0 dB to +20.0 dB	query only	6.227
DEFault:MULTitone:FILTer	ON | OFF	with query	6.226
DEFault:MULTitone:LIMit:LINE	ON | OFF	with query	6.221
INITiate:MULTitone:STEReo	–	no query	6.228
ABORt:MULTitone:STEReo	–	no query	6.228
STOP:MULTitone:STEReo	–	no query	6.228
CONTinue:MULTitone:STEReo	–	no query	6.228
CALCulate[:SCALar]:MULTitone:STEReo:AF1Channel:MATChing:LIMit?	<Result>	query only	6.241
CALCulate:ARRay:MULTitone:STEReo:AF1Channel:MATChing:LIMit?	<Result>	query only	6.242
CALCulate[:SCALar]:MULTitone:STEReo:AF1Channel:TONE<nr>:MATChing:LIMit?	<Result>	query only	6.241
READ[:SCALar]:MULTitone:STEReo:AF1Channel:TONE<nr>?	–100.0 dB to +20.0 dB	query only	6.240
FETCh[:SCALar]:MULTitone:STEReo:AF1Channel:TONE<nr>?	–100.0 dB to +20.0 dB	query only	6.240
READ:ARRay:MULTitone:STEReo:AF1Channel?	–100.0 dB to +20.0 dB	query only	6.240
FETCh:ARRay:MULTitone:STEReo:AF1Channel?	–100.0 dB to +20.0 dB	query only	6.240
CALCulate[:SCALar]:MULTitone:STEReo:AF2Channel:MATChing:LIMit?	<Result>	query only	6.241
CALCulate:ARRay:MULTitone:STEReo:AF2Channel:MATChing:LIMit?	<Result>	query only	6.242
CALCulate[:SCALar]:MULTitone:STEReo:AF2Channel:TONE<nr>:MATChing:LIMit?	<Result>	query only	6.241
READ[:SCALar]:MULTitone:STEReo:AF2Channel:TONE<nr>?	–100.0 dB to +20.0 dB	query only	6.240
FETCh[:SCALar]:MULTitone:STEReo:AF2Channel:TONE<nr>?	–100.0 dB to +20.0 dB	query only	6.240

Command	Parameters	Remarks	Page
READ:ARRay:MULTitone:STEReo:AF2Channel?	–100.0 dB to +20.0 dB	query only	6.240
FETCh:ARRay:MULTitone:STEReo:AF2Channel?	–100.0 dB to +20.0 dB	query only	6.240
CONFigure:MULTitone:STEReo:AFGLead	0 s to 0.1 s, 0 s to 0.1 s	with query	6.231
CONFigure:MULTitone:STEReo:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 1000, SONerror | NONE, STEP | NONE	with query	6.229
CONFigure:MULTitone:STEReo:COUPling	AC | DC, AC | DC	with query	6.230
CONFigure:MULTitone:STEReo:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.228
DEFault:MULTitone:STEReo:FILTer	ON | OFF	with query	6.239
CONFigure:MULTitone:STEReo:FILTer:BPASs:ACCoupling	BP01 to BP19, BP01 to BP19	with query	6.239
CONFigure:MULTitone:STEReo:FILTer:BPASs:DCCoupling	BP01 to BP19, BP01 to BP19	with query	6.238
CONFigure:MULTitone:STEReo:FILTer:WEIGhting	<Weighting_1>, <Weighting_2>	with query	6.239
CONFigure:MULTitone:STEReo:FSCale:TDEFinition:TLEVel	<Total_Level_1>, <Total_Level_2>	with query	6.237
DEFault:MULTitone:STEReo:LIMit:LINE	ON | OFF	with query	6.233
CONFigure:MULTitone:STEReo:LIMit:LINE:ASYMmetric:LOWer	<Limit_1_1>, <Enable_1_1>, ... <Limit_20_2>, <Enable_20_2>	with query	6.232
CONFigure:MULTitone:STEReo:LIMit:LINE:ASYMmetric:UPPer	<Limit_1_1>, <Enable_1_1>, ... <Limit_20_2>, <Enable_20_2>	with query	6.231
CALCulate[:SCALar]:MULTitone:STEReo:MATChing:LIMit?	<Result>	query only	6.242
CALCulate:ARRay:MULTitone:STEReo:MATChing:LIMit?	<Result>	query only	6.242
CONFigure:MULTitone:STEReo:RLEVel	0.001 V to 5.000 V	with query	6.230
CONFigure:MULTitone:STEReo:RMODe	RLEV | TON1 | ... | TON20	with query	6.230
FETCh:MULTitone:STEReo:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE	query only	6.229
CONFigure:MULTitone:STEReo:TDEFinition	<Freq_1_1>, <Lev_1_1>, <Enable_1_1>, ... <Freq_20_2>, <Lev_20_2>, <Enable_20_2>	with query	6.234
CONFigure:MULTitone:STEReo:TDEFinition	<Freq_1_1>, <Lev_1_1>, <Enable_1_1>, ... <Freq_20_2>, <Lev_20_2>, <Enable_20_2>	with query	6.235
DEFault:MULTitone:STEReo:TDEFinition	ON | OFF	with query	6.237
CONFigure:MULTitone:STEReo:TDEFinition:FSCale:TONE<nr>	<Frequency>, <Level>, ON | OFF,<Frequency>, <Level>, ON | OFF	with query	6.236
CONFigure:MULTitone:STEReo:TDEFinition:MODE	<Mode_1>, <Mode_2>	with query	6.237
CONFigure:MULTitone:STEReo:TDEFinition:TLEVel	<Total_Level_1>, <Total_Level_2>	with query	6.237
CONFigure:MULTitone:STEReo:TDEFinition:TONE<nr>	<Frequency>, <Level>, ON | OFF,<Frequency>, <Level>, ON | OFF	with query	6.236
CONFigure:MULTitone:STEReo:TONE<nr>:LIMit:LINE:ASYMmetric:LOWer	<Limit_1>, <Enable_1>, <Limit_2>, <Enable_2>	with query	6.233
CONFigure:MULTitone:STEReo:TONE<nr>:LIMit:LINE:ASYMmetric:UPPer	<Limit_1>, <Enable_1>, <Limit_2>, <Enable_2>	with query	6.232
CALCulate[:SCALar]:MULTitone:STEReo:TONE<nr>:MATChing:LIMit?	<Result>	query only	6.241

Command	Parameters	Remarks	Page
READ[:SCALar]:MULTitone:STEReo:TONE<nr>?	–100.0 dB to +20.0 dB	query only	6.240
FETCh[:SCALar]:MULTitone:STEReo:TONE<nr>?	–100.0 dB to +20.0 dB	query only	6.240
READ:ARRay:MULTitone:STEReo?	–100.0 dB to +20.0 dB	query only	6.241
FETCh:ARRay:MULTitone:STEReo?	–100.0 dB to +20.0 dB	query only	6.241
DEFault:MULTitone:TDEFinition	ON | OFF	with query	6.224
Subsystem THD (total harmonic distortion)			
INITiate:THD:AF1Channel	–	no query	6.243
ABORt:THD:AF1Channel	–	no query	6.243
STOP:THD:AF1Channel	–	no query	6.243
CONTinue:THD:AF1Channel	–	no query	6.243
CONFigure:THD:AF1Channel:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 1000, SONerror | NONE, STEP | NONE	with query	6.245
CONFigure:THD:AF1Channel:COUPling	AC | DC	with query	6.245
CONFigure:THD:AF1Channel:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.244
DEFault:THD:AF1Channel:FILTer	ON | OFF	with query	6.248
CONFigure:THD:AF1Channel:FILTer:BPASs:ACCoupling	BP01 to BP19	with query	6.247
CONFigure:THD:AF1Channel:FILTer:BPASs:DCCoupling	BP01 to BP19	with query	6.247
CONFigure:THD:AF1Channel:FILTer:WEIGhting	<Weighting>	with query	6.248
CONFigure:THD:AF1Channel:FSCale:TDEFinition	<Frequency>, <Level>	with query	6.246
READ[:SCALar]:THD:AF1Channel:HARMonic<nr>?	–150.0 dB to +150.0 dB	query only	6.248
FETCh[:SCALar]:THD:AF1Channel:HARMonic<nr>?	–150.0 dB to +150.0 dB	query only	6.248
CONFigure:THD:AF1Channel:HARMonics<nr>	<Enable>	with query	6.245
FETCh:THD:AF1Channel:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE	query only	6.244
CONFigure:THD:AF1Channel:TDEFinition	<Frequency>, <Level>	with query	6.246
READ[:SCALar]:THD:AF1Channel:THD?	0 % to 100 %, –150.0 dB to 0.0 dB	query only	6.249
FETCh[:SCALar]:THD:AF1Channel:THD?	0 % to 100 %, –150.0 dB to 0.0 dB	query only	6.249
READ:ARRay:THD:AF1Channel?	–150.0 dB to +150.0 dB	query only	6.249
FETCh:ARRay:THD:AF1Channel?	–150.0 dB to +150.0 dB	query only	6.249
INITiate:THD:AF2Channel	–	no query	6.243
ABORt:THD:AF2Channel	–	no query	6.243
STOP:THD:AF2Channel	–	no query	6.243
CONTinue:THD:AF2Channel	–	no query	6.243
CONFigure:THD:AF2Channel:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 1000, SONerror | NONE, STEP | NONE	with query	6.245
CONFigure:THD:AF2Channel:COUPling	AC | DC	with query	6.245
CONFigure:THD:AF2Channel:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.244
DEFault:THD:AF2Channel:FILTer	ON | OFF	with query	6.248
CONFigure:THD:AF2Channel:FILTer:BPASs:ACCoupling	BP01 to BP19	with query	6.247
CONFigure:THD:AF2Channel:FILTer:BPASs:DCCoupling	BP01 to BP19	with query	6.247
CONFigure:THD:AF2Channel:FILTer:WEIGhting	<Weighting>	with query	6.248
CONFigure:THD:AF2Channel:FSCale:TDEFinition	<Frequency>, <Level>	with query	6.246

Command	Parameters	Remarks	Page
READ[:SCALar]:THD:AF2Channel:HARMonic<nr>?	–150.0 dB to +150.0 dB	query only	6.248
FETCh[:SCALar]:THD:AF2Channel:HARMonic<nr>?	–150.0 dB to +150.0 dB	query only	6.248
CONFigure:THD:AF2Channel:HARMonics<nr>	<Enable>	with query	6.245
FETCh:THD:AF2Channel:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE	query only	6.244
CONFigure:THD:AF2Channel:TDEFinition	<Frequency>, <Level>	with query	6.246
READ[:SCALar]:THD:AF2Channel:THD?	0 % to 100 %, –150.0 dB to 0.0 dB	query only	6.249
FETCh[:SCALar]:THD:AF2Channel:THD?	0 % to 100 %, –150.0 dB to 0.0 dB	query only	6.249
READ:ARRay:THD:AF2Channel?	–150.0 dB to +150.0 dB	query only	6.249
FETCh:ARRay:THD:AF2Channel?	–150.0 dB to +150.0 dB	query only	6.249
DEFault:THD:FILTer	ON | OFF	with query	6.248
INITiate:THD:STEReo	–	no query	6.249
ABORt:THD:STEReo	–	no query	6.249
STOP:THD:STEReo	–	no query	6.249
CONTinue:THD:STEReo	–	no query	6.249
READ[:SCALar]:THD:STEReo:AF1Channel:HARMonic<nr>?	–150.0 dB to +150.0 dB	query only	6.252
FETCh[:SCALar]:THD:STEReo:AF1Channel:HARMonic<nr>?	–150.0 dB to +150.0 dB	query only	6.252
READ[:SCALar]:THD:STEReo:AF1Channel:THD?	0 % to 100 %, –150.0 dB to 0.0 dB	query only	6.253
FETCh[:SCALar]:THD:STEReo:AF1Channel:THD?	0 % to 100 %, –150.0 dB to 0.0 dB	query only	6.253
READ:ARRay:THD:STEReo:AF1Channel?	–150.0 dB to +150.0 dB	query only	6.253
FETCh:ARRay:THD:STEReo:AF1Channel?	–150.0 dB to +150.0 dB	query only	6.253
READ[:SCALar]:THD:STEReo:AF2Channel:HARMonic<nr>?	–150.0 dB to +150.0 dB	query only	6.252
FETCh[:SCALar]:THD:STEReo:AF2Channel:HARMonic<nr>?	–150.0 dB to +150.0 dB	query only	6.252
READ[:SCALar]:THD:STEReo:AF2Channel:THD?	0 % to 100 %, –150.0 dB to 0.0 dB	query only	6.253
FETCh[:SCALar]:THD:STEReo:AF2Channel:THD?	0 % to 100 %, –150.0 dB to 0.0 dB	query only	6.253
READ:ARRay:THD:STEReo:AF2Channel?	–150.0 dB to +150.0 dB	query only	6.253
FETCh:ARRay:THD:STEReo:AF2Channel?	–150.0 dB to +150.0 dB	query only	6.253
CONFigure:THD:STEReo:CONTrol:REPetition	CONTinuous | SINGleshot | 1 to 10000, SONerror | NONE, STEP | NONE	with query	6.250
CONFigure:THD:STEReo:EREPorting	SRQ | SOPC | SRSQ | OFF	with query	6.250
CONFigure:THD:STEReo:FSCale:TDEFinition	<Frequency_1>, <Level_1>, <Frequency_2>, <Level_2>	with query	6.252
READ[:SCALar]:THD:STEReo:HARMonic<nr>?	–150.0 dB to +150.0 dB	query only	6.252
FETCh[:SCALar]:THD:STEReo:HARMonic<nr>?	–150.0 dB to +150.0 dB	query only	6.252
CONFigure:THD:STEReo:HARMonics<nr>	<Enable_1>, <Enable_2>	with query	6.251
FETCh:THD:STEReo:STATus?	OFF | RUN | STOP | ERR | STEP | RDY, 1 to 10000 | NONE	query only	6.250
CONFigure:THD:STEReo:TDEFinition	<Frequency_1>, <Level_1>, <Frequency_2>, <Level_2>	with query	6.251
READ[:SCALar]:THD:STEReo:THD?	0 % to 100 %, –150.0 dB to 0.0 dB	query only	6.253

Command	Parameters	Remarks	Page
FETCh[:SCALar]:THD:STEReo:THD?	0 % to 100 %, –150.0 dB to 0.0 dB	query only	6.253
READ:ARRay:THD:STEReo?	–150.0 dB to +150.0 dB	query only	6.253
FETCh:ARRay:THD:STEReo?	–150.0 dB to +150.0 dB	query only	6.253

Alphabetical Command Lists

Table 6-6 Alphabetical list of remote-control commands: Base system

Table 6-7 Alphabetical list of remote-control commands: RF

Table 6-8 Alphabetical list of remote-control commands: Bluetooth Non Signalling

Command (Bluetooth Non Signalling, alphabetical)	Page
INITiate:RFGenerator	*6.40*
MMEMory:RECall:CURRent	*6.28*
MMEMory:SAVE:CURRent	*6.27*
[SENSe:]CORRection:LOSS[:MAGNitude]	*6.45*
SOURce:CORRection:LOSS[:MAGNitude]	*6.45*
SOURce:RFGenerator:BDADdress	*6.42*
SOURce:RFGenerator:BMODulation	*6.43*
SOURce:RFGenerator:DTX	*6.43*
SOURce:RFGenerator:ESDTx:FDRift	*6.44*
SOURce:RFGenerator:ESDTx:FOFFset	*6.44*
SOURce:RFGenerator:ESDTx:STERror	*6.44*
SOURce:RFGenerator:FOFFset	*6.41*
SOURce:RFGenerator:FREQuency	*6.41*
SOURce:RFGenerator:FREQuency:UNIT	*6.41*
SOURce:RFGenerator:LEVel	*6.40*
SOURce:RFGenerator:MINDex	*6.41*
SOURce:RFGenerator:PLENgth	*6.42*
SOURce:RFGenerator:PTBZero	*6.40*
SOURce:RFGenerator:PTYPe	*6.42*
SOURce:RFGenerator:SDTX:FDRift	*6.44*
SOURce:RFGenerator:SDTX:FOFFset	*6.43*
SOURce:RFGenerator:SDTX:MINDex	*6.43*
SOURce:RFGenerator:SDTX:STERror	*6.44*
STATus:OPERation:SYMBolic:ENABle	*6.28*
STATus:OPERation:SYMBolic[:EVENt]?	*6.29*
SYSTem:OPTions:INFO:CURRent?	*6.27*
SYSTem:RESet:CURRent	*6.28*

Table 6-9 Alphabetical list of remote-control commands: Bluetooth Signalling

Command (Bluetooth Signalling, alphabetical)	Page
ABORt:MODulation:DEViation	*6.117*
ABORt:MODulation:DPSKeying	*6.132*
ABORt:MODulation:ENCoding	*6.146*
ABORt:MODulation:IQANalyzer:DPSKeying	*6.152*
ABORt:MODulation:PDIFference	*6.164*
ABORt:POWer:MPE	*6.112*
ABORt:POWer:MPR	*6.96*
ABORt:POWer:RELative	*6.101*
ABORt:POWer:TIME	*6.82*
ABORt:RXQuality:BER	*6.190*
ABORt:RXQuality:SBER	*6.199*
ABORt:SPECtrum:ACPower	*6.172*
ABORt:SPECtrum:BWIDth	*6.180*
ABORt:SPECtrum:FRANge	*6.186*
CALCulate:MODulation:DEViation:MATChing:LIMit?	*6.129*
CALCulate:MODulation:DPSKeying:MATChing:LIMit?	*6.143*
CALCulate:MODulation:ENCoding:MATChing:LIMit?	*6.151*
CALCulate:MODulation:IQANalyzer:DPSKeying:MATChing:LIMit?	*6.161*
CALCulate:POWer:MPR:MATChing:LIMit?	*6.100*
CALCulate:RXQuality:BER:MATChing:LIMit?	*6.198*
CALCulate[:SCALar]:POWer:MPE:MATChing:LIMit?	*6.116*
CALCulate[:SCALar]:POWer:RELative:MATChing:LIMit?	*6.111*
CALCulate[:SCALar]:POWer:TIME:MATChing:LIMit?	*6.94*
CALCulate[:SCALar]:SPECtrum:ACPower:MATChing:LIMit?	*6.179*
CALCulate[:SCALar]:SPECtrum:BWIDth:MATChing:LIMit?	*6.185*
CALCulate[:SCALar]:SPECtrum:FRANge:MATChing:LIMit?	*6.189*
CONFigure:AFRFsync:CCONfig	*6.69*
CONFigure:DUT:AUTHentic:ENABle	*6.57*
CONFigure:DUT:PINCode	*6.57*
CONFigure:DUT:STORe:LINK:KEYS	*6.58*
CONFigure:MODulation:DEViation:AVERage:LIMit:SCALar:ASYMmetric:LOWer:ENABle	*6.124*
CONFigure:MODulation:DEViation:AVERage:LIMit:SCALar:ASYMmetric:LOWer:VALue	*6.123*
CONFigure:MODulation:DEViation:AVERage:LIMit:SCALar:ASYMmetric:UPPer:ENABle	*6.123*
CONFigure:MODulation:DEViation:AVERage:LIMit:SCALar:ASYMmetric:UPPer:VALue	*6.122*
CONFigure:MODulation:DEViation:AVERage:LIMit:SCALar:ASYMmetric[:COMBined]:ENABle	*6.125*
CONFigure:MODulation:DEViation:AVERage:LIMit:SCALar:ASYMmetric[:COMBined]:VALue	*6.124*

Table 6-10 Alphabetical list of remote-control commands: Audio measurements***

Command (RF, alphabetical) Page

Command (RF, alphabetical) **Page**

Contents

7 Remote Control – Program Examples

The following program example illustrates how to solve a typical measurement task on *Bluetooth* devices. To keep the syntax as short and simple as possible, the program was written with the aid of *Winbatch*, a batch job tool organizing and simplifying the transfer of commands and data between the controller and the instrument.

Winbatch uses device names such as *CBTBASE, CBTBT* which are previously defined and assigned to the primary address, secondary address, and some general device settings. With these device names, a complete command line reads:

```
CBTBT: <CBT_Command>
```

where `<CBT_Command>` may be any of the commands (setting commands or queries) specified within the function group and mode identified by the device name *CBTBT.* Program sequences consisting of commands that are defined in several function groups and modes can be re-used with an exchanged device name.

In addition to these data transfer commands, *Winbatch* provides *WHILE, GOTO*, and *IF* statements to express conditions and define loops. With the statement

```
WHILE CBTBT: SIGN:STAT? <> SBY
```

the instrument waits until it has reached the signalling state *Standby* before it executes the following commands.

Quick Connection Setup and Measurements

The following example illustrates how to set up a connection, force the DUT into its test mode and make fast power and modulation measurements, exploiting several features that are primarily intended to simplify and accelerate the task (see also section *Connection Setup* in Chapter 5). The entire program can be executed within approx. 2 s. We assume that the remote control setup of the R&S® CBT (primary and secondary GPIB address) matches the "Remote" settings in Winbatch and that CBTBT denotes the Bluetooth function group.

; Perform a reset to make sure default settings are restored.

```
CBTBT:   *RST;*OPC?
```

; Switch signalling info off for faster connection and to avoid
; unnecessary information being exchanged between the R&S® CBT and the DUT.

```
CBTBT:   CONF:MSIG:PAG:RSIN OFF
```

; The DUT supports Bluetooth LMP version 1.1. With the previous setting
; (switch signalling info off), this is the default version that the R&S® CBT assumes.
; The Bluetooth version can be entered explicitly.

```
CBTBT:   CONF:NETW:BTV V11
```

; Inquire a device: assume only one DUT is connected to the R&S® CBT with RF cable
; stop the inquiry after the first response.

```
CBTBT:   CONF:MSIG:INQ:NOR 1
CBTBT:   PROC:SIGN:ACT INQ
WHILE CBTBT:   SIGN:STAT? <> INQ
WHILE CBTBT:   SIGN:STAT? <> SBY
```

; If a DUT was found during inquiry it is now selected as the device to page.

; Make a connection (page and go immediately into test mode). Use the extended signalling state
; query `...:XST?` to differentiate between the test mode and the other connected states

```
CBTBT:   PROC:SIGN:ACT TEST
```

```
WHILE CBTBT:   SIGN:XST? <> TEST
```

; Perform combined power and modulation measurements. If no traces are needed
; use `POW:MPR` rather than `POWer:TIME` and `MODulation:DEViation`

```
CBTBT:   INIT:POW:MPR
CBTBT:   FETC:POW:MPR?
CBTBT:   ABOR:POW:MPR
```

; Detach from connection

```
CBTBT:   PROC:SIGN:ACT DET
WHILE CBTBT:   SIGN:STAT? <> SBY
```

Symbolic Status Event Register Evaluation

The following example program shows how the EVENt part of the `STATus:OPERation` registers can be read using the commands for symbolic status register evaluation typed in boldface. The program provokes and evaluates the event *Reference Frequency Not Locked (RFNL)* which is reported by bit no. 6 of the `STATus:OPERation:CMU:SUM1:CMU1` sub-register assigned to the R&S® CBT base system (see sections *Symbolic Status Event Register Evaluation* and *STATus:OPERation Register* in Chapter 5).

`CBTBASE: *RST;*OPC?`	Reset the instrument; prevent the following command from being executed before *RST is complete
`CBTBASE: *CLS`	Clear output buffer, set status byte
`CBTBASE: CONF:SYNC:FREQ:REF:MODE?`	
`CBTBASE: CONF:SYNC:FREQ:REF:MODE EXT`	Provoke event -> Reference Frequency Not Locked (external reference frequency selected but no external input signal available)
`CBTBASE: TRACE:REMOTE:MODE:FILE ON`	Remote trace to file
`CBTBASE: TRACE:REMOTE:MODE:DISPLAY ON`	Remote trace display ON
`CBTBASE: TRACE:REMOTE:MODE:SRQ ON`	Display SRQ event on remote trace window
`CBTBASE: STATUS:PRESET`	Reset status register system
`CBTBASE: *STB?`	Check status byte
`CBTBASE: *SRE?`	Check service request enable
`CBTBASE: *SRE 128`	Service request for OPERATION register
`CBTBASE: *STB?`	Check status byte
`CBTBASE: STAT:OPER:SYMB:ENAB?`	Check symbolic status register enable --> NONE
`CBTBASE: STAT:OPER:SYMB:ENAB RFNL`	Enable symbolic status register evaluation (event Reference Frequency Not Locked = RFNL)
`[l_LOOP]`	
`if CBTBASE: *STB? <> 0 goto read_event`	Read STB Bit 7 is set (that is SRQ)
`PAUSE 2000`	Wait 2 seconds
`goto l_LOOP`	
`[read_event]`	
`CBTBASE: STAT:OPER:EVENT:SADD?`	Eval. which SecAddr causes the Event? --> CBTBASE
`CBTBASE: STAT:OPER:SYMB?`	Eval. which bit (event) causes SRQ --> RFNL
`CBTBASE: *STB?`	
`CBTBASE: *STB?`	
`goto l_LOOP`	

Running R&S CMU Programs on the R&S CBT

The functionality of the Bluetooth Tester R&S® CBT is closely related to the functionality of the Universal Radio Communication Tester R&S® CMU (with option R&S® CMU-K53, *Bluetooth for* R&S® *CMU)*. The remote control commands for both products have been developed with the aim of ensuring maximum compatibility. In general, programs developed for the R&S® CMU-K53 can be executed on the R&S® CBT and vice versa.

The differences between the CMT and CBT command sets are mostly due to the different hardware platforms and easy to take into account for programming. The following tables give an overview and describe the consequences for program compatibility. Differences in the allowed ranges and default values of input and output signals are not listed, please refer to the detailed program description in Chapter 6.

Table 7-1: Differences in the Base system

R&S® CMU command	R&S® CBT command	Remarks
`*OPT?, SYSTem:OPTions?`	–	
`SYSTem:COMMunicate:SERial2…`		No second serial port COM 2 on R&S® CBT
`MMEMory:MSIS EXTernal`	–	No external mass storage device, see also other `MMEMory…` commands.
`CONFigure:SYNChronize :FREQuency:REFerence`	–	Fixed 10 MHz reference frequency on R&S® CBT

Table 7-2: Differences in function group *RF Non Signalling*

R&S® CMU command	R&S® CBT command	Remarks
`POWer…, …SPECtrum…, …:WPOWer…`	–	Restricted measurement functionality on R&S® CBT
`[SENSe:]RFANalyzer:BANDwidth [:RESolution] 10 Hz to 1 MHz | WIDE`	`[SENSe:]RFANalyzer:BANDwidth [:RESolution] 10 Hz to 1 MHz`	No wideband filter on R&S® CBT
`SOURCe:RFGenerator…`	`SOURCe:RFGenerator…`	Restricted settings for modulation, frequency hopping, ramping on R&S® CBT
`[SENSe:]LEVel:ATTenuation`	–	No attenuation settings in the RF input path of R&S® CBT
`TRIGger…:SOURCe SIGNalling | RFPower | IFPower`	`TRIGger…:SOURCe SIGNalling | POWer`	No external trigger for R&S® CBT, `IFPower` and `RFPower` is equivalent to `POWer`
`TRIGger…:THReshold:RFPower TRIGger…:THReshold:IFPower LOW | MEDium | HIGH`	`TRIGger…:THReshold:POWer LOW | HIGH`	Only low and high trigger thresholds on R&S® CBT
`TRIGger…:SLOPe TRIGger…:SOURce:EXTernal`	-	No trigger slope and no external trigger on R&S® CBT
`INPut[:STATe] RF1 RF2 RF4 OUTPut[:STATe] RF1 RF2 RF3`	- -	Single RF input/output connector on R&S® CBT, CBT ignores parameters `RF1` and `RF2, RF3` and `RF4` causes a settings conflict
`…CORRection:LOSS:OUTPut<nr>… …CORRection:LOSS:INPut<nr>…`	`[SENSe:]CORRection:LOSS… SOURce:CORRection:LOSS…`	Single RF input/output connector on R&S® CBT

R&S® CMU command	R&S® CBT command	Remarks
`SOURce:DM:CLOCk:STATe` `SOURce:DM:CLOCk:FREQuency`	– –	No clock frequency on R&S® CBT

Table 7-3: Differences in function group *Bluetooth Non Signalling*

R&S® CMU command	R&S® CBT command	Remarks
–	`…RFGenerator:(S)DTX:…`	No dirty transmitter on R&S® CMU
`INPut[:STATe] RF1 RF2 RF4` `OUTPut[:STATe] RF1 RF2 RF3`	– –	Single RF input/output connector on R&S® CBT, CBT ignores parameters `RF1` and `RF2, RF3` and `RF4` causes a settings conflict
`…CORRection:LOSS:OUTPut<nr>…` `…CORRection:LOSS:INPut<nr>…`	`[SENSe:]CORRection:LOSS…` `SOURce:CORRection:LOSS…`	Single RF input/output connector on R&S® CBT
`SOURce:DM:CLOCk:STATe` `SOURce:DM:CLOCk:FREQuency`	– –	No clock frequency on R&S® CBT

Table 7-4: Differences in function group *Bluetooth Signalling*

R&S® CMU command	R&S® CBT command	Remarks
`…:WPOWer…`	–	No wideband power measurement on R&S® CBT
`CONFigure MISC:CCDefault` `PROCedure…`	– –	No distinction between current and default parameters on R&S® CBT. `PROCedure…` and `CONFigure…` commands are equivalent.
`CONFigure:MSIGnal:HSCHeme EUSA | FRANce | RXTX` `CONFigure:MSIGnal:HSCHeme :FREQuency`	`CONFigure:MSIGnal:HSCHeme EUSA | FRANce` –	R&S® CBT always uses hopping for connection setup
`CONFigure:MSIGnal :DTRansmitter:SCOPe`	`CONFigure:MSIGnal :DTX:SCOPe`	Different syntax for dirty transmitter commands. R&S® CBT recognizes `DTRansmitter` commands.
`CONFigure:MSIGnal :DTRansmitter:…`	`CONFigure:MSIGnal :SDTX:…`	Different syntax for dirty transmitter commands. R&S® CBT recognizes `DTRansmitter` commands.

–	`CONFigure:MSIGnal:DTX`
	`CONFigure:MSIGnal:UTDTX`
	`CONFigure:MSIGnal:STDTX`
		No spec. table and user defined table for dirty transmitter parameters on R&S® CMU

`TRIGger[:SEQuence]:SOURCe SIGNalling | RFPower | IFPower`	`TRIGger…:SOURCe SIGNalling | POWer`	No different power triggers on R&S® CBT. `IFPower` and `RFPower` is equivalent to `POWer`.
`TRIGger…:SOURCe SIGNalling | RFPower | IFPower`	`TRIGger…:SOURCe SIGNalling | POWer`	Only low and high trigger thresholds on R&S® CBT
`TRIGger…:SLOPe` `TRIGger…:SOURce:EXTernal`	–	No trigger slope and no external trigger on R&S® CBT
`INPut[:STATe] RF1 RF2 RF4` `OUTPut[:STATe] RF1 RF2 RF3`	– –	Single RF input/output connector on R&S® CBT, CBT ignores parameters `RF1` and `RF2, RF3` and `RF4` causes a settings conflict

R&S® CMU command	R&S® CBT command	Remarks
…CORRection:LOSS:OUTPut<nr>… …CORRection:LOSS:INPut<nr>…	[SENSe:]CORRection:LOSS… SOURce:CORRection:LOSS…	Single RF input/output connector on R&S® CBT
SOURce:DM:CLOCk:STATe SOURce:DM:CLOCk:FREQuency	– –	No clock frequency on R&S® CBT

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8 Maintenance and Interfaces

The following chapter contains information on the maintenance of the R&S® CBT.

Please follow the instructions in the service manual and in the installation instructions provided with the parts when exchanging modules or ordering spare parts. The order no. for spare parts can be found in the service manual.

The address of our support center and a list of all Rohde & Schwarz service centers can be found at the beginning of this manual.

The service manual contains more information on troubleshooting, repair, exchange of modules and calibration.

Maintenance

The R&S® CBT does not require any special maintenance. Remove any dust on the instrument by means of a soft cloth. Make sure that the air vents are not obstructed.

Cleaning the Outside

The outside of the instrument is suitably cleaned using a soft, line-free dust cloth.

Caution!
Never use solvents such as thinners, acetone and similar things, as they may damage the front panel labeling or plastic parts.

Storing and Packing

The R&S® CBT can be stored in the temperature range quoted in the data sheet. When stored for an extended period of time the instrument should be protected against dust.

The original packing should be used, particularly the protective covers at the front and rear, when the instrument is transported or dispatched. If the original packing is no longer available, use a sturdy cardboard box of suitable size and carefully wrap the instrument to protect it against mechanical damage.

Hardware Interfaces

The following sections give a description of the instrument's front and rear panel connectors with their technical data.

GPIB Bus Interface

The instrument is equipped with a GPIB bus (IEC/IEEE-bus) connection. The interface connector labeled *IEEE 488 / IEC 625* is located on the rear panel of the instrument. A controller for remote control or data transfer can be connected via the GPIB bus interface using a shielded cable.

Characteristics of the Interface

- 8-bit parallel data transfer
- Bidirectional data transfer
- Three-line handshake
- High data transfer rate of max. 1 MByte/s
- Up to 15 devices can be connected
- Maximum length of the connecting cables 15 m. The length of a single connecting cable should not exceed 2 m; if many devices are used, it should not exceed 1 m.
- Wired OR if several instruments are connected in parallel

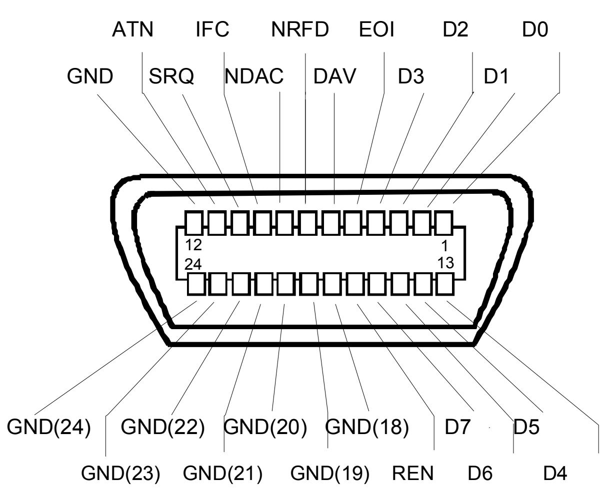


Fig. 8-1 Pin assignment of the GPIB bus interface

Bus Lines

1. Data bus with 8 lines D0 to D7

The transmission is bit-parallel and byte-serial in the ASCII/ISO code. D0 is the least significant bit, D7 the most significant bit.

2. Control bus with 5 lines

IFC (Interface Clear),
active LOW resets the interfaces of the instruments connected to the default setting.

ATN (Attention),
active LOW signals the transmission of interface messages
inactive HIGH signals the transmission of device messages.

SRQ (Service Request),
active LOW enables the connected device to send a service request to the controller.

REN (Remote Enable),
active LOW permits switchover to remote control.

EOI (End or Identify),
has two functions in connection with ATN:

ATN=HIGH	active LOW marks the end of data transmission.
ATN=LOW	active LOW triggers a parallel poll.

3. Handshake bus with three lines

DAV (Data Valid),
active LOW signals a valid data byte on the data bus.

NRFD (Not Ready For Data),
active LOW signals that one of the connected devices is not ready for data transfer.

NDAC (Not Data Accepted),
active LOW signals that the instrument connected is accepting the data on the data bus.

Interface Messages

Interface messages are transmitted to the instrument on the data lines, with the attention line being active (LOW). They serve to communicate between controller and instrument.

Universal Commands

Universal commands are encoded in the range 10 through 1F hex. They are effective for all instruments connected to the bus without pervious addressing.

Table 8-1 Universal Commands

Command	QuickBASIC command	Effect on the instrument
DCL (Device Clear)	IBCMD (controller%, CHR$(20))	Aborts processing of the commands just received and sets the command processing software to a defined initial state. Does not change the instrument setting.
IFC (Interface Clear)	IBSIC (controller%)	Resets the interfaces to the default setting.
LLO (Local Lockout)	IBCMD (controller%, CHR$(17))	Locks switchover from remote control to *Local* (manual control) by means of the front panel keys

Addressed Commands

Addressed commands are encoded in the range 00 through 0F hex. They are only effective for instruments addressed as listeners.

Table 8-2 Addressed Commands

Command	QuickBASIC command	Effect on the instrument
GTL (Go to Local)	IBLOC (device%)	Transition to the *Local* state (manual control).

Note: *The R&S® CBT can not be configured as a high-speed HS488 listener; the commands CFE (Configure Enable) and CFGn (Configure) are not supported.*

Serial Interface (COM 1)

The R&S® CBT is equipped with a serial RS-232-C interface. The 9-pin standard Sub-D male connector is labeled COM 1 and located on the rear panel. A controller for remote control or data transfer can be connected to this interface.

The interface is activated and configured in the *Setup - Remote* menu or via remote control using the `SYSTem:COMMunicate:SERial`... commands.

Interface characteristics

- Serial data transmission in asynchronous mode
- Bidirectional data transmission on two separate lines
- Transmission rate selectable from 110 to 115200 baud
- Logical 0 signal from +3 V to +15 V
- Logical 1 signal from -15 V to -3 V
- Hardware handshake RTS/CTS or software handshake XON/XOFF available

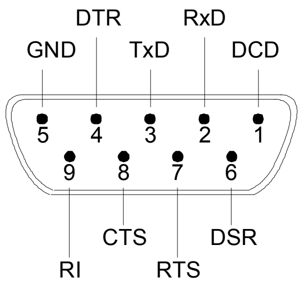


Fig. 8-2 Pin assignment of the RS-232-C interface

Designation	Abbreviation	Pin (9-pin male)	Pin (25-pin male)
Data Carrier Detect	DCD	1	8
Receive Data	RxD	2	3
Transmit Data	TxD	3	2
Data Terminal Ready	DTR	4	20
Signal Ground	GND	5	7
Data Set Ready	DSR	6	6
Request To Send	RTS	7	4
Clear To Send	CTS	8	5
Ring Indicator	RI	9	22

Signal lines

1. Data lines

RxD (Receive Data)
Input data.

Data transfer is bit-serial in the ASCII code, starting with the least significant bit (LSB).

TxD (Transmit Data)
Output data.

Data transfer is bit-serial in the ASCII code, starting with the least significant bit (LSB). The two data lines RxD and TxD are a minimum requirement for data transfer. The following control lines are necessary in addition if a hardware handshake is to be used.

2. Control and message lines

DCD (Data Carrier Detect)
active LOW.
Input; using this signal the data terminal recognizes that the modem of the remote station receives valid data with a sufficient signal level. DCD is used to disable the receiver in the data terminal and prevent reading of false data if the modem cannot interpret the signals of the remote station.

DTR (Data Terminal Ready)
active LOW,
Output; with DTR, the instrument indicates that it is ready to receive data.

DSR (Data Set Ready)
active LOW,
Input; DSR indicates to the instrument that the remote station is ready to receive data.

RTS (Request To Send)
active LOW.
Output; with RTS, the instrument indicates that it is ready to receive data. The RTS line controls whether the instrument is ready to receive data or not.

CTS (Clear To Send)
active LOW.
Input; CTS tells the instrument that the remote station is ready to receive data.

RI (Ring Indicator)
active LOW.
Input; RI is used by a modem to indicate that a remote station wants to set up a connection.

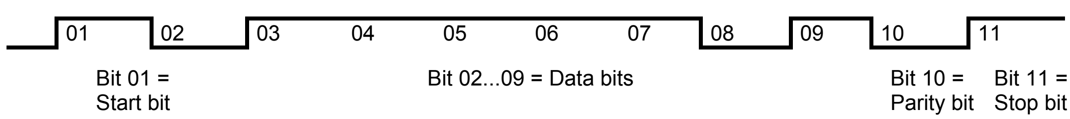
Transmission Parameters

In order to ensure error-free and correct data transmission, the parameters of the instrument and the controller must be set identically. The parameters of the RS-232 interfaces can be set in the *Setup - Remote* menu or using the command group `SYSTem:COMMunicate:SERial...`

Table 8-3 Transmission parameters of the RS-232 interface

Parameter	Default	Description / Parameter Range
Baud rate	9600 baud[1]	The instrument allows baud rates between 110 and 115200 baud to be set, see chapter 4, *Setup - Remote* menu.
Data bits	8[2]	Data transmission is in the 7- or 8-bit ASCII code, starting with the least significant bit (LSB).
Stop bit	1[3]	Transmission of a data byte is terminated by one or two stop bits. The sum of data bits and stop bits must be equal to 9.
Parity bit	None	A parity bit can be transmitted for error protection. The settings *No parity*, *even* or *odd* parity are allowed.

Example: Transmission of character 'A' (41 Hex) in 8-bit ASCII code with even parity and one stop bit:



Interface functions

For interface control, some control characters from the ASCII code range of 0 to 20 hex are predefined and can be transmitted via the interface.

Table 8-4 Control strings or control characters of the RS-232-C interface

Control Character	Function
Break (at least 1 character only log 0)	Reset instrument
0Dhex, 0Ahex	Terminator <CR>, <LF> Switchover between local / remote

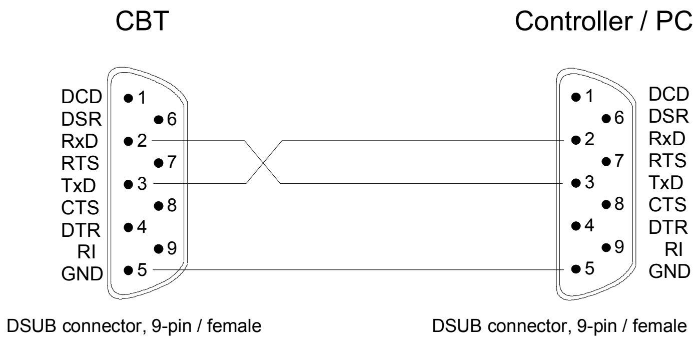
[1] The default baud rate is 19200 baud for a COM port that is used as a GPIB connector.
[2] The default number of data bits is 7 for a COM port that is used for data transfer.
[3] The default number of stop bits is 2 for a COM port that is used for data transfer.

Handshake

Software handshake

In case of a software handshake data transfer is controlled using the two control characters XON / XOFF:

- The R&S® CBT uses the control character XON to indicate that it is ready to receive data.
- If the receive buffer is full it sends the XOFF character via the interface to the controller. The controller interrupts data output until it receives another XON from the R&S® CBT.
- In the same way the controller indicates to the R&S® CBT that it is ready to receive data.



Connection between instrument and controller (Null-modem cable)

The connection of the instrument to a controller is made with a so-called null-modem cable. Here the data, control and signalling lines must be crossed. The wiring diagram on the left applies to a controller with a 9-pin or 25-pin configuration.

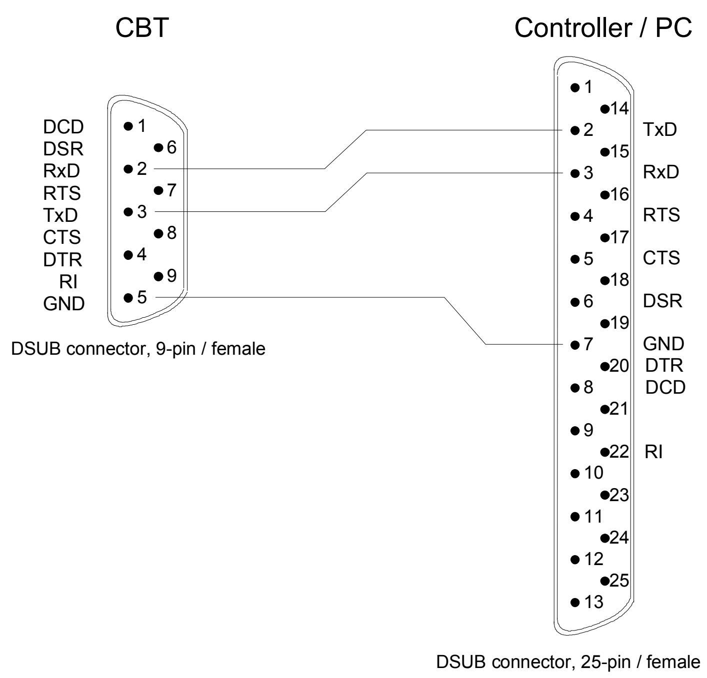
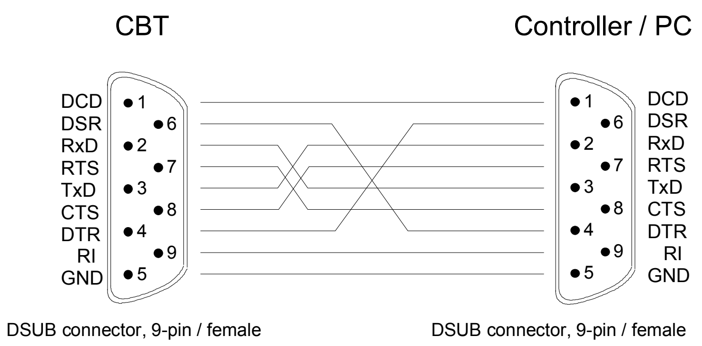


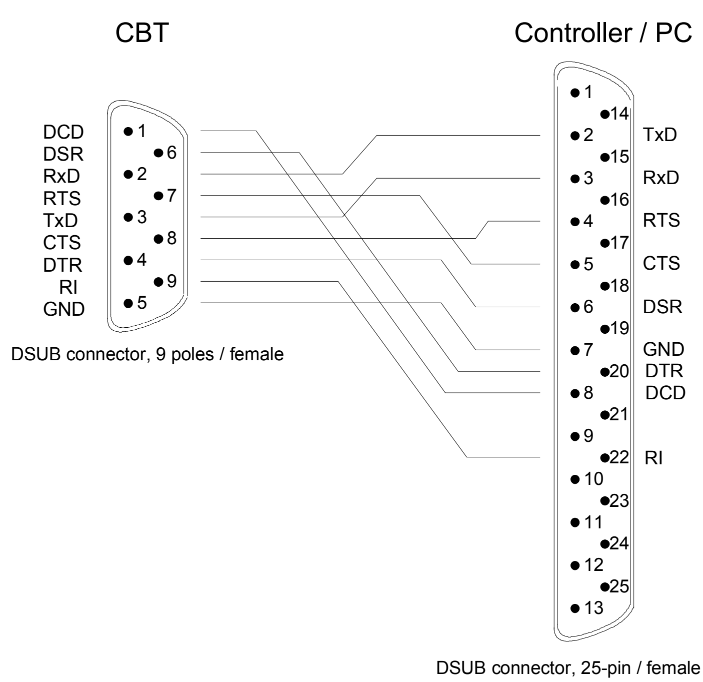
Fig. 8-3 Wiring of the data lines for software handshake

Hardware handshake

In case of a hardware handshake, the instrument signals that it is ready for reception via line DTR and RTS. A logic '0' means "ready" and a '1' means "not ready". The RTS line is always active (logical '0'), provided that the serial interface is switched on. The DTR line controls whether the analyzer is ready for reception or not.

The CTS or DSR lines (see signal lines) tell the instrument whether the remote station is ready for reception or not. A logical '0' on both lines switches on data transmission, a logical '1' on both lines stops data transmission of the generator. The TxD line is used for data transfer.





Connection between instrument and controller (Null-modem cable)

The connection of the instrument to a controller is made with a so-called null-modem cable. Here the data, control and signalling lines must be crossed. The wiring diagram on the left applies to a controller with a 9-pin or 25-pin configuration.

Fig. 8-4 Wiring of the data, control and message lines for hardware handshake

Connectors for Peripherals

Printer Connector (LPT)

The 25-pin standard Sub-D female connector LPT on the rear panel of the R&S® CBT is intended for connecting a printer. The interface is CENTRONICS compatible.

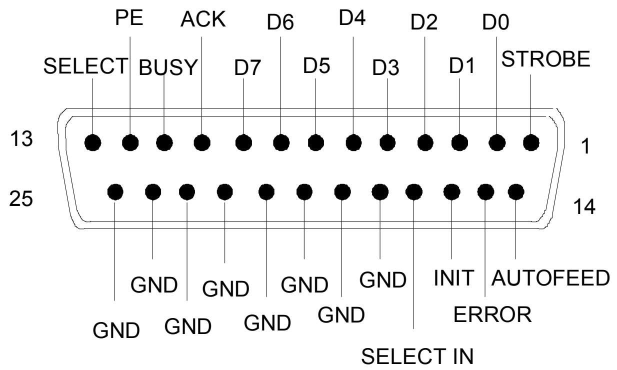
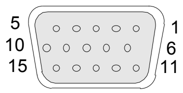


Fig. 8-5 Pin assignment of the LPT connector

Pin	Signal	Input (I) Output (O)	Description
1	STROBE	O	Impulse for transfer of a data byte, 1µs pulse width at minimum (active LOW)
2	D0	O	Data line 0
3	D1	O	Data line 1
4	D2	O	Data line 2
5	D3	O	Data line 3
6	D4	O	Data line 4
7	D5	O	Data line 5
8	D6	O	Data line 6
9	D7	O	Data line 7
10	ACK	I	Indicates that the printer is ready to receive the next byte (active LOW)
11	BUSY	I	Signal active if the printer is unable to receive data
12	PE	I	The signal is activated if no printer paper is available (active HIGH).
13	SELECT	I	The signal is activated when the printer is selected (active HIGH).
14	AUTOFEED	O	If the signal is active the printer inserts a line feed after each line (active LOW).
15	ERROR	I	The signal is activated if no printer paper is available or an error occurred (active LOW).
16	INIT	O	Initializing the printer (active LOW)
17	SELECT IN	O	If the signal is active the codes DC1/DC3 are ignored by the printer (active LOW).
18 - 25	GND		Connected to ground

Monitor Connector (MONITOR ANALOG)

The 15-pin Sub-D female connector MONITOR ANALOG at the rear panel of the R&S® CBT is intended for connecting an external VGA monitor.



Pin No.	Signal
1	RED (output)
2	GREEN (output)
3	BLUE (output)
4	MID2 (NC)
5	NC
6	R-GND
7	G-GND
8	B-GND
9	NC
10	GND
11	MID0 (NC)
12	MID1 (NC)
13	HSYNC (output)
14	VSYNC (output)
15	NC

Fig. 8-6 Pin assignment of the MONITOR connector

Keyboard Connector (USB)

Double Universal Serial Bus connector of type A (master USB), used to connect an external keyboard.

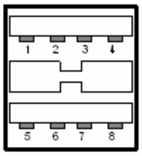


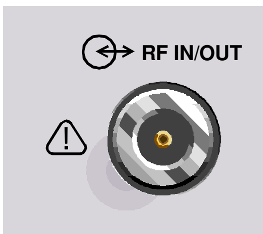
Fig. 8-7 USB connector

Note: *The USB connector is intended for keyboard connection but not for other USB pointing or storage devices.*

Signal Inputs and Outputs

RF Connectors

The N-type connector on the front panel labeled *RF IN/OUT* is used as an input and output for RF signals. The maximum permitted input level is listed in the data sheet.



Bidirectional RF connector

Fig. 8-8 RF connector

Input for the Reference Frequency (REF IN)

The BNC connector *REF IN* on the rear panel is used to synchronize the R&S CBT with external devices.

The BNC connector *REF IN* on the rear panel is used to synchronize the R&S CBT with external devices.

Input for external 10 MHz reference frequency. The frequency of the external reference signal fed in at REF IN must be set in the *Sync.* tab of the *Connection Control* menu or via the `CONFigure:SYNChronize:FREQuency:REFerence` command.

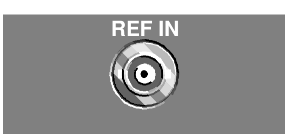


Fig. 8-9 Inputs and outputs for reference frequency

Trigger Output (TRIG. OUT)

The BNC connector *TRIG. OUT* on the rear panel is used to synchronize external devices.

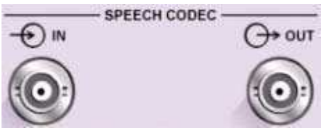
Output for trigger signals. A trigger signal is available both in Bluetooth *Signallig* and *Non Signalling* mode.

- In *Signalling* mode the trigger is a square-wave synchronized to the CBT transmit packets (x-DH1, x-DH3 or x-DH5 packets) in test mode. When not in test mode, a high-going pulse of 625 µs is synchronized to the CBT transmit packets.
- In *Non Signalling* mode the trigger output always follows x-DH5 packets.

Fig. 8-11 Trigger output

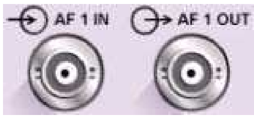
AF Connectors

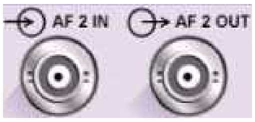
Various BNC connectors on the front panel are used as inputs and outputs for audio signals.



SPEECH CODEC IN	Input of the speech encoder
SPEECH CODEC OUT	Output of the speech decoder

The permitted output level range, the output impedance and the maximum output current of the AF connectors is listed in the data sheet. Audio test cases are reported in chapter 4, section *Audio Measurements.*





The following audio connectors are available with the audio option R&S® CBT-B41; see description in Chapter 4.

AF 1 IN	Input for audio analyzer path 1
AF 1 OUT	Output for audio generator path 1
AF 2 IN	Input for audio analyzer path 2
AF 2 OUT	Output for audio generator path 2

The technical specifications of the audio generator and analyzer are listed in the data sheet. The signal routing in the analyzer paths can be changed; see description of the *Speech Encoder* and *Speech Decoder* settings in chapter 4.

Contents

9 Error Messages

In case of an error during operation, the R&S® CBT displays a yellow notice box with a message describing the error and one or several buttons to close the box and continue operation. Accordingly, the instrument can generate error messages while executing a remote control program. Many error messages are defined in the SCPI standard. They are the same in all SCPI instruments and not related to a particular function group. These SCPI error messages are listed in section *SCPI Error Messages* on p. 9.2 ff.

The notice boxes listed below are specific to the Bluetooth function groups.

Notice Boxes during Signalling

The following notice boxes are related to Bluetooth signalling:

Message	**Explanation**
Connection Timeout	The connection was lost. After pressing *ENTER*, the R&S® CBT returns to the *STANDBY* state.
DUT not enabled for test mode	During the connection phase the R&S® CBT tried to put the DUT into test mode and got an error message back. Enable the test mode on the DUT and press *RETRY*, or press *CANCEL* to stop connecting and return to the *STANDBY* state.
Test mode parameters rejected by device	The DUT does not acknowledge the change of a test mode parameter. The user may choose to *Retry* (i.e. send the test control command again to the DUT to configure it according to the test mode parameters) or *Cancel* (i.e. ignore this error). If *Cancel* is pressed, the configuration of the DUT might not match the test mode settings of the R&S® CBT!

Notice Boxes during Measurements

The following notice boxes may be generated during measurements:

Message	**Explanation**
Bit zero not found	The power ramp is OK, but the R&S® CBT cannot correlate to the bits of the packet because the sync word couldn't be found or is wrong. Reduce maximum input level *(Max. Level* parameter in *Connection Control – Analyzer)*. If the R&S® CBT is not the master of the connection and just listens to a signal, check that the Master BD_ADDR of the R&S® CBT is the same as the BD_ADDR of the master of the connection.
Burst has wrong payload	Modulation measurement expects different payload data in the packet. Make DUT return the correct payload.
Burst too long	The burst is longer than expected. Make DUT return correct burst length.
Burst too short	The burst is shorter than expected. Make DUT return correct burst length.
Bust has wrong packet type	Modulation measurement expects a different packet type. Make DUT return correct packet type.

Message	Explanation
No power in expected centre of burst	The *Power* or *Modulation* measurement is underdriven. Reduce maximum input level *(Max. Level* parameter in *Connection Control – Analyzer).*
No power in preamble	The average power in the preamble is at least 6dB less than the power in center of the burst. No cure / measurement can't be performed in that case.
No power ramp detected or *No ramp detected*	The power ramp cannot be found, or too many ramps were detected. It is possible that the ramp down is not found because the expected length of the packet does not match the actually received packet. Check that the packet type and packet length matches the packet to be measured or reduce the expected input level *(Max. Level* parameter in *Connection Control – Analyzer).*
*Overload on RF...*or *Overload on connector...*	The input signal on the specified connector is too high to be measured, i.e. the A/D converter is in overflow. Reduce the input signal power or increase the expected input level (which defines the maximum level for the A/D converter).
Preamble not found	The preamble bits are different from 1010 or 0101. No cure / measurement can't be performed in that case.
Signal too low / burst too short	Either the input signal on the specified connector is too low to be measured or the burst is too short. Since the *Power* (and also the *Modulation* measurement) displays the measured graph even if the burst is too short or the signal is too low, it is possible to see on the screen what's going on and either correct the input level or reconfigure the burst length, depending on the measurement reading. To correct the input level, increase the input signal power or reduce the expected input level *(Max. Level* parameter in *Connection Control – Analyzer)* or use a different connector.
Trigger not found	The R&S® CBT cannot find the specified trigger. When measuring a signal without a Bluetooth connection with the R&S® CBT being the master, the trigger source must be set to power.

SCPI Error Messages

SCPI error messages are assigned negative numbers. The standard text of the error message is often supplemented by a comment from the R&S® CBT, which provides more detailed information (device-dependent information). Since this part depends on the individual situation, it often contains more relevant information than the standard text.

No error

Error code	Explanation
0	**No error** This message is output when there are no entries in the error queue.

Command error

The following errors cause bit 5 in the ESR register to be set.

Error code	Explanation
-100	**Command error** Generic error message that cannot detect a more specific error.
-101	**Invalid character** The command contains a character which is invalid for that type.
-102	**Syntax error** The data type received is not accepted at this position.
-103	**Invalid separator** The semicolon was omitted after a program message unit.
-104	**Data type error** The recognized data element is of the wrong type (e.g. character data instead of numeric data)
-105	**GET not allowed** A GET was received within a program message.
-108	**Parameter not allowed** The command contains parameters at a position where they are not accepted.
-109	**Missing parameter** The command does not contain the required parameters.
-111	**Header separator error** A character which is not a legal header separator was encountered while parsing the header; for example, no white space followed the header.
-112	**Program mnemonic too long** The header contains more than 12 characters.
-113	**Undefined header** The sent command header has not been defined.
-114	**Header suffix out of range** The command contains an illegal numeric suffix.
-120	**Numeric data error** An invalid character for the data type being parsed was encountered.
-121	**Invalid character in number** The command contains an illegal numeric suffix.
-123	**Exponent too large** The magnitude of the exponent is too large.

Error code	Explanation
-124	**Too many digits** The decimal numeric data element contains too many digits.
-128	**Numeric data not allowed** The command contains a numeric data element the device does not accept in this position.
-131	**Invalid suffix** The suffix is not appropriate for this command.
-134	**Suffix too long** The suffix contains more than 12 characters.
-138	**Suffix not allowed** A suffix is not allowed for this command or at this point of the command.
-141	**Invalid character data** The character data element contains an invalid character or the element is not valid for this command.
-144	**Character data too long** The character data element contains more than 12 characters.
-148	**Character data not allowed** The character data is prohibited for this command or at this point of the command.
-151	**Invalid string data** A string data element was expected, but was invalid for some reason.
-158	**String data not allowed** The command contains a legal string data element which is not allowed at this point.
-161	**Invalid block data** The command contains illegal block data, e.g. no numeric data element is sent after the introductory #.
-168	**Block data not allowed** The command contains legal block data which are not allowed at this point.
-171	**Invalid expression** The expression data element was invalid; for example, unmatched parentheses or an illegal character.
-178	**Expression data not allowed** A legal expression data was encountered but was not allowed by the device at this point in parsing.
-180	**Macro error** An error occurred when defining a macro or executing a macro.

Execution error

The following errors cause bit 4 in the ESR register to be set.

Error code	Explanation
-200	**Execution error** An execution error as defined in IEEE 488.2, has occurred.
-203	**Command protected**
-211	**Trigger ignored** A triggering signal was received and recognized by the device but was ignored because of timing considerations.
-212	**Arm ignored** An arming signal was received and recognized by the device but was ignored.
-213	**Init ignored** A request for a measurement initiation was ignored as another measurement was already in progress.
-221	**Settings conflict** A setting contradicts another setting. The last attempted setting was not executed.
-222	**Data out of range** A value of the transmitted command was outside the legal range.
-223	**Too much data** More data were sent by the host than the R&S® CBT can handle.
-224	**Illegal parameter value** An exact value, from a list of possible values, was expected but not received.
-225	**Out of memory** The R&S® CBT software has insufficient memory to perform the requested operation.
-230	**Data corrupt or stale** Possibly invalid data; new reading started but not completed since last access.
-240	**Hardware error** A legal program command or a query could not be executed because of a hardware problem in the device.
-241	**Hardware missing** A legal program command or a query could not be executed because of a missing device hardware.
-250	**Mass storage error** A mass storage error occurred.
-251	**Missing mass storage** A legal program command or a query could not be executed because of missing mass storage.

Error code	Explanation
-252	**Missing media** A legal program command or a query could not be executed because of missing media; for example, no floppy disk.
-253	**Corrupt media** A legal program command or a query could not be executed because of corrupt media; for example, bad floppy disk or wrong format.
-254	**Media full** A legal program command or a query could not be executed because of the media was full; for example, no room on the floppy disk.
-255	**Directory full** The specified directory is full – no more files can be written.
-256	**File name not found** A file with the specified name does not exist.
-257	**File name error** The specified file name cannot be used, e.g. because the file does not exist (reading, clearing) or already exists (writing, generation).
-258	**Media protected** A legal program command or a query could not be executed because the media was protected.

Device-specific error

The following errors cause bit 3 in the ESR register to be set.

Error code	Explanation
-300	**Device-specific error**
-310	**System error** An unspecified system error has occurred.
-311	**Memory error** An error was detected in the device's memory.
-313	**Calibration memory lost** Nonvolatile calibration data have been lost.
-314	**Save/recall memory lost** Nonvolatile saved data have been lost.
-315	**Configuration memory lost** Nonvolatile configuration data saved by the device have been lost.
-330	**Self-test failed** An error occurred during the internal self test.

Error code	Explanation
-350	**Queue overflow** Error code entered in the queue in lieu of the code when the queue is full. It indicates that an error occurred but was not recorded in the queue. The original error message is lost.
-360	**Communication error** An unspecified communication error was detected.
-361	**Parity error in program message** Parity bit was not correct when data were received on a serial port.
-362	**Framing error in program message** No stop bit was detected when data were received on a serial port.
-363	**Input buffer overrun** Software or hardware input buffer on serial port overflows with data caused by improper or nonexistent pacing.

Query error - error upon data request

When the following error codes are output, bit 2 is set in the ESR register.

Error code	Explanation
-400	**Query error**
-410	**Query INTERRUPTED** The query was interrupted. Example: a query is followed by new data before a response was completely sent.
-420	**Query UNTERMINATED** An incomplete query was received. Example: the device is addressed to talk although the received query was incomplete.
-430	**Query DEADLOCKED** A condition causing a DEADLOCKED query error occurred. Example: both input and output buffer are full and the device can not continue.
-440	**Query UNTERMINATED after indefinite response** A query was received in the same program message after a query requesting an indefinite response was execute.

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