ROHDE&SCHWARZ

Test and Measurement
Division

Operating Manual

LEVEL METER
URV35

1020.0002.02
1020.0002.03
1020.0002.63

Printed in the Federal
Republic of Germany

1020.0960.12-06   1

Tabbed Divider Overview

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Tabbed Divider

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Safety Instructions

This unit has been designed and tested in accordance with the 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, the user must observe all instructions and warnings given in this operating manual.

Safety-related symbols used on equipment and documentation from R&S:

Observe operating instructions	Weight indication for units >18 kg	PE terminal	Ground terminal	Danger! Shock hazard	Warning! Hot surfaces	Ground	Attention! Electrostatic sensitive devices require special care

1. The unit may be used only in the operating conditions and positions specified by the manufacturer. Unless otherwise agreed, the following applies to R&S products:

   IP degree of protection 2X, Pollution severity 2, overvoltage category 2, altitude max. 2000 m.

   The unit may be operated only from supply networks fused with max. 16 A.

2. For measurements in circuits with voltages V_{rms} > 30 V, suitable measures should be taken to avoid any hazards.

   (using, for example, appropriate measuring equipment, fusing, current limiting, electrical separation, insulation).

3. If the unit is to be permanently wired, the PE terminal of the unit must first be connected to the PE conductor on site before any other connections are made. Installation and cabling of the unit to be performed only by qualified technical personnel.

4. For permanently installed units without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fused such as to provide suitable protection for the users and equipment.

5. Prior to switching on the unit, it must be ensured that the nominal voltage set on the unit matches the nominal voltage of the AC supply network.

   If a different voltage is to be set, the power fuse of the unit may have to be changed accordingly.

6. Units of protection class I with disconnectible AC supply cable and appliance connector may be operated only from a power socket with earthing contact and with the PE conductor connected.

7. It is not permissible to interrupt the PE conductor intentionally, neither in the incoming cable nor on the unit itself as this may cause the unit to become electrically hazardous.

   Any extension lines or multiple socket outlets used must be checked for compliance with relevant safety standards at regular intervals.

8. If the unit has no power switch for disconnection from the AC supply, the plug of the connecting cable is regarded as the disconnecting device. In such cases it must be ensured that the power plug is easily reachable and accessible at all times (length of connecting cable approx. 2 m). Functional or electronic switches are not suitable for providing disconnection from the AC supply.

   If units without power switches are integrated in racks or systems, a disconnecting device must be provided at system level.

9. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed.

   Prior to performing any work on the unit or opening the unit, the latter must be disconnected from the supply network.

   Any adjustments, replacements of parts, maintenance or repair may be carried out only by authorized R&S technical personnel.

   Only original parts may be used for replacing parts relevant to safety (eg power switches, power transformers, fuses). A safety test must be performed after each replacement of parts relevant to safety.

   (visual inspection, PE conductor test, insulation-resistance, leakage-current measurement, functional test).

Safety Instructions

10. Ensure that the connections with information technology equipment comply with IEC950 / EN60950.

11. Lithium batteries must not be exposed to high temperatures or fire.

    Keep batteries away from children.

    If the battery is replaced improperly, there is danger of explosion. Only replace the battery by R&S type (see spare part list).

    Lithium batteries are suitable for environmentally-friendly disposal or specialized recycling. Dispose them into appropriate containers, only.

    Do not short-circuit the battery.

12. Equipment returned or sent in for repair must be packed in the original packing or in packing with electrostatic and mechanical protection.

13. Electrostatics via the connectors may damage the equipment. For the safe handling and operation of the equipment, appropriate measures against electrostatics should be implemented.

14. Any additional safety instructions given in this manual are also to be observed.

Certified Quality System

ISO 9001

DQS REG. NO 1954-04

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 Qualitätsmanagementsystems entwickelt, gefertigt und geprüft. Das Rohde & Schwarz-Qualitätsmanagementsystem ist nach ISO 9001 zertifiziert.

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 ISO 9001.

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 à la norme ISO 9001.

ROHDE & SCHWARZ

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EC Certificate of Conformity

$\mathsf{C}\,\mathsf{E}$

Certificate No.: 960247

This is to certify that:

Equipment type	Order No.	Designation
URV35	1020.0002.02	RF Levelmeter Display Unit
	1020.0002.03	
	1020.0002.63	
NRVS-B1	1029.2908.02	Testgenerator

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
  (73/23/EEC revised by 93/68/EEC)

- relating to electromagnetic compatibility
  (89/336/EEC revised by 91/263/EEC, 92/31/EEC, 93/68/EEC)

Conformity is proven by compliance with the following standards:

EN61010-1 : 1991
EN50081-1 : 1992
EN50082-1 : 1992

Affixing the EC conformity mark as from 1992

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

Munich, 10.10.96

Central Quality Management FS-QZ / Becker

2   Preparation for Use and Application Hints

2.1   Initial Start-up

2.1.1   Setting up the Instrument

The instrument may be operated in any position. The instrument is equipped with tilt feet at the bottom.

- *Ambient temperature 0 to 50 °C*

- *Prevent moisture condensation. Once the instrument has become wet, it must be dried out before it is switched on.*

2.1.2   Rackmounting

For the height of the URV35 (2 units in height), two 19" adapters are supplied:

- ZZA-97 (order No.: 827.4527.00) with 2 units in height and
- ZZA-98 (order No.: 827.4533.00) with 3 units in height,

one unit in height corresponding to 44 mm.

To mount the URV35 alone or combined with an instrument of the same height, the ZZA-97 should be used. For combination with an instrument which is higher, it is recommended to use the ZZA-98. Both adapter kits include appropriate blank panels, which permit to implement all possible combinations. For rackmounting, refer to the mounting instructions enclosed.

2.1.3   Power Supply

Two models of the Level Meter URV35 are available:

Model 02 can be operated with dry batteries, nickel-cadmium batteries and/or the power supply UZ-35 (order no 1020.1709.02). This model is dealt with in the sections 2.1.3.1 to 2.1.3.6.

Model 03 is provided with a built-in power supply unit and is only suitable for connection to the A.C. supply ($\rightarrow$ 2.1.3.7).

2.1.3.1   Operation with Dry Batteries (Model 02)

Five 1.5-V cells of the size IEC R20 (leak-proof) are required. It is recommended to use alkaline-manganese cells (IEC LR20), which permit to obtain a time of operation of 125 h (60 h with illumination switched on).

2.1.3.2   Operation with NiCd Batteries (Model 02)

As an alternative to the dry batteries, five 1.2-V nickel-cadmimum cells of the size IEC KR35/62 can be used. When the battery is fully charged, a typical operating time of 60 h (30 h with display illumination switched on) can be obtained.

The cells can be loaded externally according to the manufacturer instructions or inside the instrument using the power supply UZ-35.

When using the UZ-35, the cells are loaded with 250 mA with the instrument switched off. They are fully charged at room temperature after about

- 24 h with the instrument switched off and
- 40 h with the instrument switched on.

A low charging rate is selected such that trickle charging is possible over extended time periods without causing damage to the cells.

Charging for 1 h allows for a time of operation of 2.5 h with the instrument switched off and 1.5 h with the instrument switched on.

Charging for 12 hours thus permits to recharge the capacity for 20 to 30 hours of operation overnight.

If possible, do not charge the battery at operating temperatures over 30 °C, since the charging efficiency will then decrease on the one hand and full charging will no longer be possible on the other hand.

When charging the cells, the display illumination should be switched off in order to prevent extremely long charging.

2.1.3.3   Operation from the Power Supply UZ-35 (Model 02)

The Power Supply unit UZ-35 (order No.: 1020.1709.02) permits to operate the URV35 from the A.C. supply. To connect the power supply to the URV35, insert the jack plug of the power supply into the jack socket on the rear panel of the instrument (EXT POWER SUPPLY UZ-35) until a detent position is reached.

The power supply is connected to the power outlet via the power plug. The metal casing of the URV35 remains isolated against protective ground. Note the pertinent regulations according to VDE or DIN when connecting the power supply unit to the A.C. supply.

If the URV35 contains dry batteries, they are disconnected via the switch of the jack socket during A.C. supply operation.

NiCd cells, on the other hand, are supplied by the power supply with a trickle charging current (→ 2.1.3.2).

Different handling of NiCd batteries and dry batteries is determined by the position of the battery compartment plug (→ Fig. 2-2).

Wrong connection of the plug (position NI-CD when using dry batteries) may cause the batteries to burst and leak out.

Pay attention to the yellow warning label in the battery compartment!

After removing the jack plug from the socket, the instrument automatically changes to battery operation. When dry batteries are used, the power supply is briefly interrupted, causing a reset of the instrument.

With the power supply unit (UZ-35), the instrument can also be operated without batteries.

The UZ-35 may only be operated in dry rooms. When condensation occurs, the instrument must be dried prior to operation.

The bent jack plug permits A.C. supply operation while the URV35 is positioned on the rear-panel feet.

2.1.3.4   Replacing the Batteries (Model 02)

To replace the batteries, open the instrument. Proceed as follows:

• Loosen the screws on the rear panel of the instrument.

• Remove the top cover towards the rear.
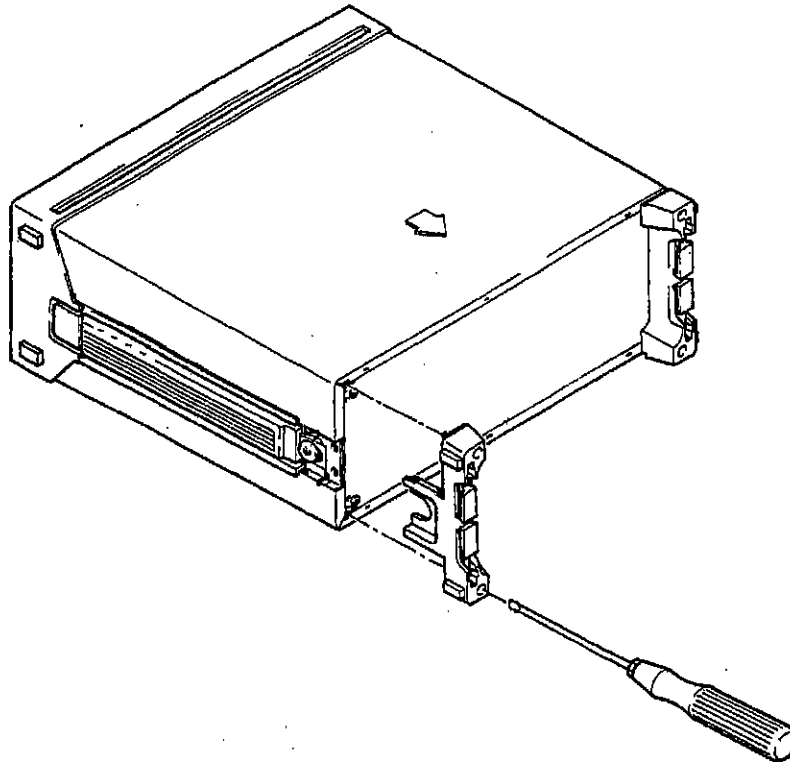
Fig. 2-1 Opening the instrument

- Remove the battery compartment plug and replace the batteries (to remove the plug, unlock by pressing on the mechanical latch).
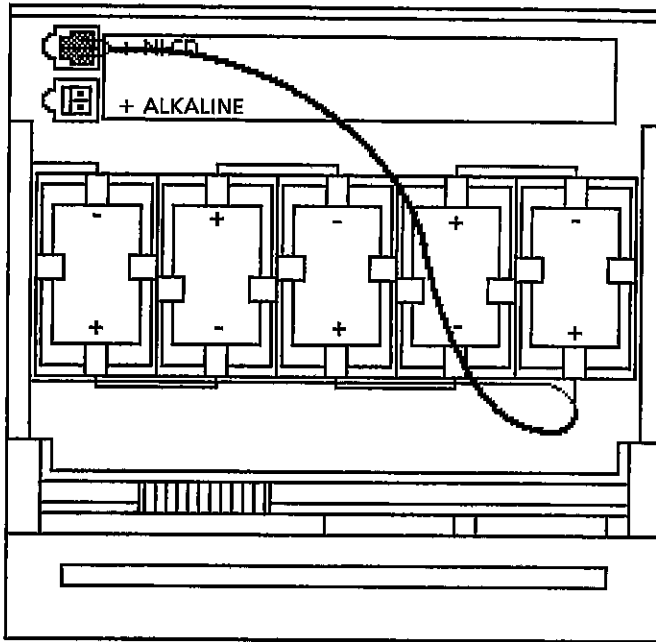
Fig. 2-2 View of battery compartment (mod. 02)

- Position the battery compartment plug correctly after replacing the batteries.

- Reassemble the instrument.
  When tightening the feet on the rear panel, press the two instrument covers firmly together.

The following instructions should absolutely be observed:

- *Insert the batteries as indicated on the battery compartment.*

- *Make sure to position the battery compartment plug correctly after changing the batteries. In the position NI-CD, a charging current is flowing which may cause dry batteries to burst and leak out. The plug positions are*

  - *ALKALINE for dry batteries*

  - *NI-CD for NiCd batteries.*

  (pay attention to the yellow warning label in the battery compartment).

- *Used batteries should be properly recycled.*

2.1.3.5 Supply Voltage Monitoring (Model 02)

The supply voltage is cyclically checked by the URV35. If it falls below 6.15 V, the following symbol appears in the display:

When the voltage falls below 5.8 V, reliable measurement operation can no longer be guaranteed, and the instrument switches off automatically.

The time between the appearance of this symbol and switch-off of the instrument depends on the discharge characteristic of the batteries used. The discharge characteristic is different for NiCd batteries and dry batteries and subject to manufacturer-dependent variations.

Typical operating times after appearance of this symbol can only be indicated as approximate values:

Alkaline-manganese batteries: approx. 15 h

NiCd batteries: a few minutes up to several hours

The supply voltage can be measured and displayed using the function SPEC → TESTS → BATT. The text "EXT" or "INT" indicates whether the instrument is supplied from the power supply (EXT) or from batteries (INT). To measure the battery voltage, the power supply must be disconnected so that "INT" appears on the display.

During operation with NiCd batteries, the symbol does not immediately disappear after connecting the UZ-35, since the battery voltage only exceeds the threshold after a particular charging time.

2.1.3.6 Switch-On Time Monitoring (Model 02)

The URV35 switches automatically off after 8 hours following switch-on when the instrument is fed by the internal battery set (this is not the case with external supply via UZ-35). The instrument is thus prevented from being switched on without being used for longer periods of time (e.g. over night or over the weekend) and thus the batteries are prevented from getting flat.

2.1.3.7 Connecting the Instrument to the A.C. Supply (Model 03)

The URV35 is suited for sine-wave A.C. voltages in the ranges

115 V	+ 15/-22 %	47 to 440 Hz and
230 V	+ 15/-22 %	47 to 63 Hz.

It can thus be connected to all conventional A.C. supplies with rated voltages of 100/110/115/120 V and 220/230/240 V.

The instrument is factory-set to 230 V. However, it can be easily adjusted by the user himself:

● Disconnect the supply cable,

● Set the voltage selection switch to the desired position using a screwdriver (fig. 3-3).

Note the relevant VDE / IEC regulations when connecting the URV35 to the A.C. supply!

The URV35 has been designed in line with safety class I according to VDE0411 or IEC348 and is protected by a thermal overload protection (with automatic reset!) integrated in the power transformer. Fuses are not contained in the instrument. The PE conductor is D.C. coupled with the casing.

2.1.4 Switch-on

The instrument is switched on using the ON/STB key on the front. The following messages appear one after the other on the alphanumeric display:

"URV35"	Instrument designation
↓	
"V x.y"	Firmware version number
↓	
"CHECK"	Testing the hardware and the instrument parameters

"PASSED"   "Err XYZ"

Error message in the case of negative test result (→ 3.3.2)

No fault has been found in the self-test.
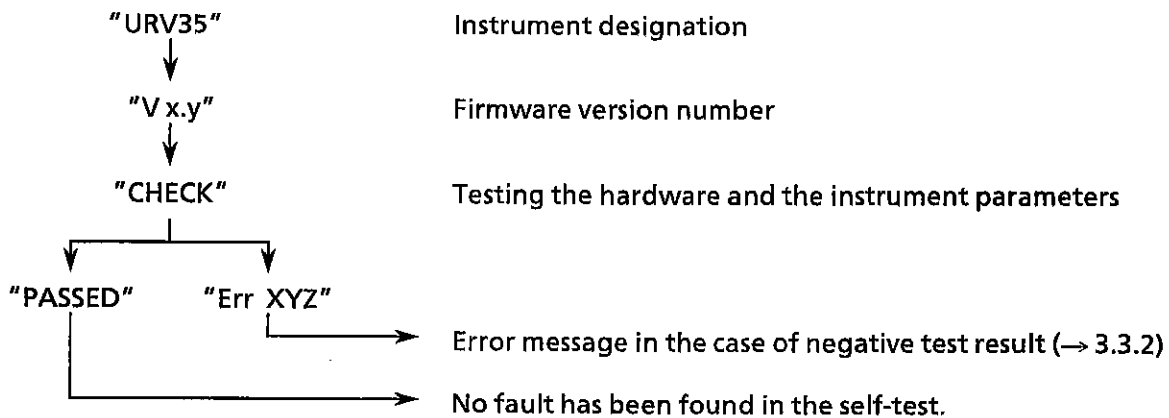
Following this switch-on sequence, the measuring head data are read in and checked if a measuring head is connected (→ 2.1.5). The instrument is then ready for the measurement and assumes its previous status valid prior to the last switch-off. An exception is the zero correction and, depending on the case, the display unit (→ 2.1.5). The zero correction is not automatically switched on, but has to be called up again each time the instrument is switched on.

The basic setting can be obtained using SPEC → SETUP → RCL 0 (→ 3.4.29 SETUP)

Note: *After replacing the batteries or connecting to the power supply, the URV35 is automatically switched on, even if it was switched off before.*

2.1.5   Connecting the Measuring Heads

All measuring heads for the URV5 and NRV can be connected to the URV35. The measuring heads are individually calibrated. The calibration data are stored in a read-only memory, which is accommodated in the casing of the plug-in adapter. After connecting the measuring head to the URV35, these calibration data are read into the URV35 and automatically taken into account by the URV35. A measuring head is connected with the URV35 by inserting the plug-in adapter into the measuring head receptacle of the URV35 until the detent position is reached.
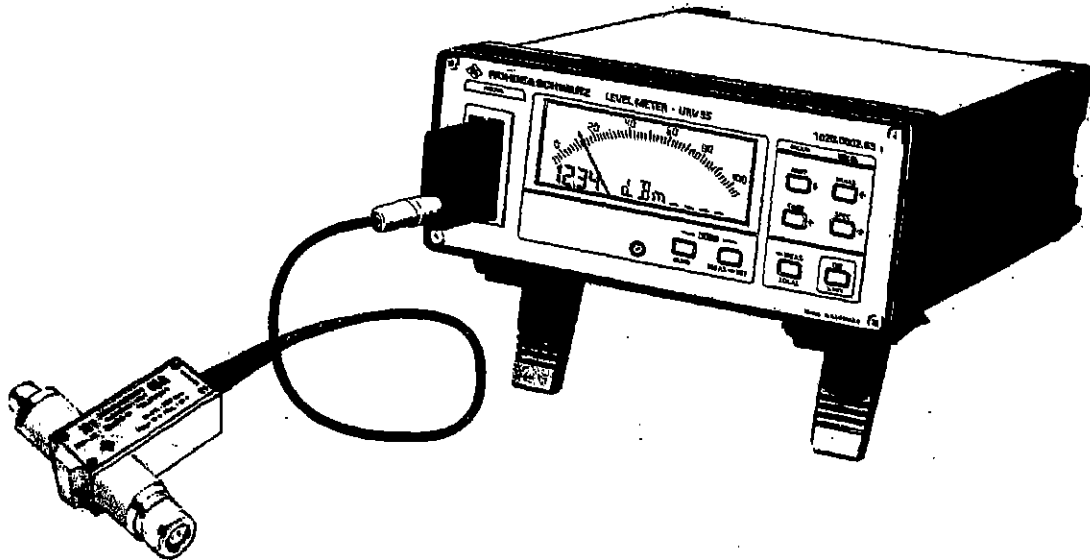
Fig. 2-3   URV35 with a measuring head connected

Connection and disconnection of a measuring head is automatically detected by the URV35 and indicated by the following messages:

```
+------------------------+
| Connect measuring head |
+------------------------+
            |
            v
+------------------------+
|     "read PRB"         |     The probe data are read in
+------------------------+
            |
    +-------+-----------------------------------------------------+
    |                         |                                   |
    v                         v                                   v
+------------+         +------------+                       +------------+
| Meas.value |         |  "Err PRB" |  The probe cannot be  |  "Err HRD" |   A hardware error
|  display   |         +------------+  identified,          +------------+   in the measuring head
+------------+                         or the probe data are faulty.         or URV35 has been
    |                                                                        detected
    v
+--------------------------+
| Disconnect the measur-   |
| ing head or switch on    |
| the instrument without   |
| probe connected!         |
+--------------------------+
            |
            v
+------------------------+
|     "no PRB"           |
+------------------------+
```
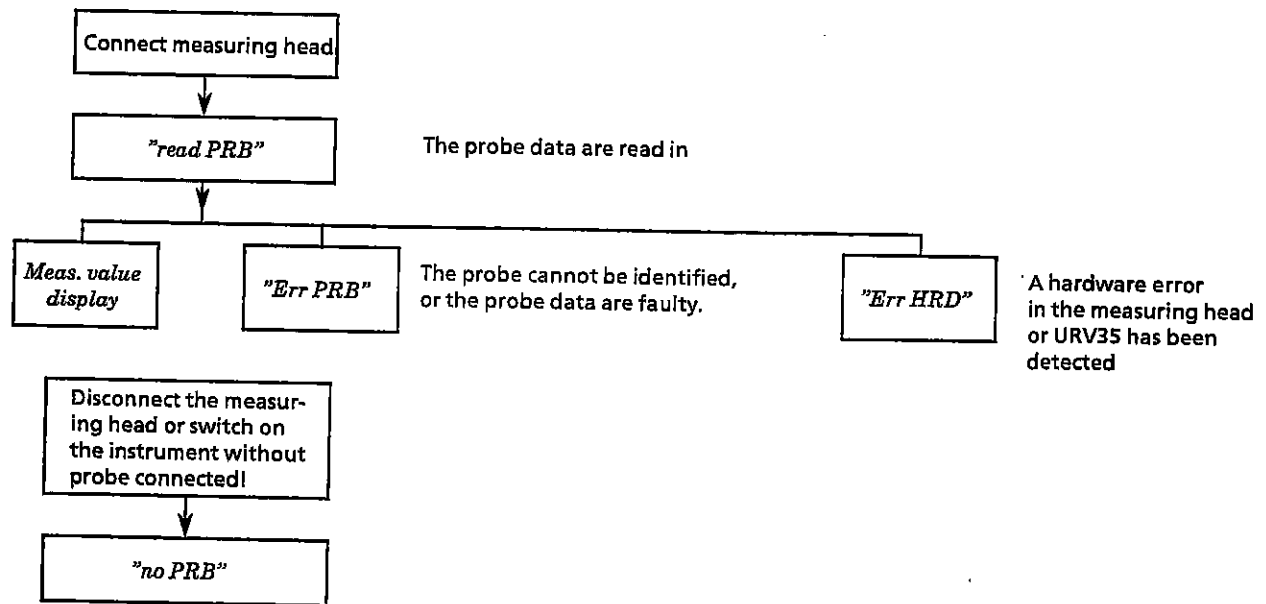
Display unit:

If a measuring head remains connected when switching the instrument off and on again, the display unit remains stored. If a voltage probe is replaced by a power sensor or vice versa with the instrument switched off, the display unit is overwritten by the basic unit of the measuring head (V or W) on power-on.

2.2   Selection and Application of the Measuring Heads

The measuring heads for the Level Meter URV35 permit to carry out voltage and power measurements according to different principles and for a variety of applications. All measuring heads have a few characteristics in common which the user should know in order to avoid errors in measurement and for safety reasons:

Ground connection

The ground connector of all measuring heads is D.C. coupled with the metal casing of the URV35! To avoid dangerous contact voltages (model 02) or current surges (model 03), do not connect the ground connector with dangerous contact voltages exceeding 50 V.

Rating

Do not exceed the limit values for voltage and power indicated in the specification for the measuring heads! Damage to measuring head! Fire hazard! Danger of current surges!

Zero adjustment

Before measuring very low voltages and powers (recommended value: sensitivity of measuring head ... +30 dB), a zero adjustment must be performed for the URV35 (ZERO, → 3.4.34).

Filtering of measured value

The URV35 features a display filtering facility matched to the measured value, i.e. when measuring low levels with a relatively high noise component, the average is taken of several subsequent measured values. This leads to a steady display and causes the measurement rate to be reduced (see Specifications URV35). In addition, the degree of filtering can be affected via the display resolution (SPEC → RESOL → LO/HI).

Weighting errors

Voltage and power measuring heads with diode rectifiers permit to measure only relatively small levels up to about 22 mV/10 µW (220 mV/1 mW with a 20-dB divider connected ahead of the measuring head) with rms weighting. With higher levels, display errors have to be expected for non-sinewave or amplitude signals.

Thermal measuring heads (NRVD-Z51 and NRVD-Z52) are suitable for rms measurements in the entire measurement range irrespective of the signal shape and the type of modulation. There is no rms weighting error.

2.2.1   High-impedance A.C. Voltage Measurement using RF Probe

The RF Probe URV5-Z7 permits almost no-load high-frequency A.C. voltage measurements in electronic circuits (Fig. 2-4). The frequency range for this application extends from 20 kHz to about 400 MHz (up to 1 GHz for indication). The voltage measurement range extends from 200 µV to 10 V (up to 100 V or 1000 V with plug-on divider).
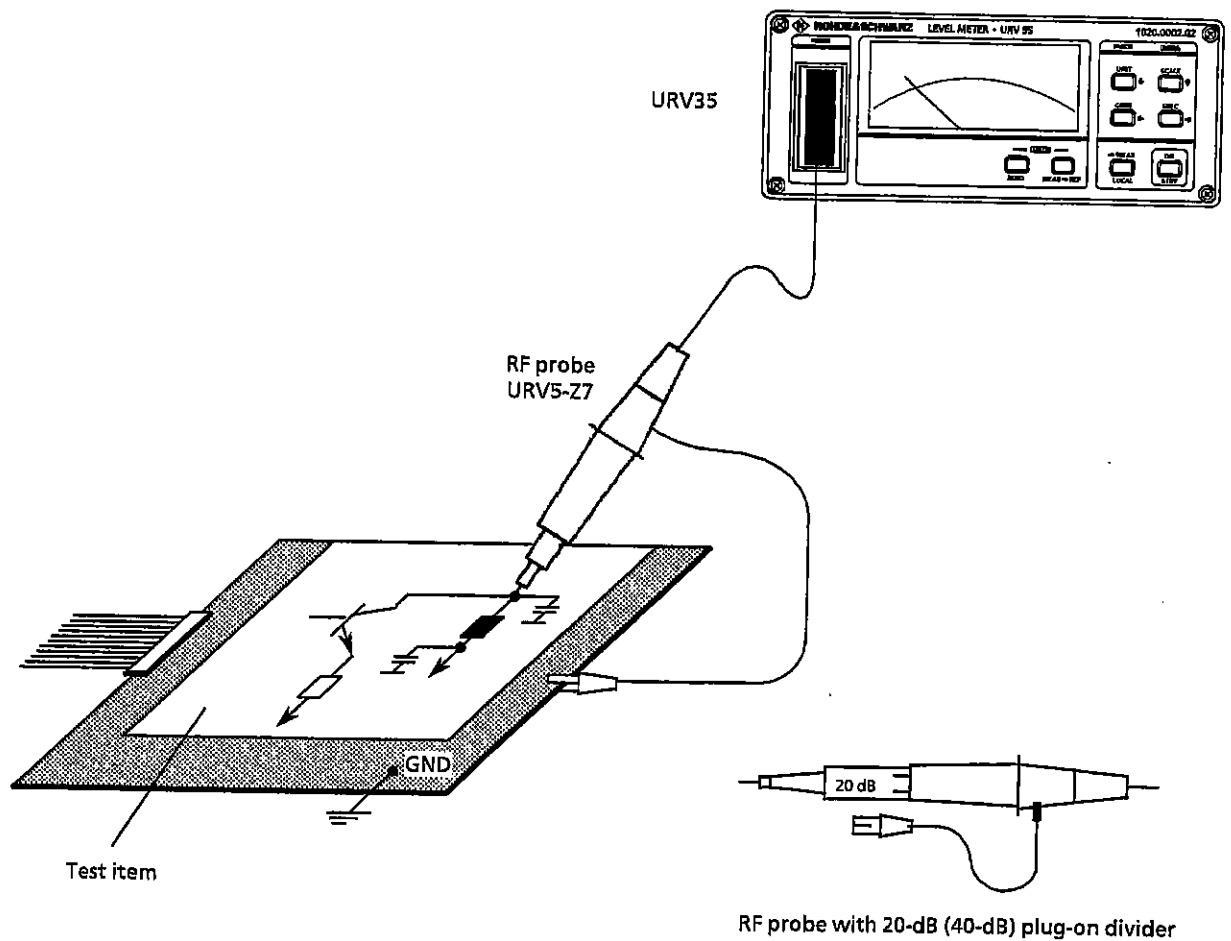
Fig. 2-4 A.C. Voltage measurement in RF circuits using probe and URV35

In addition to expanding the voltage measurement range, the plug-on dividers also increase the input impedance (Table 2-1). The attenuation value of 20 or 40 dB can immediately be taken into account in the display using the function CORR → ATT → ... .

The ground connector of the RF probe is D.C. coupled with the metal casing of the URV35! To avoid dangerous contact voltages (model 02) or current surges (model 03), do not connect the ground clip to dangerous contact voltages exceeding 50 V!

Table 2-1 Recommended ranges of application of the RF probe for high-impedance A.C. voltage measurement

	RF probe URV5-Z7	with 20-dB divider (URV-Z6)	with 40-dB divider (URV-Z6)
Frequency range	20 kHz to 300 MHz	1 MHz to 400 MHz	0.5 MHz to 500 MHz
Voltage measurement range	200 µV to 10 V	2 mV to 100 V	20 mV to 1000 V
Input impedance (at 10 MHz)	2.5 pF ‖ 80 kΩ	1pF ‖ 1 MΩ	0.5 pF ‖ 10 MΩ
Rating	44 V_{pp}/400 $V_=$/15 V_{rms}	440 V_{pp}/ 1 $kV_=$/150 V_{rms}	3 kV_{pp}/1 $kV_=$/1050 V_{rms} [1]
Frequency response correction	no	no	no

[1] Rating up to 40 MHz; for higher frequencies see Specifications URV5-Z7.

The measurement uncertainty for frequencies above 10 MHz considerably depends on the matching of the measuring head. Instead of the ground cable, the low-inductance ground connection according to Fig. 2-5 should be used. This considerably improves the frequency response of the test setup and simultaneously reduces the magnetic field sensitivity.
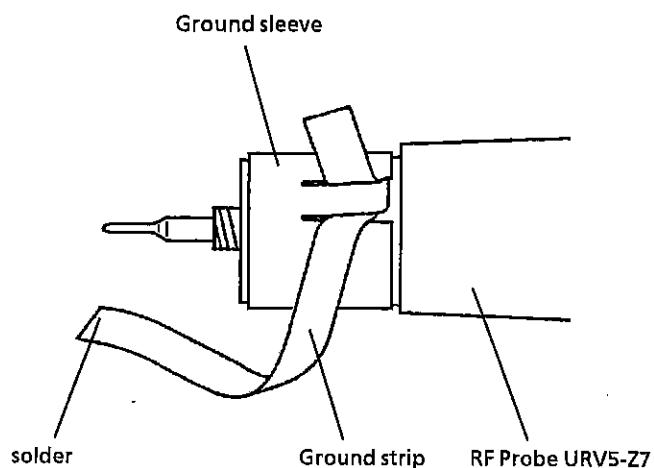
Fig. 2-5 Low-inductance ground connection

2.2.2   Level Measurement on coaxial Lines

Whenever the signal level on a transmission line is to be measured using simple means, the coaxial voltage measurement can be used (Fig. 2-6). With a small SWR, the voltage remains constant along the line and is a measure of the signal level or the transmitted power.

$$P \simeq \frac{V_{RF}^2}{Z_0}$$

$$Z_0 = 50/75 \ \Omega$$
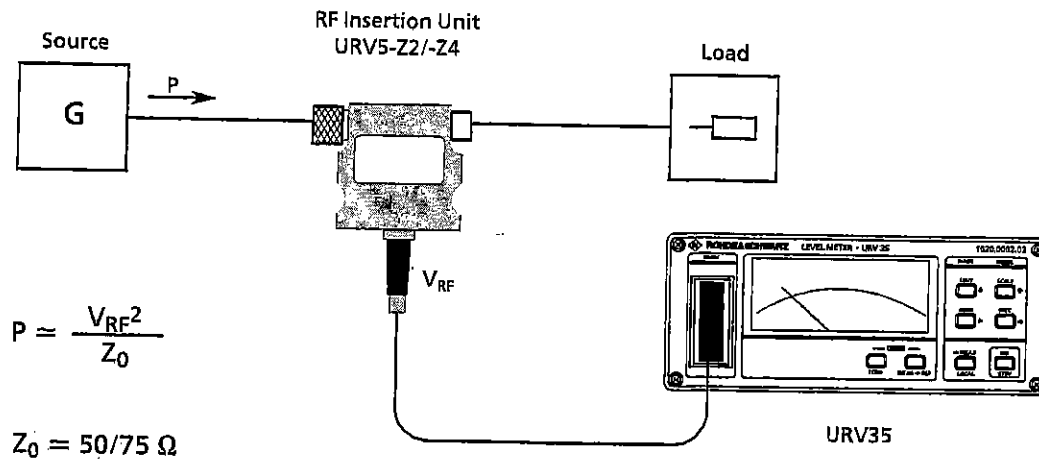
Fig. 2-6 RF level measurement using insertion unit and URV35

Three insertion units as well as the RF probe with insertion adapter and plug-on divider are available for these measurements (Fig. 2-7 and table 2-2).

Table 2-2   Recommended ranges of application for the coaxial level measurement (insertion loss <0.5 dB and SWR <1.2 for the specified frequency ranges - typ. values, if not defined otherwise in the specifications).

	Insertion unit URV5-Z2	Insertion unit URV5-Z4/50	RF probe in adapter (URV-Z6)	+ 20-dB divider (URV-Z6)	+ 40-dB divider (URV-Z6)
Frequency range	9 kHz to 1 GHz	100 kHz to 3 GHz	20 kHz to 300 MHz	2 MHz to 400 MHz	1 MHz to 500 MHz
Voltage meas. range	200 µV to 10 V	2 mV to 100 V	200 µV to 10 V	2 mV to 32 V	20 mV to 32 V
Level meas. range	-60 to +33 dBm	-40 to +53 dBm	-60 to +33 dBm	-40 to +43 dBm	-20 to +43 dBm
Power meas. range	1 nW to 2 W	100 nW to 200 W	1 nW to 2 W	100 nW to 20 W	10 µW to 20 W
Rating	44 V_{pp}/50 $V_=$/ 15 V_{rms}	440 V_{pp}/1 $kV_=$/ 150 V_{rms}	44 V_{pp}/400 $V_=$/ 15 V_{rms}	440 V_{pp}/750 V_{pk}/ 32 V_{rms}	1,5 kV_{pp}/ 750V_{pk}/ 32 V_{rms}
Impedance	50 Ω	50 Ω	50 Ω	50 Ω	50 Ω
Measuring accuracy	+ +	+ + +	+ +	o	+
Frequency response corr.	yes	yes	no	no	no

By selecting the display unit dBm or W (UNIT → dBm/W), the level and the power can automatically be displayed by the URV35. When using the RF probe, the impedance (only 50 Ω!) must first be set (CORR → IMP → 50 Ω). The insertion units already contain the impedance data in their data memory. To reduce the measurement uncertainty of the insertion units, the measuring-head-specific frequency response correction data can additionally be taken into account (CORR → FRQ → ...)
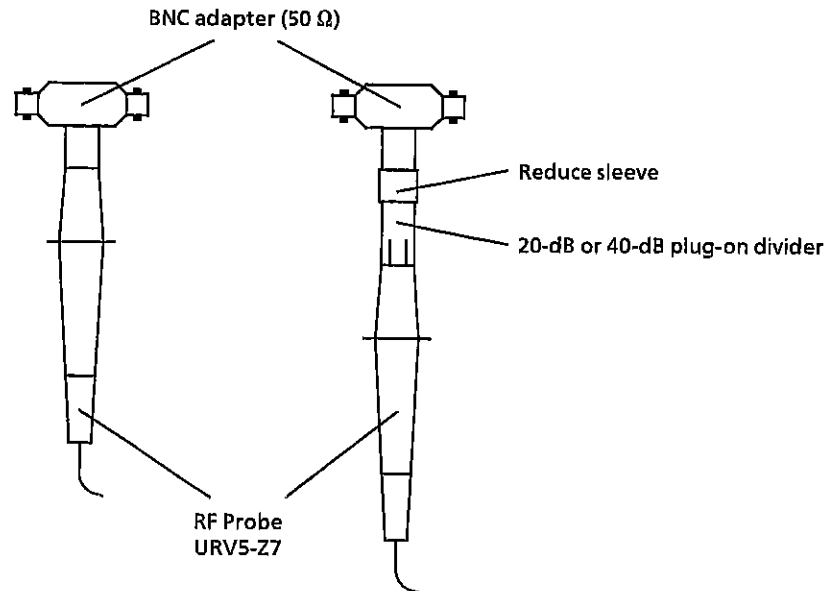
Fig. 2-7 Connection of the RF probe for coaxial level measurements

2.2.3   Terminated Power Measurement

High-frequency sources such as RF and microwave generators, but also the outputs of passive components supplied (directional couplers, attenuator pads, power dividers, filters etc.) are characterized by the reflection coefficient and their available power.

For measurement purposes, the available power is of primary interest with the termination matched (source terminated with 50 or 75 Ω). It can be measured over a wide frequency and level range using the power sensors NRV-Z... (Fig. 2-8). Due to the high calibration accuracy and excellent matching of these measuring heads, only very small errors in measurement are obtained.
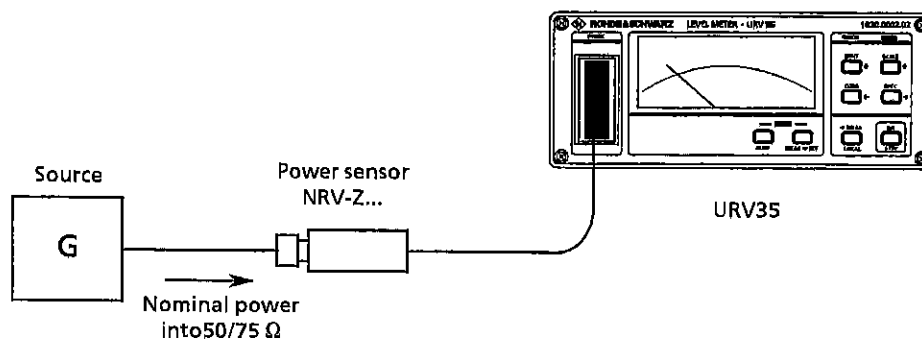
Fig. 2-8 Power measurement with terminating sensor NRV-Z... and URV35

In the RF range, the insertion units URV5-Z2/Z4 and the RF probe URV5-Z7 can also used for power measurements (Fig. 2-9). They have an advantage over the NRV measuring heads whenever a larger dynamic range and a higher rating are required. Since the insertion units and the RF probe are calibrated in the configuration shown below (probe in the 50-Ω adapter), a relatively low measurement uncertainty can additionally be achieved.

In order to be able to display the voltage measured by the RF probe in the display units W and dBm, the reference impedance of the adapter must be entered before (CORR → IMP → 50/75). The insertion units contain this information in their data memory.

The measuring-head-specific frequency response correction data of all measuring heads can be considered in the display via the function CORR → FRQ →... (not with probe in the 75-Ω adapter).

Low-reflection termination

RF Insertion Unit URV5-Z2/-Z4

RF Probe URV5-Z7

Terminating adapter URV-Z50 (50 Ω)

RF Probe URV5-Z7

Terminating adapter URV-Z3 (75 Ω)
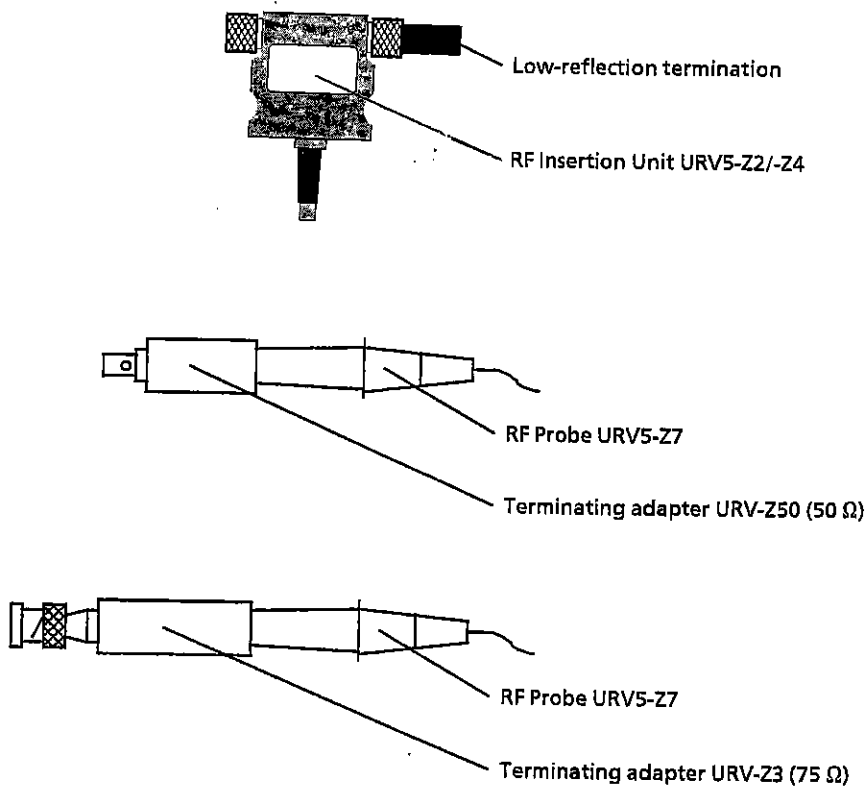
Fig. 2-9 Connection of insertion unit and RF probe for terminated power measurements

Table 2-3 Recommended ranges of application for terminated power measurements

	Power sensors NRV-Z...	Insertion unit URV5-Z2	Insertion unit URV5-Z4/50	RF probe in adapter URV-Z50	RF probe in adapter URV-Z3
Frequency range	DC to 40 GHz	9 kHz to 3 GHz	500 kHz to 3 GHz	20 kHz to 1 GHz	20 kHz to 500 MHz
Level meas. range	-70 to +45 dBm	-60 to +33 dBm	-40 to +53 dBm	-60 to +33 dBm	-62 to +31 dBm
Power meas. range	100 pW to 30 W	1 nW to 2 W	100 nW to 200 W	1 nW to 2 W	500 pW to 1.3 W
Rating	---	4,5 W	450 W	2 W	2 W
Impedance	50 and 75 Ω	50 Ω	50 Ω	50 Ω	75 Ω
Measuring accuracy	+ + + +	+ + +	+ + +	+ +	+ +
Frequency response correction	yes	yes	yes	yes	no

2.2.4   D.C. Voltage Measurement using D.C. Probe

Featuring a high input impedance, the D.C. Probe URV5-Z1 is particularly suitable for applications in RF circuits: determining the operation point of amplifiers, checking supply voltages etc. (Fig. 2-10).

Table 2-4 Characteristics of D.C. Probe URV5-Z1.

Voltage measurement range	±(1 mV to 400 V)
Resolution	0.1 mV
Input impedance	9 MΩ ‖ 3 pF
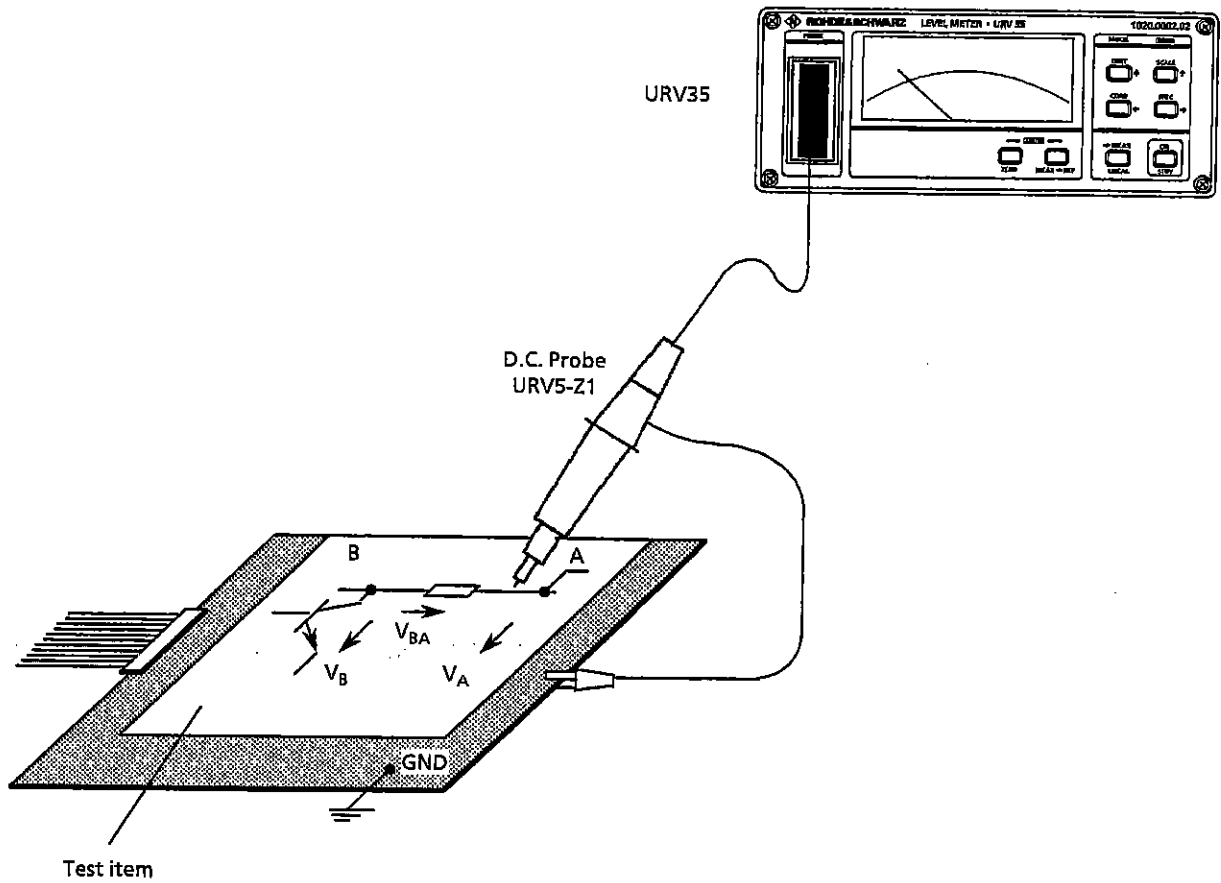
Fig. 2-10   Measure voltages and referred to ground voltage differences using D.C. Probe URV5-Z1
             and URV35

*The ground connector of the D.C. probe is D.C. coupled with the metal casing of the URV35! To avoid
current surges (model 02) or short-circuits (model 03), do not connect the ground clip to dangerous
contact voltages exceeding 50 V!*

The best thing to do is always to keep the ground clip connected with circuit ground.

Voltage differences between two test points (V_{BA} in Fig. 2-10) are measured as follows:

Test setup	URV35
Lightly touch reference point (A) (reference measurement)	Check V_A. Shift zero point of URV35 ($\rightarrow$ ZERO). Check display: 0 V. The text "ZERO" must be marked.
Lightly touch test point (B)	Read V_{BA}. By pressing the ZERO key again, the display is again referred to ground. *Note: The zero adjustment can be performed using the D.C. probe up to max. ±20 V.*

2.3   Applications

The following measuring examples illustrate the wide range of applications of the URV35. Most of the examples show power measurements, since they represent the widest range of application. Depending on the application, a Power Sensor NRV-Z..., an Insertion Unit URV5-Z2/Z4 or the RF Probe URV5-Z7 with 50 or 75-Ω adapter can be used. For the sake of simplicity, the illustrations always show power heads.

2.3.1   Attenuation Measurement (Substitution Method)

The URV35 permits coaxial attenuation measurements in the range 0 to 70 dB (NRV-Z...) or 0 to 90 dB (URV5-Z...) (Fig. 2-11). Set the source to the highest possible level if permitted by the test item and the measuring head. Besides, the matching of RF and microwave generators should be improved using a low-reflection 3-to-10-dB attenuator pad.
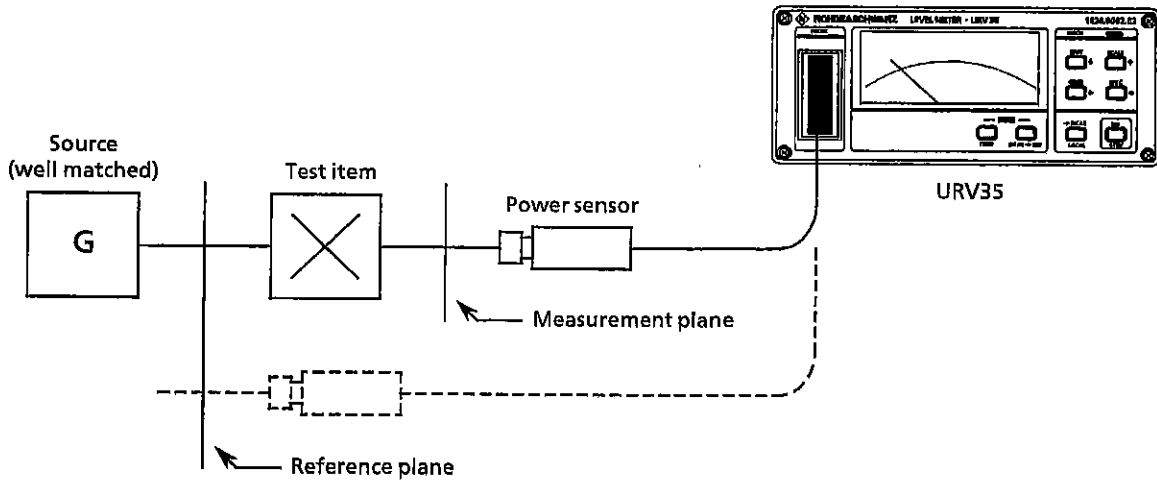
Fig. 2-11 Attenuation measurement via power comparison according to the substitution method

Procedure

Test setup	URV35
Connect measuring head to source (reference measurement).	Set unit ΔdB (UNIT → ΔdB). Select scale (SCALE → AUTO/FIX/LIMIT). Store measured value as reference value (MEAS-REF → STO). Check display: 0 dB.
Insert test item	Read attenuation value

2.3.2   Sweep Tester for Transmission Measurements

Determination of the transmission parameters attenuation or gain according to the substitution method (→ 2.3.1) is very exact, however, it always requires reconnection of the measuring head for the reference measurement.

Higher measurement uncertainties are permissible for a lot of transmission measurements, and often only relative attenuation values are required. Fig. 2-12 shows an appropriate test assembly with a level-controlled generator, URV35 and XY-recorder for documentation of the frequency-dependent attenuation characteristic.

The sawtooth output of the generator provides a D.C. voltage which is linearly dependent on the frequency to the X-input of the recorder (frequency axis) and the DCFREQ input of the URV35 for the tracking frequency correction.

The level-proportional output voltage of the URV35 (DCLEV) is applied to the Y-input of the recorder.
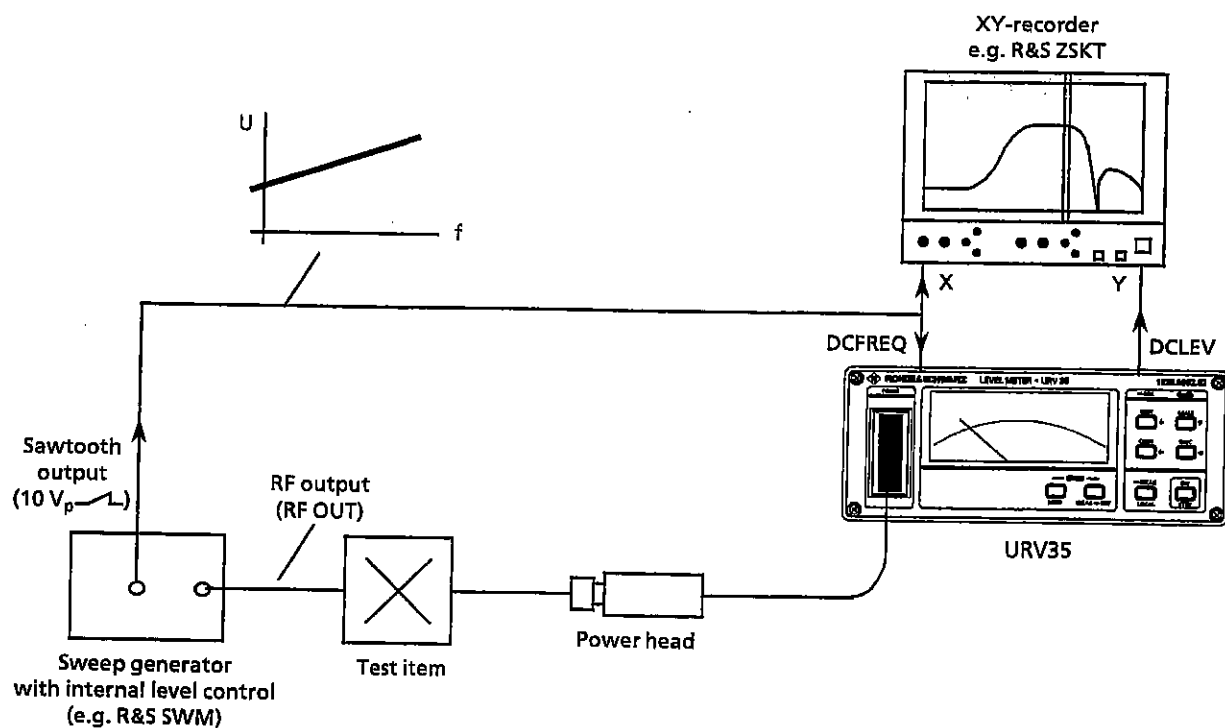
Fig. 2-12 Sweep tester with URV35 and XY recorder for transmission measurements

Operation

Sweep Generator	URV35 (V), recorder (R)

Set RF level.
Switch on internal level control.
	R: Set Y-sensitivity to 0.2 V/cm (deflection 0 to 15 cm).
	
	V: Set unit ΔdB (UNIT → Δ dB).
	
	     Select a resolution of 0.01 dB (SPEC → RESOL → LO).
	
	     Select scale for display (SCALE → LIMIT → ...):
	
	     Sensitivity 10 dB/cm → scope of display 150 dB, e.g. -120 to +30 dB
	                 5 dB/cm → scope of display 75 dB, e.g. -70 to +5 dB
	                 2 dB/cm → scope of display 30 dB, e.g. -20 to +10 dB
	                 1 dB/cm → scope of display 15 dB, e.g. -15 to 0 dB

Enter start/stop frequency.
Set manual sweep.
Set reference frequency
(0-dB point).
	V: Enter voltage-frequency characteristic of sawtooth output
	     (CORR → FRQ → DCFRQ → ...).
	     e.g. 0 V/start frequency and 10 V/stop frequency for SWM.
	
	     Check display of reference frequency.
	
	     Store instantaneous measured value as reference value
	     (MEAS-REF→ STO).
	     Check display: 0 dB.
	
	R: Set 0-dB position.
	
	     Set X-sensitivity.
	     e.g. 0.5 V/cm for 20-cm deflection with 10-V deflection (SWM).
	
	     Set position for reference frequency.

Start automatic sweep. Optimize sweep rate.	

2.3.3   Reflection Measurement using SWR Bridge

Due to their large dynamic range, the measuring heads for the URV35 are excellently suited for measuring low reflection factors, e.g. using SWR bridges of high directivity (Fig. 2-13). The power component reflected by the test item is cut off in the bridge, applied to the power sensor and displayed as return loss.

A short-circuit and/or a shielded open circuit are required for the measurement. The measuring head should feature a sensitivity of at least 1 nW (-60 dBm), the source is to be set to the highest possible output power (1 to 20 mW, 0 to +13 dBm).
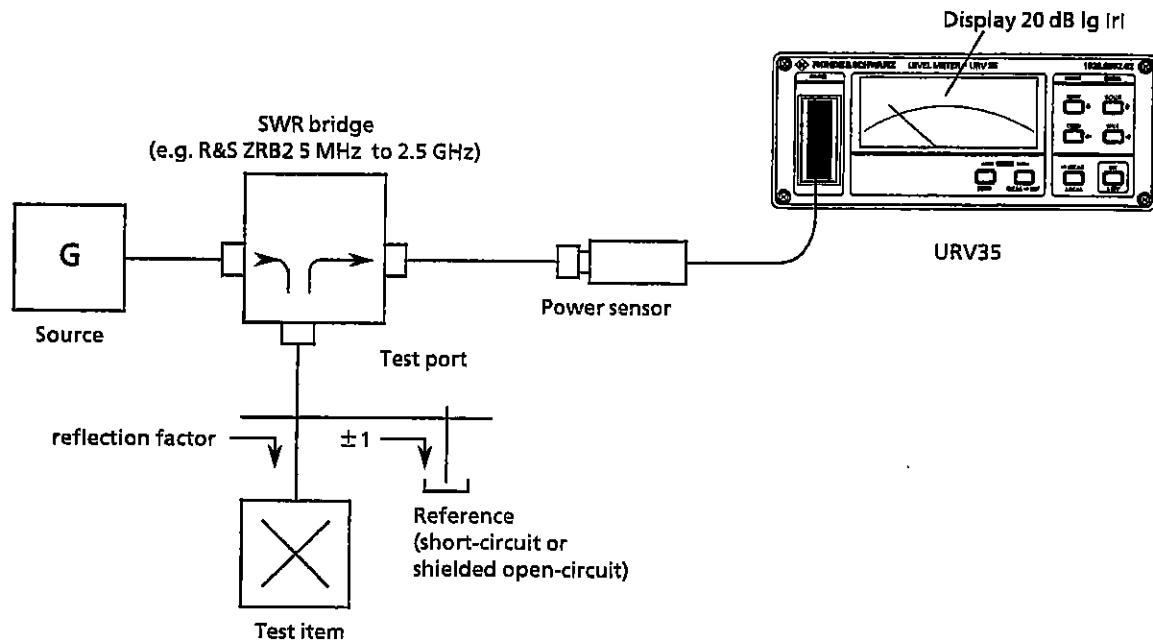
Fig. 2-13 Measurement of return loss using SWR bridge

Procedure

Test Port	URV35
Connect short-circuit (reference measurement).	Set unit ΔdB (UNIT → ΔdB). Select scale (SCALE → AUTO/FIX/LIMIT). Store measured value as reference value (MEAS-REF→ STO). Check display: 0 dB.
If present, connect shielded open circuit of the same electrical length.	Check display: ±1 dB. With greater deviations, vary the reference value such that the short-circuit and the open-circuit measurement result are symmetrical about 0 dB.
Connect test item.	Read the return loss.

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2.3.5   RF Current Measurement

High-frequency currents up to about 300 MHz can be measured without opening the measuring circuit using so-called clamp-on current probes (Fig. 2-15). These current probes provide a voltage V proportional to the RF current I to a 50-Ω termination.
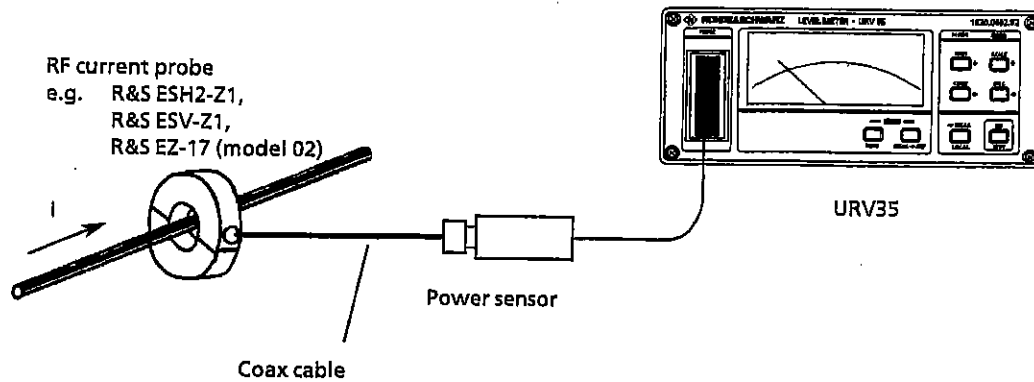
Fig. 2-15 RF current measurement with clamp-on current probe

The transmission response is characterized by the logarithmic conversion factor k:

$$V/V = I/A \cdot 10^{-k/20\,dB}$$

k must be entered with its sign into the URV35 as the attenuation correction value (CORR → ATT → ...). The numerical value read out in the unit V (UNIT → V) will then be equal to the current in A.

A terminated Insertion Unit URV5-Z2 is particularly suitable for use with the current probes ESH2-Z1, ESV-Z1 and EZ-17 (model 02) (Table 2-5).

Table 2-5 Current probe/measuring head combinations for RF current measurement

	ESH2-Z1 + URV5-Z2	ESV-Z1 + URV5-Z2	EZ-17 (mod. 02) + URV5-Z2
Frequency range*)	100 (9) kHz to 30 MHz	20 MHz to 100 (300) MHz	5 MHz (9 kHz) to 100 MHz
Current measurement range	200 µA to 10 A	20 µA to 1 A	50 µA to 2 A
Conversion factor k	0 dB	-20 dB	-10 dB
Permissible current	10 A_{rms} / 15 A_{pp}	1,5 A_{rms} / 2 A_{pp}	2 A_{rms} / 3 A_{pp}

*) values in ( ): extended available frequency range with a frequency dependent conversion factor.

2.3.6   Level Control for Signal Generator

Signal generators are stabilized via an internal level control in general. A d.c. voltage proportional to the output level is generated via a directional-coupler/detector combination and used for control. This control voltage can often be supplied from outside as well. Such an external control is generally superior to the internal one since exact power meters can be used to measure the output level. Further, external control has the advantage that the power can be directly stabilized at the test object. The attenuation of filters or relatively long connection cables inserted between generator and test object is compensated.

Fig. 2-16 shows such a level control for signal generator SMP 02/22 in connection with level meter URV35. It features high stability, a low amplitude error and a very simple operation: the RF level desired is simply entered into the URV35 in dBm or W as a reference value. Settling to a level or frequency change only takes 1 to 2s.

Level meter URV35   Signal generator SMP02/22
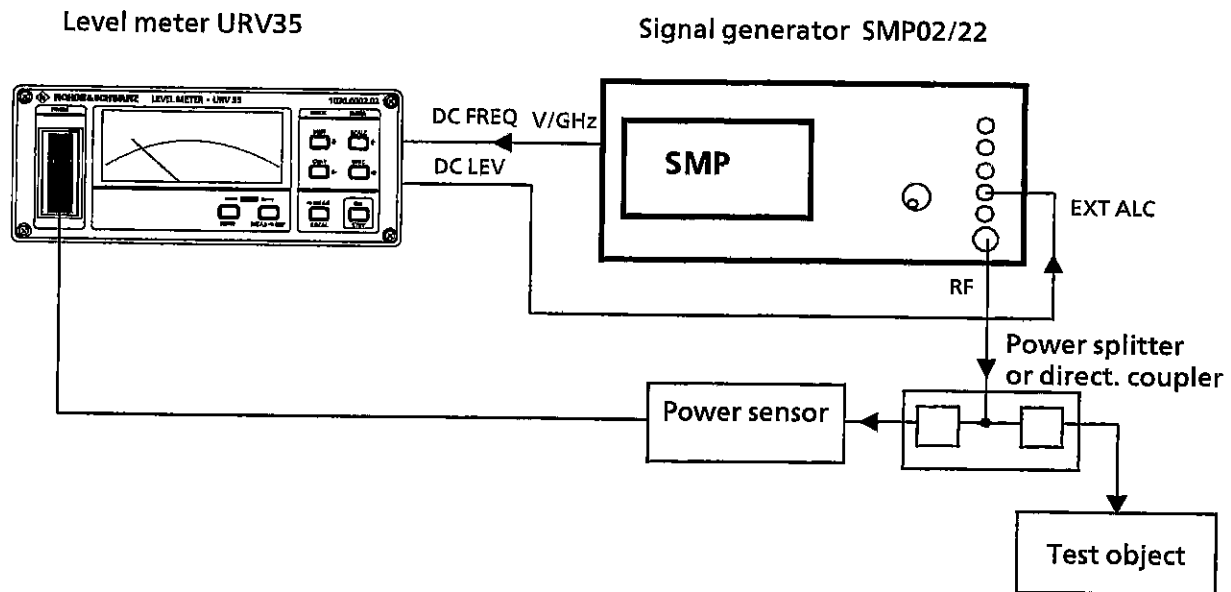
Fig. 2-16   Precision level control for SMP 0/22.

Function: The d.c. voltage output (DC LEV) of the URV35 feeds a voltage proportional to the system deviation into the external ALC input of the SMP. This voltage is integrated and varies the output level until the system deviation disappears via a PIN control element. In addition, the frequency information is transmitted to the URV35 in the form of a d.c. voltage and used for frequency response correction of the sensor via output V/GHz of the SMP.

The control operates in a level range of -20 to +8.5 (SMP 02) or -20 to +20 dBm (SMP22), measured at the RF output of the SMP.

Almost all sensors of series NRV-Z can be used as power sensors. The following levels at the sensor should not be fallen below to ensure a high stability of the output power:

NRV-Z1, -Z4, -Z6, -Z7:   -30 dBm
NRV-Z2, -Z5, -Z8:   -10 dBm
NRV-Z51, -Z52:   -5 dBm

Operation

SMP	URV35

Set frequency-proportional d.c. voltage
 	
UTILITIES
    AUX I/O
        V/GHZ
            0.5 V/GHZ
	Select 3 1/2-digit display (SPEC→RESOL→LO res.→STO)
	
	Set unit ΔdB (UNIT→ ΔdB)
	
	Fixedly scale display to ± 3 dB
	(SCALE→LIMIT → -3 dB → STO → + 3 dB → STO)
	
	Enter coupling attenuation of the directional coupler in dB
	(with Power Splitter 0 dB)
	(CORR→ATT→attenuation value→STO/ON)
	
	Activate dynamic frequency response correction
	(CORR → FRQ → DCFRQ → 2GHZ F1 → 1V U1 → 20 GHZ F2 → 10V U2 →MEAS)
	
	Check frequency readout
	
	Switchover to power display
	(→MEAS)
	
	Enter rated level in W or dBm
	(CORR→REF→level→STO)

Switch on external level control (EXT.ALC).
 	
LEVEL
    ALC
      SOURCE
        PMETER
          NRVS	

2.4   Fitting Option

2.4.1   Fitting Option NRVS-B1 (Sensor Check Source)

The sensor check source can be retrofitted into any URV35 basic unit provided that rear panel of the unit has an appropriate opening (labelling: POWER REF 1.00 mW · 50 MHz). No special accessories or knowledge are required for fitting the option. The sensor check source is factory set and so its specifications are guaranteed when it is installed in the URV35 basic unit.

Stick to the following order when fitting the option:

- Disconnect power plug (model 03) or Power Unit/Battery Charger UZ-35.

- Undo the two rear feet.

- Remove top and bottom cover (slightly lift at the back and withdraw towards the rear).

- Place unit onto a flat surface (batteries/rechargeable batteries or power supply facing upwards).

- Remove one cell of the battery/rechargeable battery set.

- Press out plug from the inside to clear opening in rear panel.

- Pass RF connector of sensor check source through opening in rear panel; the soldered side of the PCB is facing upwards.

- Shorten pin 5 of 9-pin connector X505. Move polarizing contact of cable W1 from pin 10 to pin 5. Remove connector shell no. 10 with a side-cutter.

- Fasten sensor check source with the supplied screws.

- Run twisted connecting line W1 through partition opening.

- Slide cable grommets over connecting line and insert into partition.

- Connect line on the one side to sensor check source and on the other to connector X505. Make sure that locks catch on both sides.

- Run connecting cable so that it cannot get trapped when closing the unit.

- Put unit back together in the reverse order. Prior to fixing rear feet tightly press the two covers.

- Switch on unit and test functioning of sensor check source (→ 3.8, 5.2.9).
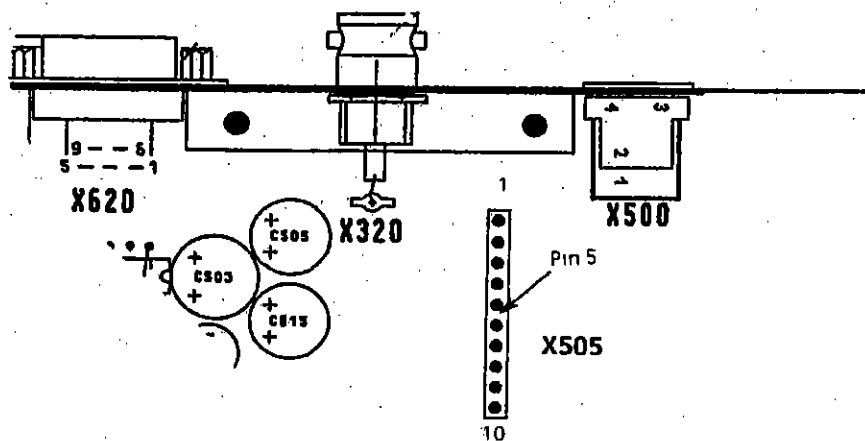
Fig. 2-17 Position X505

3   Operation

3.1   Explanation of Front and Rear Panel Views
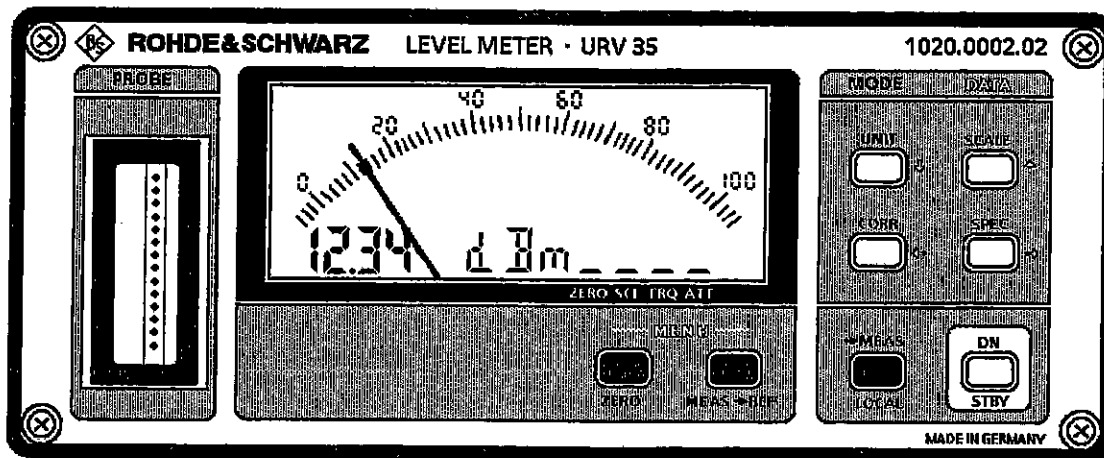
Fig. 3-1 Front view

UNIT
☐ : Display units

V
W
dBm
dB

SCALE
☐ : Scaling mode

AUTO: Automatic needle scaling
FIX: Fixed scale with the same scale limit values as with
        automatic scaling
LIMIT: Fixed scale with freely selectable scale limit values

CORR
☐ : Measured value correction and reference value entry

FRQ: Frequency response correction
        ● OFF: Switch off correction
        ● SINGLE: Single-frequency correction
        ● DCFREQ: Tracking frequency response correction via DC-FREQ input

ATT: Attenuation compensation

REF: Reference value entry in V, W, dBm

IMP: Entry of reference impedance

SPEC : Special functions

SETUP: Storing and recalling of instrument setups

dBmWND: Selection of scale section of dBm scale

RS232:   Setting the RS-232 parameters

TESTS: Testing various instrument components
- BATT: Battery test
- LCD: LC display test
- KEYB: Keyboard test
- RS232:   Serial interface test

CAL: Auxiliary calibration functions
- DATE: Date display of the six calibration functions
- ACCEL: Precalibration of needle acceleration
- LIN: Precalibration of needle linearization

DISP: Fading out of digital or scale display

RESOL: Resolution of measurement result

ILLUM: Switching on or off of LCD backlighting

ZERO : Activation and switching on or off zero correction

MEAS→REF : Display hold function and transfer of measurement result
as reference value for relative display in dB

LOCAL : Unlocking key entry after RS-232 operation

→ MEAS : Aborts an entry, the functions set and the parameters selected are preserved.

— MENU — : Menu keys

PROBE : Probe socket

DATA : Data input keys
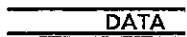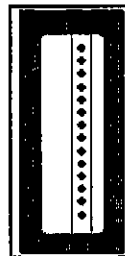
ZERO SCL FRQ ATT : Status display
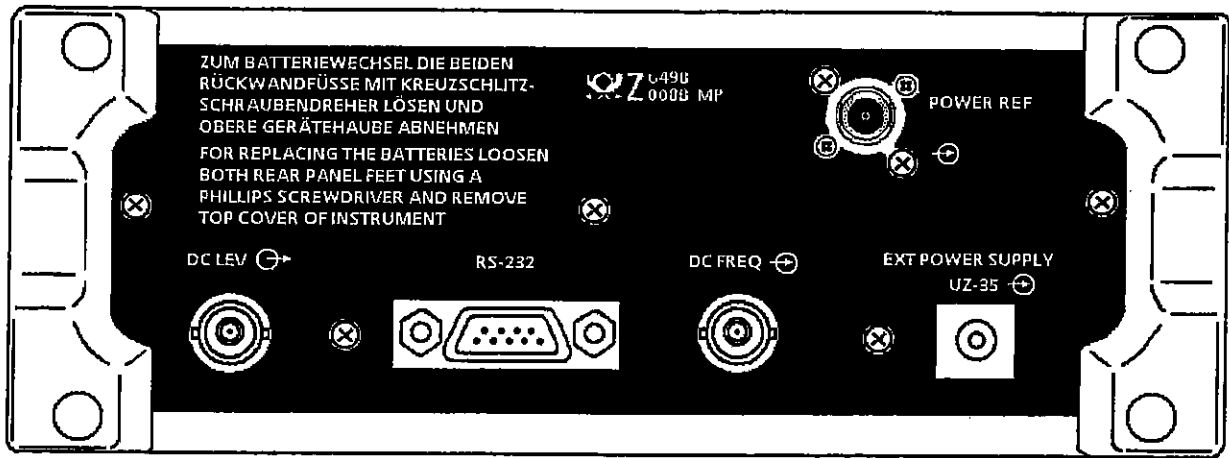
Fig. 3-2 Rear panel view, model 02

DC LEV   :   DC voltage output (→ 3.7)

RS-232   :   RS-232 interface (→ 3.6.1.1)

DC FREQ   :   D.C. frequency correction input (→ 3.4.10)

EXT POWER SUPPLY UZ-35   :   Connector for external power supply (→ 2.1.3.3)

POWER REF 1.00 mW . 50 MHz   :   RF output of sensor check source (→ 3.8)
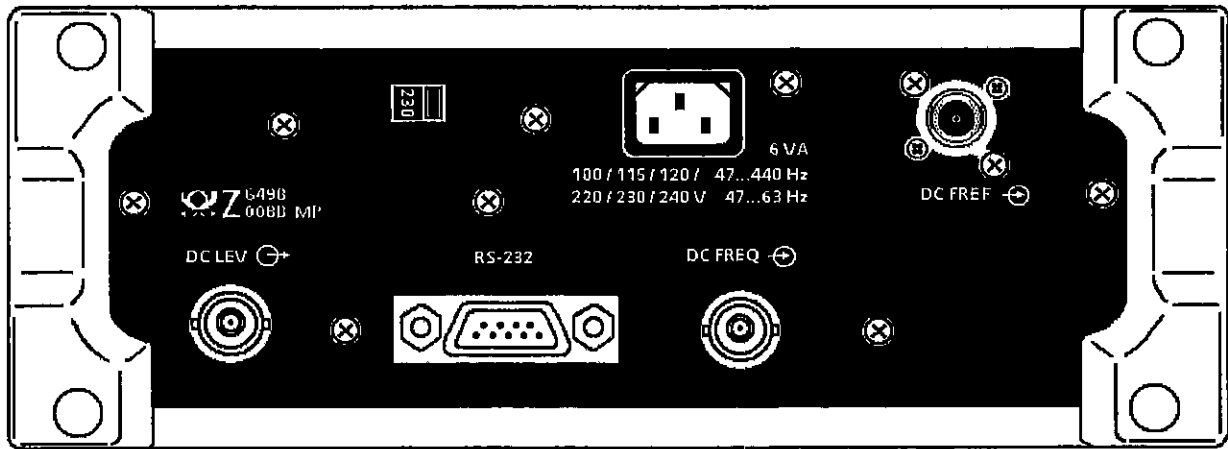
Fig. 3-3 Rear panel view, model 03

DC LEV ⊖•

: DC voltage output (→ 3.7)

RS-232

: RS-232 interface (→ 3.6.1.1)

DC FREQ ⊕

: D.C. frequency correction input (→ 3.4.10)

: Voltage selection switch (→ 2.1.3.7)

: Mains input connector (→ 2.1.3.7)

POWER REF ⊖•
1.00 mW . 50 MHz

: RF output of sensor check source (→ 3.8)

3.2   Manual Operation

To ensure easy and clear operation in spite of the relatively large number of facilities of the URV35, the instrument can be menu-controlled.

All functions which can be operated via the keys are described in section 3.4.

Each function is described on at least one page which is provided with a function header. The function header has the following structure:

3.4.x	Abbreviation: Short Description	(Key/Menu/Function)

The abbreviations correspond to the abbreviated function names with which the keys are labelled or which appear as menu key labelling on the display.

The addition (key), (menu) or (function) has the following meaning:

(Key):   Description of a key. The abbreviation is also to be found on the front panel. If possible, the appropriate RS-232 command is added.

(Menu):   Not a function, but a menu node is described, from which various functions or other menu nodes can be called. Selection of a menu node has no effect on the instrument status, which is why there are no equivalent RS-232 commands. Therefore, no RS-232 commands are added to the menu descriptions.

(Function):   The described function represents a branch of a menu tree and affects the instrument status. If possible, the appropriate RS-232 command is added.

3.2.1   General Notes on Menu Operation

Each function represents a branch of a menu tree whose root is the measurement mode. A menu can be entered via one of the function keys UNIT, SCALE, CORR, SPEC. Within a menu, the alphanumeric display indicates the functions which can be selected by means of the menu keys. The right-hand part of the display is assigned to the right-hand menu key, and the left-hand part to the left-hand menu key.

If a main menu branch has more than two branches, the left-hand function key is used to select the function of the branch, and the right-hand function key is used to select the next branch. In this case, an arrow is shown in the right-hand display section. An arrow pointing downwards indicates that further menu items follow, an arrow pointing upwards indicates the end of the menu branch. Selection of the arrow pointing up returns to the beginning of the main menu branch.

Nomenclature:

In the following, menu items are declared as follows: Key → Menu 1 → Menu 2 → Function.
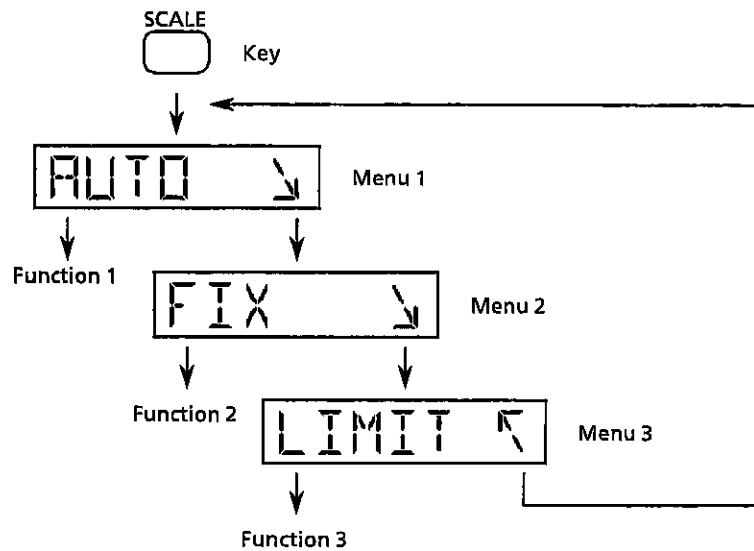
Fig. 3-4 Menu operation

If the main branch has only two branches, a second function name appears instead of the arrow, which is then assigned to the right-hand menu key.

3.2.2   Data Entry

It is necessary in a few menu branches to enter numerical data via the keyboard or select values from tables. This is done using the arrow keys ↑ , ↓. In general, only flashing values can be varied and, when a display is flashing, a data entry is expected.

3.2.2.1   Selecting Values from Tables

When selecting values from tables, the variable flashes as a whole. Whereas the keys ← and → do not produce any effect, the table can be scrolled using the keys ↑ and ↓. The table value to be selected is stored using STO.

3.2.2.2   Numerical Entries

All values which can be varied by numerical entries are defined by the basic setting or by previous entries. When a numerical entry is requested, the current value of the variable is displayed first. The number can then be varied using a cursor, which appears when pressing a data key for the first time. The cursor position is marked by a flashing display digit. Only digits selected by the cursor can be varied.

The cursor can be shifted to the left and right using the keys ← and →. The marked digit is incremented or decremented using the keys ↑ and ↓.

The sign can be changed by shifting the cursor to the first digit in the numerical display and pressing the key ← once more.

The decimal point is shifted in the same way: It is selected by the cursor and shifted to the desired position using the keys ↑ and ↓. Leading zeros or zeros following the last significant digit are shifted out of the display, if required.

Numerical entry can be terminated in two ways:

By pressing →MEAS and by pressing the right-hand menu key to which the text "STO" is assigned.

When pressing →MEAS, all modifications during numerical entry are ignored, whereas, in the case of STO, the value shown in the display is stored.

Storing of the entered value

Numerical entry is ignored,
the old value is retained.
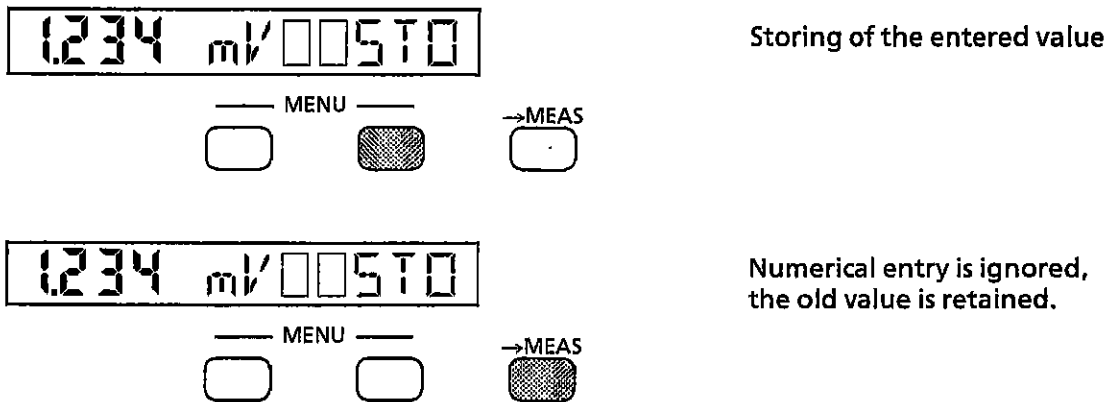
Fig. 3-5 Entry of values

In order to change the exponent, shift the cursor to the prefix (e.g. m (milli), k (kilo)) of the unit. If there is no such prefix, an underscore character is placed ahead of the unit symbol. At this cursor position, the keys ↑ and ↓ permit to select the following exponents: p, n, µ, m, _, k,M,G.

In some cases, only exponents which make sense can be selected. In the case of the reference frequency, e.g., only k, M and G can be selected.

When entering the dB reference value, its unit can be changed.
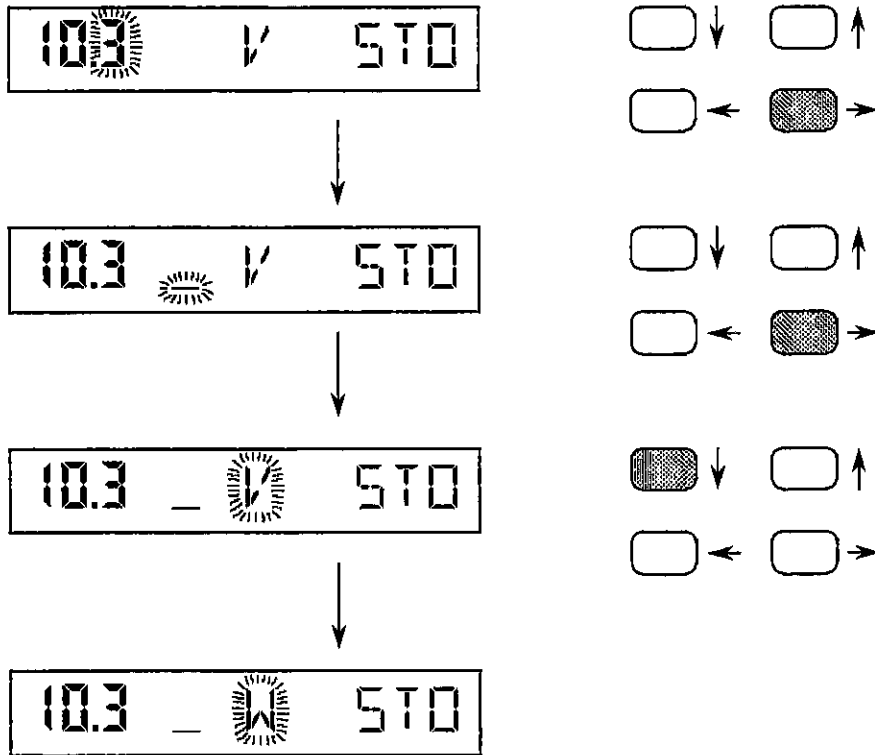
Fig. 3-6 Selecting the input unit

3.3   Instrument Reactions shown in the Display

3.3.1   Display of the Measurement Results and Instrument Status

Bar above ZERO	Zero correction is active.
Bar above SCL	The current scale is fixed.
Bar above FRQ	Frequency response correction is active.
Bar above ATT	Attenuation compensation.
Needle at right-hand full-scale deflection	The scale is fixed, and the measured value displayed exceeds the right-hand scale limit value.
Needle at left-hand full scale deflection	The scale is fixed, and the measured value displayed lies below the left-hand scale limit value.
HI in numerical display	The indicated value is greater than the maximum display value.
O.LOAd in numerical display	The max. permissible voltage/power for the measuring head has been exceeded. Overrange indication in calibration mode.
Only the scale ends are labelled.	The scale mode is LIMIT, and for labelling the scale marks, fractions are obtained which can no longer be displayed with full accuracy.
LO and UP as scale limit values	The scale mode is LIMIT, and the selected scale limit values cannot be displayed with full accuracy in the scale labelling or: right-hand scale limit value = left-hand scale limit value.
🔋	Exhaustion of the battery is about 90% (model 02).

3.3.2   Error Messages in the Display

All faults are indicated to the user by an error message in the display. Faults occurring during keyboard operation must be acknowledged using the key →MEAS , whereas faults occurring in interface mode remain on the display until the LOCAL key is pressed or the next valid command received.

All faults indicated on the display can be called up via RS-232 from error status registers. Hardware errors as well as faults in the calibration or instrument setting data sets may be read out in greater detail (only possible via serial interface).

Err RNG (Data entry: RaNGe Error):

A numerical value entered via keyboard or interface lies outside the valid value range. The following table lists the limit values for all variable instrument parameters:

Frequency response correction	0 kHz to +9999.9 GHz
Voltages with tracking frequency response correction	-12 V to +12 V
Level offset	-200 to +200 dB
Reference impedance	50 and 75 Ω
Reference value in V	-10^{13} to 10^{13} V
Reference value in W	0 to 10^{13} W
Reference value in dBm	-200 to +150 dBm
Reference value in dBμV	-100 to +300 dBμV

Err SYN (RS-232: SYNtax error):

A command entered via the serial interface has not been understood by the instrument.

Err ILL (RS-232: ILLegal command):

The command entered has been understood, however, it does not make any sense with respect to the current instrument status.

Err PTY (RS-232: PariTY Error):

The parity of a received byte does not comply with its parity bit.

Err FRM (RS-232: FRaMe Error):

No stop bit has been received.

Err PRB (PRoBe Error):

The probe connected has been identified as faulty.

Err ZRO (ZeRO Error):

The value of the input voltage (power) measured during zeroing exceeds the specified sensitivity of the probe by more than 14 dB. In the case of the RF probe (URV5-Z7), for example, maximum permissible offset voltage is about 1 mV as against ±20 V with the D.C. probe (URV5-Z1) to allow for difference measurements.

Err CAL (Initialization: error in CALibration data)

After switching on the instrument, the calibration data sets are checked with respect to their check sum and plausibility. If one of these tests is negative, the error message indicated above is displayed, and the destroyed calibration data set is replaced by data from the read-only memory until the next calibration or repair.

The error message is displayed each time the instrument is switched on until the error is corrected.

Possible causes: Replacing the lithium battery with the instrument switched off or hardware error

Err DTA (Initialization: error in state DaTA)

After switching on the instrument, the instrument parameters are checked with respect to their check sum. If the calculated check sum does not comply with the stored one, the error message indicated above is displayed. Upon acknowledgement of the error message, the basic setting is copied from the read-only memory into the main memory, so that a valid instrument setting is obtained. Afterwards this message must not appear any more when the instrument is switched on again.

Possible causes: Replacing the lithium battery with the instrument switched off or hardware error

Caution:

In all probability, the stored instrument setups are also destroyed.

Err RCL (RS-232(MR < 1-9 >)): error in ReCaLl of instrument setup)

This error message is displayed when an attempt is made to load an instrument setup via RS-232 with "MR < 1-9 >" from a memory where no setting was previously stored.

Err JMP (CALMODE: JuMPer error)

A calibration attempt has been made without enabling calibration mode by jumper X717 on the main board.

Err HRD (Initialization: HaRDware error)

An error in the hardware of the instrument has occurred. The type of error is described in detail by the appropriate error status register (→ 3.6.5).

3.4   Description of Operating Functions

3.4.1	ACCEL: Precalibration of Needle Acceleration	(Function)

Description:

The moving coil instrument of the URV35 features a deadbeat step response. With the aid of a preceding differentiating network (simulation in the µP), the response can be accelerated without overshooting to speak of.

Since the transient response depends on parameters which may differ from instrument to instrument, it must be individually optimized for every instrument.

Trimming procedure:

The needle jumps between 20 and 80 % of full-scale deflection. The keys ↑ and ↓ can be used to optimize acceleration such that the needle neither overshoots when jumping nor shows deadbeat step response. STO is used to store the acceleration setting.

Note that the transient response of the needle may not be the same at all deflections because of the inhomogeneity of the magnetic field. The selected step width of 20 to 80% ensures optimal performance.

Operation:

SPEC CAL **ACCEL** DATA STO/→MEAS

RS-232:   ---

Display:

Note:

The trimming procedure performed as described above is only temporarily valid after termination (invalid after switching the instrument off and on). It must explicitly be stored in the calibration data memory using the calibration function "CA3".

3.4.2   ATT: Compensating for a Preceding Attenuator or   (Function)
                        Amplifier in the Measurement Display

Description:

The measured value is amplified (attenuated) by the entered compensation factor (level offset) and displayed.

The level offset is entered in dB. A negative dB value compensates for an amplification and a positive one for an attenuation.

After a successful entry, the compensation is automatically activated. It can be switched on and off using ON/OFF (right-hand menu key) after this menu item has been selected again.

Operation:

CORR **ATT** DATA STO/→MEAS

CORR **ATT** OFF →MEAS

CORR **ATT** ON →MEAS

RS-232:   "DA <Data>":   Enter level offset in dB
            "KA0":   Switch off compensation
            "KA1":   Activate compensation with stored factor
            "Z3":   Output level offset in dB

Display:

In measurement mode, the activated compensation is identified by a bar over the text ATT.

ZERO SCL FRQ ATT

Note:

The permissible value range of the level offset lies within the range -199.99 to +199.99 dB. The attempt to enter a value outside this range produces the error message "Err RNG".

3.4.3   AUTO: Automatic Scaling of Needle   (Function)

Description:

In this scale mode, the scaling of the needle is automatically adapted to the display value. The scale limit values depend on the display unit selected.

W: In the case of display unit W, the right-hand scale limit value is varied using a 1-2.5-5 graduation, whereas the left one is always zero. For example, if the display value continuously varies from 25 µW to 2.5 W, the following right-hand scale limit values are displayed during this variation:

25 µW, 50 µW, 100 µW, 250 µW, 500 µW, 1 mW, 2.5 mW, 5 mW, 10 mW, 25 mW, 50 mW, 100 mW, 250 mW, 500 mW, 1 W, 2.5 W.

V: For all A.C. probes and power sensors, the same limit values as with the display unit W are obtained.

In the case of D.C. probe (URV5-Z1), however, a symmetrical scale is obtained, where:

● *left-hand scale limit value = – right-hand scale limit value and*

● *midscale = 0*

dBm: The following applies to a display in dBm:

right-hand scale limit value – left-hand scale limit value = size of scale section (10 or 20 dB)

Switching to the next scale section is performed in 5 or 10-dB steps; the following applies when switching is necessary because the display value increases:

new scale limit values = old scale limit values + size of scale section/2

When switching is necessary because of display value reduction, the following applies:

new scale limit values = old scale limit values – size of scale section/2

The size of the scale section can be switched between 10 and 20 dB using menu item SPEC → dBmWND.

dB: The scale is always symmetrical in the dB display mode. The following applies to the scale limit values:

right-hand scale limit value = – left-hand scale limit value.

They are also varied using a 1-2.5-5 graduation.

The criteria for switching to the next scale section depend on the display unit:

Unit	Up-scale	Down-scale
V,W	A > 106 %	A < 30 %
dB	|A| > 53 %	|A| < 15 %
dBm	A > 106 %	A < -6 %

A: Needle deflection normalized to full deflection angle, starting from the zero point for V, W and dB or the left-hand scale limit for dBm respectively.

The smallest possible scale limit value with automatic scaling depends on the measuring head and lies about 10 dB above the specified sensitivity of the probe.

Operation:

SCALE AUTO

RS-232:   "SCO"

Display:

In measurement mode, the bar above the text "SCL" disappears with automatic scaling.

| 3.4.4 | BATT: Battery Test (only mod. 02) | (Function) |

Description:

The battery test is used to check the supply voltage which is displayed in volts.

The supply voltage can be measured using the function SPEC → TESTS → BATT and displayed. The text "EXT" or "INT" indicates whether the instrument is supplied from the power supply (EXT) or from batteries (INT). To measure the battery voltage, the power supply must be disconnected so that "INT" appears on the display. (With RS-232 operation, see alphaheader).

Since the discharge characteristics of NiCd batteries and dry batteries are neither linear nor comparable, the battery voltage value does not really indicate the capacity of the batteries. When fully charged, the typical voltage is > 6.5 V in the case of NiCd cells and > 7.5 V in the case of dry batteries.

Irrespective of the residual capacity, the URV35 switches off automatically when the battery voltage falls below approx. 5.8 V.

When the battery voltage falls below 6.15 V, the following symbol is displayed above the text ATT:

Operation:

SPEC TESTS **BATT**

RS-232:   "SB":   Battery voltage in V (with or without alphaheader)

Display:

Note:

When replacing batteries, observe the instructions in the battery compartment or section 2.1.3.4 respectively.

3.4.5   BAUD: Setting the Baud Rate of the RS-232 Interface   (Function)

Description:

The baud rate is the transmission speed of the RS-232 interface. The unit baud is defined as bit/second. Possible settings are:

110, 300, 1200, 2400, 4800, 9600 bauds

Operation:

SPEC RS232 BAUD DATA STO/→MEAS

RS-232:   ---

Display:

Note:

| **3.4.6** | **CAL:** | **Auxiliary Calibration Functions** | **(Menu)** |

Description:

This menu contains two functions for precalibration of the moving coil instrument and one for the date display of the calibration functions:

- **DATE:**   Date display of the six calibration functions

- **LIN:**   Precalibration of needle linearization

- **ACCEL:** Precalibration of needle acceleration

General information on moving-coil instrument control:

The moving-coil instrument is driven by a pulse-width modulated signal directly generated by the microprocessor in the URV35. In addition to processor-controlled correction of the non-linear needle deflection, the needle can also be accelerated such as to minimize its transient response.

Operation:

SPEC **CAL**

Display:

Note:

The needle calibration is the only calibration function which is not exclusively carried out via the serial interface. With the aid of the functions SPEC → CAL → LIN and SPEC → CAL → ACCEL, the calibration data are only processed in order to be transferred to the calibration memory by means of the CAL function "CA3" (RS-232).

| 3.4.7 | CORR: | Correction and Reference Value Entry | (Key) |

Description:

This key is used to select the menu for entering the following correction and reference values:

- **FRQ:** Tracking and single-frequency response correction.

- **ATT:** Attenuation compensation.

- **IMP:** Entry of the reference impedance for converting between the display units V and W/dBm.

- **REF:** Entry of the reference value for the relative display in dB.

Operation:

CORR

RS-232:   ---

Display:

Note:

| 3.4.8 | DATE: | Date Display for the Six Calibration Functions | (Function) |

Description:

This function indicates when the instrument was calibrated for the last time. Six instrument components can be calibrated independently of each other, i.e.:

- Needle instrument (INSTR)
- A.C. probe amplifier (AC AMP)
- D.C. probe amplifier (DC AMP)
- Temperature sensor input (T SENS)
- D.C. frequency input on rear panel of instrument (DCFREQ)
- D.C. output on rear panel of instrumernt (DCLEV)

The calibration date can be entered and called up separately for every partial calibration.

In the date display via RS-232, the texts "AC AMP", "DC AMP" and "T SENS" are followed by the identification P or C. This identification indicates a complete or partial calibration of the amplifiers.

Operation:

```
SPEC CAL DATE DATA →MEAS
```

RS-232:   "S4":

```
"dd.mm.yy - INSTR   -"
"dd.mm.yy - AC AMP  P"
"dd.mm.yy - DC AMP  C"
"dd.mm.yy - T SENS  C"
"dd.mm.yy - DC FREQ -"
"dd.mm.yy - DC LEV  -"
```

Display:

For technical reasons, only the month and year of calibration can be read out in the numerical section of the display, whereas, in the response to the RS-232 command, the complete date specifications are sent.

Note:

The date is specified in a string consisting of 6 lines. Each line is ended by a specified terminator (cf. Table 3-5).

For information on reading and further processing of data in the user program, please refer to Section 3.6.10.

```
              ┌──────────────────────────┐
              │      05.91  INSTR         │
              └──────────────────────────┘
                    ⇩                        ⇧

              ┌──────────────────────────┐
              │      05.91  AC AMP        │
              └──────────────────────────┘
                    ⇩                        ⇧

              ┌──────────────────────────┐
              │      05.91  DC AMP        │
              └──────────────────────────┘
        ⇩           ⇩                        ⇧        ⇧

              ┌──────────────────────────┐
              │      05.91  T SENS        │
              └──────────────────────────┘
                    ⇩                        ⇧

              ┌──────────────────────────┐
              │      05.91  DC FREQ       │
              └──────────────────────────┘
                    ⇩                        ⇧

              ┌──────────────────────────┐
              │      05.91  DC LEV        │
              └──────────────────────────┘
```
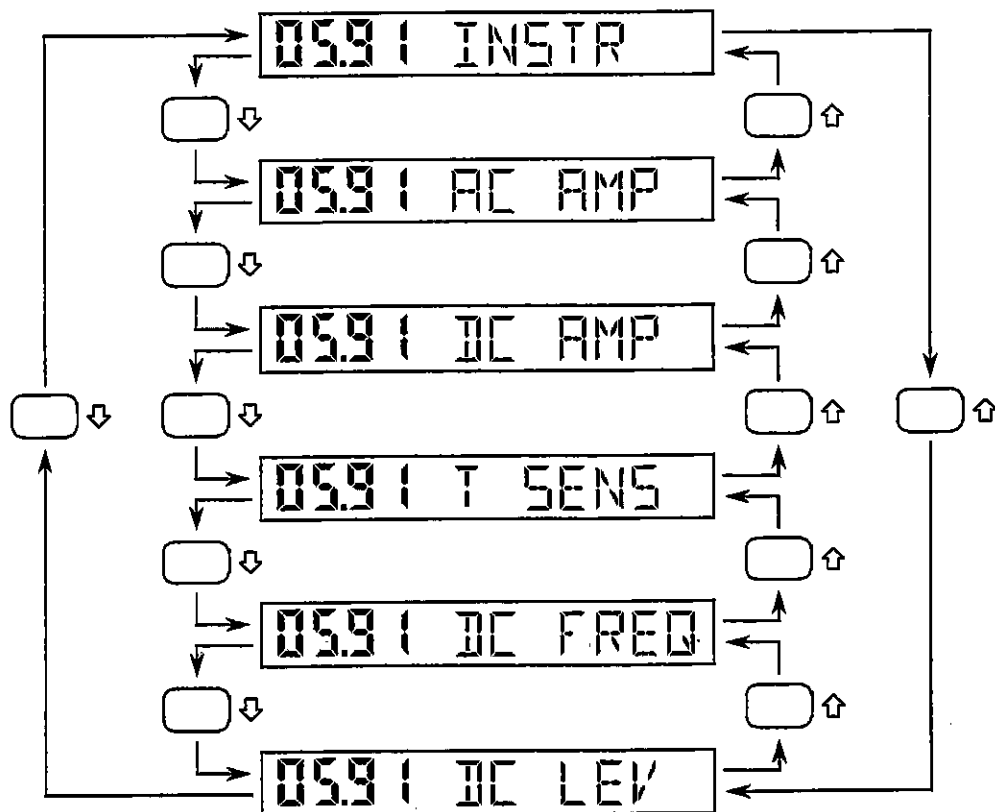
Note:

If the calibration data are unintentionally deleted when changing the lithium battery for the CMOS-RAM, random data are displayed which usually lie outside the value ranges of dd, mm and yy ($1 \leq$ dd ≤ 31, $1 \leq$ mm ≤ 12, $0 \leq$ yy ≤ 99). When these value ranges are exceeded, the text "EE" is displayed instead of a number.

| 3.4.9 | dBmWND: | Selecting the Size of the Scale Section for the dBm and dBµV Scale | (Function) |

Description:

This function permits to switch the width of the scale section between 10 and 20 dB.

Operation:

SPEC **dBmWND** DATA STO/→MEAS

RS-232:   "DD 10":   10 dB
          "DD 20":   20 dB

Display:

The size of the scale section to be selected flashes in the display and can be switched using the keys ↑ and ↓.

Note:

| 3.4.10 | DCFRQ: | Tracking Frequence Response Correction via DC-FREQ Input | (Function) |

Description:

This correction mode is of particular advantage for swept measurements in LOCAL mode, where manual frequency entry is not possible. The generator supplies the URV35 with a D.C. voltage of max. ± 12 V which is linearly dependent on the frequency.

Enter the start and the stop point of the voltage-frequency characteristic into the URV35:

Start point: $(V_1$ (voltage) $/ F_1$ (frequency))
Stop point: $(V_2$ (voltage) $/ F_2$ (frequency))
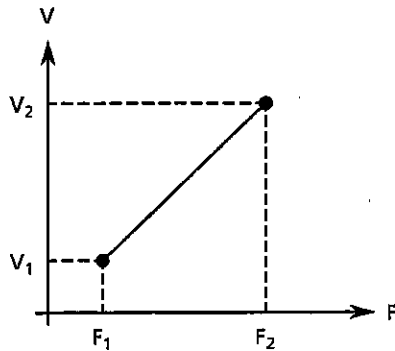
Operation:

CORR FRQ **DCFRQ**

Using the right-hand menu key, the four coordinates can be called up using the sequence $V_1 \rightarrow F_1 \rightarrow V_2 \rightarrow F_2 \rightarrow V_1$... The coordinates can be varied using the left-hand menu key and one of the data keys. After the entry of coordinates has been terminated by means of $\rightarrow$MEAS the frequency equivalent to the voltage at the DC-FREQ input is displayed so that the entry can be checked. Pressing $\rightarrow$MEAS again causes a return to the measurement mode. Automatic frequency response correction is then activated. It can be deactivated again using the key sequence CORR FRQ OFF.

RS-232:	"DCV1 <Data>":	Entry of V_1
	"DCF1 <Data>":	Entry of F_1
	"DCV2 <Data>":	Entry of V_2
	"DCF2 <Data>":	Entry of F_2
	"KF0":	Switch off frequency response correction
	"KF2":	Switch on tracking correction
	"ZCV1": "ZCF1": "ZCV2": "ZCF2":	Output voltage-frequency coordinates for tracking correction
	"ZF":	Output frequency equivalent for D.C. voltage

Display:

An active frequency response correction is marked by a bar above the text FRQ in measurement mode.

ZERO SCL FRQ ATT

Note:

Single frequency response correction which is to be activated under menu item SINGLE switches tracking correction off and vice versa.

An attempt to make an entry outside the permissible value ranges produces the error message "Err RNG".

These value ranges are as follows:

V_1, V_2 -12 V to +12 V
F_1, F_2 0 kHz to 9999.9 GHz

The RS-232 command "ZF" will only output a valid measurement result from the input DCFREQ if the measurement was first triggered using "X1" or "X2".

3.4.11   DISP: Fading Out of Scale or Digital Display   (Function)

Description:

In some cases, it may disturb the optical impression when the needle and the digital display are operated in parallel. This function permits to fade out the scale or digital display. With the scale display faded out, the scale disappears, and the needle is set to the extreme right-hand position where it disturbs as little as possible.

With the digital display faded out, the numerical display section disappears while the unit and the scale are still displayed.

Operation:

SPEC **DISP** DATA STO/→MEAS

RS-232:   "A0":   digital + analog
           "A1":   only analog
           "A2":   only digital

Display:

The selectable mode is represented by the flashing texts "anlg", "digi" and "a+d".

Note:

| 3.4.12 | FIX: | Fixed Scale | (Function) |

Description:

For some measurement tasks, it is unwanted that the scale automatically adapts to the measured value. The FIX function can be used to

- maintain the current scale

- set any scale from the values provided by the autoscaler.

When FIX is called up, the current scale limit value flashes. It can be immediately fixed using the STO key or first varied using the keys ↑, ↓.

During the scaling procedure, the needle continuously points to the display value prior to menu entry and thus follows the varied scaling. If the measured value lies outside the selected scale limits, the needle is positioned on the first or last overflow mark.

Operation:

SCALE **FIX** DATA STO/→MEAS

RS-232:   ---

Display:

In measurement mode, fixing of the scale is marked by a bar above the text "SCL".

```
ZERO SCL FRQ ATT
```

Note:

In principal, the FIX scale is a LIMIT scale with given scale limit values for easy manual operation. Therefore, via serial interface a fixed scale is only available using the LIMIT function (→ 3.4.18) with values selectable by the user.

3.4.13   FRQ: Correction of Measuring Head Frequency Response   (Function)

Description:

The URV35 can take into account the frequency response of an A.C. Probe URY-Z... or the calibration factors of a Power Sensor NRV-Z... For this purpose, each measuring head is equipped with a read-only memory which includes the correction factors for various frequency sampling points. When connecting the measuring head to the basic unit, these data are read into the basic unit. The correction factor for the frequency of the measuring signal applied is determined by the URV35 by interpolating the sampling points read.

To this end, the signal frequency must be reported to the URV35. The FRQ menu offers two possible ways of frequency response correction:

- SINGLE: Explicit entry of measuring signal frequency and correction at this value.

- DCFRQ: Tracking correction via a D.C. voltage applied at input DCFREQ.
            For this purpose, the start and stop point of the frequency-voltage characteristic must be entered into the URV35.

Operation:

CORR **FRQ**

Display:

A frequency response correction activated by means of SINGLE or DCFRQ is marked by a bar above the text "FRQ" in measurement mode.

```
   ━
ZERO SCL FRQ ATT
```

Note:

The two functions SINGLE and DCFRQ are mutually excluding. For example, if a correction frequency is entered via SINGLE during a tracking frequency response correction, the tracking correction is deactivated and single-frequency correction activated.

With frequency response correction switched off, the calibration values for the probe-specific default frequencies are used.

| 3.4.14 | ILLUM: | Switching Backlighting On and Off | (Function) |

Description:

For applications in poorly lit rooms or in insufficient daylight, the LC display is provided with a backlighting facility, which can be switched on or off with ILLUM.

Operation:

SPEC **ILLUM**

When the illumination is switched off, it can be switched on using ILLUM and vice versa.

RS-232:   "S2":   illumination off
          "S3":   illumination on

Display:

Note:

During battery operation, the illumination should by used as economically as possible, since it halves the service life of a battery.

| 3.4.15 | IMP: | Selecting the Reference Impedance Z between 50 and 75 Ω | (Function) |

Description:

Depending on the probe type either voltage (voltage probe URY-Z...) or power/power level (power sensor NRV-Z...) is measured. For converting between voltage (V) and power (W) or power level (dBm) in the display, the reference impedance is required.

Except for the RF probe (URY-Z7) and the D.C. probe (URV5-Z1), the reference impedance is always part of the probe data, i.e. the probe itself sends it to the instrument. In these cases, the IMP function is disabled. However, if the RF probe or D.C. probe mentioned above is used, the reference impedance can be switched between 50 and 75 Ω using IMP.

Operation:

```
CORR IMP DATA STO/→MEAS
```

RS-232:   "DR 50" or "DZ 50"
          "DR 75" or "DZ 75"

Display:

The impedance to be selected flashes in the numeric display.

Note:

| 3.4.16 | KEYB: | Testing the Keyboard | (Function) |

Description:

This test can be used to check the function of the keys and the debouncing circuit.

After selecting KEYB, the instrument requests the user with "any key" to press any key. Then it responds to every keystroke with the name of the key (exception: ON/STBY key). When a key is pressed twice in sequence (intentionally or due to debouncing), the instrument returns to measurement mode.

Operation:

SPEC TESTS KEYB

RS-232:   "S1"

Display:

Note:

3.4.17   LCD: Testing the LCD   (Function)

Description:

This function permits to detect defective LCD segments. All segments are switched on. The test can be aborted using the →MEAS key.

Operation:

SPEC TESTS **LCD**

RS-232: "S0"

Display:

Note:

3.4.18   LIMIT: Fixed Scale with Freely Selectable Scale limit values   (Function)

Description:

For comparing measured values with user-defined specifications, e.g. in testing departments or incoming inspection, individual scales can be generated using this function. The scale limit values can be entered via the keyboard or the serial interface; the left-hand scale limit value may be greater than the right-hand one.

Whether the left-hand or right-hand scale limit value is to be entered is indicated by flashing of the texts LO or HI at the scale ends. Since it is not possible to indicate any fractional number in the scale labelling, the scale may not be labelled at all or only partially. There are three possible ways of labelling:

- All 10 scale marks are labelled if all values can be displayed with full accuracy.

- Only the scale ends are labelled, if an intermediate scale value cannot be displayed.

- Only the scale ends are labelled with "LO" and "HI" if one scale limit value cannot be displayed.
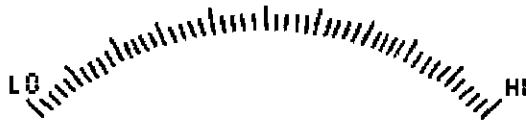
Operation:

```
SCALE LIMIT DATA STO/→MEAS DATA STO/→MEAS
```

The LIMIT function is only activated when both scale limit values have been acknowledged using STO.

RS-232: "SC1":   Switching on LIMIT mode
         "DSL":   Entering the left-hand scale limit value
         "DSR":   Entering the right-hand scale limit value
         "ZSL":   Output of left-hand scale limit value
         "ZSR":   Output of right-hand scale limit value

Display:

The activated LIMIT function is marked by a bar above the text "SCL" in measurement mode.

Note:

Unlike with the FIX function, the scale limit values entered remain stored even after deactivation (by means of AUTO or FIX). They can be activated again the next time LIMIT is called up.

If a measured value is requested using the RS-232 command "ZM" and if it lies outside the scale section when a fixed scale is used, this is indicated by the special identification "L" (below) or "H" (above scale section) in the alphaheader (→ 3.6.4).

3.4.19 | LIN: Precalibration of Needle Linearization | (Function)

Description:

Inhomogeneities in the magnetic field of the moving-coil instrument as well as variations in the gain and in the offset of the instrument driver produce individual deviations from the nominal display. Without correction, errors up to ±10 % (full-scale deflection) may arise so that the needle deflection need be corrected.

After selecting LIN, the needle is trimmed as follows:

The numerical display shows the value of needle deflection (in percent of full-scale deflection) to which the needle may be adjusted using the keys (↑ or ↓) By continuously pressing the appropriate arrow key for more than one second, the needle will be shifted continuously to the specified direction. The corrected deflection value can be stored using STO. A total of seven sampling points 0, 10, 30, 50, 70, 90 and 100% of full-scale deflection are recorded which are then linearly interpolated by the processor.

By pressing the key →MEAS instead of STO, all settings stored so far using STO are transferred, whereas the old correction values are still valid for all current and subsequent settings.

Operation:

SPEC CAL LIN (DATA STO/→MEAS)

RS-232:   ---

Display:

Note:

The needle linearization performed as described above is only temporarily valid after the correction has been terminated (invalid after switching the instrument off and on). It must explicitly be transferred to the calibration data memory using the calibration function "CA3".

| 3.4.20 | LOCAL: | Sets the Instrument from Remote Status to LOCAL mode | (Key) |

Description:

If the URV35 is addressed via the RS-232 interface, it automatically assumes the remote status. Since all keys are disabled except for LOCAL, only this key (or the RS-232 command "L0") permits to return to LOCAL mode.

In manual mode, the LOCAL key is irrelevant, and the initial function → MEAS is valid again.

Operation:

→MEAS / **LOCAL**

RS-232: "L0"

Display:

Note:

In the remote status, the RS-232 commands "L0" and "L1" permit to enable all keys or disable them including the LOCAL key.

3.4.21	→MEAS: Ending Menu Operation Macro Functions	(Key)

Description:

This key has the following three functions:

- Aborting menu operation
  Using this key, a called menu can be ended at any position. The URV35 retains its former settings and returns to measurement mode.

- Ending remote control (second function LOCAL → 3.4.20).

- Recording and execution of macros.

The definition of macros provides for the simple execution of any complex operating function merely by pressing a key, thus facilitating the calling of frequently occurring settings.

A macro is recorded by pressing and holding down the →MEAS key until the letters MAC ON are displayed. All further key depressions are now recorded and executed as a macro at a later date. The macro recording is ended by pressing and holding down the →MEAS key again until the letters MAC Off are displayed.

The defined macro can be executed at any time simply by means of a short depression on the →MEAS key.

Example 1: Macro simplifying the frequency entry

Key: **Display:**

→MEAS

                             . . .

→MEAS

                             . . .

                             MAC ON

CORR

                             FRQ   ↘

ZERO

                             OFF   ↘

MEAS→REF

                             SINGLE   ↘   } Macro recording

ZERO

                             . . . . GHz STO

→MEAS

                             . . . . GHz STO

→MEAS

                             MAC OFF
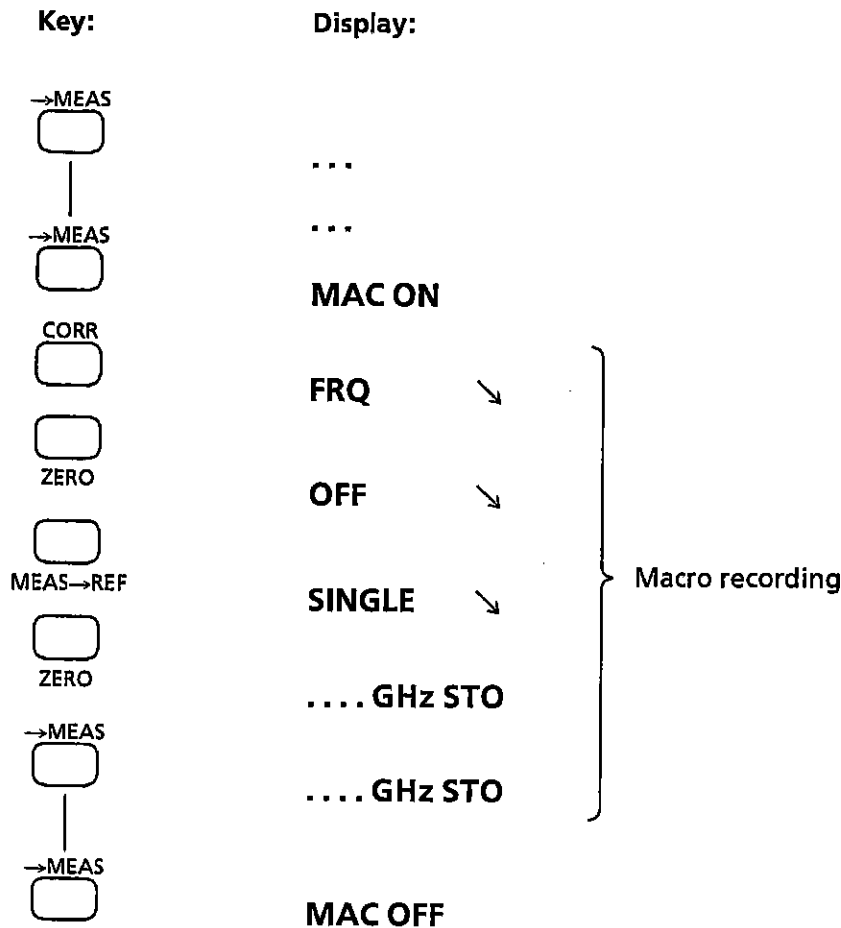
The macro is recorded. Any short depression on the →MEAS key allows the user to immediately enter the numeric values.

Set the measured value display to one of the two desired units before defining a macro for switchover of the unit. The other unit is defined during the macro recording. In the following example (switchover W ↔ dBm) the unit W must first be set. The second unit (dBm) is defined while the macro is being recorded.

Example 2: Macro for switching between the units W and dBm

Taste: **Display:**

→MEAS   . . . . (m, µ, n) **W**

                              . . . . (m, µ, n) **W**

→MEAS   . . . . (m, µ, n) **W**

                              MAC ON

UNIT

MEAS→REF   . . .   ↘

                              . . .   ↘

                              . . .   ↘
MEAS→REF

                              dBm   ↘   Macro recording

ZERO   . . . . **dBm**

→MEAS   . . . . **dBm**

→MEAS   **MAC OFF**
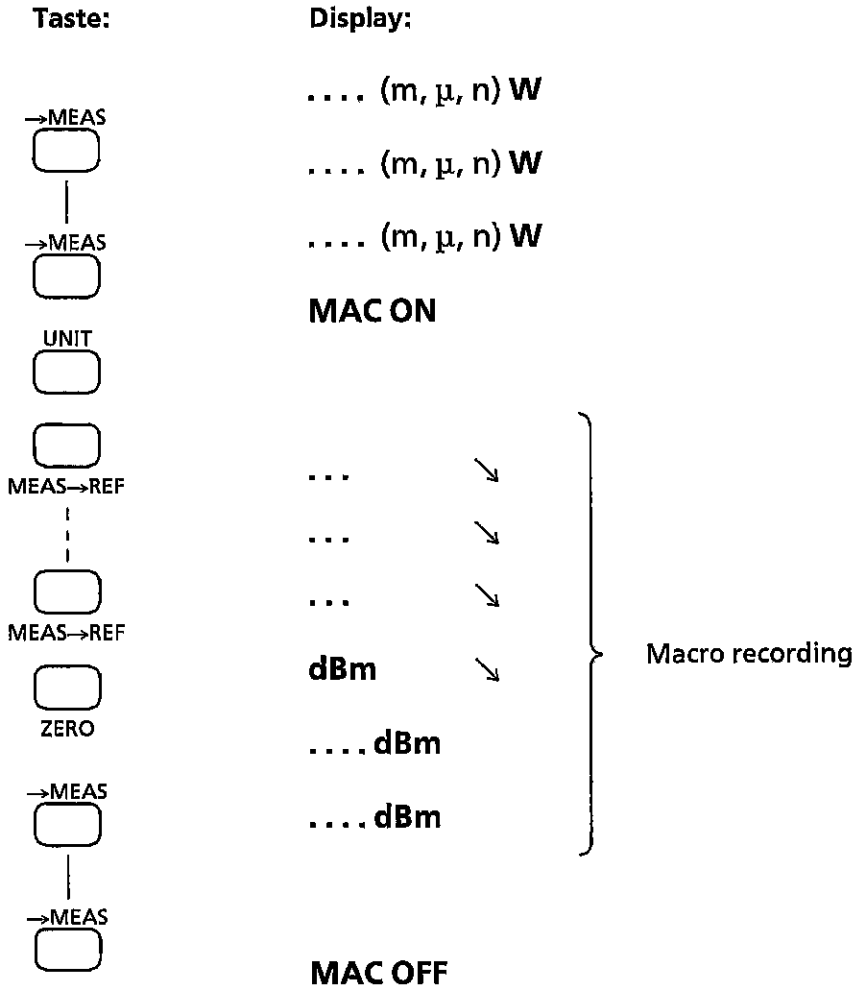
The macro is recorded. Switchover between the units W and dBm is now possible by pressing the →MEAS key.

Example 3: Deleting a macro

Taste:	Display:
→MEAS ▭	. . .
|	. . .
→MEAS ▭	. . .
→MEAS ▭	**MAC ON**
|	**MAC ON**
→MEAS ▭	**MAC OFF**
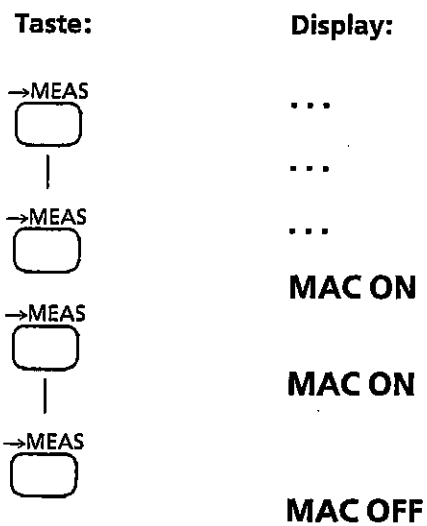
3.4.22	MEAS→REF: Display Hold and	(Key)
	Storing the Measured Value as Reference Value	

Description:

The current measured value is held in the display using the MEAS→REF key and the characters "STO" are displayed above the right-hand menu key.

The display value can be adapted as reference value using "STO", whereas the key →MEAS is used to return to measurement mode without changing the stored reference value.

The reference value is the reference magnitude for displaying a relative measurement result in dB.

If the current display unit is V, W or dBm, the reference value is stored in this display unit. If the current display unit is dB, the reference value is stored depending on the measuring head:

V   Voltage probe (URV5-Z...)
W   Power sensor (NRV-Z...)

The reference value can also be entered explicitly or re-edited under menu item CORR→REF.

Operation:

MEAS→REF STO   Display hold and the display value is adapted as reference value.
NEAS→REF →MEAS   Only display hold.

RS232: "x2":   Triggering a measurement and storing result as reference value.

Display:

Note:

| 3.4.23 | PARITY: Setting the Parity of the Serial Interface | (Function) |

Description:

To be able to detect an error during serial transfer, the RS-232 standard permits to transmit a so-called parity bit together with each byte.

The parity bit supplements the data word such that the total number of the set bits is either even or odd.

The URV35 permits the following settings:

none parity: No parity bit is transmitted or evaluated.

even parity: even parity of the set bits

odd parity: odd parity of the set bits

The selected parity applies to transmission and reception and is to be set identically for both ends of the transmission link.

Operation:

SPEC RS232 **PARITY** DATA STO/→MEAS

Display:

The parity to be selected flashes in the alphanumeric display. The keys ↑ and ↓ can be used to scroll the three modes

"none PTY",

"even PTY" and

"odd PTY".

Note:

If the instrument detects a parity error upon reception of a data word, this is entered in the error status register, and the error message "Err PTY" is read out on the alphanumeric display.

3.4.24 REF: Entering the dB Reference Value (Function)

Description:

The dB reference value is the reference magnitude for display of the relative measurement results in dB.

It can be entered in the units V, W, dBm and dBμV. For this purpose, the cursor is shifted to the unit symbol in the alphanumeric display. The desired unit can be selected using the keys ↑ und ↓.

The reference value is stored in the unit used for the entry. For calculation with the measured value, it is automatically converted to the unit of the measured value.

Operation:

CORR **REF** DATA STO/→MEAS

RS232:   "DU" or "DV": Reference value entered in volts
          "DM":   Reference value entered in dBm
          "DW":   Reference value entered in watts
          "DS":   Reference value entered in dBμV

Display:

Note:

By pressing the keys MEAS→REF and STO the dB reference value is irrevocably overwritten by the current measured value.

Remedy:

Before pressing MEAS→REF, store the instrument setup using SPEC→SETUP.

3.4.25   RESOL: Resolution of Digital Display and Display Filtering   (Function)

Description:

The resolution of the digital display can be varied between low (LO) and high (HI).

Depending on the display unit LO and HI have the following meanings.

	ΔdB, dBm, dBμV	V, W
HI	Resolution to 0.001 dB	$4^1/_2$-digit display
LO	Resolution to 0.01 dB	$3^1/_2$-digit display

The resolution setting involves the averaging degree of the display filter, i.e. the number of single measured values which constitute a display value.

The display filtering depends of the level, i.e. the averaging degree increases with decreasing level below a probe-specific threshold until the limit values indicated in the table are reached.

Resolution	Single measured values	Averaging time/s
LO	1 to 32	0.05 to 2
HI	16 to 256	0.8 to 16

The averaging degree is identical for scale display and digital display.

LO resolution is the standard setting and results in a short response time of the URV35 with not too small levels.

The HI setting should be selected if a higher resolution or a longer averaging time is required, e.g with modulated or noisy signals.

$$A = \frac{1}{n} \sum_{i=1}^{n} M_i$$

A: displayed measured value
M_i: measured value provided by the measuring head
n: discrete integration time (number of measuring cycles)

Operation:

SPEC **RESOL** DATA STO/→MEAS

RS232:   "R3":   LO
          "R4":   HI

Display:

Note:

3.4.26   RS232 (SPEC):   Setting the RS-232 Parameters   (Menu)

Description:

The serial interface must be adapted to the respective communication partner with respect to the transmission speed and type of parity check. Both entries have to be made in this menu:

- **BAUD:**   The transmission speed can be selected between
              110, 300, 1200, 2400, 4800 and 9600 bauds.

- **PARITY:** Selection between no parity check, even parity or odd parity

Operation:

SPEC **RS232**

Display:

Note:

The URV35 is factory-set to the parameters given below. This setup is also present after the acknowledgement of an "Err DTA".

Baud: 9600
Paritry: none

3.4.27   RS232 (SPEC→TESTS):   Testing the Serial Interface   (Function)

Description:

This test permits to check the function of the two signal lines RXD and TXD used by the URV35 (DTR is set to high level after initialization) (Fig. 3-7).

To this end, a host computer with RS-232 interface is required. Before the tests are started, the interface parameters of host and URV35 are to be adapted to each other (→ SPEC → RS232).

After selecting the function SPEC → TESTS → RS232 the URV35 answers with the message "String?". The next string transmitted via the serial interface to the URV35 is then output on the alphanumeric display. Then the same string is returned to the host computer.

If there is a fault in the RS-232 receiver, the string sent by the host computer is not or only incompletely written on the display.

If there is a fault in the RS-232 transmitter of the URV35, the string is written to the display, however it is not or only incompletely returned to the host computer.

All the ASCII characters with a decimal equivalent in the range of 32 to 45 or 47 to 122 are permissible. The string can be terminated by any terminator (decimal equivalent 0 to 16).

Operation:

SPEC TESTS **RS232** (transmission of any character strings) →MEAS

RS-232:   ---

Display:

Note:

In measurement mode, the URV35 is capable of detecting the following errors on its own:

"Err PTY":   Parity error (only with even or odd parity)

"Err FRM":   Frame error. The stop bit has not been received.

3.4.28   SCALE: Selecting the Scale Mode   (Key)

Description:

This key is used for all functions which determine the labelling and the display range of the LCD needle scale. However, the displayed scale section is not connected with the internal hardware measurement ranges. In most cases, the switching threshold between the two hardware measurement ranges lies within the scale section. A very fast automatic range selection makes sure that switching between the measurement ranges does not affect the behaviour of the needle.

The SCALE menu covers the following functions:

- **AUTO:** Automatic scaling
- **FIX:**   Fixed scaling with the same scale limit values as with automatic scaling
- **LIMIT:** Fixed scaling with freely selectable scale limit values

Operation:

SCALE

Display:

A scale fixed by means of FIX or LIMIT is marked by a bar above the text SCL in measurment mode. When AUTO is selected, the bar disappears.

```
ZERO SCL FRQ ATT
```

The unit prefix displayed in measurement mode is likewise fixed in FIX or LIMIT mode.

Note:

| 3.4.29 | SETUP: Storing and Recalling of Instrument Setups | (Function) |

Description:

The current instrument setup is always stored in a non-volatile memory, and, after switching on, the URV35 assumes the same status as before switching off. Besides, the URV35 permits to store and recall nine further instrument setups. A tenth memory can only be read; it contains the basic setting.

The following table shows the stored instrument parameters and their basic setting:

Parameter	Basic setting
Scale mode	AUTO
Display unit	V or W (depending on measuring head)
Scale limit values of LIMIT function for all display units	0/10 or -10/10
Size of scale section of dBm scale	20 dB
Display mode	Digital and scale display
End-of-string characters	CR + LF
Alphaheader (with, without)	with
Level offset	40 dB
Correction frequency	1 GHz
dB reference value	1 V
Reference impedance	50 Ω
Frequency response correction	off
Attenuation correction	off
Resolution of measured value	LO
Backlighting of LC display	off
Voltage-frequency coordinates for tracking frequency response correction via DCFREQ input	(0 V, 1 GHz), (2 V, 18 GHz)

Operation:

```
SPEC SETUP DATA (1..9) STO:    Store setup
SPEC SETUP DATA (0..9) RCL:    Recall setup
```

RS-232:   "MS <1..9>": Store setup
           "MR <0..9>": Recall setup

Memory 0 can only be read; it contains the basic setting.

Display:

Note:

Every data set of an instrument setup is checked by the SETUP function. IF a data set has been destroyed, for example, by replacing the buffer battery for the CMOS RAM, only "STO_____" is displayed in the SETUP menu instead of the menu key labellings "STO__RCL". When STO has been actuated, the data set in this memory is valid again and can be recalled using RCL after new calling of the menu.

If an attempt is made to read an invalid data set via RS-232 using "MR<0..9>, the message "Err RCL" appears on the display.

Simplified Manual Operation using Setups (from Firmware Version 4.0)

Brief description

Calling stored setups is much easier if the URV35 is operated in SETUP mode. This mode can be set by means of a remote control command and allows the setup number (1 to 8) to be changed stepwise by a single keystroke. Important functions such as zeroing and unit selection remain available.

The current setup is indicated by Sx (x = 1 to 8) in the bottom right part of the display.

Keys and their functions

Most keys have a different function in the SETUP mode.

UNIT	⇓	switchover between W and dBm
SCALE	⇑	lighting on/off
CORR	⇐	selects the setup with the next lower number
SPEC	⇒	selects the setup with the next higher number
ZERO		zeroing (as in normal mode)
MEAS → REF		no function
→ MEAS (LOCAL)		return to manual operation (as in normal mode)
ON / STBY		on/standby selector

Selecting the SETUP mode and returning to normal manual operation

The SETUP mode is selected by the remote control command S8 and deselected by the command S7. In both cases the instrument has to be set back to manual operation by pressing the → MEAS (LOCAL) key.

Note:

Since the parameters of the RS-232 interface cannot be modified in the SETUP mode, note the parameters before switchover to this mode. We recommend using the default setups.

3.4.30 **SINGLE:** Entering a Single Correction Frequency and (Function)
Activating the Frequency Response Correction

Description:

In addition to the tracking frequency response correction via the DCFREQ input (CORR → FRQ → DCFRQ) the URV35 permits to explicitly enter the correction frequency via the keyboard or the RS-232 interface. When the frequency has been successfully entered, the single frequency correction mode is activated. In this mode, the URV35 performs a frequency response correction only for the frequency that has been entered.

The correction can only be activated when the frequency entry has been terminated with STO.

Operation:

```
CORR FRQ SINGLE DATA STO/→MEAS
```

RS-232: "DF <date>:   Enter the correction frequency.
"KF0":   Switch off correction.
"KF1":   Activate correction with stored frequency value.
"Z2":   Output correction frequency.

Display:

In measurement mode, an active frequency response correction is marked by a bar above the text FRQ.

```
ZERO SCL FRQ ATT
```

Note:

For further information on the frequency response correction of the URV35, refer to 3.4.13 FRQ.

The tracking frequency response correction which is to be activated under menu item DCFRQ switches SINGLE correction off and vice versa.

3.4.31   SPEC: Special Functions   (Key)

Description:

This menu key is used for all functions and setting parameters which have to be used or varied only rarely:

- **SETUP:**   Storing and recalling of instrument setups
- **RESOL:**   Resolution of measurement result
- **dBmWND:**   Selection of scale section of dBm scale
- **ILLUM:**   Switch backlighting of LCD on, off
- **RS232:**   Setting the RS-232 parameters
- **DISP:**   Fading out the analog or digital display
- **TESTS:**   Battery test (only with model 02), LCD test, keyboard test and RS-232 test
- **CAL:**   Auxiliary calibration functions

Operation:

SPEC

Display:

Note:

| 3.4.32 | TESTS: | Test Functions | (Menu) |

Description:

This menu contains functions for checking the peripheral components of the URV35:

- **BATT:**   Battery test (only with model 02)
- **LCD:**   LCD test
- **KEYB:**   Keyboard test
- **RS232:** Testing the serial interface (called only via keyboard)

Operation:

SPEC **TESTS**

· RS-232:   "SB":   · Battery test
             "S0":   LCD test
             "S1":   Keyboard test

Display:

Note:

3.4.33   UNIT: Selection of Display Unit   (Key)

Description:

Depending on the type of measuring head, the URV35 measures voltages (voltage probes URV5-Z...) or powers (power sensors NRV-Z...) and displays the measured values in the unit V or W, respectively.

Besides, the instrument permits to vary the measurement display and display each measured value in terms of

- voltage (V),

- power (W),

- voltage level (dBµV),

- power level (dBm) or

- relative level (dB)

In the case of a power sensor, the following conversion formulae are used:

$$D_V = \sqrt{P_m Z} \qquad D_W = P_m$$

$$D_{dBm} = 10 \lg \left| \frac{P_m}{1mW} \right| \qquad D_{dB} = 10 \lg \left| \frac{P_m}{P_{Ref}} \right|$$

$$D_{dB\mu V} = 20 \lg \left| \frac{\sqrt{P_m Z}}{1 \mu V} \right|$$

D_X: Display value in the unit X
P_m: Measured value in watts (power sensor)
Z: Reference impedance
P_{Ref}:   Reference value in watts

In the case of a voltage probe, the following conversion formulae are used:

$$D_V = V_m \qquad D_W = \frac{V_m^2}{Z}$$

$$D_{dBm} = 10 \lg \left| \frac{V_m^2}{Z \cdot 1 mW} \right| \qquad D_{dB} = 20 \lg \left| \frac{V_m}{V_{Ref}} \right|$$

$$D_{dB\mu V} = 20 \lg \left| \frac{V_m}{1 \mu V} \right|$$

D_X: Display value in the unit X
V_m: Measured value in volts (voltage probe)
Z: Reference impedance
V_{Ref}:   Reference value in volts

As reference value Ref, either a measured value can be used (key MEAS→REF) or a numerical value entered (in V, W, dBµV or dBm) (CORR→REF). For calculation of the relative level, the reference value is converted into a reference voltage V_{ref} or a reference power P_{ref}, if required.

The reference impedance Z is in most cases part of the probe data and is read into the basic instrument when the probe is connected. Only the probes URV5-Z1 and URV5-Z7 are not assigned any reference impedance. It must be selected by the user under menu item CORR→IMP.

Operation:

UNIT V/W/dB/dBm/dBμV

RS-232:   "U0":   V
            "U1":   dBm
            "U5":   dB
            "U7":   W
            "U8":   dBμV

Display:

Note:

The entered scaling mode and if applicable the entered full-scale values assigned to a display unit will be stored when the display unit is changed.

In this way, these settings do not need to be re-entered when the display unit is reselected.

3.4.34   ZERO: Switching Zero Correction On and Off   (Key)

Description:

Zero correction is used to increase the measuring accuracy when measuring relatively small voltages or powers, referred to the nominal voltage or power of the measuring head.

The measured values are corrected such that an average of zero is indicated with the measuring head disconnected from source.

Switching on zero correction produces the following effects:

● Triggering of an automatic measurement for determination of internal offset voltages (duration approx. 4 s)

● Subsequent permanent correction of the measured value.

Before switching on zero correction, the measuring power must be switched off. (Plug RF probe into BNC adapter or 50/75-Ω termination for shielding purposes).

In general, D.C. voltage measurements using the D.C. Probe URV5-Z1 require no zero correction, since the internal offset voltages are negligibly small. However, the zero-correction function can be used to suppress spurious external D.C. voltage offsets up to max. ±20 V. The URV35 then subtracts the D.C. voltage applied when switching on zero correction from every measured value. The offset measuring phase has a duration of approx. 1 s.

Operation:

ZERO

Zero correction can be switched on and off using the ZERO key. A short key depression always initiates a zero correction, which is indicated by the letters "ZEROING". All subsequently indicated measured values are corrected correspondingly. Pressing and holding down the key until the message "ZERO OFF" is displayed switches zero correction off.

RS-232:   "00":   Switch off zero correction
            "01":   Measure offset voltage and switch on zero correction

Display:

When zero correction is activated, this is marked in measurement mode by a bar above the text ZERO.

ZERO SCL FRQ ATT

Note:

When the error message "Err ZRO" appears in the display, the offset voltage measured is too high. In most cases, this error is caused by the fact that the signal voltage or power had not been switched off before ZERO was activated (Limit values see 3.3.2 → Err ZRO).

3.5 Menu Trees

The following illustrations provide a graphical overview of the menu trees associated with the four keys UNIT, SCALE, CORR and SPEC. Only the menu nodes and not the functions are shown:

3.5.1 UNIT Menu

3.5.2   SPEC Menu

SPEC

| SETUP ↘ |

| BAUD ↘ |

| PARITY ↰ |

| RESOL ↘ |

| dBmWND ↘ |

| ILLUM ↘ |

| BATT ↘ | *)

| LCD ↘ |

| KEYB ↘ |

| RS232 ↘ |

| DISP ↘ |

| RS232 ↰ |

| TESTS ↘ |

| CAL ↰ |

| DATE ↘ |

| LIN ↘ |

| ACCEL ↰ |
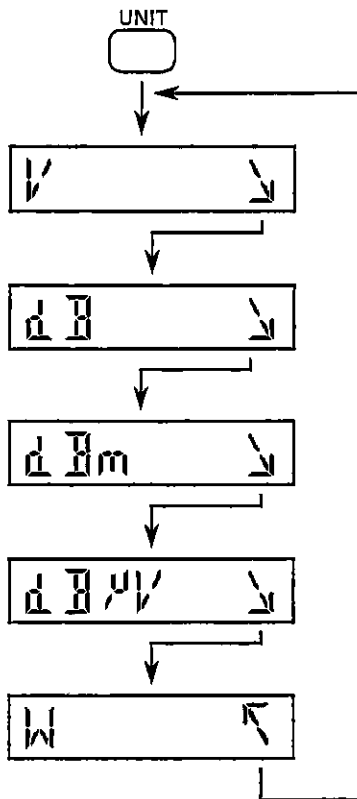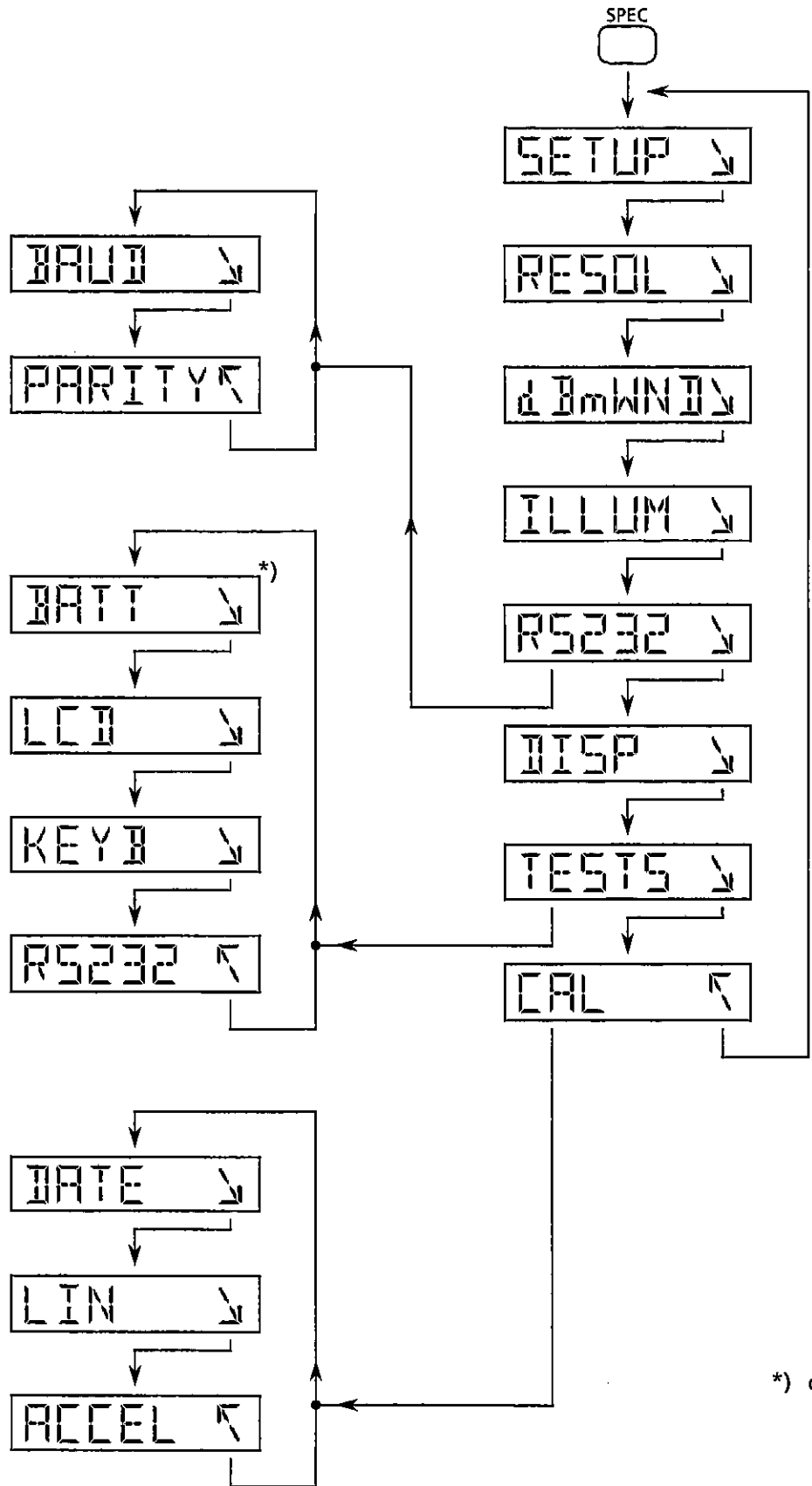
*) only with model 02

3.5.3   CORR Menu

```
        CORR
        ┌──┐
        └──┘
          │ ←──────────────┐
          ↓                │
    ┌──────────────┐       │
    │ FRQ       ↘  │       │
    └──────────────┘       │
          │                │
          ↓                │
    ┌──────────────┐       │
    │ ATT       ↘  │       │
    └──────────────┘       │
          │                │
          ↓                │
    ┌──────────────┐       │
    │ REF       ↘  │       │
    └──────────────┘       │
          │                │
          ↓                │
    ┌──────────────┐       │
    │ IMP       ↖  │       │
    └──────────────┘       │
          └────────────────┘
```

3.5.4   SCALE Menu

```
       SCALE
        ┌──┐
        └──┘
          │ ←──────────────┐
          ↓                │
    ┌──────────────┐       │
    │ AUTO      ↘  │       │
    └──────────────┘       │
          │                │
          ↓                │
    ┌──────────────┐       │
    │ FIX       ↘  │       │
    └──────────────┘       │
          │                │
          ↓                │
    ┌──────────────┐       │
    │ LIMIT     ↖  │       │
    └──────────────┘       │
          └────────────────┘
```
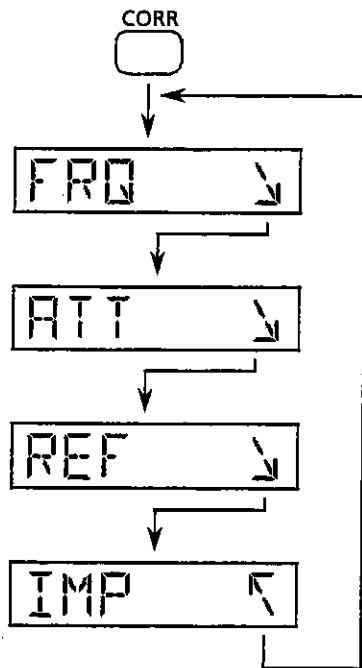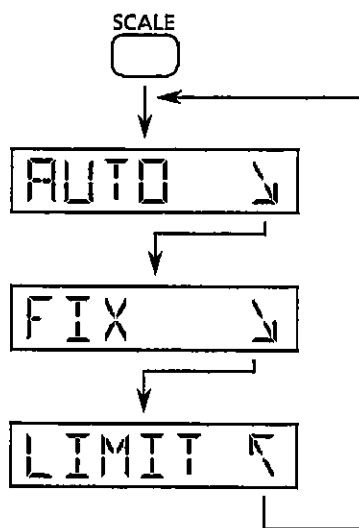
3.6 Remote Control

The instrument is fitted with an RS-232 interface as standard. Almost all functions which can be selected via the keyboard can also be operated via the interface.

3.6.1 Preparation for Interface Operation

3.6.1.1 RS-232 Connector
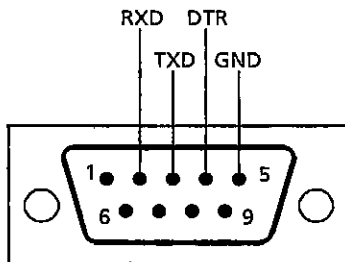
Fig. 3-7 Connector pin assignment of serial interface

The RS-232 connector at the rear panel of the instrument features the pin assignment shown above. The connection cable between host computer and URV35 is to be precut and terminated according to Fig. 3-8. Since the URV35 only performs a software handshake (XON-XOFF), the lines RTS and CTS on the computer must be connected when an IBM-PC/XT/AT is used.
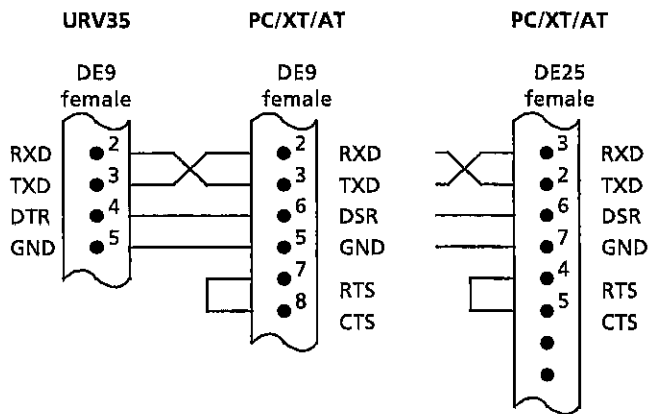
Fig. 3-8 Precut cable with connectors

The electrical specifications of the interface driver in the URV35 correspond to the RS-232 standard. The signal levels are typically ±7 V.

3.6.1.2 Setting of the Interface Parameters

In order to successfully set up a connection between a host computer or a terminal and the URV35, the interface parameters of host computer and URV35 must first be matched with each other.

The baud rate (SPEC → RS232 → BAUD) and the parity (SPEC → RS232 → PARITY) are settable in the URV35.

All other parameters are set such that the host must be adapted correspondingly:

Handshake protocol: XON/XOFF
Stop bit: 1
Data bits: 8

The serial interface of the computer must be configured either on operating system level (using the MODE COMx:... command with DOS) or in the user program (→ 3.6.10.1).

3.6.1.3   Testing the Serial Connection

To test whether the connection functions properly, select the menu item SPEC → TESTS → RS-232. A character string sent by the host in this status is written on the alphanumeric display by the URV35 and returned to the host. If this is not or only partially done (the URV35 writes the character string to the display, but does not send it back), the connection is faulty.

Remedy:

● Check plug-and-socket connections according to 3.6.1.1.

● Check interface parameters (baud rate, parity, number of stop and data bits, handshake protocol) of host and URV35 for compliance.

3.6.2   Interface Functions

3.6.2.1   General Information on the Command Syntax

The interface commands are grouped into five clusters:

● Setting commands (A..., C..., K..., L..., M..., N..., O..., R..., S..., U...)

● Data input commands (D...)

● Trigger commands (X...)

● Output commands (Z...)

● Terminators (W...)

● Special commands (S...)

The setting commands are used for switching particular instrument features of the URV35 on or off. After a switching command, the URV35 does not send back any data to the host computer.

The data input commands are used for transferring parameters (numerical values) to the URV35. Like the setting commands, they do not cause data to be returned from the URV35 to the host computer.

The trigger commands are used to trigger a measurement, the result of which is stored in an internal buffer. No data are returned from the URV35 to the host computer.

The output commands are used to read out measurement results and input data. Each output command causes a string to be sent back from the URV35 to the host computer. All strings returned by the output commands feature a uniform format (→ 3.6.4 Alphaheader).

The special commands comprise all commands which do not fit into the groups of commands listed above. Part of them causes data returns which are different in format or type. They will be described in greater detail.

The following rules apply for the command syntax:

No differentiation is made between upper-case and lower-case letters.

Blank characters are ignored.

Every command or command sequence is only interpreted when an end-of-string character has been received. These are all ASCII characters between NUL and DLE.

Commands can be transmitted one after the other (each terminated by an end-of-string character) or all at once (the commands are written in a command line, separated by commas).

In the case of data input commands, the date must be in the same line as the command.

The maximum length of a command line is 255 characters. Subsequent characters are ignored.

For reasons of compatibility, the command syntax has been adapted as far as possible to the IEC command syntax of the URV5 (R&S Millivoltmeter).

3.6.2.2   Operating and Setting Commands

For reasons of clarity, each command group is supplemented by the reference to the respective keyboard entry, if possible. References specified by numbers only refer to sections in which the function is described in greater detail.

Table 3-1 Setting commands

Display mode (SPEC → DISP)	
A0	Digital and scale display combined
A1	Digital display is faded out.
A2	Scale is faded out, and the needle is set to the extreme right-hand position.

Basic setting (SPEC → SETUP → RCL 0):	
C1 or MR0	KA0, KF0, O0, R3,U0/U7 (depending on measuring head), A0, L0, N0, SC0, S2
Attenuation compensation (CORR → ATT):	
KA0	switch off (CORR → ATT → OFF)
KA1	switch on (CORR → ATT → ON)
Frequency response correction (CORR → FRQ):	
KF0	switch off (CORR → FRQ → OFF)
KF1	Switch on single frequency response correction (CORR → FRQ → SINGLE)
KF2	Switch on tracking correction via DCFREQ input (CORR → FRQ → DCFRQ)

Keyboard disabled:	
L0	The keyboard is enabled until the next RS-232 command.
L1	All keys are disabled. L1 can be reset by switching off and on the instrument or using the command L0.
Storing and recalling of instrument setups (SPEC → SETUP):	
MR <0-9>	Recall instrument setup from memory <0-9> (→RCL)
MS <1-9>	Store instrument setup in memory <1-9> (→ STO)
Alphaheader (3.6.4):	
N0	With alphaheader
N1	Without alphaheader
Zero correction (ZERO)	
O0	Switch off
O1	Trigger zero measurement and activate correction.
Resolution of measured value: (SPEC → RESOL):	
R3	LO ($3^{1}/_{2}$-digit, 0.01 dB)
R4	HI ($4^{1}/_{2}$-digit, 0.001 dB)
Scale mode (SCALE)	
SC0	Auto (SCALE → AUTO)
SC1	Limit (SCALE → LIMIT) (A previously set FIX mode is overwritten.)
Display unit (UNIT)	
U0	V
U1	dBm
U5	dB
U7	W
U8	dBµV

Table 3-2 Data Input Commands

Reference value entry (CORR → REF)		
DU, DV	<Data>	Reference value in V
DM	<Data>	Reference value in dBm
DS	<Data>	Reference value in dBµV
DW	<Data>	Reference value in W
DR, DZ	<50, 75>	Reference impedance in Ω (CORR → IMP)
DA	<Data>	Level offset value in dB (CORR → ATT)
DF	<Data>	Single correction frequency in Hz (CORR → FRQ → SINGLE)
Voltage-frequency coordinates for tracking frequency response correction via DCFREQ input (CORR → FRQ → DCFREQ)		
DCV1	<Data>	V_1 in V
DCF1	<Data>	F_1 in Hz
DCV2	<Data>	V_2 in V
DCF2	<Data>	F_2 in Hz

Scale limit values (SCALE → LIMIT)		
DSL	\<Data\>	Left-hand scale limit value in previously set unit
DSR	\<Data\>	Right-hand scale limit value in previously set unit
Size of scale section with display unit dBm and dBµV		
DD	\<10, 20\>	10 or 20 dB

Table 3-3 Trigger commands

X0	Reset X3
X1	Trigger measurement
X2	Trigger and transfer measured value as reference value
X3	Each time a measured value is requested ("ZM"), a measurement is automatically triggered

Table 3-4 Output commands

ZM	Measured value
Z0	Reference value for dB display (in stored unit)
Z1	Reference impedance in Ω
Z2	Single correction frequency in Hz
Z3	Level offset value in dB
ZCV1	V_1 in V ──── Frequency-voltage coordinates ────
ZCF1	F_1 in Hz for tracking
ZCV2	V_2 in V frequency response correction
ZCF2	F_2 in Hz ──── via DCFREQ input
ZF	Frequency equivalent for voltage applied at DCFREQ input
ZSL	Left-hand scale limit value in previously set unit
ZSR	Right-hand scale limit value in previously set unit
ZV	Identification string (→ 3.6.9)

Table 3-5 Separators and terminators for transmission URV35 → host computer

W0	LF (0A HEX, 10 DEZ)
W1	CR (0D HEX, 13 DEZ)
W2	ETX (03)
W3	CR + LF

Table 3-6 Special commands

S0	LCD test (SPEC → TESTS → LCD)
S1	Keyboard test (SPEC → TESTS → KEYB)
S2	Switch off backlighting (SPEC → ILLUM)
S3	Switch on backlighting (SPEC → ILLUM)
S4	Date output of the six calibration functions (SPEC → CAL → DATE)
S6	Checksum of program memory (→ 3.6.3)
S7	Switchover from normal operation to SETUP mode
S8	Switchover from SETUP mode normal manual operation
SB	Battery test (SPEC → TESTS → BATT), only with model 02
SE0	Global error byte
SE1	Hardware error byte
SE2	Checksum error byte of calibration memory
SE3	RS-232 operating error byte
SEV <hardware error bit>	The tested value resulting in the error bit incl. tolerance range
ST	Status output of all instrument setups (→ 3.6.6)
SP	Output of probe identification (→ 3.6.7)
SI	Output of calibration data

(Note: SE0–SE3 grouped as "Output of error status registers (→ 3.6.5)")

3.6.3 Checksum of Program Memory

The software in the URV35 is stored in a read-only memory (EPROM). The checksum of the program memory corresponds to the sum of all bytes contained in the read-only memory. It is used as an additional safety precaution for identification of EPROM versions.

The string returned from the special command S6 has the following format:

`checksum:␣xxxxxxxxx␣(dez)␣-␣xxxxxx␣(hex)`   (␣ = blank character)

3.6.4 Alphaheader

All values which can be called up via the RS-232 interface using the output commands (Z..) can be provided with an alphaheader. Within the returned character string, the alphaheader precedes the numerical value. It contains additional information on the numerical value, and has a fixed format so that it can be easily evaluated by the host computer.

The format of a complete character string (alphaheader + numerical value) is shown in the following illustration:
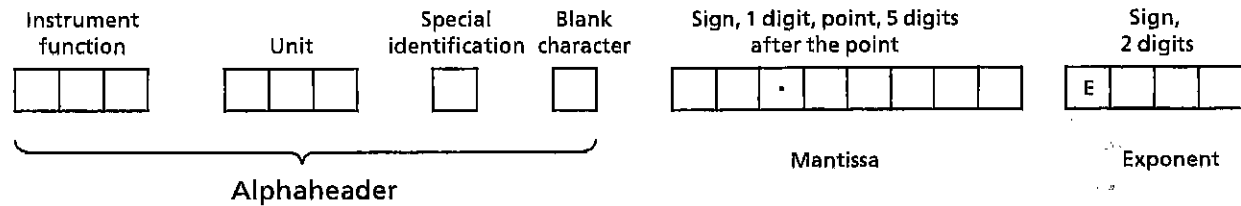
Table 3-7 Coding of the instrument function in the alphaheader

Instrument function	Meaning
AC–	A.C. measurement result
DC–	D.C. measurement result
REF	dB reference value
ATT	Level offset value
FRQ	Single correction frequency
DCF	Frequency equivalent for the D.C. voltage applied at the DCFREQ input
Z–	Reference impedance
SL–	Left-hand scale limit value
SR–	Right-hand scale limit value
CV1	U_1
CF1	F_1 Voltage-frequency coordinates for tracking frequency response correction via DC-FREQ input
CV2	U_2
CF2	F_2

Table 3-8 Coding of the unit in the alphaheader

Coding	Unit
V–	V
W–	W
DBU	dBμV
DBM	dBm
DB–	dB
HZ–	Hz
OHM	Ω

The special identification is represented by an ASCII character, the meaning of which is shown in the following table.

Table 3-9 Coding of the special identification in the alphaheader

Special identification	Meaning
blank	Valid measured value.
!	Overload of probe or basic unit (display: O.LOAd).
E	Hardware error. The measured value may be invalid.
H	The scale is fixed and the measured value is to the right of the right-hand scale limit value.
L	The scale is fixed and the measured value is to the left of the left-hand scale limit value.
A	Scale limit value: automatic scaling
F	Scale limit value: fixed scale
1	Voltage: internally via battery (only model 02).
X	Voltage: externally via power supply unit (only model 02).

Example:
```
AC-V--!-1.4142E+01
```

3.6.5   Error Status Registers

The RS232 commands "SE0", "SE1", "SE2" and "SE3" permit to read out the error status registers. Every byte is returned in hexadecimal format in the form of two ASCII characters (0 to 9, A to F). The error status registers provide detailed information on the error status of the instrument.

All instrument errors are combined in a global error byte. Each type of error is assigned one bit:

Table 3-10 Global error byte (SE0)

Error bits	Meaning
0 (LSB)	Measuring head is not detected or is faulty (Err PRB).
1	Hardware error (Err HRD).
2	Checksum of calibration data memory is faulty (Err CAL).
3	Error in RS232 operation.
4	Error in ZERO measurement (Err ZRO).
5	Error in value entry (Err RNG).
6	Offset calibration out of tolerance
7	Calibration factor out of tolerance.

The error bits 3 to 7 are temporary and are reset after reading out the global error byte. Bits 0 to 2 are directly linked with the occurence of the respective error and remain set as long as the error is present.

The following error bits can be decoded further:

● Checksum of calibration data memory   (5 bits / 1 byte)
● Hardware error   (58 bits / 8 bytes)
● RS232 operating error   (4 bits / 1 byte)

Table 3-11 Hardware errors (SE1)

Error bit	Meaning
0 ... 4	reserved
5 ... 10	Offset voltage A.C. measuring head amplifier range 6 to 11
11, 12	reserved
13, 14	Switch-off status of current source for temperature sensors
15	Temperature measuring voltage 100 µA sensor
16	Temperature measuring voltage 1 mA sensor
17 ... 20	Offset voltage D.C. measuring head amplifier, range 1 to 4
21	Offset current D.C. measuring head amplifier
22	Supply voltage -12 V
23	Supply voltage -5 V
24	Supply voltage -6 V
25	Operating voltage
26	Offset A/D converter
27 ... 46	reserved
47	Timeout A/D converter
48	Setting offset DAC for A.C. measuring head amplifier
49	Setting offset DAC for D.C. measuring head amplifier
50 ... 54	reserved
55	global error bit (ORing of bits 0 to 54)
56	reserved
57	Battery voltage < 6.15 V (only model 02)
58 ... 63	reserved

Bit 57 is independent of the global error bit 55 and can be set without 55 being set.

A total of 16 characters of the following format are returned. Reserved bits are set to zero.

reserved
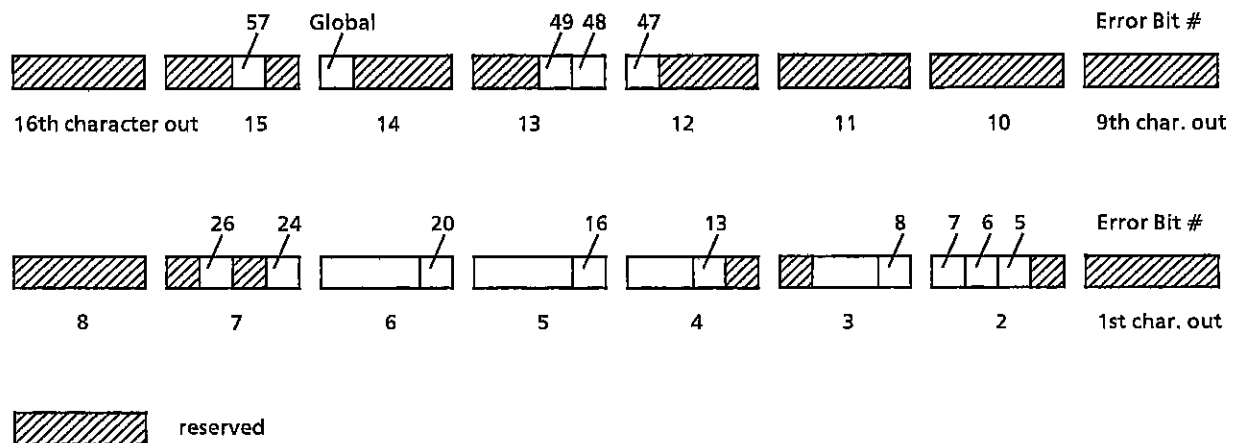
The tested value resulting in the error bit can be read using the command SEV < hardware error bit>.

Table 3-12 Checksum of calibration data memory (SE2)

Error bit	Defective data set
0	A.C. measuring head amplifier
1	D.C. measuring head amplifier
2	Needle calibration
3	DCFREQ input and D.C. output
4	Temperature sensor
5	reserved
6	reserved
7	reserved

All bits are set or reset after initialization or calibration of the instrument, respectively.

Table 3-13 RS232 operating errors (SE3)

Error bit	Meaning
0	Command is illegal in the current context (Err ILL).
1	An attempt has been made to read out an instrument status memory where no instrument status was stored before (Err RCL).
2	Calibration jumper on the main board is in the write protection position (Err JMP).
3	Command has not been understood (Err SYN).
4	reserved
5	reserved
6	reserved
7	reserved

All bits are reset after reading of the error byte.

3.6.6   Status Output of all Instrument Setups

The status output is initiated using the RS-232 command "ST". The URV35 then sends a character string in the following format:

"Ax, KAx, KFx, Lx, Nx, Ox, Rx, SCx, Sx, Ux, Wx"

The upper-case letters represent the interface commands, and the x are the dummy values for their arguments ($\rightarrow$ 3.6.2).

3.6.7   Output of Probe Identification

In addition to the correction data, each measuring head contains an identification required by the URV35 for identifying the measuring head. The RS-232 command "SP" causes this identification to be transmitted as a character string to the process controller. The string contains the following information in the order given below:

Designation of measuring head   (12 characters)

Serial number   (10 characters)

Calibration date   (8 characters)

Additional data are provided in measuring heads with electrically erasable correction data memory:

Order number   (12 characters)

Name of calibration laboratory   (20 characters)

Identification of calibration   (20 characters)

3.6.8   Output of Calibration Factors

The calibration factors are correction values for the various measurement functions and ranges of the URV35. They are determined within the scope of a calibration and permanently stored in a RAM with battery back-up. Using the RS-232 command "SI", they can be read out via the RS-232 interface.

The calibration factors are contained in a string consisting of 44 lines. The individual lines are ended by the specified terminators (Table 3-5).

For information on reading and further processing of data in the user program, please refer to Section 3.6.10.

Range	Factor

```
AC+_RANGE_1__OK_CF=X.XXXXXX
AC-_RANGE_1__OK_CF=X.XXXXXX
AC+_RANGE_2__OK_CF=X.XXXXXX
AC-_RANGE_2__OK_CF=X.XXXXXX
AC+_RANGE_3__OK_CF=X.XXXXXX
AC-_RANGE_3__OK_CF=X.XXXXXX
AC+_RANGE_4__OK_CF=X.XXXXXX
AC-_RANGE_4__OK_CF=X.XXXXXX
AC+_RANGE_5__OK_CF=X.XXXXXX
AC-_RANGE_5__OK_CF=X.XXXXXX
AC+_RANGE_6__OK_CF=X.XXXXXX
AC-_RANGE_6__OK_CF=X.XXXXXX
AC+_RANGE_7__OK_CF=X.XXXXXX
AC-_RANGE_7__OK_CF=X.XXXXXX
AC+_RANGE_8__OK_CF=X.XXXXXX
AC-_RANGE_8__OK_CF=X.XXXXXX
AC+_RANGE_9__OK_CF=X.XXXXXX
AC-_RANGE_9__OK_CF=X.XXXXXX
AC+_RANGE_10_OK_CF=X.XXXXXX
AC-_RANGE_10_OK_CF=X.XXXXXX
AC+_RANGE_11_OK_CF=X.XXXXXX
AC-_RANGE_11_OK_CF=X.XXXXXX

DC__RANGE__1_OK_CF=X.XXXXXX
DC__RANGE__2_OK_CF=X.XXXXXX
DC__RANGE__3_OK_CF=X.XXXXXX
DC__RANGE__4_OK_CF=X.XXXXXX

TEMP_0.1MA___OK_CF=X.XXXXXX
TEMP_1__MA___OK_CF=X.XXXXXX

DC_FREQ<-____OK_CF=X.XXXXXX
DC_LEV->_(G)_OK_CF=X.XXXXXX
DC_LEV->_(0)_OK_CF=X.XXXXXX

DEF_LIN___0__OK_CF=X.XXXXXX
DEF_LIN__10__OK_CF=X.XXXXXX
DEF_LIN__30__OK_CF=X.XXXXXX
DEF_LIN__50__OK_CF=X.XXXXXX
DEF_LIN__70__OK_CF=X.XXXXXX
DEF_LIN__90__OK_CF=X.XXXXXX
DEF_LIN_100__OK_CF=X.XXXXXX

DEF_ACCEL____OK_CF=X.XXXXXX
```

_ = Blank character

Fig. 3-9 Output of calibration factors

The calibration factors are the quotients from actual value and nominal value and therefore lie within the range 1. Within the scope of the calibration and when switching on, a plausibility check is made. If a calibration factor lies outside the tolerance of 5% (20% for LIN/ACCEL), the error message "Err CAL" is read out in the display. In the output string according to the table (e.g.: AC+_RANGE_8...), the extension "OK" is replaced by "ER" for the faulty calibration factor. When switching on the instrument, a faulty calibration factor is replaced by 1 after the error message "Err CAL" has been acknowledged (→ MEAS). Following switch-on, "Err CAL" is displayed until the instrument is recalibrated.

3.6.9   Output of the Identification String

The identification string allows the identification of the URV35 in the remote mode. Following the command "ZV" the character string

```
ROHDE & SCHWARZ URV35 VER.: X.Y
```

is returned. X.Y stands for the firmware version.

3.6.10   Control of the URV35 via a User Program

All programming languages frequently used for IBM-PC/XT/AT offer the possibility of controlling the serial interface. The output of characters to the URV35 is not as precarious as is the readin of measurement results or other data. In particular with long measuring times or with the output of texts consisting of several lines such as calibration factors (→ 3.6.8), the URV35 may respond in an unexpected way.

As to the data transmission according to the XON/XOFF handshake mode the following is to be said: Both partners can send each other data in full-duplex mode until one side requests transmission to be stopped by sending the character XOFF (hexadecimal 13). The reason is usually the imminent overflow of the receive buffer. The other side then interrupts data transmission and waits for the character XON (hexadecimal 11) to be sent requesting to continue the transmission.

The receive buffer of the URV35 is dimensioned such that it allows for the processing of even very long setting strings without interruption. The transfer of the data to be sent from the user program to the send buffer of the computer is usually feasible by means of simple commands.

Reading the data sent by the URV35 in the user program is, to some extent, more complex. Under normal conditions, the URV35 sends all data strings in one piece to the receive buffer of the computer. Here, they are stored in the order they were sent without any further read command being required from the user program. Another read command is only necessary when the received data are to be processed further in the program. Depending on the programming language and the type of read command, either the complete buffer or only the least recent partial string up to a specified terminator can be read out. Reading a character removes it from the buffer.

The terminator relevant for the reading of partial strings is defined for each programming language (eg carriage return "CR" for R&S BASIC command INPUT#). Using the commands W0...W3, the URV35 is to be set such that this character is included in the terminator sequence.

All measurement results and other short messages of the URV35 contain only one terminator sequence, which is at the end of the string. When reading in measured values consider the fact that the URV35 does not immediately supply the measurement results to the computer. It depends however on the measurement time when the results are supplied. With a high resolution (RESOL HI) and low levels the delay between trigger and transmission of the measured values may be up to 16 s.

Relatively long strings, as they occur with the output of calibration factors (→ 3.6.8) and the calibration date (→ 3.4.8), are segmented by terminators at the end of each line. Line-by-line reading is thus enabled.

It would be ideal if the receive buffer of the computer is as large as to allow the one-piece transmission of any data string from the URV35 to the computer (ie > 1141 bytes for output of the calibration factors). The buffer has usually only the size of 256 or 512 bytes. In this case, it must be ensured that the URV35 can discard the remaining characters after any stop in transmission (triggered by the character XOFF shortly before the buffer overflows). To this end, always read out the complete buffer or, with a program stop, close the file for data reception before. The URV35 is otherwise disabled and can no longer be operated by means of the keyboard.

3.6.10.1 Programming in R&S BASIC

Configuration of the interface

In the programming language R&S BASIC for IBM-AT and compatible computers, the statements for setting the interface and opening up a logic file for input/output are integrated in one command. Identical parameters are to be used for input and output. The respective commands are:

```
[n] OPENI# x, "COMz: baud rate, parity, data bits, stop bits, timeout, terminator, handshake mode"
[n] OPENO# y, "COMz: baud rate, parity, data bits, stop bits, timeout, terminator, handshake mode"
```

n	:	line number	
x	:	1 to 15	(file number for readin)
y	:	1 to 15	(file number for output)
z	:	1 to 4	(current number of serial interface)

Baud rate	:	150 to 9600		
Parity	:	N	(no parity)	⎤
		E	(even parity)	as URV35
		O	(odd parity)	⎦
Data bits	:	8		
Stop bits	:	1		
Timeout	:	1 to 65535	(in ms; for read command INPUT# and write command PRINT#)	
Terminator	:	13	(carriage return CR; evaluated only with the query ON COM)	
Handshake mode	:	C	(XON/XOFF)	

Note: Setting the interface parameters using the BASIC program requires the device driver COMX.SYS to be loaded (DEVICE = COMX.SYS must be entered in the configuration file CONFIG.SYS).

Setting the URV35

Commands are sent to the URV 35 using the statement

```
[n] PRINT# y, "Befehl1, Befehl2, ..."
```

n	:	line number	
y	:	1 to 15	(file number for output).

Reading of data

The receive buffer of the computer can be read out using the statement

$[n]$ INPUT# $x,m\$$

n	:	line number	
x	:	1 to 15	(file number for reading)
$m\$$	:	string variable which is allocated.	

Reading starts with the least recent character and ends with the next terminator CR. In order to ensure that the URV35 terminates its data with this terminator it must be appropriately set using the commands W1 or W3. If the receive buffer of the computer contains several strings or a string segmented by a terminator (calibration factors), the read command must be repeated. If the buffer is empty, reading is aborted only after the timeout which has been set using the OPEN statement (see above).

The BASIC statement

$[n]$ $m\$$=INPUT$ (p,#x)

n	:	line number
$m\$$	:	string variable which is allocated
p	:	number of characters to be read
x	:	1 to 15 (file number for readin)

allows access to any number of characters in the receive buffer. However, the current buffer state only is considered, ie with an empty buffer or if partial strings without terminator are present, only an empty string or the present characters are sent. The INPUT$ command is less suited for program-controlled measurements than for testing the data transmission. Contrary to the INPUT# command, this command permits the readout of terminators.

Event-controlled program branching

Transmission of the data to the receive buffer of the computer is continuously monitored after having opened the input file using OPENI #.... On recognition of a carriage return character CR, program branching is possible. The required statements are:

```
[n] ON COMz GOSUB m          ** calling the subprogram
[n] ON COMz GOTO m           ** branch
[n] ON COMz RETURN           ** return
```

m, n	:	line numbers	
z	:	1 to 4	(current number of serial interface)

Program example 2 demonstrates the calling of a subprogram.

Program example 1:   Triggering of a single measurement and output of the measurement result on the screen:

```
10 OPENI# 1,"COM1:9600,N,8,1,20000,13,C"
```
** Input file #1, ser. interface COM1, 9600 baud, no parity bit, timeout 20 s.

```
20 OPENO# 2,"COM1:9600,N,8,1,20000,13,C"
```
** Output file #2, ser. interface COM1, 9600 baud, no parity bit, timeout 20s.

```
30 PRINT# 2,"W1, X3"
```
** Set terminator CR and "trigger on input"

```
40 PRINT# 2,"ZM"
```
** Trigger and output request

```
50 INPUT# 1,A$
```
** Reading

```
60 PRINT A$
```

```
70 STOP
```

The timeout has been selected sufficiently long in order to avoid interruption of the read operation prior to the output of the measurement result

Program example 2:   Continuous output of a measurement result after having pressed the X key

```
10 OPENI# 1,"COM1:9600,E,8,1,100,13,C"
```
** Input file #1, ser. interface COM1, 9600 baud, even parity, timeout 0.1 s.

```
20 OPENO# 2,"COM1:9600,E,8,1,100,13,C"
```
** Output file #1, ser. interface COM1, 9600 baud, even parity, timeout 0.1 s.

```
30 PRINT# 2,"W1, X3"
```
** Set terminator CR and "trigger on input"

```
40 INKEY C$
```

```
50 IF C$="X" or C$="x" THEN PRINT# 2,"ZM"
```
** Query key X, trigger and output request

```
60 ON COM1 GOSUB 100
```
** Branching to the subprogram on receipt of the terminator CR

```
70 GOTO 40
```

```
100 REM UNTERPROGRAMM ZUM EINLESEN
```

```
110 INPUT# 1,A$
```

```
120 PRINT A$
```

```
130 RETURN
```

Reading is started only with the string being already in the receive buffer of the computer as a result of the event-controlled program branching. The timeout can thus be kept very low.

3.7   D.C. Voltage Output (DCLEV)

The D.C. voltage output is primarily used for driving X-Y and Y-T recorders, providing a positive D.C. voltage for this purpose, which is linearly connected with the needle deflection. 0 V corresponds to the left-hand and +3 V to the right-hand scale limit value.

For most applications, it is recommended to fix the scale (FIX, LIMIT), since automatic changing of the scale affects the relationship between measured value and voltage at the D.C. voltage output. This might result in unwanted changing of the scale and, as a result of this, also in a sudden change in the recorded characteristic.

3.8   Sensor Check Source (Option)

The sensor check source can be used to check the connected measuring head. It supplies a constant RF power of 1.00 mW at a frequency of 50 MHz (see specifications). The signal is almost free from harmonics and nonharmonics, so that no additional errors are encountered with diode power sensors. The sensor check source is permanently on.

- Measuring heads with a 50-Ω N connector can be directly connected to the sensor check source. For measuring heads with PC 3.5 connector, the adapter supplied with the sensor check source can be used.

- Measuring heads with a 75-Ω N connector have to be connected via a Matching Pad RAM or at least via a mechanical adapter. When using the RAM, its insertion loss of 5.72 dB has to be taken into account. Purely mechanical adapters always reduce the displayed power by approx. 4% to 0.96 mW due to the mismatch of the measuring head which also causes major measurement uncertainties.

- Without a termination, Insertion Units URV5-Z2 and URV5-Z4   (50 Ω) display 6 dB too much (0.447 V or 4 mW).

4   Maintenance

Under normal operating conditions, regular maintenance is not required apart from occasional cleaning of the inscription panel and display field and replacing of the batteries (only mod. 02). However, we recommend to check the lithium backup battery and recalibrate the basic instrument every 2 years.

Recalibration is dealt with in the Service Manual of the URV35 (1020.0960.24). It can be performed in a few minutes only using the Service Kit URV35-S1 (1029.2608.02), a D.C. calibration unit and a process controller.

4.1   Cleaning the Inscription Panel and the Display Field

These parts may only be cleaned using a soft cloth and non-alcoholic solvent, e.g. commercially available detergent (no benzine). For this purpose, remove the inscription panel by unscrewing the four Phillips screws.

4.2   Replacing the Dry Batteries or NiCd Batteries (Mod. 02)

If dry batteries are fitted in the URV35, the cells have to be replaced in case the battery voltage is too low. This is the case if the symbol ▨ appears in the display field (→2.1.3.5), or if the instrument can no longer be switched on, or if it switches off immediately. Battery replacement is described in section 2.1.3.4.

The service life of the rechargeable cylindrical NiCd cells depends on the conditions of use. It is advisable during idle periods to disconnect the instrument from the power supply unit after it has been fully charged. If the operating time considerably falls below that indicated for battery operation in the specifications, five new cylindrical NiCd cells 1.2 V (IEC KR 35/62) should be inserted. The cells are replaced in the same way as the batteries.

After checking the battery voltage (→ 2.1.3.5), close the casing again and screw on the instrument feet.

If the URV35 is provided with NiCd batteries , it is recommended to charge them every two to three months if they are not in use for a longer period of time (switch off the instrument and connect it via the power supply unit to the mains supply for 24 hours).

4.3   Checking and Replacing the Lithium Backup Battery

To protect the stored calibration and reference values as well as complete setups during instrument switch-off, a CMOS RAM with battery backup is provided.

The service life of the backup battery is typ. 5 years. However, the current consumption of the CMOS RAM and self-discharge of the battery are subject to large manufacturing tolerances. In particular at higher ambient temperatures, this may lead to faster battery discharge.

Checking the battery:

- Switch off instrument.

- Remove the two rear feet (4 Phillips screws).

- Push the lower instrument cover towards the rear panel and remove it (see Fig. 2-1).

- Switch on instrument.

- Measure the battery voltage after connection of a digital voltmeter to soldering terminals X700 and X701. Make sure not to produce a short-circuit from the positive battery terminal X700 to ground (Fig. 4-1).

- Battery voltage with new battery: U_{nom} = 3.67 V
                                  permissible limit: U_{batt} $\geq$ 3.2 V.

- When the value falls below the permissible limit, replace the battery.

Replacing the battery:

- Careful handling during battery replacement may avoid data loss in the RAM. Recalibration will not be necessary then.

- Switch on instrument (RAM is supplied via +5 V_{DIG}).

- Cut the fastening strap of battery G700 and unsolder the terminals. Make sure that the battery is not short-circuited (use ungrounded soldering iron).

- Solder new battery in place and fasten using a new fastening strap.

- Switch off the instrument and complete.

- If no error message appears when the instrument is put into operation again, the URV35 is immediately ready for use.

- If the error message "Err CAL" (calibration data missing) appears, the instrument is to be recalibrated.
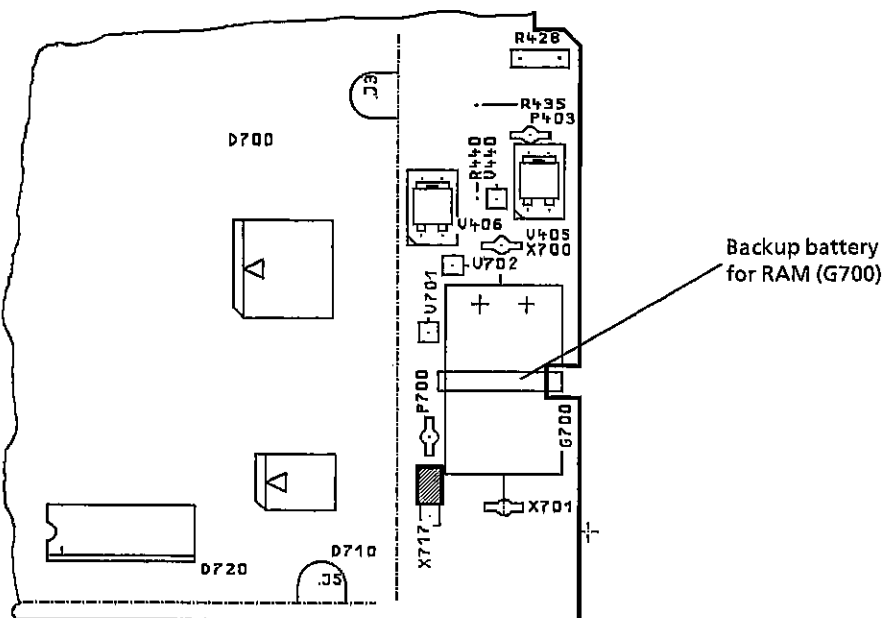

Fig. 4-1 Position of the backup battery on the main board

4.4   Storage

If the instrument is to be stored for a longer period of time, we recommend to remove the batteries (only model 02) according to section 2.1.3.4 in order to prevent damage due to leaking cells or overdischarging.

5   Testing the Rated Specifications

5.1   Measuring Instruments and Auxiliary Means

Table 5-1 Measuring Instruments and Auxiliary Means

Item	Instrument	Specifications	Recommended R&S instrument	Use section
1	D.C. calibrator	1 V to 400 V ±0.01 %		5.2.5, 5.2.7, 5.2.8
2	A.C. calibrator	200 µV to 10 V ±0.1 % 100 kHz (200 kHz)		5.2.6
3	D.C. Probe URV5-Z1			5.2.5, 5.2.7
4	RF Probe URY-Z7 or 10-V Insertion Unit URY-Z2			5.2.6
5	Thermocouple Sensor		NRV-Z51	5.2.9
6	Controller with RS-232 interface			5.2.3
7	D.C. voltmeter	0 V to 3 V ±(0,01 % + 100 µV)		5.2.7

5.2   Test Sequence

The test sequence corresponds to the test report given in section 5.3, from which the nominal values and permissible tolerances can also be obtained.

5.2.1   Testing the Switch-on Routine and the Voltage Supply

After switching on, the URV35 logs on with the sequence described in section 2.1.4.

Mod. 02: To differentiate between internal supply (dry batteries or NiCd batteries) and external supply (connection of power supply UZ-35), see section 2.1.3.5.

5.2.2   Testing the Function of Keyboard and Display

The function of the keyboard can be checked according to section 3.4.16. By operating any key, the key recognition is checked as well as possible bouncing detected.

The liquid crystal display can be checked according to section 3.4.17. For testing the backlighting, proceed according to section 3.4.14. The function of the moving-coil instrument can be checked by means of sections 3.4.19 (linearity) and 3.4.1 (transient response).

5.2.3   Remote Control Connection

The URV35 features an installed RS-232 interface for remote control.

If there is no fault, the character string transmitted via the interface to the URV35 is indicated on the display and sent back to the controller after calling up the test routine according to section 3.4.27.

5.2.4   Measuring Head Connection

The following test permits to check the interaction between measuring head and basic instrument. First, set the URV35 to LOCAL mode using the "LOCAL" key and remove the measuring head from the instrument. The display must then read out "no PRB". Then plug any measuring head into the probe receptacle. After a certain response time, the display must read out measured values. "readPRB" must be visible during the readout. When the measuring head is removed, the display "no PRB" must appear again. If the contents of the probe memory are read out with errors, the display reads "Err PRB".

5.2.5   D.C. Measuring Accuracy

In the subsequent measurements, the URV35 measures the output voltage of a D.C. calibrator using a D.C. Probe URV5-Z1 (Fig. 5-1). Test voltages and permissible display values are referred to in the test report (section 5.3).
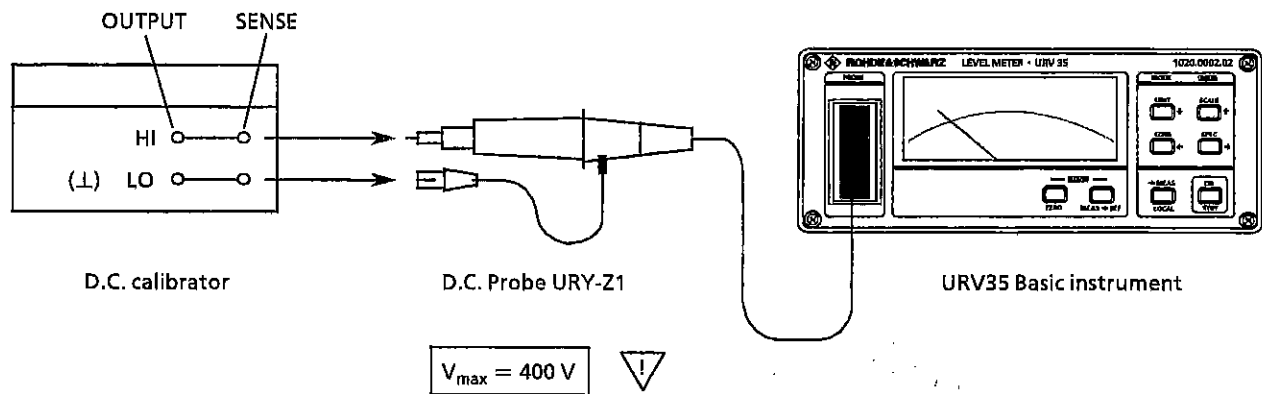
Instrument settings:

Unit	UNIT	V
Resolution	RESOL	HI
Zero correction	ZERO	OFF
Attenuation correction	CORR ATT	OFF
Scale	SCALE	AUTO

Fig. 5-1 Checking the D.C. measuring accuracy

5.2.6   A.C. Measuring Accuracy

The following tests permit to determine the A.C. measuring accuracy of the basic instrument URV35, measuring the output voltage of an A.C. calibrator using an RF Probe URY-Z7 or a 10-V Insertion Unit URY-Z2 (Fig. 5-2). Make sure that the noise voltage (determined in broadband measurement) of the A.C. calibrator does not exceed 200 µV. Otherwise, a divider or a lowpass filter has to be provided at the calibrator output.

Calibrator settings: 0.2 mV / 10 Hz

With this calibrator setting, zero adjustment of the URV35 is started. Due to the low frequency, only the residual noise voltage is measured and eliminated like an offset error.

After the zero adjustment, the frequency is set to 100 kHz (200 kHz with RF probe) and the output voltage measured with the following values:

0.2 mV / 10 mV / 100 mV / 1 V / 10 V

The permissible display values are entered in the test report (section 5.3).

You are kindly requested to perform the measurements in the given order!
After high voltages have been measured, the RF probes need some recovery time before small levels can be measured again.
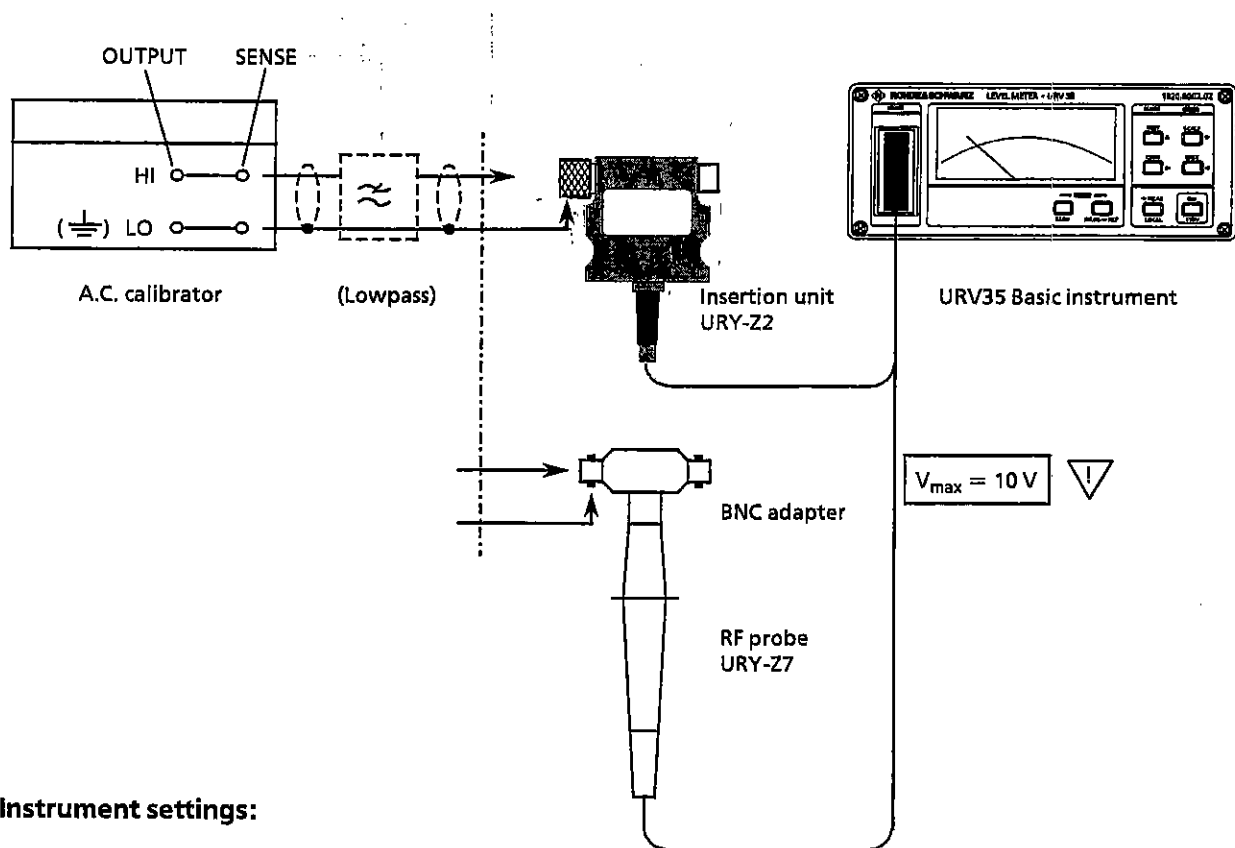
Instrument settings:

Unit	UNIT	V
Resolution	RESOL	HI
Attenuation correction	CORR ATT	OFF
Frequency response correction	CORR FRQ	OFF
Scale	SCALE	AUTO

Fig. 5-2 Checking the A.C. measuring accuracy

5.2.7   D.C. Voltage Output

The D.C. voltage output can be checked using a D.C. calibrator and the selectable scale. To this end, set the D.C. calibrator to a voltage of 1 V and connect to the URV35 via D.C. Probe URV5-Z1. After the measured value has been transferred as reference value, a symmetrical scale can be freely selected (e.g. ±10 dB). The pointer is then positioned at midscale, and the D.C. output provides a D.C. voltage of +1.50 V. When selecting 0 dB as the left-hand or right-hand full-scale value, a voltage of 0 V or +3.00 V, respectively, is obtained at the output.

The output voltage is superimposed by an A.C. voltage with $f \approx 50$ Hz and a peak-to-peak value of typ. 5 mV_{pp}.

5.2.8   DCFREQ Input

The DCFREQ input can be checked by applying a D.C. voltage. For this purpose, call the frequency response correction via → CORR → FRQ → DCFRQ and then enter the pairs of values for f_1/V_1 and f_2/V_2 stated below. By pressing the "→MEAS" key, the DCFREQ input can then be checked. Depending on the applied voltage, the equivalent frequency is displayed.

Pair of values to be entered: $V_1 = 0$ V, $f_1 = 1$ GHz
                                                        $V_2 = 10$ V, $f_2 = 11$ GHz

$V_i = 2$ V results in a frequency reading of $f = 3$ GHz.
$V_i = 8$ V results in a frequency reading of $f = 9$ GHz.

Repeated pressing of the "→MEAS" key causes the URV35 to return to normal measurement mode.

5.2.9   Testing the Sensor Check Source (Option)

The output power is measured with Thermocouple Sensor NRV-Z51. The limit values given in the test report also contain the errors of the basic unit and the measuring head. The influence of the ambient temperature is also taken into account.

How to proceed:

● Connect thermocouple sensor to URV35.
● Set the instrument:

Unit	UNIT	W
Resolution	RESOL	HI
Attenuation correction	CORR ATT	OFF
Frequency response correction	CORR FRQ	OFF
Scaling	SCALE	AUTO

● Carry out zero adjustment (ZERO key) at the earliest 1 minute after having connected the measuring head.
● Connect measuring head to sensor check source and measure power.

5.3   Test Report

R&S
LEVEL METER URV35   Date: . . . .
Order no.: 1020.0002.02 (.03)
Serial no.: . . . .   Name: . . . .

Item No.	Characteristic	Measure-ment	min.	actual	max.	Unit
1	Switching-on and voltage supply	5.2.1	---		---	
2	Testing the function of keyboard and display	5.2.2	---		---	
3	Testing the remote-control connection	5.2.3	---		---	
4	Testing the probe connection	5.2.4	---		---	
5	Testing the D.C. measuring accuracy	5.2.5				
	0 V		- 6E-4	. . . .	+6E-4	V
	+1 V		+0.9955	. . . .	+1.0045	V
	−1 V		- 0.9955	. . . .	−1.0045	V
	+10 V		+9.959	. . . .	+10.041	V
	+100 V		+99.59	. . . .	+100.41	V
	+400 V		+397.6	. . . .	+402.4	V
6	Testing the A.C. measuring accuracy	5.2.6				
	Zero adjustment		---		---	
	0.2 mV		0.174	. . . .	0.223	mV
	10 mV		9.883	. . . .	10.117	mV
	100 mV 100 kHz		98.83	. . . .	101.17	mV
	1 V (200 kHz)		0.9883	. . . .	1.0117	V
	10 V		9.883	. . . .	10.117	V
7	Testing the D.C. voltage output	5.2.7				
	1.50 V		1.495	. . . .	1.505	V
	0.00 V		−0.005	. . . .	0.005	V
	3.00 V		2.995	. . . .	3.005	V
8	Testing the DCFREQ input	5.2.8				
	2 V		2.99	. . . .	3.01	GHz
	8 V		8.97	. . . .	9.03	GHz
9	Testing the sensor check source	5.2.9	0.98	. . . .	1.02	mW