R&S®SMW-K54/-K86/-K142
IEEE 802.11a/b/g/n, IEEE 802.11ac, IEEE 802.11ax
User Manual

1175674902
Version 22

ROHDE&SCHWARZ
Make ideas real

This document describes the following software options:

- R&S®SMW-K54 IEEE 802.11a/b/g/n/j/p (1413.4139.xx)
- R&S®SMW-K86 IEEE 802.11ac (1413.5635.xx)
- R&S®SMW-K142 IEEE 802.11ax (1414.3259.xx)

This manual describes firmware version FW 4.80.041.xx and later of the R&S®SMW200A.

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Mühldorfstr. 15, 81671 München, Germany
Phone: +49 89 41 29 - 0
Email: info@rohde-schwarz.com
Internet: www.rohde-schwarz.com
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1175.6749.02 | Version 22 | R&S®SMW-K54/-K86/-K142

The following abbreviations are used throughout this manual: R&S®SMW200A is abbreviated as R&S SMW, R&S®WinIQSIM2™ is abbreviated as R&S WinIQSIM2; the license types 02/03/07/11/13/16/12 are abbreviated as xx.

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1 Welcome to the IEEE 802.11 WLAN Digital Standard

The R&S SMW-K54/-K86/-K142 are firmware applications that add functionality to generate signals in accordance with the wireless LAN standards IEEE 802.11a/b/g/n/ac/p/j/ax.

The option R&S SMW-K54 offers signal generation according to IEEE 802.11n, also legacy modes of IEEE 802.11a/b/g and IEEE 802.11p/j are supported. For IEEE 802.11ac signal generation option R&S SMW-K86 is required and for IEEE 802.11ax signal generation option R&S SMW-K142.

At least one R&S SMW-K54 option must be installed on the respective instrument as a prerequisite.

This user manual contains a description of the functionality that the application provides, including remote control operation.

All functions not discussed in this manual are the same as in the base unit and are described in the R&S SMW user manual. The latest version is available at:

www.rohde-schwarz.com/manual/SMW200A

Installation

You can find detailed installation instructions in the delivery of the option or in the R&S SMW service manual.

1.1 Key Features

The R&S SMW-K54/-K86/-K142 options support all mandatory and almost all optional features of related IEEE 802.11 standards. The following list gives an overview of the main features:

- Support of up to eight Tx antennas
- 20 MHz and 40 MHz
- 80 MHz and 160 MHz bandwidth with option R&S SMW-K86/-K142
- Support of all three operation modes (Legacy, Mixed Mode, Green Field)
- Support of all legacy transmission modes (L-10 MHz, L-20 MHz, L-Duplicate, L-Upper, L-Lower)
- Support of all 11n transmission modes (HT-20 MHz, HT-40 MHz, HT-Duplicate, HT-Upper, HT-Lower)
- Support of all 11ac transmission modes with option R&S SMW-K86 (VHT-20 MHz, VHT-40 MHz, VHT-80 MHz, VHT-80+80 MHz, VHT-160 MHz)
- Support of all 11ax transmission modes with option R&S SMW-K142 (HE-20 MHz, HE-40 MHz, HE-80 MHz, HE-80+80 MHz, HE-160 MHz)

- Additional support of the CCK and PBCC frames in accordance with IEEE 820.11a/b/g standard
- Support of Space Time Block Coding (STBC) and Spatial Multiplexing
- Up to 8 spatial streams in all supported channel widths
- Multi-User MIMO available with 2 or more total spatial streams
- Configurable number of spatial streams, space time streams and additional spatial streams,
- Configurable modulation per spatial stream
- Support of short guard interval
- Configurable state of the scramble, interleaver, time domain windowing and channel coding
- Configurable PPDU, MAC header and FCS
- Integrated frame block concept for the generation of sequence of cascaded frame blocks with different configurations and data rates
- Support of simple diversity and MIMO tests (frequency flat MIMO channel simulation) without additional channel simulator
- Simulation of real-time MIMO channel condition for instruments equipped with the fading options R&S SMW-K74/-B14(x2)
- Support of up to 37 users in 802.11ax trigger frame user info field

1.2 Accessing the IEEE 802.11 WLAN Dialog

To open the dialog with IEEE 802.11 WLAN settings

► In the block diagram of the R&S SMW, select "Baseband > IEEE 802.11".

A dialog box opens that displays the provided general settings.

The signal generation is not started immediately. To start signal generation with the default settings, select "State > On".

1.3 Documentation Overview

This section provides an overview of the R&S SMW user documentation. Unless specified otherwise, you find the documents on the R&S SMW product page at:

www.rohde-schwarz.com/manual/smw200a

1.3.1 Getting Started Manual

Introduces the R&S SMW and describes how to set up and start working with the product. Includes basic operations, typical measurement examples, and general information, e.g. safety instructions, etc. A printed version is delivered with the instrument.

1.3.2 User Manuals and Help

Separate manuals for the base unit and the software options are provided for download:

- Base unit manual
  Contains the description of all instrument modes and functions. It also provides an introduction to remote control, a complete description of the remote control commands with programming examples, and information on maintenance, instrument interfaces and error messages. Includes the contents of the getting started manual.
- Software option manual
  Contains the description of the specific functions of an option. Basic information on operating the R&S SMW is not included.

The contents of the user manuals are available as help in the R&S SMW. The help offers quick, context-sensitive access to the complete information for the base unit and the software options.

All user manuals are also available for download or for immediate display on the Internet.

1.3.3 Tutorials

The R&S SMW provides interactive examples and demonstrations on operating the instrument in form of tutorials. A set of tutorials is available directly on the instrument.

1.3.4 Service Manual

Describes the performance test for checking compliance with rated specifications, firmware update, troubleshooting, adjustments, installing options and maintenance.

The service manual is available for registered users on the global Rohde & Schwarz information system (GLORIS):

https://gloris.rohde-schwarz.com

1.3.5 Instrument Security Procedures

Deals with security issues when working with the R&S SMW in secure areas. It is available for download on the Internet.

1.3.6 Printed Safety Instructions

Provides safety information in many languages. The printed document is delivered with the product.

1.3.7 Data Sheets and Brochures

The data sheet contains the technical specifications of the R&S SMW. It also lists the options and their order numbers and optional accessories.

The brochure provides an overview of the instrument and deals with the specific characteristics.

See www.rohde-schwarz.com/brochure-datasheet/smw200a

1.3.8 Release Notes and Open Source Acknowledgment (OSA)

The release notes list new features, improvements and known issues of the current firmware version, and describe the firmware installation.

The open-source acknowledgment document provides verbatim license texts of the used open source software.

See www.rohde-schwarz.com/firmware/smw200a

1.3.9 Application Notes, Application Cards, White Papers, etc.

These documents deal with special applications or background information on particular topics.

See www.rohde-schwarz.com/application/smw200a and www.rohde-schwarz.com/manual/smw200a

1.4 Scope

Tasks (in manual or remote operation) that are also performed in the base unit in the same way are not described here.

In particular, it includes:

- Managing settings and data lists, like saving and loading settings, creating and accessing data lists, or accessing files in a particular directory.
- Information on regular trigger, marker and clock signals and filter settings, if appropriate.
- General instrument configuration, such as checking the system configuration, configuring networks and remote operation
- Using the common status registers

For a description of such tasks, see the R&S SMW user manual.

1.5 Notes on Screenshots

When describing the functions of the product, we use sample screenshots. These screenshots are meant to illustrate as many as possible of the provided functions and possible interdependencies between parameters. The shown values may not represent realistic usage scenarios.

The screenshots usually show a fully equipped product, that is: with all options installed. Thus, some functions shown in the screenshots may not be available in your particular product configuration.

2 About the IEEE 802.11 WLAN Options

2.1 Required Options

The basic equipment layout for generating IEEE 802.11 WLAN signals includes:

- Standard or wideband baseband Generator (R&S SMW-B10/-B9)
- Baseband main module (R&S SMW-B13) or wideband baseband main module (R&S SMW-B13XT)
- Frequency option (e.g. R&S SMW-B1003)
- Option IEEE 802.11a/b/g/n (R&S SMW-K54) per signal path
- Option IEEE 802.11ac (R&S SMW-K86) per signal path
- Option IEEE 802.11ax (R&S SMW-K142) per signal path

You can generate signals via play-back of waveform files at the signal generator. To create the waveform file using R&S WinIQSIM2, you do not need a specific option.

To play back the waveform file at the signal generator, you have two options:

- Install the R&S WinIQSIM2 option of the digital standard, e.g. R&S SMW-K255 for playing LTE waveforms
- If supported, install the real-time option of the digital standard, e.g. R&S SMW-K55 for playing LTE waveforms

For more information, see data sheet.

2.2 About IEEE 802.11 WLAN Technology

IEEE 802.11n is the extension of the WLAN IEEE 802.11a/g standard to nominal peak data rates of 600 Mbps. Like IEEE 802.11a/g, IEEE 802.11n is also based on OFDM. Also, IEEE 802.11n uses MIMO technology, up to 40 MHz bandwidth and special coding for increased throughput. The extension towards higher data rates is also known as high throughput mode (HT mode) of 802.11n. The non-HT mode can be seen as the part of 802.11n, which is backwards compatible to EEE 802.11a/g.

IEEE 802.11p is another extension to the WLAN IEEE 802.11a/g standard for the usage of wireless access in vehicular environment, e.g. Car-to-Car (C2C)/ Vehicle-to-Vehicle (V2V), intelligent transport systems (ITS).

IEEE 802.11ac further extends 802.11n to nominal peak data rates of 6240.0 Mbps. Like IEEE 802.11a/g/n, IEEE 802.11ac is also based on OFDM. Also, IEEE 802.11ac uses MIMO technology, up to 160 MHz bandwidth and special coding for increased throughput. The extension towards higher data rates is also known as very high throughput (VHT) mode of 802.11ac.

IEEE 802.11ax is aimed to improve the user experience and network performance in dense deployments in the 2.4 GHz and 5 GHz band. It supports uplink and downlink

multi user MIMO and up to 160 MHz bandwidth. It is based on OFDM and OFDMA modulation.

A short comparison between the IEEE 802.11 standards is provided in Table 2-1.

Table 2-1: Overview comparison of 11n, 11ac, and 11ax*

	802.11n	**802.11ac**	**802.11ax**
Channel bandwidth (MHz)	20, 40	20, 40, 80, 80+80, 160	20, 40, 80, 80+80, 160
Subcarrier spacing (kHz)	312.5	312.5	78.125
Symbol time (us)	3.2	3.2	12.8
Cyclic prefix (us)	0.8	0.8, 0.4	0.8, 1.6, 3.2
MU-MIMO	No	Downlink	Uplink and downlink
Modulation	OFDM	OFDM	OFDM, OFDMA
Data subcarrier modulation	BPSK, QPSK, 16-QAM, 64-QAM	BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM	BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM, 1024- QAM
Coding	BCC (mandatory) LDPC (optional)	BCC (mandatory) LDPC (optional)	BCC (mandatory) LDPC (mandatory)

* this table is taken from the white paper 1MA222: IEEE 802.11ax Technology Introduction.

The following application notes contain information about the different IEEE 802.11 standards. The documents are available for free download on the Rohde & Schwarz website.

- 1GP94: Generating Signals for WLAN 802.11ac
- 1MA152: Intelligent Transportation Systems Using IEEE 802.11p
- 1MA179: WLAN 802.11n: From SISO to MIMO
- 1MA192: 802.11ac Technology Introduction
- 1MA222: IEEE 802.11ax Technology Introduction

2.3 Operation Modes

The IEEE 802.11n standard defined the following three operation modes:

- Legacy mode
  This mode is provided for backwards compatibility with the IEEE 802. a/g standard. The mode is also known as Non-HT mode.
- Mixed Mode
  A legacy preamble and header (L-STF, L-LTF and L-SIG) are wrapping the HT part of the frame so that the frame is complying with OFDM-PHY and ERP-OFDM-PHY corresponding to 802.11 a/g respectively.
- Green Field

In this mode, frames are being transmitted in a new high throughput format that does not comply with the legacy mode. Green Field is an optional mode.

The Figure 2-1 shows the packet formats of the different operation modes that can be triggered by a device supporting the IEEE 802.11n standard.

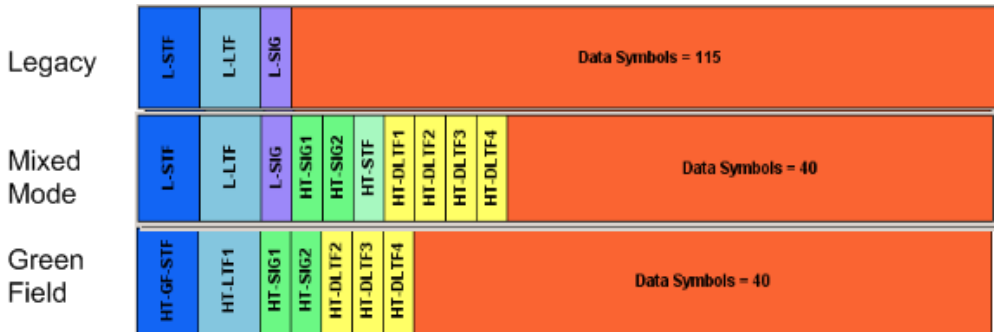


Figure 2-1: PLCP packet format for IEEE 802.11

The Table 2-2 gives an overview of the frequency domain operation modes of the physical layer. Note that the duplicate mode corresponds to repeating the same complex numbers modulating the subcarriers of the upper channel on the lower channel.

Table 2-2: Frequency domain PHY operation

LM	Legacy mode as in IEEE 802.11a/g Also, the CCK and the PBCC frames as in IEEE 802.11b/g
HT-Mode	Frequency: 20 MHz and 40 MHz, 1...4 spatial streams (HT Duplicate Mode included)
Duplicate Non-HT mode	IEEE 802.11a OFDM-PHY format, 20 MHz and 40 MHz dual operation, upper channel rotated by 90° relative to lower channel
Upper mode	Non-HT/HT frame in the upper 20 MHz channel
Lower mode	Non-HT/HT frame in the lower 20 MHz channel
VHT-Mode	Frequency 20 MHz, 40 MHz, 80 MHz, 160 MHz, 1...8 spatial streams (option R&S SMW-K86 required)
HE mode	Frequency 20 MHz, 40 MHz, 80 MHz, 160 MHz, 1...8 spatial streams (option R&S SMW-K142 required)

When operating in the OFDM 20 MHz mode, there are 64 subcarriers available; the migration to 40 MHz mode offers 128 subcarriers with the same frequency spacing of 312.5 KHz. 80 MHz bandwidth is using 256 subcarriers, keeping the original frequency spacing. With 160 MHz bandwidth 512 subcarriers apply.

For IEEE 802.11ax in the OFDMA frequency allocation, the resource units (RU) may contain 26, 52, 106, 242, 484 or 996 tones (aka subcarriers) and are in fixed locations. The tones/subcarriers in the resource units are adjacent and contiguous except in the middle of the channel where DC null carriers are present.

2.4 Signal Generation

The generation of an IEEE 802.11n/ac/ax signal is done in multiple steps. In high throughput (HT) and very high throughput (VHT) modes, the data of a single user is specially coded and transmitted via up to eight Tx antennas.

In this implementation, the mapping of the Tx antennas' signals to the output paths of the instrument can be configured. This function can be used for the simulation of frequency flat MIMO channel, i.e. one carrier analysis like BER tests for instance. Another application of the configurable mapping is the possibility to generate a combined signal from different antennas if there is one path instrument or limited number of baseband paths.

Refer to Figure 2-2 for an overview of the signal flow for generation of such a signal in HT mode.

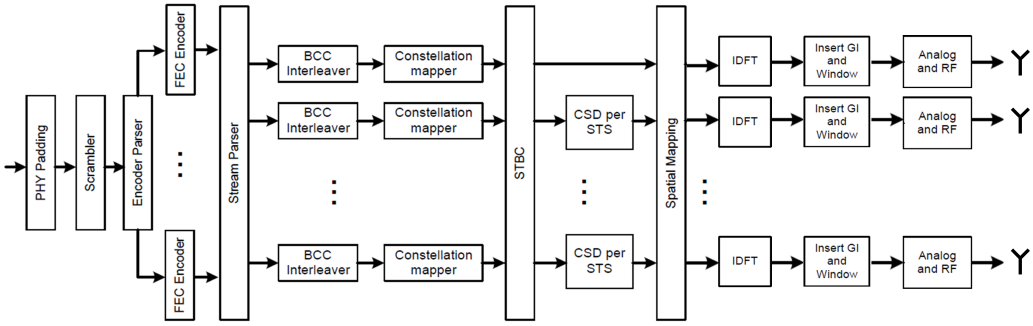


Figure 2-2: IEEE 802.11 n/ac/ax transmission chain

3 WLAN Configuration and Settings

Access:

► Select "Baseband > IEEE 802.11".

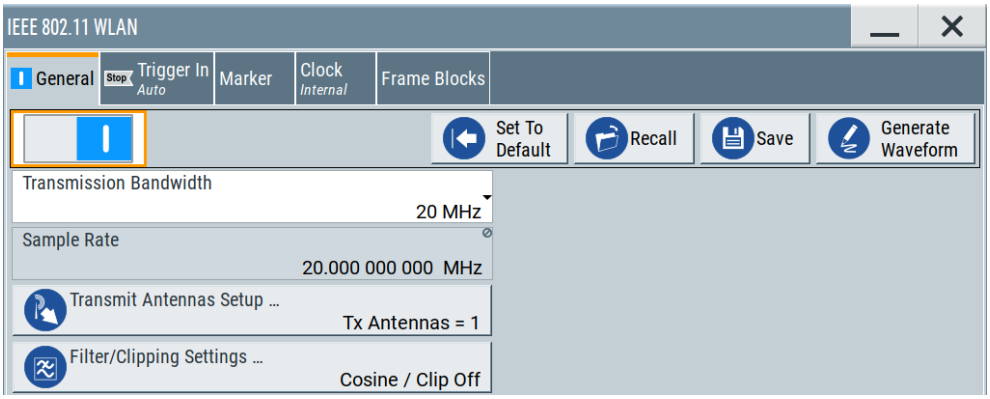
The remote commands required to define these settings are described in Chapter 6, "Remote-Control Commands", on page 107.

- General Settings 16
- Transmit Antenna Setup 20
- Frame Block Configuration 22
- PPDU Configuration 28
- A-MPDU Settings 50
- MAC Header and FCS Configuration for Frame Block 52
- MAC Header HT/HE and VHT Configuration 70
- Spatial Mapping 80

3.1 General Settings

Access:

► Select "Baseband > IEEE 802.11 > General".



The tab provides access to the default and the "Save/Recall" settings, and displays the sample rate.

Settings

State 17
Set to Default 17
Save/Recall 18
Generate Waveform File 19
Transmission Bandwidth 19

Sample Rate 19
Transmit Antennas Setup 19
Filter / Clipping Settings 19

State
Activates the standard and deactivates all the other digital standards and digital modulation modes in the same path.

Remote command:
`[:SOURce<hw>]:BB:WLNN:STATe` on page 114

Set to Default
Calls the default settings. The values of the main parameters are listed in the following table.

Parameter	Value
General parameters	
"State"	Not affected by "Set to Default"
"Transmission Bandwidth"	20 MHz
"Configure Baseband B from Baseband A"	Off
"Tx Antennas"	1
"Filter"	Cosine
"Clipping "	Off
Frame blocks configuration	
"Frame Blocks"	1
"Frame Block Type"	DATA
"Frame Blocks State"	On
"Physical Mode"	Mixed mode
"Tx Mode"	HT-20 MHz
"Frames"	1
"Idle Time"	0.1 ms
"Data Source"	PN9
TX antenna setup	
"Antennas"	1
"Mapping Coordinates"	Cartesian
"Output"	First set "Baseband", rest is set to Off
"Matrix Elements" ("Real", "Imaginary", "Magnitude", "Phase")	All zero but diagonal = 1
PPDU configuration	
"Spatial Streams"	1

Parameter	Value
"Space Time Streams"	1
"Extended Spatial Streams"	0
"Space Time Block Coding"	inactive
Parameter value	
"MCS"	1
"Data Rate (Mbps)"	13
"Data Bits Per Symbol"	52
"Stream 1"	QPSK
"Channel Coding"	BCC
"Coding Rate"	½
"Guard"	Long
"Data Length"	1024 bytes
"Number of Data Symbols"	158
"Scrambler"	"ON (user init)"
"Scrambler Init"	01
"Interleaver Active"	ON
"Service Field"	0000
"Time Domain Windowing Active"	On
"Transition Time"	100 ns
"Preamble/Header Active"	ON
"Smoothing"	ON
Spatial mapping	
"Mode"	Spatial expansion
"Index k"	20

Remote command:
`[:SOURce<hw>]:BB:WLNN:PRESet` on page 112

Save/Recall
Accesses the "Save/Recall" dialog, that is the standard instrument function for saving and recalling the complete dialog-related settings in a file. The provided navigation possibilities in the dialog are self-explanatory.

The settings are saved in a file with predefined extension. You can define the filename and the directory, in that you want to save the file.

See also, chapter "File and Data Management" in the R&S SMW user manual.

Remote command:
[:SOURce<hw>]:BB:WLNN:SETTing:CATalog? on page 113
[:SOURce<hw>]:BB:WLNN:SETTing:LOAD on page 113
[:SOURce<hw>]:BB:WLNN:SETTing:STORe on page 114
[:SOURce<hw>]:BB:WLNN:SETTing:DELete on page 113

Generate Waveform File
With enabled signal generation, triggers the instrument to save the current settings of an arbitrary waveform signal in a waveform file with predefined extension `*.wv`. You can define the filename and the directory, in that you want to save the file.

Using the ARB modulation source, you can play back waveform files and/or process the file to generate multi-carrier or multi-segment signals.

Remote command:
[:SOURce<hw>]:BB:WLNN:WAVeform:CREate on page 114

Transmission Bandwidth
Selects the transmission bandwidth.

If the system bandwidth is set to 20 MHz, all invalid configurations in the frame blocks table are set to the default values.

Remote command:
[:SOURce<hw>]:BB:WLNN:BWidth on page 111

Sample Rate
Displays the sample rate of the signal specific for the selected bandwidth.

Remote command:
[:SOURce<hw>]:BB:WLNN:SRATe? on page 120

Transmit Antennas Setup
Accesses the dialog for configuring the TX antennas.

The menu is described in Chapter 3.2, "Transmit Antenna Setup", on page 20.

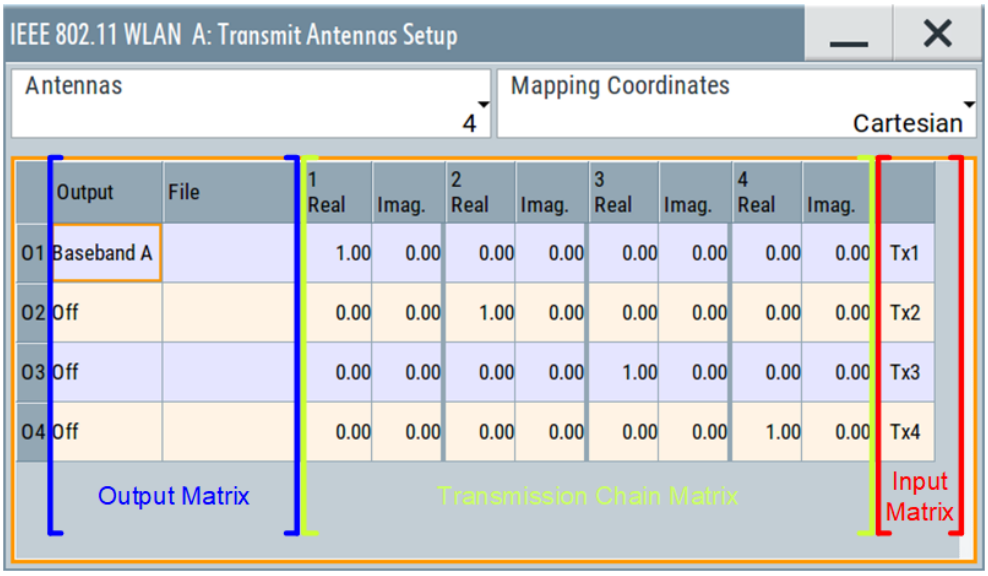
Remote command:
n.a.

Filter / Clipping Settings
Accesses the dialog for setting baseband filtering and clipping, see Chapter 5.1, "Filter/ Clipping Settings", on page 91.

3.2 Transmit Antenna Setup

Access:

► Select "Baseband > IEEE 802.11 > General > Transmit Antennas Setup".



This dialog is used to map the generated Tx chains to different destinations ("Baseband A/B", "File" or "OFF") and makes it possible to combine different Tx antenna signals.

Settings

Antennas 20
Mapping Coordinates 20
Transmission Antenna Table 21
└ Output 21
└ Real/Magnitude 21
└ Imaginary/Phase 21

Antennas
Selects the number of transmit antennas to be used.

Remote command:
`[:SOURce<hw>]:BB:WLNN:ANTenna:MODE` on page 132

Mapping Coordinates
Selects the coordinate system of the transmission chain matrix.

"Cartesian" Sets the Cartesian coordinates system ("Real", "Imaginary").

"Cylindrical" Sets the cylindrical coordinates system ("Magnitude", "Phase").

Remote command:
`[:SOURce<hw>]:BB:WLNN:ANTenna:SYSTem` on page 133

Transmission Antenna Table
Configures the output matrix and transmission chain matrix coefficients.

During signal calculation, the R&S SMW evaluates the transmission chain matrix and takes into account the set phase ratios. However, the power ratio of the antennas is not considered.

To generate a WLAN signal of antennas with different power level, set the power level of the corresponding path to the desired level in the header display of the instrument.

Output ← Transmission Antenna Table
Selects the destination of the calculated IQ chains.

"OFF" No mapping takes place.

"Baseband A/B"
The IQ chain is output to the selected baseband. Exactly one output stream can be mapped to a baseband.

"File" The IQ chain is saved in a file.

Remote command:
`[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:OUTPut:DESTination` on page 133
`[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:OUTPut:FSELect` on page 134

Real/Magnitude ← Transmission Antenna Table
Enters the value of the real or the magnitude coordinates.

Remote command:
For "Cartesian" mapping coordinates:
`[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:TX<dir>:REAL` on page 134
For "Cylindrical" mapping coordinates:
`[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:TX<dir>:MAGNitude` on page 135

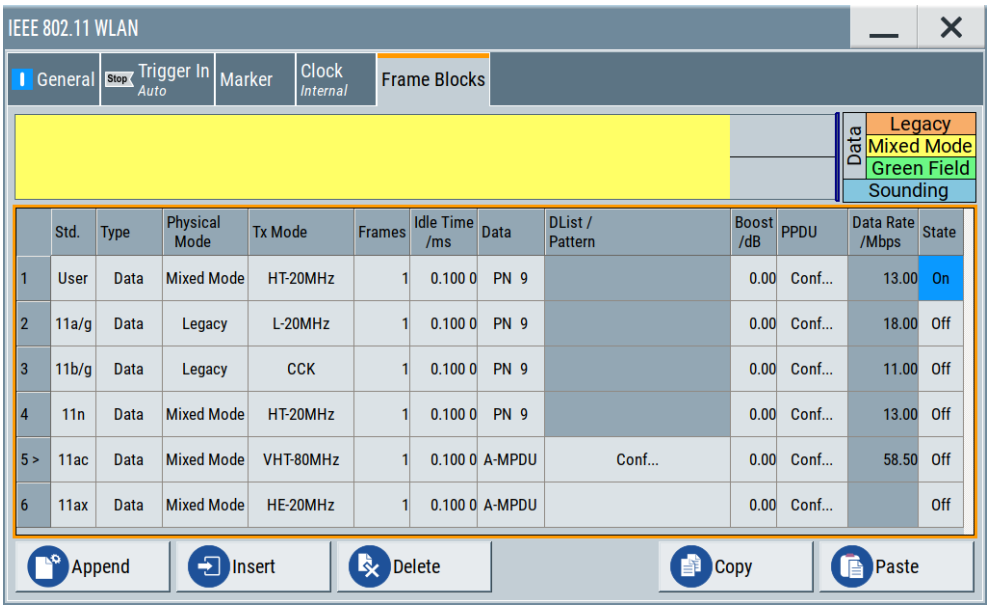
Imaginary/Phase ← Transmission Antenna Table
Enters the value of the imaginary or the phase coordinates.

Remote command:
For Cartesian mapping coordinates:
`[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:TX<dir>:IMAGinary` on page 134
For "Cylindrical" mapping coordinates:
`[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:TX<dir>:PHASe` on page 134

3.3 Frame Block Configuration

Access:

► Select "Baseband > IEEE 802.11 > Frame Blocks".



This tab comprises the settings to select and configure a frame block.

Settings:

Std. 22
Type 23
Physical Mode 24
Tx Mode 24
Frames 26
Idle Time /ms 26
Data 27
Boost /dB 27
PPDU 27
Data Rate /Mbps 28
State 28
Append 28
Insert 28
Delete 28
Copy 28
Paste 28

Std.
Selects the IEEE 802.11 WLAN standard.

After setting the standard, only settings that are relevant for this standard are available. Affected parameters are "Type", "Physical Mode" and "Tx Mode", see Table 3-1.

"Std. > 11be" constitutes the preliminary IEEE 802.11be standard, that is based on the current specifcation framework document.

Table 3-1: Availability "Standard", "Type", "Physical Mode", "TxMode"

Standard	Type	Physical mode	Txmode
User	all	all	all except EHT-320MHz
11a/g	Data/ Beacon/ Trigger	Legacy	L-20MHz
			L-Duplicate
			L-Upper
			L-Lower
11b/g	Data/ Beacon/ Trigger	Legacy	CCK
			PBCC
11p/j	Data/ Beacon/ Trigger	Legacy	L-10MHz
11n	all	Mixed Mode/ Green Field	HT-20MHz
			HT-40MHz
			HT-Duplicate
			HT-Upper
			HT-Lower
11ac	all	Mixed Mode	VHT-20MHz
			VHT-40MHz
			VHT-80MHz
			VHT-80 + 80 MHz
			VHT-160MHz
11ax	Data/ Trigger	Mixed Mode	HE-20MHz
			HE-40MHz
			HE-80MHz
			HE-80 + 80MHz
			HE-160MHz
11be	Data/ Trigger	Mixed Mode	EHT-320MHz

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:STANdard` on page 139

Type
Selects the PPDU type.

"Data" Only "Data Long Training" fields are used to probe the channel.

"Sounding" Staggered preambles are used to probe additional dimension of the MIMO channel.
"Type > Sounding" is not available for "Physical Mode > Legacy".

"Beacon" A frame of type "Beacon" contains all the information about a network, for example the beacon interval, capability information and the IBSS parameter set. The access point (AP) of a service set periodically transmits the beacon frame to establish and maintain the network.

"Trigger" A downlink trigger frame is generated to synchronize the transmission of a DUT's trigger-based uplink frame.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:TYPE` on page 140

Physical Mode
Selects the preamble design.

For "Physical Mode > Legacy", only "Type > Data" is available.

For 80 MHz transmission bandwidth and "Type > Data", you can only operate in "Physical Mode > Mixed Mode".

Note: "Physical Mode > Mixed Mode" transmissions can be detected by a physical layer transceiver of 802.11a/g OFDM, MAC FCS would however fail.

"Legacy" Compatible with 802.11a/g OFDM devices. Also, CCK/PBCC frames as defined in IEEE 802.11b/g are supported.
This mode applies to "Cylindrical" mapping coordinates.

"Mixed Mode" For High Throughput (HT), Very High Throughput(VHT) , High Efficiency (HE), Extremely High Throughput (EHT) and 802.11a/g OFDM devices.

"Green Field" For HT networks only.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PMODe` on page 138

Tx Mode
Sets the Tx mode.

The available Tx modes depend on the physical mode, see the tables below.

Table 3-2: Tx modes for "Type > Data/ Trigger", and "Physical Mode > Legacy"

Tx mode	Transmission bandwidth				
	20 MHz	40 MHz	80 MHz	160 MHz	320 MHz
L-10MHz	x	x	x	x	-
L-20MHz	x	x	x	x	-
L-Duplicate	-	x	x	x	-
L-Upper	-	x	x	x	-
L-Lower	-	x	x	x	-
CCK	x	x	x	x	-
PBCC	x	x	x	x	-

Table 3-3: Tx modes for "Type > Data/ Trigger" and "Physical Mode > Mixed Mode"

Tx mode	Transmission bandwidth				
	20 MHz	40 MHz	80 MHz	160 MHz	320 MHz
HT-20MHz	x	x	x	x	-
HT-40MHz	-	x	x	x	-
HT-Duplicate	-	x	x	x	-
HT-Upper	-	x	x	x	-
HT-Lower	-	x	x	x	-
VHT-20MHz	x	x	x	x	-
VHT-40MHz	-	x	x	x	-
VHT-80MHz	-	-	x	x	-
VHT-80+80MHz	-	-	x	x	-
VHT-160MHz	-	-	-	x	-
HE-20MHz	x	x	x	x	-
HE-40MHz	-	x	x	x	-
HE-80MHz	-	-	x	x	-
HE-80 + 80MHz	-	-	x	x	-
HE-160MHz	-	-	-	x	-
EHT-320MHz	-	-	-	x	x

Table 3-4: Tx modes for "Type > Data", and "Physical Mode > Green Field"

Tx mode	Transmission bandwidth				
	20 MHz	40 MHz	80 MHz	160 MHz	320 MHz
HT-20MHz	x	x	x	x	-
HT-40MHz	-	x	x	x	-
HT-Duplicate	-	x	x	x	-
HT-Upper	-	x	x	x	-
HT-Lower	-	x	x	x	-

Table 3-5: Tx modes for "Type > Sounding" and "Physical Mode > Mixed Mode"

Tx mode	Transmission bandwidth				
	20 MHz	40 MHz	80 MHz	160 MHz	320 MHz
HT-20MHz	x	x	x	x	-
HT-40MHz	-	x	x	x	-
HT-Duplicate	-	x	x	x	-
HT-Upper	-	x	x	x	-

Tx mode	Transmission bandwidth				
	20 MHz	40 MHz	80 MHz	160 MHz	320 MHz
HT-Lower	-	x	x	x	-
VHT-20MHz	x	x	x	x	-
VHT-40MHz	-	x	x	x	-
VHT-80MHz	-	-	x	x	-
VHT-80+80MHz	-	-	x	x	-
VHT-160MHz	-	-	-	x	-

Table 3-6: Tx modes for "Type > Sounding" and "Physical Mode > Green Field"

Tx mode	Transmission bandwidth				
	20 MHz	40 MHz	80 MHz	160 MHz	320 MHz
HT-20MHz	x	x	x	x	-
HT-40MHz	-	x	x	x	-
HT-Duplicate	-	x	x	x	-
HT-Upper	-	x	x	x	-
HT-Lower	-	x	x	x	-

Table 3-7: Tx modes for "Type > Beacon", and "Physical Mode > Legacy"

Tx mode	Transmission bandwidth				
	20 MHz	40 MHz	80 MHz	160 MHz	320 MHz
L-10MHz	x	x	x	x	-
L-20MHz	x	x	x	x	-
L-Duplicate	-	x	x	x	-
L-Upper	-	x	x	x	-
L-Lower	-	x	x	x	-
CCK	x	x	x	x	-
PBCC	x	x	x	x	-

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:TMODe` on page 140

Frames
Sets the number of frames to be transmitted in the current frame block.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:FCOunt` on page 136

Idle Time /ms
Sets the time interval separating two frames in this frame block.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:ITIMe on page 138

Data
Selects the data source.

For "Std. > 11ax/11be", only the "A-MPDU" data source is available.

The following standard data sources are available:
- "All 0, All 1"
  An internally generated sequence containing 0 data or 1 data.
- "PNxx"
  An internally generated pseudo-random noise sequence.
- "Pattern"
  An internally generated sequence according to a bit pattern.
  Use the "Pattern" box to define the bit pattern.
- "Data List/Select DList"
  A binary data from a data list, internally or externally generated.
  Select "Select DList" to access the standard "Select List" dialog.
  – Select the "Select Data List > navigate to the list file *.dm_iqd > Select" to select an existing data list.
  – Use the "New" and "Edit" functions to create internally new data list or to edit an existing one.
  – Use the standard "File Manager" function to transfer external data lists to the instrument.

See also:
- Section "Modulation Data" in the R&S SMW user manual.
- Section "File and Data Management" in the R&S SMW user manual.
- Section "Data List Editor" in the R&S SMW user manual

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DATA on page 137
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DATA:PATTern on page 138
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DATA:DSELection on page 137

Boost /dB
Assigns a specific RMS power boost/attenuation to the corresponding frame block modulation.

The power level of a frame block modulation is calculated as sum of the power boost and the power level set in the header of the instrument.

Note: At least one frame block should have a power boost set to 0 dB value, so that the gated power mode functionality works properly.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BOOSt on page 136

PPDU
Calls the dialog for PPDU configuration of the frame blocks.

The dialog is described in Chapter 3.4, "PPDU Configuration", on page 28.

Remote command:
n.a.

Data Rate /Mbps
Indicates the PPDU data rate.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DATA:RATE? on page 138
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:DATA:RATE? on page 146

State
Enables the corresponding frame block for transmission.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:STATe on page 139

Append
Adds a default frame block behind the selected frame block.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock:APPend on page 111

Insert
Adds a default frame block before the selected frame block.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:INSert on page 111

Delete
Deletes the selected frame block.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DELete on page 112

Copy
Copies the selected frame block.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:COPY on page 112

Paste
Pastes the copied frame block behind the selected frame block.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PASTe on page 112

3.4 PPDU Configuration

Access:

► Select "Frame Blocks > PPDU > Config...".

In this dialog, the mode, the time shifts and the transmit parameters can be configured.

The parameters available for configuration depend on the selected "Type", "Physical Layer" and "Tx Mode".

Settings

- General Settings 29
- HE Configuration Settings 35
- User Configuration 41
- Data Settings 44

3.4.1 General Settings

Access:

1. Select "Frame Blocks > PPDU > Config...".
2. Select "General".

   The dialog comprises the settings for the configuration of the stream settings, the modulation and coding scheme and also the PSDU bit rate. The parameters available for configuration depend on the selected "Type", "Physical Layer" and "Tx Mode".

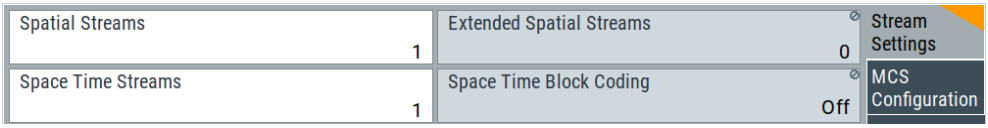
Settings

- Stream Settings 29
- User Settings 30
- Modulation and Coding Scheme Settings 31
- CCK/PBCC Settings 34

3.4.1.1 Stream Settings

Access:

1. Select "Frame Blocks > PPDU > Config...".
2. Select "General > Stream Settings".



Provided are the following settings:

Spatial Streams 30
Space Time Streams 30
Extended Spatial Streams 30
Multi User MIMO 30
Segment 30
Space Time Block Coding 30

Spatial Streams
Enters the number of the spatial streams. For "Physical Mode > Legacy", only the value 1 is valid. For "Tx Mode > HT-Duplicate", only the value 1 is valid. In all other cases, the number of spatial streams depends on the number of antennas configured in the "TX Antenna Setup" window.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SSTReam` on page 155

Space Time Streams
Enters the number of the space time streams. This value depends on the setting in the "Spatial Streams" field. Changing the number of the spatial streams immediately changes the value of the "Space Time Streams" to the same value.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:STSTream` on page 156

Extended Spatial Streams
Enters the value of the extended spatial streams. This field is active for "Type > Sounding" only to probe additional dimensions of the channel.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:ESSTream` on page 147

Multi User MIMO
Activates multi user MIMO. This function applies to "Spatial Streams > 1".

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MUMimo:STATe` on page 149

Segment
Requires "Tx Mode > VHT-80+80 MHz".

In "Tx Mode > VHT-80+80 MHz", one of the two segments can be selected with transmission bandwidth 80 MHz or 160 MHz. Both segments can be only generated with bandwidth 160 MHz.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SEGMent` on page 154

Space Time Block Coding
Displays the status of the space time block coding.

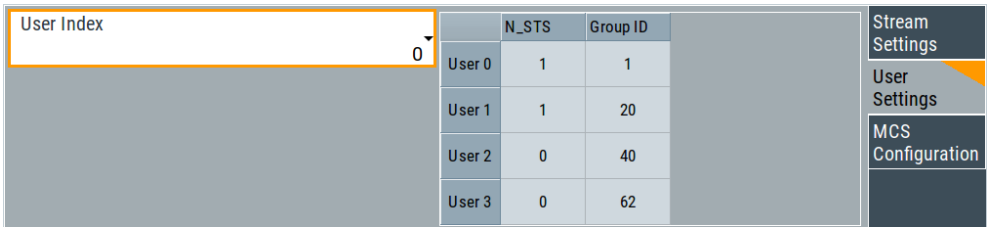
Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:STBC:STATe?` on page 156

3.4.1.2 User Settings

Access:

1. In the "Frame Blocks" dialog, select "Std. > 11ac".
2. Open the "PPDU > Conf.." dialog.

3. Select "Spatial Streams" > 2.
4. Select "Multi User MIMO > On".



This section contains the parameters for selecting and configuring signal generation of multiple users.

Settings:

User Index....31
Multi User MIMO Settings Table....31

User Index
Defines the currently generated user. For "Multi User MIMO > Active", only one user can be generated at a time. This parameter selects the generated one out of four available users.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:UINDex` on page 157

Multi User MIMO Settings Table
Sets the user-defined parameters for all available users.

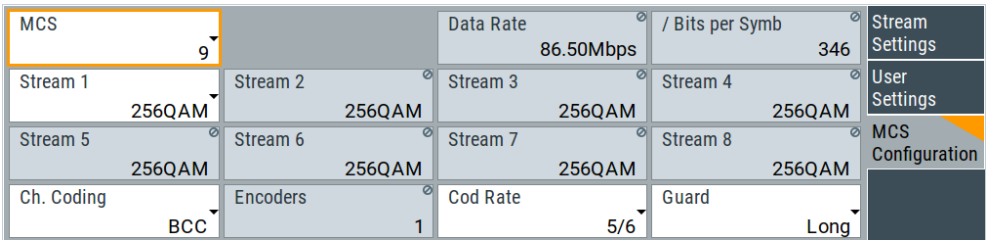
- User index
  A maximum of four users are supported
- N_STS
  Number of space time streams for each user
- Group ID
  Group ID for each user

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MU<st0>:NSTS` on page 149
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MU<st0>:GID` on page 149

3.4.1.3 Modulation and Coding Scheme Settings

Access:

1. Select "Frame Blocks > PPDU > Config...".
2. Select "General > MCS Configuration".



Settings:

MCS 32
Data Rate /Mbps 32
Data Bits Per Symbol 32
Stream n 32
Channel Coding 33
Encoders 33
Cod Rate 33
Guard 33
DCM 33

MCS
Selects the modulation and coding scheme for all spatial streams.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MCS` on page 148
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MCS` on page 148

Data Rate /Mbps
Indicates the PPDU data rate.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DATA:RATE?` on page 138
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:DATA:RATE?` on page 146

Data Bits Per Symbol
Displays the number of data bits sent by an OFDM symbol on all spatial streams.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DATA:BPSymbol?` on page 144
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:DATA:BPSymbol?` on page 144

Stream n
Selects the modulation used for the selected spatial stream.

"4096QAM" Requires "MCS 12/13".

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MODulation<st>` on page 149
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MODulation<st>` on page 149

Channel Coding
Selects the channel coding.

"Off"	No channel coding is used.
"BCC"	Binary convolution code
"LDPC"	Requires "Tx Mode > HT.../VHT...". Low density parity check is an optional coding for the IEEE 802.11ac and IEEE 802.11n standards.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:CODing:TYPE` on page 144
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:CODing:TYPE` on page 144

Encoders
Displays the number of encoders to be used. This value depends on the data rate. For data rates ≤ 300 mps, this value is 1. Otherwise, the number of encoders is 2.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:CODing:ENCoder?` on page 143
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:CODing:ENCoder?` on page 143

Cod Rate
Selects the coding rate.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:CODing:RATE` on page 143
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:CODing:RATE` on page 143

Guard
Selects which guard interval is used for the OFDM guard.

For "Physical Mode > Green Field/Legacy", the field is read-only, since the modes have long guard intervals only.

The values "0.8µs", "1.6 µs" and "3.2 µs" are available only for "Std.> 11ax".

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:GUARd` on page 147

DCM
Requires "MCS > 0/1/3/4".

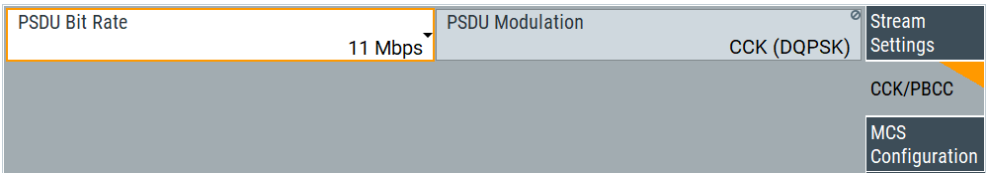
Indicates the use of dual carrier modulation (DCM) for a HE data field.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:USER<di>:DCM` on page 144

3.4.1.4 CCK/PBCC Settings

Access:

1. Select "Frame Blocks > Physical Mode > Legacy ".
2. Select "Tx Mode > CCK/PBCC ".
3. Select "PPDU > Conf".



In this dialog, the "PSDU Bit Rate (OFDM)" can be set.

Settings

PSDU Bit Rate..... 34
PSDU Modulation..... 34
Barker Spreading..... 35

PSDU Bit Rate
Requires "Tx Mode > CCK/PBCC".

Selects the bit rate of the PSDU.

The data rates available are 1 Mbps, 2 Mbps, 5.5 Mbps, 11 Mbps and 22 Mbps. The 1 Mbps data rate is only available if the long PLCP format has been selected. The selection of the data rate also determines the possible modulation modes.

The following table shows the correlation between data rate and modulation.

Data rate	Possible modulation mode
1 Mbps	Barker sequence (DBPSK) the information data sequence is spread with an 11-chip Barker sequence, chip rate is 11 Mcps
2 Mbps	Barker sequence (DQPSK) the information data sequence is spread with an 11-chip Barker sequence, chip rate is 11 Mcps
5.5 Mbps	CCK (DQPSK) or PBCC (BPSK)
11 Mbps	CCK (DQPSK) or PBCC (QPSK)
22 Mbps	PBCC (8PSK)

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PSDU:BRATe` on page 152

PSDU Modulation
Requires "Tx Mode > CCK/PBCC".

Indicates the modulation type. The modulation type is determined by the selected PSDU "Bit Rate".

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PSDU:MODulation?` on page 153

Barker Spreading
Requires "Tx Mode > CCK/PBCC".

Activates barker spreading (bit rates 1 Mbps or 2 Mbps only).

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PSDU:BSPReading:STATe` on page 152

3.4.2 HE Configuration Settings

This chapter describes the HE configuration settings for 802.11ax.

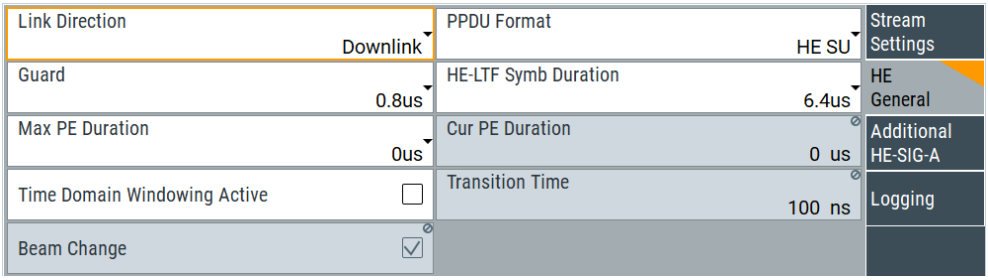
- HE General Settings 35
- Additional HE-SIG-A-Fields 38
- Logging 40

3.4.2.1 HE General Settings

Contains the general HE settings like "Link direction", "PPDU Format" and the settings for the "HE-SIG A fields".

Access:

1. Select "IEEE 802.11... > Frame Blocks".
2. Select "Std > 11ax" or "Std > User".
3. Select "Tx Mode > HE-20/40/80/80+80/160MHZ "
4. Select "PPDU > Config".
5. Select "General > Additional HE-SIG-A".



Settings

Link Direction 36
Guard 36
Max PE Duration 36
Time Domain Windowing Active 36

Beam change....36
PPDU Format....36
HE-LTF Symb Duration....37
Cur PE Duration....37
Right 106-Tone RU....37
Transition Time....37
SIG-B DCM....37
SIG-B MCS....37
Preamble Puncturing....38

Link Direction
Selects the link direction.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:LINK` on page 159

Guard
Selects which guard interval is used for the OFDM guard.

For "Physical Mode > Green Field/Legacy", the field is read-only, since the modes have long guard intervals only.

The values "0.8µs", "1.6 µs" and "3.2 µs" are available only for "Std.> 11ax".

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:GUARd` on page 147

Max PE Duration
Selects the maximum packet extension (PE) duration.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAXPe` on page 160

Time Domain Windowing Active
Activates/deactivates the time domain windowing.

Time domain windowing is a method to influence the spectral characteristics of the signal, which is not stipulated by the standard. However, it does not replace oversampling and subsequent signal filtering.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:TDWindowing:STATe` on page 156

Beam change
Requires "PPDU Format > HE SU/HE SU EXT".

If enabled, the beam is changed between pre-HE and HE modulated fields. The pre-HE fields are: L-STF, L-LTF, L-SIG, RL-SIG, HE-SIG-A, HE-SIG-A-R, and HE-SIG-B fields. The HE modulated fields are: HE-STF, HE-LTF and data fields.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BCHG` on page 158

PPDU Format
Selects the PPDU format.

"HE SU"	HE SU (single-user) carries a single PSDU. The HE signal A (HE-SIG-A) field is not repeated.
"HE MU"	HE MU (multi-user) carries multiple PSDUs to one or more users.
"HE SU EXT"	Carries a single PSDU. The HE-SIG-A field is repeated. This format is only transmitted in 20 MHz channel bandwidths. It is intended for a user who is further away from the access point (AP).
"HE TRIG"	Available only for "Link Direction > Uplink". Carries a single PSDU. It is sent as a response to a PPDU that contains a trigger frame.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PFORmat` on page 161

HE-LTF Symb Duration
Selects the duration of the HE long training field (LTF).The symbol duration value does not include the guard interval. The values available are 3.2 µs (1x LTF), 6.4 µs (2x LTF), and 12.8 µs (4x LTF) LTF symbol durations.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SYMDuration` on page 162

Cur PE Duration
Displays the current PE duration for all users. The possible values are 0 µs, 4 µs, 8 µs, 12 µs and 16 µs.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:CURPe?` on page 159

Right 106-Tone RU
Available only for "Tx Mode > HE-20MHz" and "PPDU Format > HE SU EXT".

If enabled, indicates that the right 106-tone RU is within the primary 20 MHz.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:RIGHt106tone` on page 154

Transition Time
Sets the transition time when "Time Domain Windowing > Active".

The transition time defines the overlap range of two OFDM symbols. At a setting of 100 ns and if BW = 20 MHz, one sample overlaps.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:TTIMe` on page 157

SIG-B DCM
Enables the use of dual carrier modulation (DCM) in a signal B field.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BDCM` on page 158

SIG-B MCS
Selects the modulation and coding scheme (MCS) for the signal B field.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BMCS on page 158

Preamble Puncturing
Requires "Tx Mode > HE-80MHz/HE-80+80MHz" and "PPDU Format > HE MU".

Enables preamble puncturing of the HE MU PPDU in 80 MHz or (80+80)/160 MHz channels.

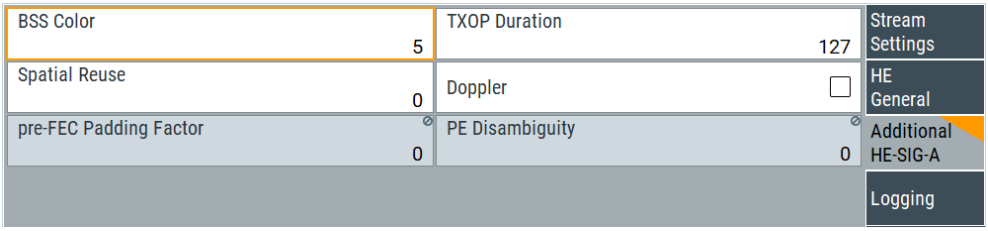
If enabled, preambles of specific 20 MHz subchannels are not transmitted.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PPUNcturing:STATe on page 162

3.4.2.2 Additional HE-SIG-A-Fields

Access:

1. Select "IEEE 802.11... > Frame Blocks".
2. Select "Std > 11ax" or "Std > User".
3. Select "Tx Mode > HE-20/40/80/80+80/160MHZ "
4. Select "PPDU > Config".
5. Select "General > Additional HE-SIG-A".



The signal A field provides information about how to interpret the HE PPDUs.

Settings

BSS Color 38
TXOP Duration 39
Spatial Reuse 39
Doppler 39
pre-FEC Padding Factor 39
PE Disambiguity 39
Preamble Puncturing Bandwidth 39

BSS Color
Sets the BSS color, an identifier of the basic service sets (BSS) field. This parameter helps to check if a detected frame is coming from an overlapping station.

If a WLAN station detects an 802.11ax frame, it checks the BSS color. The station compares the color result to the color that was announced by the access point (AP). If the BSS colors match, the frame is treated as intra-BSS. If the BSS colors mismatch, the wireless station considers the frame as inter-BSS.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BSSColor` on page 159

TXOP Duration
If transmission opportunity (TXOP) is set to *127*, it indicates no duration information. If it is set to any other value, it indicates duration information for network allocation vector (NAV) parameter and that the TXOP is protected.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:TXOPduration` on page 162

Spatial Reuse
Indicates if the spatial reuse is allowed (value set to **1**) or not (value set to **0**).

The spatial reuse is a method of the 802.11ax standard that aims to improve network performance in dense deployments.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SPAReuse<st>` on page 162

Doppler
If enabled, the Doppler effect is used for the PPDU.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DOPPler` on page 159

pre-FEC Padding Factor
Displays the pre forward error condition (FEC) padding factor used in the trigger PPDU.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PFPFactor?` on page 161

PE Disambiguity
Displays the disambiguity in the number of symbols occurring due to the packet extension.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PED?` on page 160

Preamble Puncturing Bandwidth
Requires "Preamble Puncturing > On".

Sets the bandwidth mode of preamble puncturing.

If enabled, the preamble part of the 20/40 MHz subchannel(s) is punctured, i.e. this part is not transmitted (see Table 3-8).

Use enabled preamble puncturing, when you want to simulate channel allocation in highly deployed access point or station scenarios.

Table 3-8: Bandwidth modes of preamble puncturing for HE-80MHz/80+80MHz PPDUs

Bandwidth mode	HE channel	Primary 20 MHz	Secondary 20 MHz	Secondary 40 MHz low	Secondary 40 MHz high	Secondary 80 MHz
4	80 MHz	Unpunctured	Punctured	Unpunctured	Unpunctured	-
5	80 MHz	Unpunctured	Unpunctured	Punctured	Unpunctured	-
	80 MHz	Unpunctured	Unpunctured	Unpunctured	Punctured	-
6	80+80 MHz	Unpunctured	Punctured	Unpunctured	Unpunctured	Unpunctured
7	80+80 MHz	Unpunctured	Unpunctured	Punctured	Punctured	Unpunctured
	80+80 MHz	Unpunctured	Unpunctured	Unpunctured	Punctured	Unpunctured
	80+80 MHz	Unpunctured	Unpunctured	Punctured	Unpunctured	Unpunctured
	80+80 MHz	Unpunctured	Unpunctured	Unpunctured	Unpunctured	Unpunctured

"4,5" Sets the bandwidth mode for "Tx Mode > HE-80MHz" channels.

"6,7" Sets the bandwidth mode for "Tx Mode > HE-80+80MHz" channels.

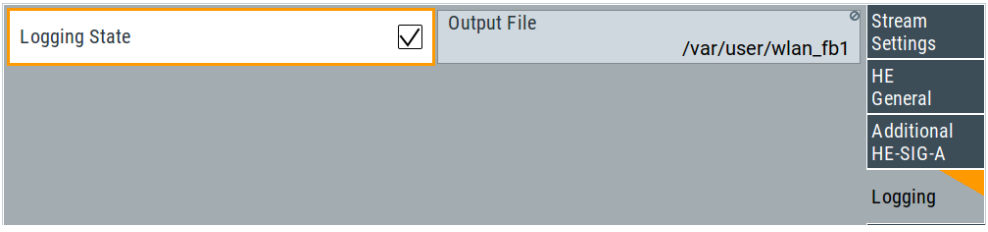
Remote command:

`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PPUNcturing:STATe` on page 162

3.4.2.3 Logging

Access:

1. Select "IEEE 802.11... > Frame Blocks".
2. Select "Std > 11ax" or "Std > User".
3. Select "Tx Mode > HE-20/40/80/80+80/160MHZ "
4. Select "PPDU > Config".
5. Select "General > Logging".



This tab includes the setting for configuring a logging state.

Settings

Logging State....41
Output File....41

Logging State
If enabled, the contents of HE-SIG-A and HE-SIG-B fields and the payload are written into a file in text form.

When the 802.11 standard is active ("General > State > On"), the file is saved into the file path as specified in "Output File".

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:LOGGing` on page 160

Output File
Displays the fixed file path including the file name, in that the log file is saved.

The file name consists of the digital standard "wlan" and the selected frame block. For example, the file `wlan_fb7` has logging data of frame block 7.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:LOGFile?` on page 160

3.4.3 User Configuration

This chapter describes the user configuration settings for 802.11ax. For more information on the settings, you can also refer to the white paper 1MA222: IEEE 802.11ax Technology Introduction.

Since multiple users are intended recipients in the OFDMA downlink, the AP needs to tell the STAs which resource unit belongs to them. In 802.11ax, the AP uses the HESIG- B field in the HE_MU_PPDU for this purpose.

The SIG-B contains two fields:

- Common field, where RU allocation info is included.
- User-specific field, where per-STA info belongs.

In the "User Configuration" dialog, you can define the different settings of the SIG-B fields.

Access:

1. Select "IEEE 802.11 > Frame Blocks".
2. Select "Std > 11ax" or "Std > User".
3. Select "Type > Trigger"
4. Select "Tx Mode > HE-20/40/80/80+80/160MHZ "
5. Select "PPDU > Config".
6. Select "User Configuration".

   The dialog comprises settings for user-defined HE configuration.

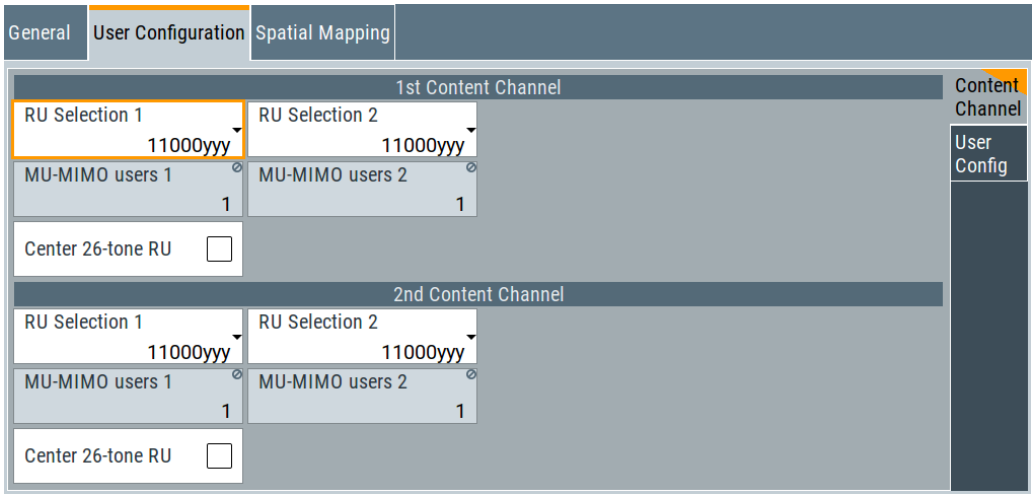
Settings

1st/2nd Content Channel 42
└ RU Selection 42
└ Number of MU-MIMO users 42
└ Center 26-tone RU 43
User Config 43
└ STA Id 43
└ Nsts 43
└ RU Type 43
└ MU MIMO 43
└ Gain / dB 44
└ TxBF 44
└ PPDU 44
└ State 44

1st/2nd Content Channel
Available only for "PPDU Format > HE MU/HE TRIG".

Defines the settings of the common field of the HE-SIG-B field. For "Tx Mode > HE-20 MHz ", only the 1st content channel is available.

Access: Select the "Content Channel" side tab.



RU Selection ← 1st/2nd Content Channel
Selects the RU allocation subfield of the HE-SIG-B common block field.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:CCH1:RUSelection<st>` on page 163
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:CCH2:RUSelection<st>` on page 163

Number of MU-MIMO users ← 1st/2nd Content Channel
Sets the number of MU-MIMO users. This value depends on the RU selection and the number of spatial streams. It configures the yyy/zzz value of the RU allocation subfield.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:CCH1:MUNum<st>` on page 164
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:CCH2:MUNum<st>` on page 164

Center 26-tone RU ← 1st/2nd Content Channel
Available only for "Tx Mode > HE-80MHz/HE-80+80MHz/HE-160MHz".

For full bandwidth 80 MHz: if enabled, indicates that center 26 -tone RU is allocated in the common block fields of both SIGB content channels with same value.

For full bandwidth 160/80+80 MHz: if enabled, indicates that center 26 -tone RU is allocated for one individual 80 MHz in common block fields of both SIGB content channels.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:CENRu<st>` on page 164

User Config
Access:
- Select the "User Config" side tab.

In this table, you can define settings of the user-specific part of the HE-SIG-B field.

STA Id ← User Config
Sets the station ID, the 11 least significant bits of the association identifier (AID).

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:USER<di>:STAid` on page 165

Nsts ← User Config
Sets the number of space time streams allocated to a particular user.

If "Space time stream" is greater than 1 and "Number of MU-MIMO users" is also greater than 1, RUs of size 106 subcarriers or larger can accommodate more than one user. The "Nsts" setting allocates a portion of the available space time streams to a particular user.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:USER<di>:NSTS` on page 165

RU Type ← User Config
Displays the resource unit type for each user.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:USER<di>:RUTYpe?` on page 165

MU MIMO ← User Config
Displays if the MU-MIMO is used for current user. All MU-MIMO users share the same RU using different space time streams.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:USER<di>:MUMimo:STATe?
on page 165

Gain / dB ← User Config
Sets the additional gain that can be applied to the RU allocated by a particular user.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:USER<di>:GAIN on page 164

TxBF ← User Config
If enabled, indicates that the beamforming matrix is applied to the waveform.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:USER<di>:TXBF on page 166

PPDU ← User Config
Opens a dialog for configuring the PPDU.

State ← User Config
Sets the state of the respective user.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:USER<di>:STATe on page 165

3.4.4 Data Settings

Access:

1. Select "Frame Blocks > PPDU > Config...".
2. Select "Data".

The "Data" dialog comprises the settings for the configuration of the data and the header. The parameters available for configuration depend on the selected "Type", "Physical Layer" and "Tx Mode".

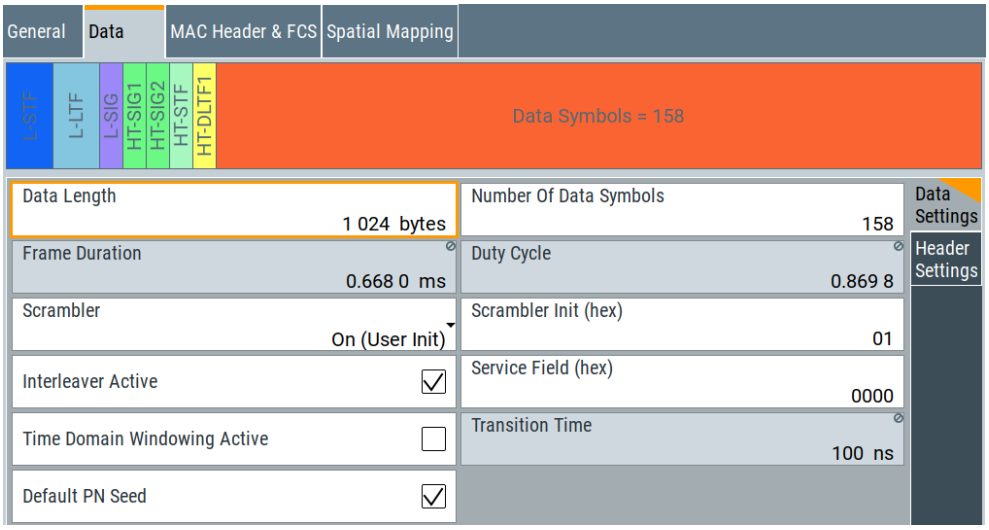
Settings

- Data Settings.....44
- Header Settings..... 49

3.4.4.1 Data Settings

Access:

1. Select "Frame Blocks > PPDU > Config...".
2. Select "Data > Data Settings".



The dialog comprises the settings for the configuration of the data.

Settings

Data Length 45
Frame Duration....46
Scrambler 46
Ch. Bandwidth in Non HT 46
Interleaver Active 47
Time Domain Windowing Active 47
Default PN Seed....47
Number Of Data Symbols 47
Duty Cycle....47
Scrambler Init (hex) 47
Dyn. Bandwidth in Non HT 48
Service Field (hex) 48
Transition Time 48
Service Field Clock Bit 48
PLCP P+H Format 48
PN Seed....49

Data Length
Sets the size of the data field in bytes.

For "Data Length" = 0, no data field is generated for the case of a sounding frame.

The maximum data length depends on the physical mode:
- In "Physical Mode > Legacy", the maximum value is 4061 bytes.
- In "Physical Mode > Mixed Mode" and "Physical Mode > Green Field", the maximum value is 1048575 bytes.

The data length is related to the number of data symbols. Whenever the data length changes, the number of data symbols is updated and vice versa.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DATA:LENGth on page 145
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:DATA:LENGth on page 145

Frame Duration
Displays the duration of the frame, i.e. the WLAN burst length.

Frame duration and duty cycle are related to data length and number of data symbols. Whenever one of them changes, the frame duration and duty cycle are updated.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DATA:FDURation? on page 145

Scrambler
Selects the different options for the scrambler.

"OFF" The scrambler is deactivated.

"On (Random Init)" (not available for "Tx Mode > CCK/PBCC"
The scrambler is activated.
The initialization value of the scrambler is selected at random. Each frame has a different random initialization value. This value is also different if there is successive recalculations with the same setting parameters so that different signals are generated for each calculation.

"On (User Init)" (not available for "Tx Mode > CCK/PBCC")
The scrambler is activated.
The initialization value of the scrambler is set to a fixed value that is entered in the "Scrambler Init (hex)". This value is then identical in each generated frame.

"ON" (available only for "Tx Mode > CCK/PBCC")
The scrambler is activated.

"Preamble Only" (available only for "Tx Mode > CCK/PBCC")
The scrambler is activated.
Only the preamble is scrambled.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SCRambler:MODE on page 153
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:SCRambler:MODE on page 153

Ch. Bandwidth in Non HT
(available only for "Tx Mode > VHT")

This parameter is used to modify the first 7 bits of the scrambling sequence to indicate the duplicated bandwidth of the PPDU.

"NON_HT20 | 40 | 80 | 160"
Indicates 20 MHz, 40MHz, 80MHz or 160 (80+80) MHz channel bandwidth of the transmitted packet.

"Not present" Channel bandwidth in non HT is not present.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:CBINonht on page 143

Interleaver Active
Activates/deactivates the interleaver of the data field.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:ILEaver:STATe on page 148
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:ILEaver:STATe on page 148

Time Domain Windowing Active
Activates/deactivates the time domain windowing.

Time domain windowing is a method to influence the spectral characteristics of the signal, which is not stipulated by the standard. However, it does not replace oversampling and subsequent signal filtering.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:TDWindowing:STATe on page 156

Default PN Seed
Requires "Data > PNxx" set as the data source.

Activates the default PN seed. The seed is used initially to generate the pseudo-random noise sequence.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:DPNSeed:STATe on page 147

Number Of Data Symbols
Sets the number of data symbols per frame block.

If the number of OFDM data symbols is changed, the generator calculates the data field length as a function of the set PPDU bit rate. This value is displayed at "Data Length".

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DATA:SYMBols on page 146

Duty Cycle
Displays the duty cycle, i.e. the ratio of frame duration and total signal length.

Frame duration and duty cycle are related to data length and number of data symbols. Whenever one of them changes, the frame duration and duty cycle are updated.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DATA:DCYCle? on page 144

Scrambler Init (hex)
Enters the initialization value for "Scrambler >User". This value is then identical in each generated frame.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SCRambler:PATTern on page 154
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:SCRambler:PATTern on page 154

Dyn. Bandwidth in Non HT
(available only for "Tx Mode > VHT")

If present, this parameter is used to modify the first 7 bits of the scrambling sequence to indicate if the transmitter supports "Static" or "Dynamic" bandwidth operation.

"Not present" Dynamic bandwidth in non HT is not present.

"Static" The transmitter supports static bandwidth operation.

"Dynamic" The transmitter supports dynamic bandwidth operation.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DBINonht on page 146

Service Field (hex)
Enters the value of the service field. The standard specifies a default value of 0. Other values can be entered in hexadecimal form for test purposes or future extensions.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SERVice:PATTern on page 155
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:SERVice:PATTern on page 155

Transition Time
Sets the transition time when "Time Domain Windowing > Active".

The transition time defines the overlap range of two OFDM symbols. At a setting of 100 ns and if BW = 20 MHz, one sample overlaps.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:TTIMe on page 157

Service Field Clock Bit
(available only for "Tx Mode > CCK/PBCC")

Sets the locked clock bit in service field of the PLCP header.

Via this flag (bit), the transmitter indicates whether transmission frequency and symbol rate have been derived from the same oscillator. If so (locked), the bit is set to 1, otherwise (not locked) to 0.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PLCP:LCBit:STATe on page 151

PLCP P+H Format
(available only for "Tx Mode > CCK/PBCC")

Selects the packet type (PPDU format) with long or short PLCP (physical layer convergence protocol).

Depending on the selected format, the structure, modulation and data rate of the PLCP the preamble and the header are modified.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PLCP:FORMat on page 150

PN Seed
Requires "Default PN Seed > Off".

Sets the PN seed, a 24 bit value in hexadecimal representation. Use this setting, if you don't use the default PN seed.

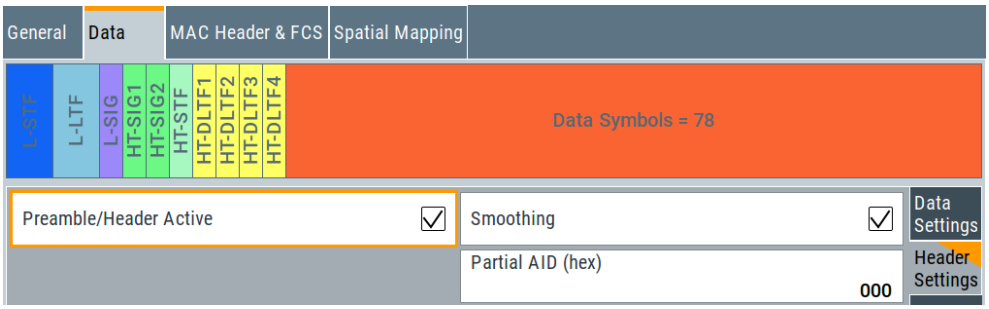
The maximum PN seed value is internally limited by the length of the used shift register. E.g. "Data > PN 9" has 9 bit resolution for and limits the PN seed to 1FF.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:PNSeed on page 151

3.4.4.2 Header Settings

Access:

1. Select "Frame Blocks > PPDU > Config...".
2. Select "Data > Header Settings".



This dialog comprises the settings for the configuration of the header.

Settings

Preamble/Header Active 49
Smoothing 50
Partial AID (hex) 50
No TXOP PS 50

Preamble/Header Active
Activates/deactivates the preamble and signal fields of the frames in the current frame block.

For "Type > Sounding", the preamble and signal field are always activated and cannot be deactivated.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PREamble:STATe on page 151

Smoothing
(available for all except "Tx Mode > VHT")

Indicates to the receiver whether frequency-domain smoothing is recommended as part of channel estimation.

"On" Indicates that channel estimate smoothing is recommended.

"Off" Indicates that only per-carrier independent channel (unsmoothed) estimate is recommended.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SMOothing` on page 155

Partial AID (hex)
(available only for "Tx Mode > VHT")

Provides an abbreviated indication of the intended recipient(s) of the frame.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PAID:PATTern` on page 150

No TXOP PS
(available only for "Tx Mode > VHT")

Indicates whether the VHT access point (AP) allows VHT non-AP stations (STAs) in transmit opportunity (TXOP) power save mode to enter during TXOP.

"On" Indicates that the VHT AP allows VHT non-AP STAs to enter doze mode during a TXOP.

"Off" Indicates that the VHT AP does not allow VHT non-AP STAs to enter doze mode during a TXOP.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:NTPS` on page 150

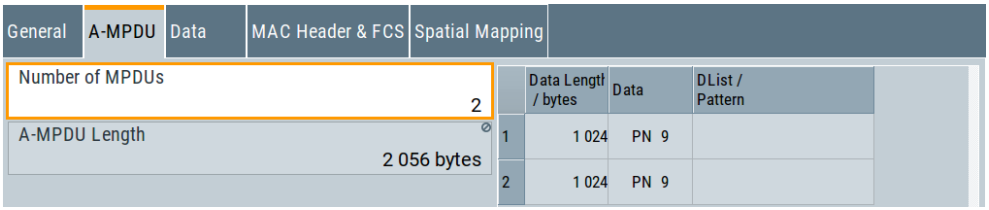
3.5 A-MPDU Settings

This chapter describes the aggregate mac protocol data unit (A-MPDU) settings.

Access:

1. Select "IEEE 802.11... > Frame Blocks".
2. Select "Type > Data".
3. Select "Data > A-MPDU".
4. Select "DList/Pattern > Config".

5. Select "A-MPDU".



The dialog comprises the A-MPDU settings.

Settings

Number of MPDUs....51
A-MPDU Length....51
EOF....51
Data Length / bytes....51
Data....51
DList / Pattern....52

Number of MPDUs
Determines the number of MPDUs in the frame.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MPDU:COUNt` on page 166
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MPDU:COUNt` on page 166

A-MPDU Length
Indicates the overall A-MPDUs length, resulting from the "Data Length / bytes" settings of all MPDUs.

Remote command:
n.a.

EOF
Selects the EOF value.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MPDU:EOF` on page 168
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MPDU:EOF` on page 168

Data Length / bytes
Determines the size of the data field in bytes.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MPDU<st>:DATA:LENGth` on page 167
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MPDU<st>:DATA:LENGth` on page 167

Data
Selects the data source.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MPDU<st>:DATA:SOURce on page 168
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MPDU<st>:DATA:SOURce on page 168

DList / Pattern
Depending on the selected data source, selects a data list or allows entering a user defined bit pattern.

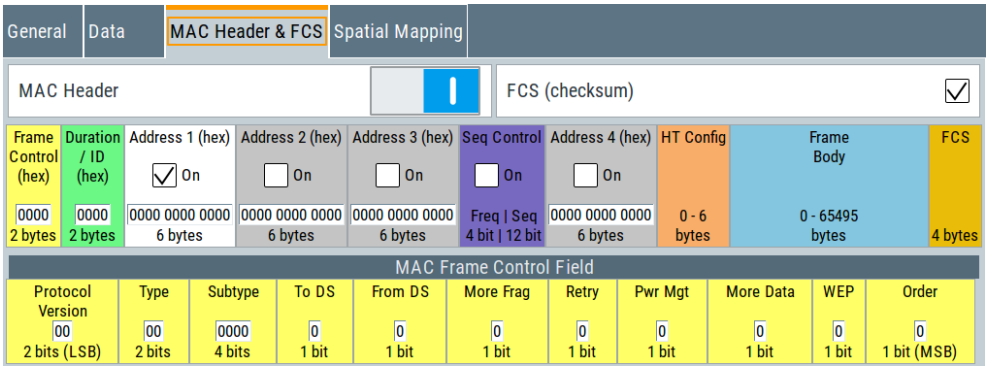
Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MPDU<st>:DATA:DSELection on page 166
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MPDU<st>:DATA:DSELection on page 166
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MPDU<st>:DATA:PATTern on page 167
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MPDU<st>:DATA:PATTern on page 167

3.6 MAC Header and FCS Configuration for Frame Block

In the real IEEE 802.11 system, a MAC (medium access control) header is transmitted in the PPDU before the actual data section. This header comprises the control information of the MAC layer. It is also possible to protect the PPDU by a frame checksum. These two functions can be controlled in the dialog.

Access:

1. Select "IEEE 802.11 > Frame Blocks".
2. Select "PPDU > Config...".
3. Select "MAC Header & FCS".



The dialog comprises the "MAC Header" and "MAC Frame Control Field" settings.

Settings

- MAC Header and FCS 53
- 802.11 MAC Frame Field 53
- Beacon Settings 58
- Trigger Frame Settings 64

3.6.1 MAC Header and FCS

MAC Header
Activates/deactivates the generation of the MAC header for the PPDU. If the MAC header is activated, all MAC header fields are enabled for operation.

The individual fields of the MAC header are described in the following.

All values of the MAC fields (except addresses) are entered in hexadecimal form with least significant bit (LSB) in right notation. In the data stream, the values are output standard-conformal with the LSB coming first.

Note: IEEE 802.11ac requires an A-MPDU frame aggregation. Therefore, when generating a IEEE 802.11ac signal you have to set "IEEE 802.11... > Frame Blocks> Data > A-MPDU".

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:STATe` on page 175
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:STATe` on page 175

FCS (checksum)
Activates/deactivates the calculation of the FCS (frame check sequence). The standard defines a 32-bit (4-byte) checksum to protect the MAC header and the user data (frame body).

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCS:STATe` on page 172
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCS:STATe` on page 172

3.6.2 802.11 MAC Frame Field

The MAC frame control field is used to define the protocol version, the frame type, sub type, and its function, etc.

Frame Control

MAC Frame Control Field										
Protocol Version	Type	Subtype	To DS	From DS	More Frag	Retry	Pwr Mgt	More Data	WEP	Order
00	00	0000	0	0	0	0	0	0	0	0
2 bits (LSB)	2 bits	4 bits	1 bit	1 bit	1 bit	1 bit	1 bit	1 bit	1 bit	1 bit (MSB)

Enters the value of the frame control field.

The MAC frame control field has a length of 2 bytes (16 bits) and is used to define the protocol version, the frame type, sub type, and its function, etc. As an alternative, the individual bits can be set in the lower part of the graph.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol on page 171
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:PVERsion on page 171
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:TYPE on page 172
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:SUBType on page 172
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:TDS on page 172
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:FDS on page 171
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:MFRagments
on page 171
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:RETRy on page 172
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:PMANagement
on page 171
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:MDATa on page 171
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:WEP on page 172
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:ORDer on page 171
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol
on page 171
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:
PVERsion on page 171
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:TYPE
on page 172
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:SUBType
on page 172
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:TDS
on page 172
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:FDS
on page 171
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:
MFRagments on page 171
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:RETRy
on page 171
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:
PMANagement on page 171
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:MDATa
on page 171
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:WEP
on page 172
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:ORDer
on page 171

Duration Id
Enters the value of the duration ID field.

Depending on the frame type, the 2-byte field "Duration/ID" is used to transmit the association identity of the station transmitting the frame. Or it indicates the duration assigned to the frame type.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:DID on page 170
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:DID on page 170

MAC Address
Enters the value of the address fields 1 ... 4.

The MAC header can contain up to four address fields, but not all must be available. Each of the 4 address fields can be activated or deactivated. The fields are used for transmitting the basic service set identifier, the destination address, the source address, the receiver address and the transmitter address. Each address is 6 bytes (48 bit) long. The addresses can be entered in hexadecimal form in the entry field of each address field. The LSB is in left notation.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:ADDRess<st>:STATe on page 170
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:ADDRess<st>:STATe on page 170

SA (hex)
(available only for "Physical Mode > Beacon")

Enters the value of the source address (SA) field.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SA on page 172

BSSID (hex)
(available only for "Physical Mode > Beacon")

Enters the value of the basic service set identification (BSSID) field.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:BSSid on page 171

Sequence Control
Activates/deactivates the sequence control field.

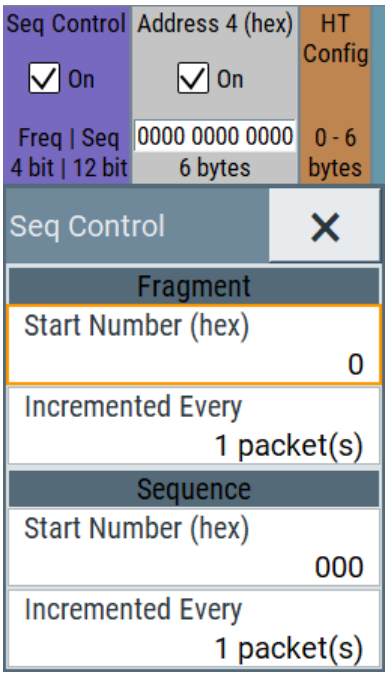
The sequence control field has a length of 2 bytes and is divided in two parts, the fragment number (4 bits) and the sequence number (12 bits) field. A long user data stream to be transmitted is first split up into MSDUs (MAC service data units). The MSDUs can either be transmitted as PSDU frames or further divided into fragments.

The sequence number and the fragment number are then used to number the individual subpackets of the user data stream to be transmitted. Thus, all PSDUs are assigned a consecutive number. The assignment allows the receiver to arrange the data packets in the correct order. It also allows the receiver to determine whether an incorrectly transmitted packet was retransmitted and to find out whether packets are missing.

If the receiver can detect a packet without an error and does not request a retransmission, the sequence number is incremented by 1 for each packet (the field is reset to 0 at the latest after a count of 4095). The fragment number field is incremented by 1 when another fragment of the current MPDU is transmitted. The start count for the transmission (normally 0) and the number of packets required to increment the corresponding counter can be defined for both numbers. This is done with the parameters "Start Number" and "Incremented every ... packet(s)".

Example:

An error-free transmission of 50 packets (no packet retransmission) is to be simulated. The sequence number should be incremented by 1 for each packet. Since no packet is fragmented, the fragment counter can always remain at 0. In this case the following values have to be set:



If it is to be simulated that some packets are received incorrectly or if the response of the receiver should be tested when the same packet arrives several times, the number of packets required to increment the sequence number can be set to 2, for example. Each packet will then automatically be sent twice (with identical data).

Remote command:

`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SCONtrol:STATe` on page 175

`[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:SCONtrol:STATe` on page 175

Start Number ← Sequence Control

Sets the start number of the fragment bits or the sequence bits of the sequence control.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SCONtrol:FRAGment:STARt on page 174
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SCONtrol:SEQuence:STARt on page 174
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:SCONtrol:FRAGment:STARt on page 174
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:SCONtrol:SEQuence:STARt on page 174

Increment Every ← Sequence Control
Defines the number of packets required to increment the counter of the fragment bits or the sequence bits of the sequence control.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SCONtrol:FRAGment:INCRement on page 173
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SCONtrol:SEQuence:INCRement on page 174
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:SCONtrol:FRAGment:INCRement on page 173
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:SCONtrol:SEQuence:INCRement on page 174

HT Config
Calls the menu for configuring the MAC high throughput (HT).

Note: Only the"Physical Modes > Mixed Mode " or "Physical Modes > Green Field " (QoS data frames) provide the HT or VHT transmission technology. For "Physical Modes > Legacy ", this configuration field is not indicated.

The dialog is described in Chapter 3.7, "MAC Header HT/HE and VHT Configuration", on page 70.

Remote command:
n.a.

Frame Body
Indicates the length of the user data (frame body).

Remote command:
n.a.

FCS
Indicates the length of the check sum.

Remote command:
n.a.

3.6.3 Beacon Settings

A beacon frame is a management frame that contains all the information about a network. The beacon settings are used to define the timestamp, the beacon interval, the SSID, the supported rate etc. They also comprise the capability information and the ERP parameters.

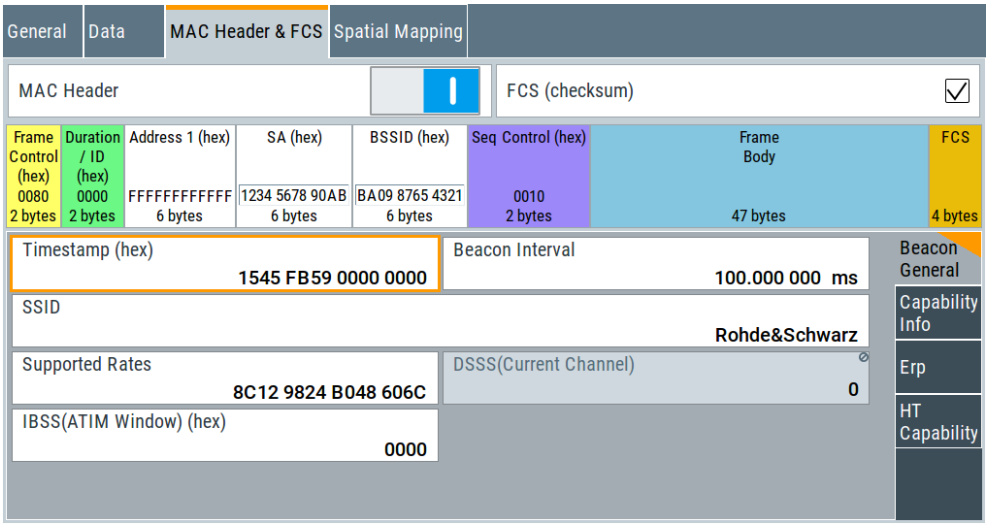
Settings

- General Beacon Functions....58
- Capability Information Parameters....60
- ERP Parameters....62
- HT Capability Information....63

3.6.3.1 General Beacon Functions

Access:

1. Select "IEEE 802.11 > Frame Blocks".
2. Select "Type > Beacon".
3. Select "PPDU > Config...".
4. Select "MAC Header & FCS > Beacon General".



The dialog provides general beacon settings.

Settings

Timestamp (hex)....59
Beacon Interval....59
SSID....59

Supported Rates..... 59
DSSS(Current Channel)..... 59
IBSS(ATIM Window) (hex)..... 59

Timestamp (hex)
Updates the local clock of a station (the timing synchronization function (TSF) of a frames' source) after receiving a beacon frame.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:TSTamp`
on page 189

Beacon Interval
Defines the time interval between two beacon transmissions in ms.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:BINTerval`
on page 188

SSID
Specifies the desired service set identifier (SSID) or the wildcard SSID. The maximal allowed length is 32 characters.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:SSID` on page 189

Supported Rates
Contains the set of data rates supported by the AP, including indication which rates are part of the BSSBasicRateSet.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:SRATe` on page 189

DSSS(Current Channel)
Indicates the current channel of this direct sequence spread spectrum (DSSS) network.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:DCCHannel?`
on page 188

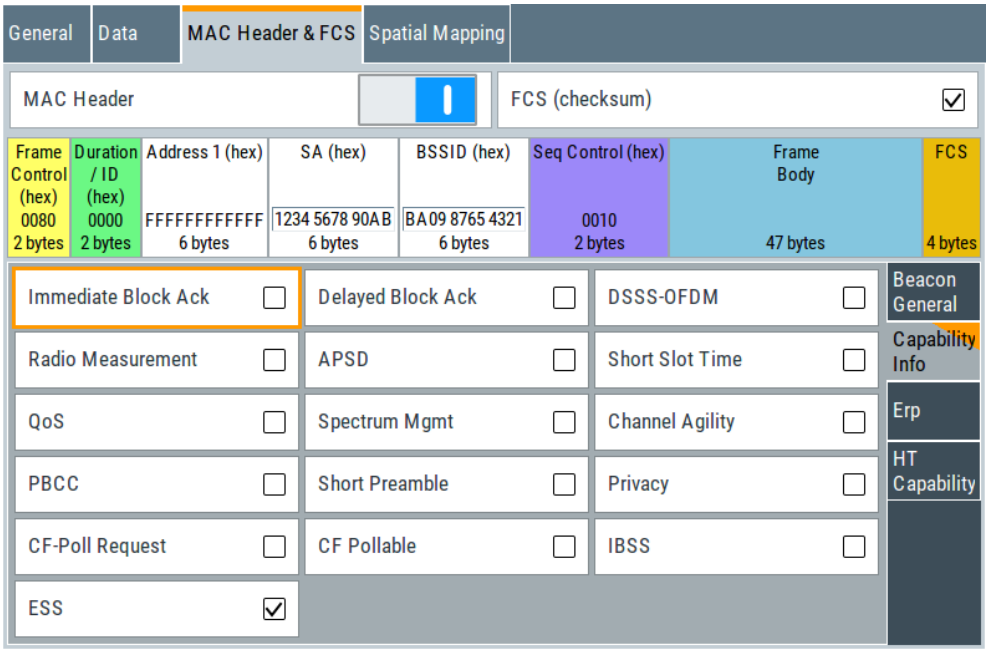
IBSS(ATIM Window) (hex)
Contains the set of parameters necessary to support an independent basic service set (IBSS). The information field contains the announcement traffic indication message (ATIM) window parameter.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:IAWindow`
on page 188

3.6.3.2 Capability Information Parameters

Access:

1. Select "IEEE 802.11 > Frame Blocks".
2. Select "Type > Beacon".
3. Select "PPDU > Config...".
4. Select "MAC Header & FCS >Capability Info".



The dialog displays the capability info parameters.

The capability info parameters indicate, if requested optional capabilities and services are allowed, supported or in use.

For example if "DSSS-OFDM" is enabled the associated stations in the network is informed that use of direct sequence spread spectrum - OFDM modulation (DSSS-OFDM) is allowed.

Settings

Capability Information Parameters.....61

Capability Information Parameters

Table 3-9: Functions of capability information parameters

Function name	If enabled this function indicates that:	SCPI command
"Immediate Block Ack"	Immediate block Ack is allowed (suitable for high-bandwidth, low latency traffic).	`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:IBACk` on page 191
"Delayed Block Ack"	Delayed block Ack is allowed (delayed block Ack is suitable for applications that tolerate moderate latency).	`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:DBACk` on page 192
"DSSS-OFDM"	Direct sequence spread spectrum - OFDM is allowed (encodes packet data using the DSSS headers and OFDM encoding of the payload).	`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:DOFDm` on page 192
"Radio Measurement"	Radio measurement is supported (for example requests, performs and reports radio measurements in supported channels and provides information about neighbor APs).	`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:RMEasurement` on page 193
"APSD"	Automatic power save delivery (APSD) is supported (energy saving function).	`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:APSD` on page 190
"Short Slot Time"	Short slot time is supported (reduces the slot time resulting in higher throughput (used at IEEE802.11g). The AP only uses short slot time when all clients support short slot time).	`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:SSTime` on page 194
"QoS"	Quality of service (QoS) is supported (takes care that important applications always get enough bandwidth).	`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:QOS` on page 193
"Spectrum Mgmt"	Spectrum management is enabled (the process of regulating the use of radio frequencies).	`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:SMGMt` on page 194
"Channel Agility"	Channel agility is enabled (overcomes some inherent difficulty with a tone jammer).	`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:CAGility` on page 190
"PBCC"	Packet binary convolutional coding (PBCC) is allowed (a modulation mode for IEEE 802.11g).	`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:PBCC` on page 193

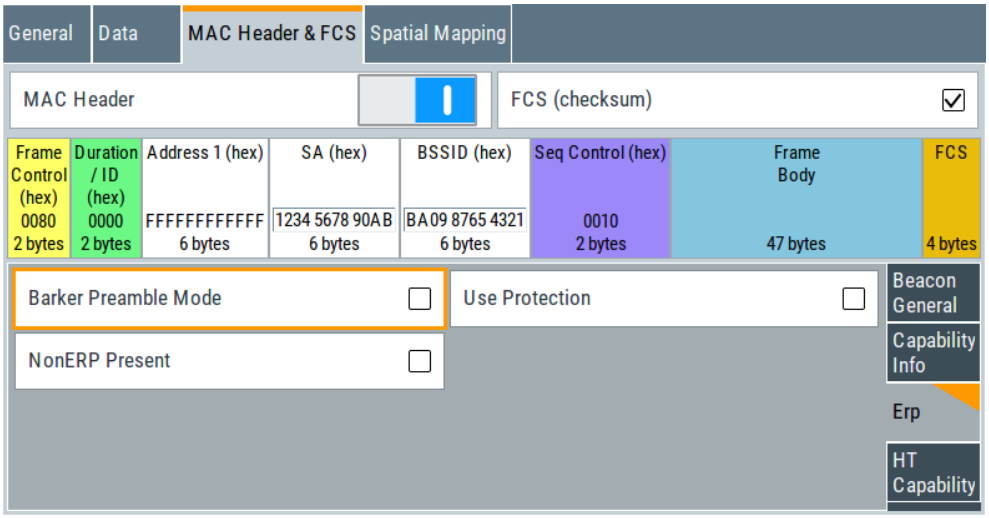
Function name	If enabled this function indicates that:	SCPI command
"Short Preamble"	Short preamble is allowed (uses 56 instead of 128 bits for the "sync" field. Created to improve WLAN efficiency).	[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:SPReamble on page 194
"Privacy"	Privacy mode is enabled (thus encryption is required for all data frames).	[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:PRIVacy on page 193
"CF-Poll Request"	Contention-free poll is requested (indicates how the AP handles poll requests).	[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:CPRequest on page 191
"CF Pollable"	The node can use the point coordination function (PCF), as opposed to the distributed coordination function (DCF). PCF is a method of coordinating wireless transmissions in which one station notifies other stations when they can broadcast.	[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:CPOLlable on page 191
"IBSS"	The network is an independent basic service set (IBSS) type network. IBSS is an operation mode of a WLAN. An IBSS does not need an AP. The wireless clients directly connect with each other. This mode is also named ad hoc mode.	[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:IBSS on page 192
"ESS"	The network is an extended service set (ESS) type network (ESS is a set of connected BSSs. APs in an ESS are connected by a distribution system. Each ESS has an ID called the SSID which is a 32-byte (maximum) character string).	[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:ESS on page 191

3.6.3.3 ERP Parameters

Access:

1. Select "IEEE 802.11 > Frame Blocks".
2. Select "Type > Beacon".
3. Select "PPDU > Config...".

4. Select "MAC Header & FCS >ERP".



The dialog comprises extended rate PHY (ERP) settings.

The ERP parameters indicate special features/modes.

Settings

ERP Parameters..... 63

ERP Parameters

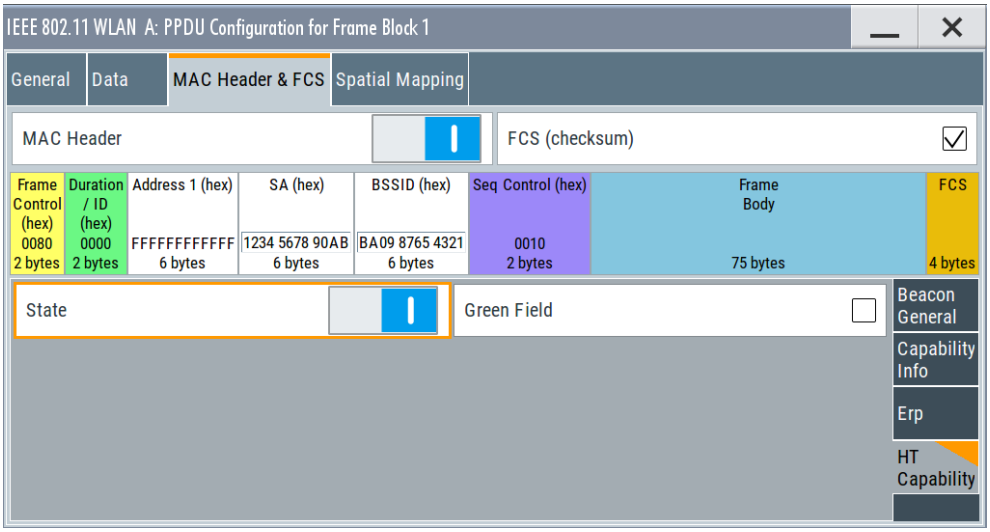
Function name	If enabled this function indicates that:	SCPI command
"Barker Preamble Mode"	Associated stations have to use the long preamble (in IEEE802.11g networks) . If all stations are capable of short preambles, Barker Preamble Mode should be disabled and all stations will use short preambles for efficiency.	`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:ERP:BPMode` on page 195
"Use Protection"	A station not IEEE802.11g-capable (usually stations equipped with IEEE802.11b or IEEE802.11) is associated to the network and thus all stations have to enable use protection. "Use Protection" may be activated when "NonERP Present" is activated.	`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:ERP:UPRotection` on page 196
"NonERP Present"	A non ERP station is present in the network.	`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:ERP:NEPResent` on page 195

3.6.3.4 HT Capability Information

Access:

1. Select "IEEE 802.11 > Frame Blocks".

2. Select "Type > Beacon".
3. Select "PPDU > Config...".
4. Select "MAC Header & FCS > HT Capability".



The dialog provides HT capability information.

Settings

State....64
Green Field....64

State
Activates/ deactivates the HT capability information element.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:HTCapability:STATe` on page 195

Green Field
If enabled, the function indicates that the reception of PPDUs with HT Greenfield format is supported.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:HTCapability:GFIeld` on page 195

3.6.4 Trigger Frame Settings

Access:

1. Select "IEEE 802.11 > Frame Blocks".
2. Set "Type > Trigger"

3. Select "PPDU > Config...".
4. Select "MAC Header & FCS".

   The dialog comprises the trigger frame settings, including the setup of the common info and user info fields.

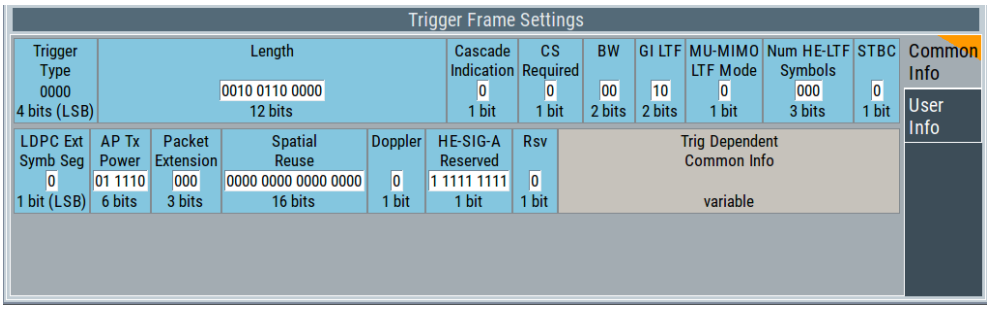
Settings

- Common Info Field....65
- User Info Field....68

3.6.4.1 Common Info Field

Access:

1. Select "IEEE 802.11 > Frame Blocks".
2. Set "Type > Trigger"
3. Select "PPDU > Config...".
4. Select "MAC Header & FCS > Common Info ".



This dialog comprises the trigger frame settings, including the setup of the common info and user info fields.

Settings

Trigger Type....66
Length....66
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CS Required....66
BW....66
GI LTF....66
MU-MIMO LTF Mode....67
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LDPC Ext Symb Seg....67
AP Tx Power....67
Packet Extension....67
Spatial Reuse....67
Doppler....68

HE-SIG-A Reserved....68
Rsv....68
Trigger Dependent Common Info....68

Trigger Type
Specifies the type of trigger frame.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:TTYPe?` on page 187

Length
Specifies the value of the L-SIG length field.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:LEN` on page 186

Cascade Indication
If set to 1, then there is a subsequent trigger frame.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:CINDication` on page 186

CS Required
If set to 1, the stations identified in the user field can sense the medium state and consider the nav in determining if to respond or not.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:CSRequired` on page 186

BW
Specifies the bandwidth. It can have the following values:

- **0**: corresponds to a bandwidth of 20 MHz
- **1**: corresponds to a bandwidth of 40 MHz
- **2**: corresponds to a bandwidth of 80 MHz
- **3**: corresponds to a bandwidth of 80+80 MHz or 160 MHz

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:BW` on page 186

GI LTF
Specifies the GI and HE-LTF. It can have the following values:

- **0**: corresponds to a value of 1xLTF + 1.6µs GI
- **1**: corresponds to a value of 2xLTF + 0.8µs GI
- **2**: corresponds to a value of 2xLTF + 1.6µs GI
- **3**: corresponds to a value of 4xLTF + 3.2µs GI

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:GILTf on page 186

MU-MIMO LTF Mode
Specifies the LTF mode of the UL MU-MIMO.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:MLTFmode on page 187

Num HE-LTF Symbols
Specifies the number of HE-LTF symbols present.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:NHLSym on page 187

STBC
If set to 1, STBC encoding is used for the HE trigger-based PPDU response. Otherwise the value is set to 0.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:STBC on page 187

LDPC Ext Symb Seg
If set to 1, LDPC extra symbol is present. Otherwise the value is set to 0.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:LESSeg on page 187

AP Tx Power
Specifies the combined average power per 20 MHz bandwidth of all antennas that transmitted the trigger frame.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:TXPow on page 187

Packet Extension
Specifies the packet extension duration.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:PEXTension on page 187

Spatial Reuse
Specifies the value of the spatial reuse of the HE trigger-based PPDU transmitted as a response to a trigger frame.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:SPAReuse on page 187

Doppler
Specifies a high doppler mode of transmission.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:DOPPler on page 186

HE-SIG-A Reserved
Specifies the value of the reserved bits in the HE-SIG-A field.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:HREServed on page 186

Rsv
Specifies the value of the reserved bits in the "Rsv" field.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:RSV on page 187

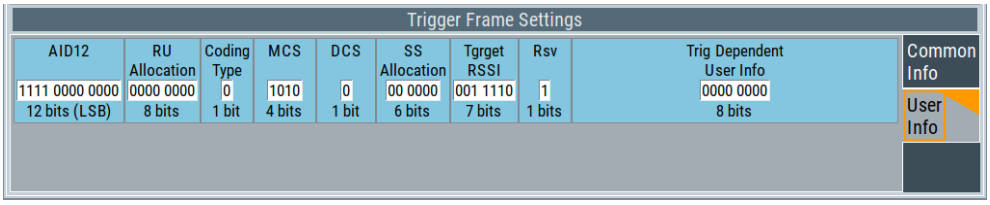
Trigger Dependent Common Info
The value of this field depends on the trigger variant. It is present for MU-BAR frame formats.

Remote command:
n.a.

3.6.4.2 User Info Field

Access:

1. Select "IEEE 802.11 > Frame Blocks".
2. Set "Type > Trigger"
3. Select "PPDU > Config...".
4. Select "MAC Header & FCS > User Info ".



This dialog comprises the trigger frame settings, including the setup of the common info and user info fields.

Settings

No. Of User Info....69
User Info....69
AID12....69
RU allocation....69
Coding Type....69
MCS....69
DCM....70
SS Allocation....70
Target RSSI....70
Rsv....70
Trigger Dependent User Info....70

No. Of User Info
Sets the number of "User Info" fields in the trigger frame.

You can set up to 37 fields.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:NUINfo` on page 187

User Info
"No. Of User Info = 1": Displays the "User Info = 0" field.

"No. Of User Info > 1": Selects the "User Info x" field, where "x = 1 to 36".

Remote command:
n.a.

AID12
Carries the least significant 12 of the AID of the STA.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:UINFo<st0>:AID` on page 187

RU allocation
Specifies the RU used by the HE trigger-based PPDU of the STA, which is identified by the "AID12" field value.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:UINFo<st0>:RUALlocation` on page 187

Coding Type
Specifies the code type. The value 0 indicates a BCC coding and 1 LDPC.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:UINFo<st0>:CODType` on page 187

MCS
Specifies the MCS.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:UINFo<st0>:MCS on page 187

DCM
Specifies the dual carrier modulation. If the value is 0, then no DCM is used.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:UINFo<st0>:DCM on page 187

SS Allocation
Specifies the spatial streams. This field contains 3 bits that specify the starting spatial stream and 3 bits that specify the number of spatial streams.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:UINFo<st0>:SSALlocation on page 187

Target RSSI
Specifies the target received signal power.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:UINFo<st0>:TRSSi on page 187

Rsv
Specifies the value of the reserved bits in the "Rsv" field.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:UINFo<st0>:RSV on page 187

Trigger Dependent User Info
The value of this field depends on the trigger variant.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:UINFo<st0>:TDUSerinfo on page 187

3.7 MAC Header HT/HE and VHT Configuration

Access:

1. Select "Frame Blocks > PPDU > Config...".

2. Select "MAC Header & FCS > HT Config"/"MAC Header & FCS > VHT Config"/"MAC Header & FCS > HE Config".

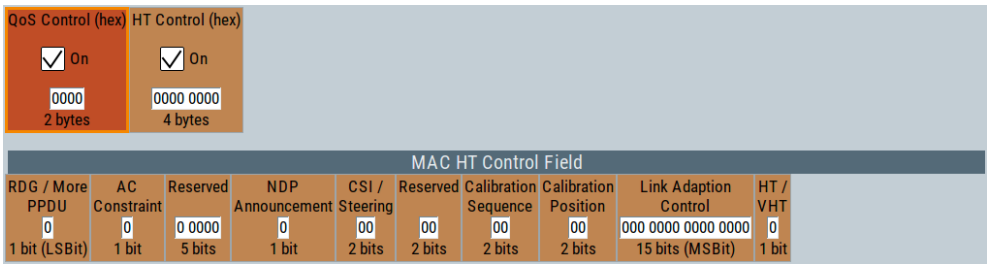


Figure 3-1: MAC header: HT configuration

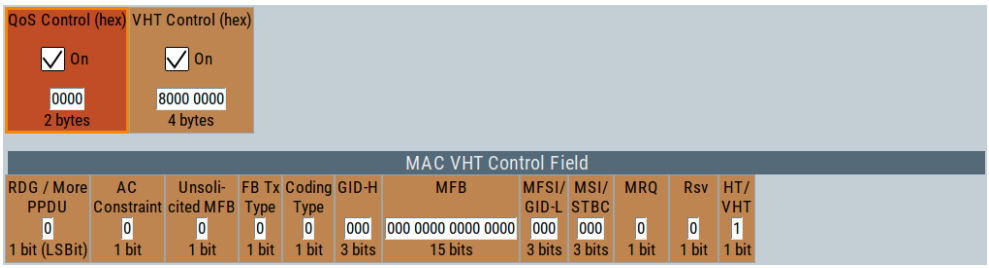


Figure 3-2: MAC header: VHT configuration

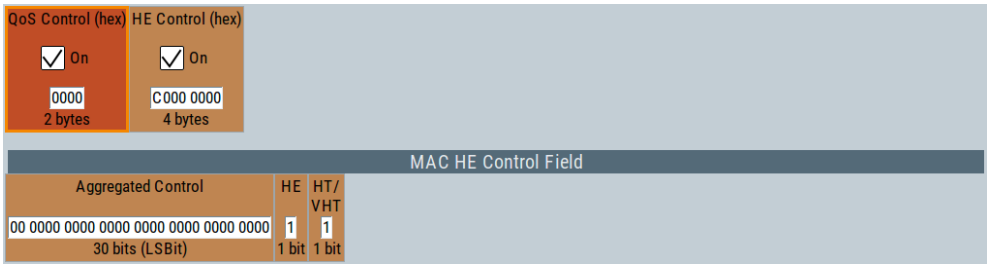


Figure 3-3: MAC header: HE configuration

In this dialog, the mode, the time shifts and the transmit parameters can be configured.

The "HT/VHT Control Field" may be included in any frame except a non-QoS Data frame. The presence of the HT/VHTcontrol field in frames carried in a HT/VHT PPDU is indicated by setting the order bit in the MAC header. The HT/VHT Control Field appears last in the MAC header, excluding any security fields.

Settings

- Common Settings....72
- MAC HT Configuration....72
- MAC VHT Configuration....75
- MAC HE Configuration....79

3.7.1 Common Settings

Provided are the following settings for enabling the MAC HT/VHT Control Field:

QoS Control 72
HT/VHT/HE Control 72

QoS Control
Control field (2 Bytes) with an embedded checkbox for activating the control mechanism of Quality of Service (QoS) Data Frames.

The QoS solicits an acknowledgement policy from the receiver, according to specific feedback rules. QoS control ensures a high level of transmission performance like high bit rate, low latency or low bit error probability.

Information on contents of the QoS Control Data frame is for example duration request field, TXOP limit, and AP Buffer State or queue size.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:QSControl:STATe` on page 173
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:QSControl` on page 173
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:QSControl` on page 173
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:QSControl:STATe` on page 173

HT/VHT/HE Control
Enables HT/VHT/HE control and sets the HT/VHT/HE control field as hex value.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl` on page 175
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl` on page 181
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:STATe` on page 180
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:HTControl:STATe` on page 180
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:HEControl` on page 185

3.7.2 MAC HT Configuration

MAC HT Control Field									
RDG / More PPDU	AC Constraint	Reserved	NDP Announcement	CSI / Steering	Reserved	Calibration Sequence	Calibration Position	Link Adaption Control	HT / VHT
0	0	0 0000	0	00	00	00	00	000 0000 0000 0000	0
1 bit (LSBit)	1 bit	5 bits	1 bit	2 bits	2 bits	2 bits	2 bits	15 bits (MSBit)	1 bit

The following functions describe the control field of the MAC HT configuration:

Settings

RDG/More PPDU 73
AC Constraint 73
Reserved 73

NDP Announcement 73
CSI Steering 74
Reserved 74
Calibration Sequence 74
Calibration Position 74
Link Adaption Control 74
HT/VHT 75

RDG/More PPDU
The RDG/More signal field (LSB, 1 bit) issues the reverse direction grant. When transmitted by an initiator or a responder, this field is interpreted differently.

Transmitted by initiator

0 = No reverse grant.

1 = A reverse grant is present, as defined by the Duration/ID field.

Transmitted by responder

0 = The PPDU carrying the MPDU is the last transmission by the responder.

1 = The PPDU carrying the frame is followed by another PPDU.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:RDGMore` on page 179

AC Constraint
Indicates the access point of the responder (1 bit).

0 = The response may contain data from any traffic identifier (TID)

1 = The response may contain data only from the same AC as the last data received from the initiator.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:ACConstraint` on page 176

Reserved
This signal field (5 bit) is defined, but not used. It is set to zero by the transmitter and ignored by the receiver.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:REServed` on page 179

NDP Announcement
The NDP announcement (1 bit) indicates that a null data packet (NDP) will be transmitted after the frame.

0 = no NDP follows

1 = NDP follows

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:NDP` on page 179
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:ZLF` on page 180

CSI Steering
Sets the position of the CSI feedback (2 bit)

00 = CSI

01 = uncompressed steering matrix

10 = compressed steering matrix

11 = reserved

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:CSISteering`
on page 177

Reserved
This signal field (2 bit) is defined, but not used.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:SREServed`
on page 180
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:FREQuest`
on page 177

Calibration Sequence
Identifies the calibration sequence (2 bit). The field is included in each frame within the calibration procedure. Its value remains unchanged during one calibration procedure and is incremented each time a new calibration procedure starts.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:CALibration:SEQuence` on page 177

Calibration Position
Sets the position in the Calibration Sounding Exchange sequence (2 bit):

00 = Not a calibration frame (Default setting)

01 = Calibration Start

10 = Sounding Response

11 = Sounding Complete

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:CALibration:POSition` on page 176

Link Adaption Control
Sets the parameters of the link adaption control field. The following subfields enable configuring the response signal of the link adaption.

B0 (1bit) MA - MA payload

When the MA (Management Action) field is set to 1, the payload of the QoS Null Data MPDU (Medium Access Controller Protocol Data Unit) is interpreted as a payload of the management action frame.

B1 (1bit) TRQ - Sounding Request

1 = Request to the responder to transmit a sounding PPDU (Physical layer Protocol Data Unit).

B2 (1bit) MRQ - MCS Request

1 = Request for feedback of MCS (Modulation Coding Scheme).

B3-B5 (3bit) MRS - MRQ Sequence Identifier

Set by sender to any value in the range '000'-'110' to identify MRQ. = Invalid if MRQ = 0

B6-B8 (3bit) MFS - MFB Sequence Identifier

Set to the received value of MRS. Set to '111' for unsolicited MFB.

B9-B15 (7bit) MFB - MCS Feedback

Link adaptation feedback containing the recommended MCS. When a responder is unable to provide MCS feedback or the feedback is not available, the MFB is set to 'all-ones' (default value) and also MFS is set to '1'.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:LAControl`
on page 178

HT/VHT
The subfield indicates the used format (HT or VHT).

0 = indicates use of the HT format.

1 = indicates use of the VHT format.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:HVINdicator?`
on page 178

3.7.3 MAC VHT Configuration

Access:

1. Set "Frame Blocks > Tx Mode" to "VHT-20MHz","VHT-40MHz","VHT-80MHz","VHT-80 + 80MHz" or "VHT-160MHz".
2. Select "Frame Blocks >PPDU > Config..."
3. Select "MAC Header & FCS > VHT Config"

MAC VHT Control Field											
RDG / More PPDU	AC Constraint	Unsoli-cited MFB	FB Tx Type	Coding Type	GID-H	MFB	MFSI/ GID-L	MSI/ STBC	MRQ	Rsv	HT/ VHT
0	0	0	0	0	000	000 0000 0000 0000	000	000	0	0	1
1 bit (LSBit)	1 bit	1 bit	1 bit	1 bit	3 bits	15 bits	3 bits	3 bits	1 bit	1 bit	1 bit

The following functions describe the control field of the MAC VHT configuration:

Settings

RDG/More PPDU 76
AC Constraint 76
Unsolicited MFB 76
FB Tx Type 77
Coding Type 77
GID-H 77
MFB 77
MFSI/GID-L 78
MSI 78
MRQ 78
Rsv 79
HT/VHT 79

RDG/More PPDU
The RDG/More signal field (LSB, 1 bit) issues the reverse direction grant. When transmitted by an initiator or a responder, this field is interpreted differently.

Transmitted by initiator

0 = No reverse grant.

1 = A reverse grant is present, as defined by the Duration/ID field.

Transmitted by responder

0 = The PPDU carrying the MPDU is the last transmission by the responder.

1 = The PPDU carrying the frame is followed by another PPDU.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:RDGMore` on page 184

AC Constraint
Indicates the access point of the responder (1 bit).

0 = The response may contain data from any TID (Traffic Identifier)

1 = The response may contain data only from the same AC as the last data received from the initiator.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:ACConstraint` on page 181

Unsolicited MFB
0 = if the MFB is a response to an MRQ.

1 = if the MFB is not a response to an MRQ.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:UMFB` on page 184

FB Tx Type
0 = If the Unsolicited MFB subfield is set to 1 and FB Tx Type subfield is set to 0, the unsolicited MFB refers to either an unbeamformed VHT PPDU or transmit diversity using an STBC VHT PPDU.

1 = If the Unsolicited MFB subfield is set to 1 and the FB Tx Type subfield is set to 1, the unsolicited MFB refers to a beamformed SU-MIMO VHT PPDU.

Otherwise this subfield is reserved.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:FTTYpe` on page 182

Coding Type
If the Unsolicited MFB subfield is set to 1, the Coding Type subfield contains the Coding information (set to 0 for BCC and set to 1 for LDPC) to which the unsolicited MFB refers.

0 = for BCC

1 = for LDPC

Otherwise this subfield is reserved.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:CTYPe` on page 181

GID-H
If the Unsolicited MFB subfield is set to 1, the GID-H subfield contains the highest 3 bits of Group ID of the PPDU to which the unsolicited MFB refers.

Otherwise this subfield is reserved.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:GIDH` on page 182

MFB
MFB subfield is interpreted as defined in Table 3-10. This subfield contains the recommended MFB. The value of MCS=15 and VHT N_STS=7 indicates that no feedback is present.

Table 3-10: MFB subfield in the VHT format HT control field

Subfield	Meaning	Definition
VHT N_STS	Recommended VHT N_{STS}	Indicates the recommended VHT N_{STS} (Link adaption using the VHT format of the HT Control field).
MCS	Recommended MCS feedback	Indicates the recommended VHT MCS (Link adaption using the VHT format of the HT Control field).

Subfield	Meaning	Definition
BW	Bandwidth of the recommended MCS	**MFB = 1** If the unsolicited MFB subfield is set to 1, the BW subfield contains the bandwidth of which the recommended MCS is intended for (Link adaption using the VHT format of the HT Control field). The BW subfield is set as follows: • 0 for 20 MHz • 1 for 40 MHz • 2 for 80 MHz • 3 for 160 MHz and 80+80 MHz **MFB = 1** If the Unsolicited MFB subfield is set to 0, the BW subfield is reserved and set to 0.
SNR	Average SNR	Indicates the average SNR, which is an SNR averaged over data subcarriers and spatial streams (Link adaption using the VHT format of the HT Control field).

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:MFB` on page 183

MFSI/GID-L
MFB = 0

If the Unsolicited MFB subfield is set to 0, the MFSI/GID-L subfield contains the received value of MSI contained in the frame to which the MFB information refers.

MFB = 1

The MFSI/GID-L subfield contains the lowest 3 bits of Group ID of the PPDU to which the unsolicited MFB refers.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:MGL` on page 183

MSI
MRQ = 0

When the MRQ subfield is set to 0, the MSI subfield is reserved.

MRQ = 1

When the MRQ subfield is set to 1, the MSI subfield contains a sequence number in the range 0 to 6 that identifies the specific request.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:MSI` on page 184

MRQ
0 = to request MCS feedback (solicited MFB).

1 = otherwise.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:MRQ` on page 183

Rsv
This signal field (1 bit) is defined, but not used. It is set to zero by the transmitter and ignored by the receiver.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:VREServed`
on page 185

HT/VHT
The subfield indicates the used format (HT or VHT).

0 = indicates use of the HT format.

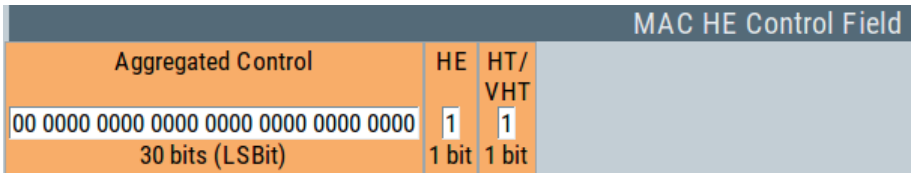
1 = indicates use of the VHT or HE format, depending on the value of the HE field.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:HVINdicator?`
on page 182
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:VHTControl:HVINdicator?`
on page 178

3.7.4 MAC HE Configuration

Access:

1. Set "Frame Blocks > Type > Data".
2. Set "Tx Mode" to "HE-20MHz","HE-40MHz","HE-80MHz","HE-80 + 80MHz" or "HE-160MHz".
3. Select "Frame Blocks > PPDU > Config..."
4. Select "User Configuration > PPDU > Config..."
5. Select "MAC Header & FCS > HT Config"



The following functions describe the control field of the MAC HE configuration:

Settings

Aggregated control 79
HE 80
HT/VHT 80

Aggregated control
Enters the value of the aggregated control (A-Control) field. This field consists of a sequence of one or more control subfields.

A control subfield consists of a 4-Bit control ID subfield and a control information of a variable size. The values are as defined in the 802.11ax amendment.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:HEControl:ACONtrol` on page 185

HE
Indicates the use of the HE format, if "HT/VHT" is set to **1**.

0 = indicates use of the VHT format.

1 = indicates use of the HE format.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:HEControl:HEINdicator?` on page 185

HT/VHT
The subfield indicates the used format (HT or VHT).

0 = indicates use of the HT format.

1 = indicates use of the VHT or HE format, depending on the value of the HE field.

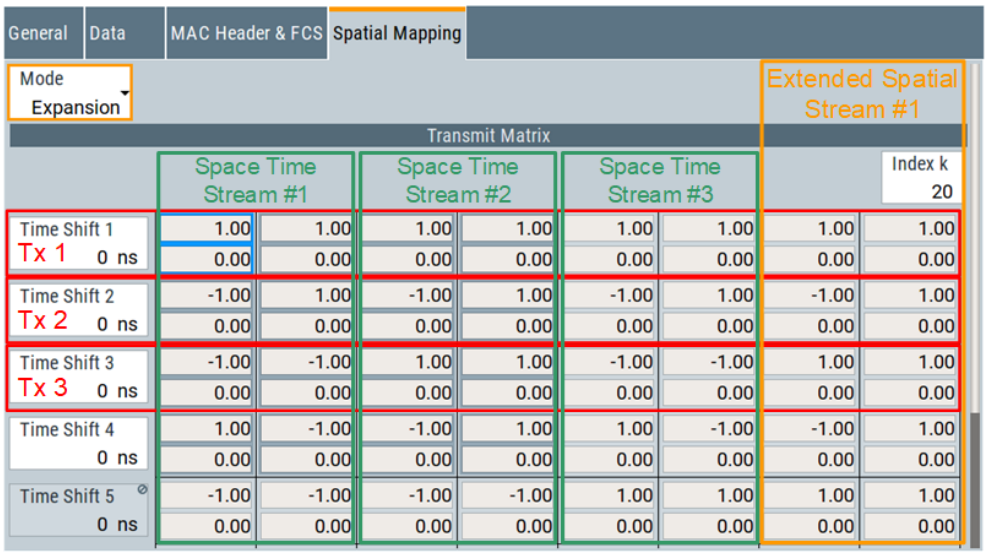
Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:HVINdicator?` on page 182
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:VHTControl:HVINdicator?` on page 178

3.8 Spatial Mapping

Access:

1. Select "Frame Blocks > PPDU > Config".

2. Select "Spatial Mapping"



In this dialog, the mode, the time shifts and the transmit parameters can be configured.

The WLAN standard IEEE 802.11 builds upon previous 802.11 standards by adding MIMO (multiple-input multiple-output). MIMO uses multiple transmitter and receiver antennas for increased data throughput via spatial multiplexing and increased range by exploiting the spatial diversity. Mode, time shifts and transmit parameters are defined in the "Spatial Mapping for Frame Block" dialog.

When loaded, the spatial mapping dialog shows the frame block number for which this spatial mapping dialog is loaded. The transmit matrix corresponding to index **k** has N_{TX} rows (representing the number of transmit antennas) and N_{STS} columns (representing the space time streams). The text label shows the spatial mapping mode selected in the dialog which is updated whenever the mode changes. For "Physical Layer" > "Sounding", a second submatrix horizontally sided to the transmit matrix with N_{TX} rows and N_{ESS} columns is used as a transmit matrix for the extended long training fields (ELTF). The values displayed for the transmit matrices are also normalized (internally) so that the expectation of IQ sum-power of all antennas is 0 dBr. Also for "OFF", "Direct", and "Spatial Expansion", the expected IQ power is the same for all antennas and hence these modes can be intermixed without caring about any power regulation issue. Relative RMS levels are displayed in the dialog for each antenna.

Settings

Mode 82
Index k 82
Time Shift 82
I (Transmit Matrix) 82
Q (Transmit Matrix) 83

Mode
Selects the spatial mapping mode for the selected frame block. The matrix element values are loaded using Info Class Methods.

"Off" (available only for "Physical Mode > Legacy" frame)
The spatial mapping mode is switched off automatically.

"Direct" (available only for "Physical Mode > Mixed Mode" or "Physical Mode > Green Field" when $N_{TX} = N_{STS}$)
Sets the spatial mapping to "Direct" mode.
The transmit matrix is a CSD matrix, that is, a diagonal matrix of unit magnitude and complex values that represent cyclic shifts in the time domain.

"Indirect" (available only for "Physical Mode > Mixed Mode" or "Physical Mode > Green Field")
In indirect mode, the transmit matrix is the product of a CSD matrix and the Hadamard unitary matrix.

"Expansion" Requires "Physical Mode > Mixed Mode" or "Physical Mode > Green Field".
In expansion mode, the transmit matrix is the product of a CSD matrix and a square matrix formed of orthogonal columns, as defined in the IEEE 802.11 specification.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SMAPping:MODE` on page 196

Index k
Sets the index of the subcarrier. A matrix is mapped to each subcarrier.

Except for k = 0, the index can be set in the following ranges:
- 20 MHz channel, e.g. HT-20 MHz: -32 ... 31
- 40 MHz channel, e.g. VHT-40 MHz: -64 ... 63
- 80 MHz channel, e.g. VHT-80 MHz: -128 ... 127
- 160 MHz channel, e.g. VHT-160 MHz: -256 ... 255

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SMAPping:INDex` on page 197

Time Shift
Sets the spatial mapping time shift. This value is relevant for spatial mapping mode "Direct" and "Spatial Expansion" only.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SMAPping:TSHift<st>` on page 197

I (Transmit Matrix)
Displays the time shift value of element I of the selected row and column of the spatial transmit matrix.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SMAPping:ROW<st>:COL<dir>:I?`
on page 198

Q (Transmit Matrix)
Displays the time shift value of element Q of the selected row and column of the spatial transmit matrix.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SMAPping:ROW<st>:COL<dir>:Q?`
on page 198

4 How to Work with the IEEE 802.11 WLAN Option

The R&S SMW equipped with the option digital standard IEEE 802.11 WLAN allows you to generate signals for different transmitter and receiver tests scenarios.

The following step-by-step instructions provide examples of some typical generic workflows and setups for working with this options.

4.1 Generating a 160 MHz 2x2 WLAN 802.11ax Signal

The IEEE 802.11ac/ax uses MIMO technology, up to 160 MHz bandwidth and special coding for increased throughput. The following options are required for the generation of such a signal:

- Option standard baseband generator (R&S SMW-B10)
- Option R&S SMW-B13T
- Frequency option (e.g. R&S SMW-B1003 and R&S SMW-B2003)
- 2x option baseband extension to 160 MHz RF bandwith (R&S SMW-K522)
- 2x option WLAN IEEE802.11ac/ax (R&S SMW-K86/142)
- Optional, 2x option fading simulator (R&S SMW-B14)
- Optional, option fading MIMO (R&S SMW-K74)
- Optional, option AWGN (R&S SMW-K62)

The following step-by step instruction describes how to configure the instrument for generating a 160 MHz 2x2 WLAN 802.11ac signal.

Configure the R&S SMW for a 160 MHz 2x2 MIMO WLAN 802.11ac/ax signal generation

1. Configure the basebands in the "System Configuration > Fading/Baseband Config" dialog to generate a 1x2x2 coupled sources signal.
   For a detailed description of how to do that, refer to the R&S SMW user manual.
2. Configure the reference oscillator settings, depending on whether an external reference source is provided.
   Select "External Reference Frequency Source" and configure the "Synchronization Bandwidth" and the "External Reference Frequency" accordingly.
3. Set the power level and the frequency in the header display of the instrument.
4. Select an "IEEE 802.11 WLAN > Trigger in > Source > External Global Trigger".
5. In the "IEEE 802.11 WLAN > General > Transmit Antenna Setup" dialog set the transmit antennas:
   a) Set "Antennas > = 2".
   b) Set "Output > O1 > Baseband A" and "Output > O2 > Baseband B".

6. Set "IEEE 802.11 WLAN > General > Transmission Bandwith > 160 MHz ".
7. Set the frame block in the "IEEE 802.11 WLAN > Frame Block Configuration" dialog:
   a) Set "Std.> 11ac/ax".
   b) Set the required "Type" and "Physical Mode" of the frame block.
   c) Set "Tx Mode > VHT-160 MHz"/"Tx Mode > HE-160 MHz".
   d) For "Type > Data" and "Physical Mode > Mixed Mode" set "Data > A-MPDU".
   e) Set "State > ON".
   f) Use the default "IEEE 802.11 WLAN > Frame Block Configuration > PPDU Configuration" settings or adjust them if necessary to, for instance, add redundancy.
8. Enable the WLAN 802.11ac/ax signal generation.
9. (optional)
   The signal can be additionally fed to a fading simulator.
   An example of how to configure the fading simulator is given below. For a detailed description, refer to the R&S SMW user manual.
   a) In the "Fading" configuration dialog select "General > Standard > 802.11ac-MIMO > Modell A".
   b) Set "State > On".
10. (optional)
    In the block diagram select "AWGN > On".
    For a detailed description of how to do that, refer to the R&S SMW user manual.
11. In the block diagram select "RF A > On" and "RF B > On".
    For a detailed description of how to do that, refer to the R&S SMW user manual.

4.2 Generating a 3x3 MIMO WLAN 802.11n Signal with a R&S SMW for Transmitter Tests

This example shows the connection and configuration of the instrument for the generation of a 3x3 MIMO WLAN 802.11n signal for transmitter tests.

The 3x3 MIMO WLAN 802.11n signal generation scenario requires one two-path instrument and a signal generator that provides the third RF Path, like the R&S SGS.

- Option standard baseband generator (R&S SMW-B10)
- Option R&S SMW-B13T
- Frequency option (e.g. R&S SMW-B1003 and R&S SMW-B2003)
- 2x option baseband extension to 160 MHz RF bandwith (R&S SMW-K522)
- 2x option WLAN IEEE802.11n (R&S SMW-K54)
- Optional, 4x option fading simulator (R&S SMW-B14)
- Optional, option fading MIMO (R&S SMW-K74)

- Optional, option AWGN (R&S SMW-K62)

The instruments have to be configured and connected as described in the following section.

Connecting a R&S SGS and a R&S SMW for 3x3 MIMO WLAN 802.11n signal generation

Connect the instruments as described below:

1. Connect the [I OUT 1/Q OUT 1] connectors of the R&S SMW to the [I IN / Q IN] connectors of the R&S SGS.
2. To provide the R&S SGS with reference frequency, connect the input [REF IN] of the instrument to the "REF OUT" connector of the R&S SMW.
3. Provide an external trigger signal to the input [USER 3] of the R&S SMW.
4. Avoid unnecessary cable lengths and branching points.

   The figure below shows the cabling of a two-path R&S SMW and a R&S SGS for the generation of a 3x3 MIMO WLAN 802.11n signal.

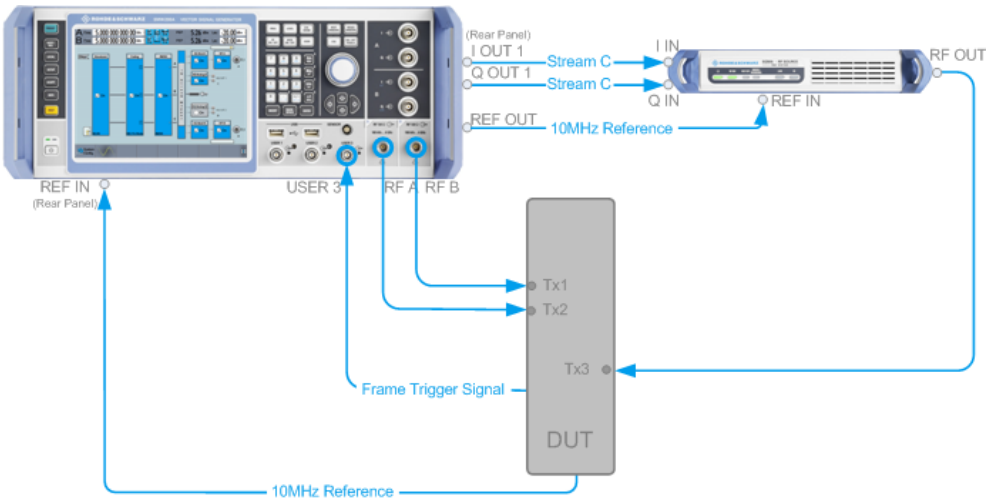


Figure 4-1: Setup for tests with three antennas (Example of R&S SMW and a R&S SGS)

Configure the R&S SMW for 3x3 MIMO WLAN 802.11n signal generation

1. Connect the R&S SGS in the "System Configuration > External RF and I/Q > I/Q OUT 1 > External Instrument > Config...".
   For a detailed description of how to do that, refer to the R&S SMW user manual.
2. Configure the basebands in the "System Configuration > Fading/Baseband Config" dialog to generate a 1x3x3 coupled source signal.
   For a detailed description of how to do that, refer to the R&S SMW user manual.
3. Configure the reference oscillator settings, depending on whether an external reference source is provided.

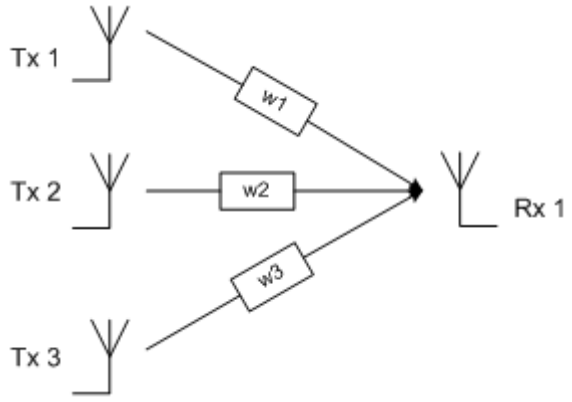
Select "External Reference Frequency Source" and configure the "Synchronization Bandwidth" and the "External Reference Frequency" accordingly.
For a detailed description of how to do that, refer to the R&S SMW user manual.

4. Set the power level and the frequency in the header display of the instrument.
5. Select an "IEEE 802.11 WLAN > Trigger in > Source > External Global Trigger 1".
6. In the "IEEE 802.11 WLAN > General > Transmit Antenna Setup" dialog set the transmit antenna:
   a) Set "Antennas > =3".
   b) Set "Output > O1 > Baseband A", "Output > O2 > Baseband B" and "Output > O3 > Baseband C".
7. To enable the R&S SMW to generate a WLAN 802.11n/802.11ac signal of antennas with different power level, set the power level of the corresponding path to the desired level in the header display of the instrument.
8. Set the frame block in the "IEEE 802.11 WLAN > Frame Block Configuration" dialog:
   a) Set "Std.> 11n".
   b) Set the required "Type" and "Physical Mode" of the frame block.
   c) Set "State > ON".
   d) Use the default "IEEE 802.11 WLAN > Frame Block Configuration > PPDU Configuration" settings or adjust them if necessary to, for instance, add redundancy.
9. Enable the WLAN 802.11n signal generation.
10. (optional)
    The signal can be additionally fed to a fading simulator.
    An example of how to configure the fading simulator is given below. For a detailed description, refer to the R&S SMW user manual.
    a) In the "Fading" configuration dialog select "General > Standard > 802.11n-MIMO > Modell A".
    b) Set "State > On".
11. (optional)
    In the block diagram select "AWGN > On".
    For a detailed description of how to do that, refer to the R&S SMW user manual.
12. In the block diagram select "I/Q Analog A > On", "RF A > On" and "RF B > On".
    For a detailed description, refer to the R&S SMW user manual.

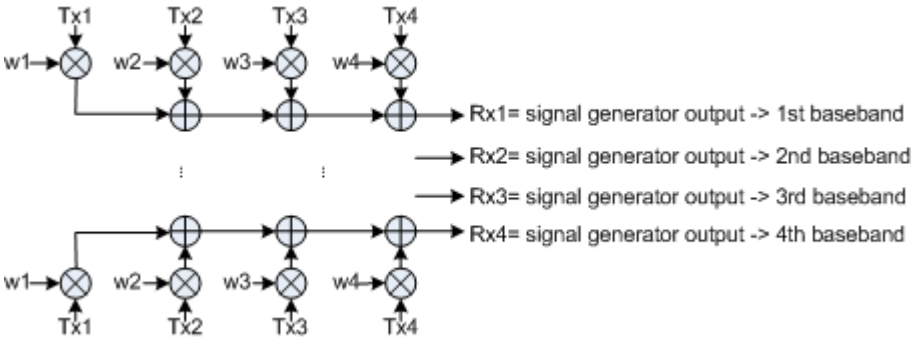
4.3 Generating a Realistic MxN MIMO WLAN 802.11n/ac/p Signal for Receiver Test under Static Conditions

This example shows you how to enable the R&S SMW to generate a WLAN 802.11n/ 802.11ac/802.11p signal for simple diversity and simulation of frequency flat MIMO channel conditions. No additional channel simulator is necessary for this test application.

The figure below shows an example of a simple diversity scenario with three transmission antennas Tx1..Tx3 and one receiving antenna Rx1. The channel is represented by the weight coefficients w1 .. w3.



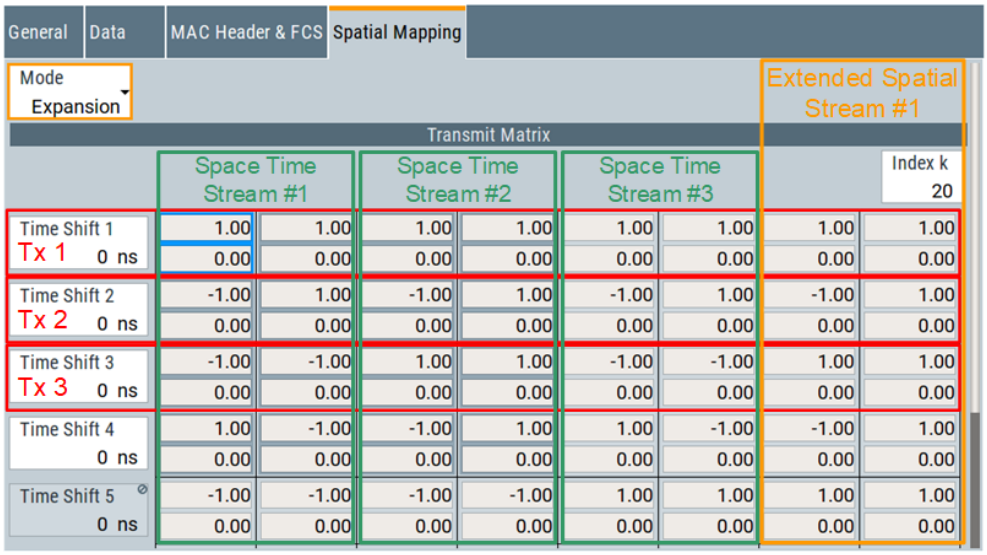
The R&S SMW provides the possibility to weight, sum and map the generated Tx antenna signals to the output(s) of the signal generator, i.e. to simulate a frequency flat MIMO channel conditions for single carrier analysis e.g. BER tests.



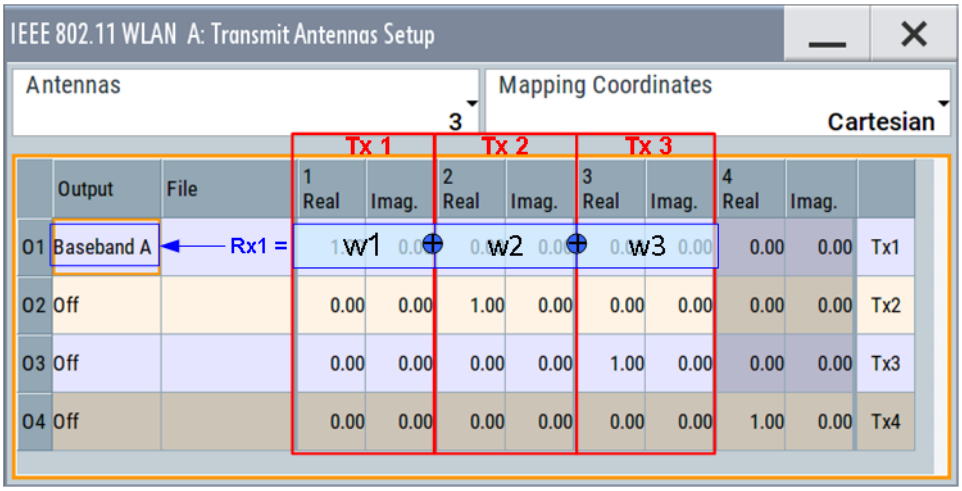
To generate a realistic WLAN 802.11n/802.11ac/802.11p MIMO signal under static conditions, configure the instrument(s) as follows:

1. In the "Frame Block Configuration" dialog set the "Std." for the required standard.
2. Use the default "Frame Block Configuration" settings or adjust them as required.
3. Use the default "PPDU Configuration" settings or adjust them if necessary to, for instance, add redundancy.

4. In the "Transmit Antenna Setup" dialog, select the number of "Tx Antennas" to be simulated. The number of the Tx Antennas determines the value M in the MxN MIMO system and the number of the transmission chains.
5. Configure the subcarrier to be analyzed, i.e. configure the "Spatial Mapping Mode" and set the "Time Shifts".



6. In the Tx Antenna Setup dialog, enable the Baseband to generate the Rx1 signal.
7. Select the mapping coordinates and adjust the weights of the Tx signals in the Transmission Chain Matrix.



8. To enable the R&S SMW to generate a WLAN 802.11n/802.11ac/802.11p signal of antennas with different power level, set the power level of the corresponding path to the desired level in the header display of the instrument.
9. Enable signal generation.

The Baseband of the R&S SMW will generate the Rx signal as a sum of the three Tx signals, weighted with the selected coefficients.

4.4 Generating a Realistic MxN MIMO WLAN 802.11n/ac/p Signal for Receiver Test under Real Word Conditions

The simulation of real-time MIMO channel condition requires instruments equipped with the fading options R&S SMW-K74/-B14.

The instruments have to be configured as follows:

1. Enable the instrument to generate a 2xN, 3xN or 4xN MIMO WLAN 802.11n/ 802.11ac/802.11p signal as described in Chapter 4.2, "Generating a 3x3 MIMO WLAN 802.11n Signal with a R&S SMW for Transmitter Tests", on page 85.
2. Enable the instrument to generate 2xN, 3xN or 4xN MIMO fading signal. Refer to section "Multiple Input Multiple Output" in the description of the Fading Simulator.

5 Signal Control and Signal Characteristics

This section lists settings provided for configuring the baseband filter, for defining the signal generation start and for generating signals necessary for synchronization with other instruments.

Settings

- Filter/Clipping Settings 91
- Trigger Settings 96
- Marker Settings 101
- Clock Settings 104
- Local and Global Connector Settings 106

5.1 Filter/Clipping Settings

Access:

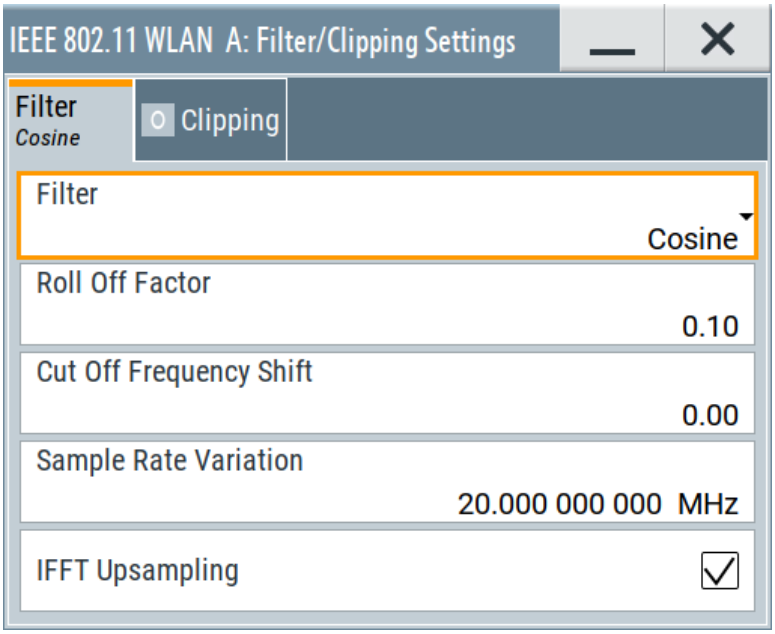
► Select "IEEE 802.11 > General > Filter/Clipping Settings".

The dialog comprises the settings, necessary to configure the baseband filter and to enable clipping.

5.1.1 Filter Settings

Access:

► Select "Filter/Clipping Settings > Filter".



The dialog comprises the settings, necessary to configure the baseband filter.

Settings

Use Default Wlan Filter 92
Filter 92
Roll Off Factor or BxT 92
Cut Off Frequency Factor 93
Cut Off Frequency Shift 93
Sample Rate Variation 94
IFFT Upsampling 94

Use Default Wlan Filter
Requires "Transmission Bandwidth > 40 MHz" or higher.

Activates the WLAN default filter. The default filter setting is optimized to achieve best possible EVM results while complying with the spectrum emission mask.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FILTer:DEFSetting:STATe` on page 116

Filter
Selects the baseband filter.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FILTer:TYPE` on page 119

Roll Off Factor or BxT
Sets the roll-off factor

The rolloff factor affects the steepness of the filter slopes. A "Rolloff Factor = 0" results in the steepest slopes; values near to 1 make the slopes more flat.

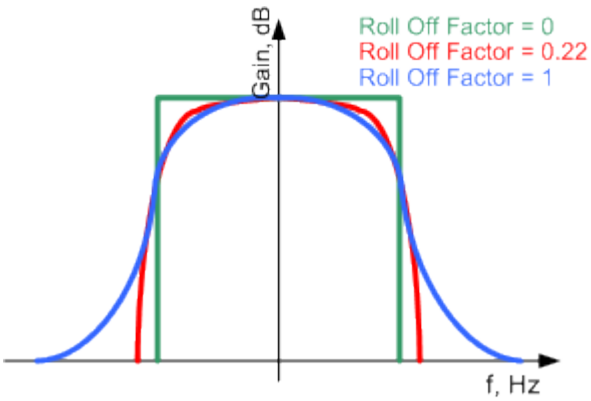


Figure 5-1: Example of the frequency response of a filter with different roll off factors

For the default cosine filter, a roll-off factor of 0.10 is used.

Remote command:
[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:APCO25 on page 117
[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:COSine on page 117
[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:GAUSs on page 118
[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:PGAuss on page 119
[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:RCOSine on page 119
[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:SPHase on page 119

Cut Off Frequency Factor
Sets the value for the cutoff frequency factor. The cutoff frequency of the filter can be adjusted to reach spectrum mask requirements.

Remote command:
[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:LPASs on page 118
[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:LPASSEVM on page 118

Cut Off Frequency Shift
Requires "Filter > Cosine".

The cutoff frequency is a filter characteristic that defines the frequency at the 3 dB down point. The "Cut Off Frequency Shift" affects this frequency in the way that the filter flanks are "moved" and the transition band increases by "Cut Off Frequency Shift"*"Sample Rate".

- A "Cut Off Frequency Shift" = -1 results in a very narrow-band filter
- Increasing the value up to 1 makes the filter more broad-band
- By "Cut Off Frequency Shift" = 0, the -3 dB point is at the frequency determined by the half of the selected "Sample Rate".

Tip: Use this parameter to adjust the cutoff frequency and reach spectrum mask requirements.

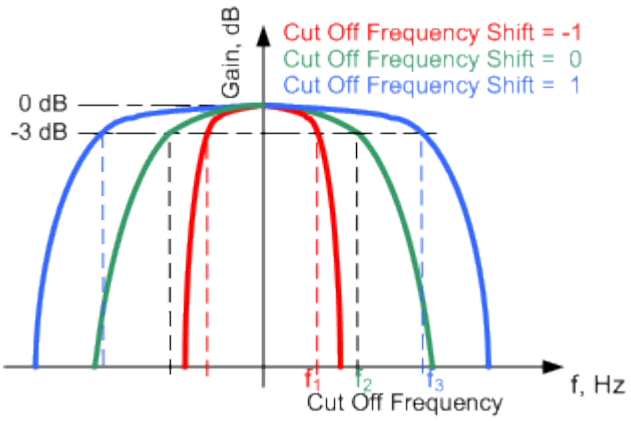


Figure 5-2: Example of the frequency response of a filter with different cut off frequency shift

Remote command:
`[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:COSine:COFS` on page 117

Sample Rate Variation
Sets the sample rate of the signal.

A variation of this parameter only affects the ARB clock rate; all other signal parameters remain unchanged. If the sampling rate in the frame configuration menu is changed, this parameter is reset to the chosen sampling rate.

Remote command:
`[:SOURce<hw>]:BB:WLNN:SRATe:VARiation` on page 120

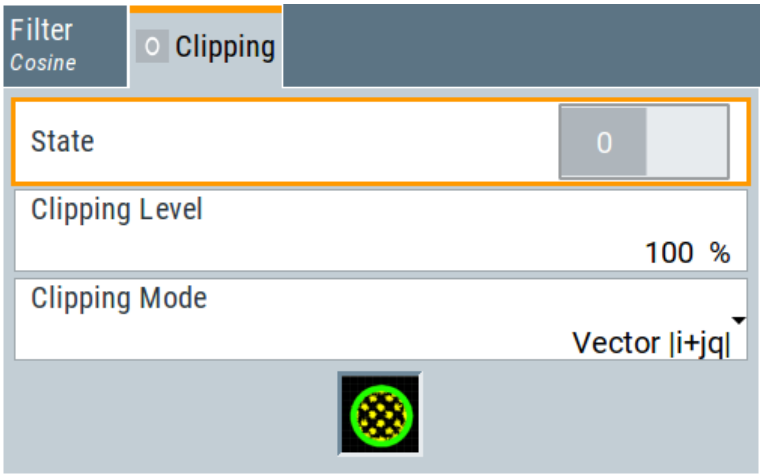
IFFT Upsampling
Activates inverted Fast Fourier Transformation (IFFT) upsampling.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FILTer:IUPSampling` on page 117

5.1.2 Clipping Settings

Access:

► Select "Filter/Clipping Settings > Clipping".



The dialog comprises the settings, necessary to configure the clipping.

Settings

Clipping State....95
Clipping Level....95
Clipping Mode....96

Clipping State
Switches baseband clipping on and off.

Baseband clipping is a simple and effective way of reducing the crest factor of the signal. Since clipping is done before to filtering, the procedure does not influence the spectrum. The EVM however increases.

WLAN signals can have high crest factors. High crest factors entail two basic problems:

- The nonlinearity of the power amplifier (compression) causes intermodulation which expands the spectrum (spectral regrowth).
- Since the level in the D/A converter is relative to the maximum value, the average value is converted with a relatively low resolution. This results in a high quantization noise.

Both effects increase the adjacent-channel power.

With baseband clipping, all the levels are limited to a settable value ("Clipping Level"). This level is specified as a percentage of the highest peak value. Since clipping is done before filtering, the procedure does not influence the spectrum. The EVM however increases.

Since clipping the signal not only changes the peak value but also the average value, the effect on the crest factor is unpredictable. The following table shows the effect of the "Clipping" on the crest factor for typical scenarios.

Remote command:
`[:SOURce<hw>]:BB:WLNN:CLIPping:STATe` on page 116

Clipping Level
Sets the limit for clipping.

This value indicates at what point the signal is clipped. It is specified as a percentage, relative to the highest level. 100% indicates that clipping does not take place.

Remote command:
[:SOURce<hw>]:BB:WLNN:CLIPping:LEVel on page 115

Clipping Mode
Selects the clipping method. The dialog displays a graphical illustration on how this two methods work.

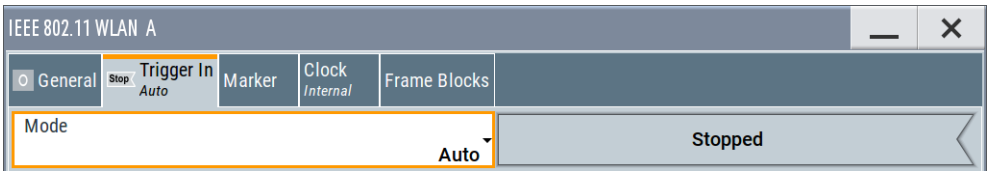
- "Vector | i + jq |"
  The limit is related to the amplitude | i + q |. The I and Q components are mapped together, the angle is retained.
- "Scalar | i | , | q |"
  The limit is related to the absolute maximum of all the I and Q values | i | + | q |. The I and Q components are mapped separately, the angle changes.

Remote command:
[:SOURce<hw>]:BB:WLNN:CLIPping:MODE on page 116

5.2 Trigger Settings

Access:

► Select "Baseband > IEEE 802.11 WLAN > Trigger In".



This tab provides access to the settings necessary to select and configure the trigger and to arm or trigger an internal trigger manually. The current signal generation status is displayed in the header of the tab together with information on the enabled trigger mode. As in the "Marker" and "Clock" tabs, this tab provides also access to the settings of the related connectors.

This section focuses on the available settings.

For information on how these settings affect the signal, refer to section "Basics on ..." in the R&S SMW user manual.

Routing and enabling a trigger

The provided trigger signals are not dedicated to a particular connector. Trigger signals can be mapped to one or more USER x or T/M connectors.

Use the Local and Global Connector Settings to configure the signal mapping, the polarity, the trigger threshold and the input impedance of the input connectors.

To route and enable a trigger signal, perform the following *general steps*:

- Define the signal source and the effect of a trigger event.
  Select the "Trigger In > Mode" and "Trigger In > Source".
- Define the connector where the selected signal is provided.
  Use the "Global Connectors" settings.

Settings

Trigger Settings Common to All Basebands 97
Trigger Mode 97
Signal Duration Unit 98
Trigger Signal Duration 98
Running/Stopped 98
Arm 98
Execute Trigger 98
Trigger Source 99
Sync. Output to External Trigger/Sync. Output to Trigger 99
External Trigger Inhibit 100
Trigger Delay 100

Trigger Settings Common to All Basebands

To enable simultaneous signal generation in all basebands, the R&S SMW couples the trigger settings in the available basebands in any instrument's configuration involving signal routing with signal addition. For example, in MIMO configuration, routing and summing of basebands or of streams.

The icon indicates that common trigger settings are applied.

You can access and configure the common trigger source and trigger mode settings in any of the basebands. An arm or a restart trigger event applies to all basebands, too. You can still apply different delay to each of the triggers individually.

Trigger Mode

Selects trigger mode, i.e. determines the effect of a trigger event on the signal generation.

For more information, refer to chapter "Basics" in the R&S SMW user manual.

- "Auto"
  The signal is generated continuously.
- "Retrigger"
  The signal is generated continuously. A trigger event (internal or external) causes a restart.
- "Armed Auto"
  The signal is generated only when a trigger event occurs. Then the signal is generated continuously.

An "Arm" stops the signal generation. A subsequent trigger event (internal or external) causes a restart.

- "Armed Retrigger"
  The signal is generated only when a trigger event occurs. Then the signal is generated continuously. Every subsequent trigger event causes a restart.
  An "Arm" stops signal generation. A subsequent trigger event (internal or external) causes a restart.
- "Single"
  The signal is generated only when a trigger event occurs. Then the signal is generated once to the length specified at "Signal Duration".
  Every subsequent trigger event (internal or external) causes a restart.

Remote command:
`[:SOURce<hw>]:BB:WLNN[:TRIGger]:SEQuence` on page 126

Signal Duration Unit
Defines the unit for describing the length of the signal sequence to be output in the "Single" trigger mode.

Remote command:
`[:SOURce<hw>]:BB:WLNN:TRIGger:SLUNit` on page 124

Trigger Signal Duration
Enters the length of the signal sequence to be output in the "Single" trigger mode.

Use this parameter to output part of the signal deliberately, an exact sequence of the signal, or a defined number of repetitions of the signal.

Remote command:
`[:SOURce<hw>]:BB:WLNN:TRIGger:SLENgth` on page 124

Running/Stopped
With enabled modulation, displays the status of signal generation for all trigger modes.

- "Running"
  The signal is generated; a trigger was (internally or externally) initiated in triggered mode.
- "Stopped"
  The signal is not generated and the instrument waits for a trigger event.

Remote command:
`[:SOURce<hw>]:BB:WLNN:TRIGger:RMODe?` on page 123

Arm
Stops the signal generation until subsequent trigger event occurs.

Remote command:
`[:SOURce<hw>]:BB:WLNN:TRIGger:ARM:EXECute` on page 122

Execute Trigger
For internal trigger source, executes trigger manually.

Remote command:
`[:SOURce<hw>]:BB:WLNN:TRIGger:EXECute` on page 122

Trigger Source
The following sources of the trigger signal are available:

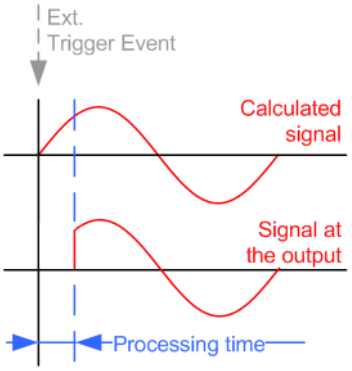
- "Internal"
  The trigger event is executed manually by the "Execute Trigger".
- "Internal (Baseband A/B)"
  The trigger event is provided by the trigger signal from the other basebands.
  If common trigger settings are applied, this trigger source is disabled.
- "External Global Trigger"
  The trigger event is the active edge of an external trigger signal provided and configured at the USER x connectors.
- "External Local Trigger"
  The trigger event is the active edge of an external trigger signal provided and configured at the local T/M/C connector.
  With coupled trigger settings, the signal has to be provided at the T/M/C1/2/3 connectors.
- "External Local Clock"
  The trigger event is the active edge of an external local clock signal provided and configured at the local T/M/C connector.
  With coupled trigger settings, the signal has to be provided at the T/M/C1 connector.
- "Baseband Sync In"
  Option: R&S SMW-B9
  In master-slave mode, slave instruments are triggered by the active edge of the synchronization signal.

"External Local Clock/Trigger" require R&S SMW-B10.

Remote command:
`[:SOURce<hw>]:BB:WLNN:TRIGger:SOURce` on page 125

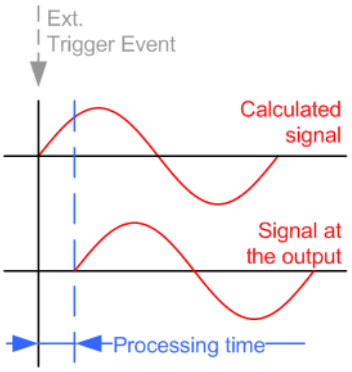
Sync. Output to External Trigger/Sync. Output to Trigger
Enables signal output synchronous to the trigger event.

- "On"
  Corresponds to the default state of this parameter.
  The signal calculation starts simultaneously with the trigger event. Because of the processing time of the instrument, the first samples are cut off and no signal is output. After elapsing of the internal processing time, the output signal is synchronous to the trigger event.



- "Off"

The signal output begins after elapsing of the processing time. Signal output starts with sample 0. The complete signal is output.
This mode is recommended for triggering of short signal sequences. Short sequences are sequences with signal duration comparable with the processing time of the instrument.



In master-slave mode, this setting ensures that once achieved, synchronization is not lost if the baseband signal sampling rate changes.

Remote command:
`[:SOURce<hw>]:BB:WLNN:TRIGger:EXTernal:SYNChronize:OUTPut` on page 122

External Trigger Inhibit
Applies for external trigger signal or trigger signal from the other path.

Sets the duration with that any following trigger event is suppressed. In "Retrigger" mode, for example, a new trigger event does not cause a restart of the signal generation until the specified inhibit duration does not expire.

For more information, see chapter "Basics" in the R&S SMW user manual.

Remote command:
`[:SOURce<hw>]:BB:WLNN:TRIGger[:EXTernal]:INHibit` on page 126
`[:SOURce<hw>]:BB:WLNN:TRIGger:OBASeband:INHibit` on page 123

Trigger Delay
Delays the trigger event of the signal from:
- The external trigger source
- The other path
- The other basebands (internal trigger), if common trigger settings are used.

Use this setting to:
- Synchronize the instrument with the device under test (DUT) or other external devices
- Postpone the signal generation start in the basebands compared to each other
- Compensate delays and align the signal generation start in multi-instrument setup

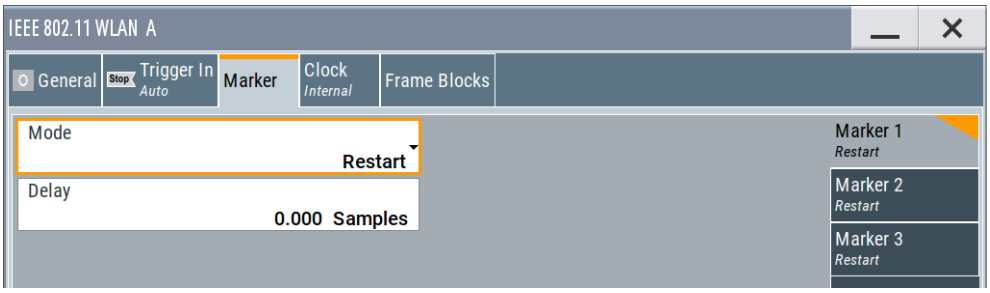
For more information, see chapter "Basics on ..." in the R&S SMW user manual.

Remote command:
`[:SOURce<hw>]:BB:WLNN:TRIGger[:EXTernal]:DELay` on page 125
`[:SOURce<hw>]:BB:WLNN:TRIGger:OBASeband:DELay` on page 123

5.3 Marker Settings

Access:

► Select "Baseband > IEEE 802.11 > Marker".



The tab provides access to the settings necessary to select and configure the marker output signal, like the marker mode or marker delay settings.

This section focuses on the available settings.

For information on how these settings affect the signal, refer to section "Basics on ..." in the R&S SMW user manual.

Routing and enabling a marker

The provided marker signals are not dedicated to a particular connector. They can be mapped to one or more USER x or T/M connectors.

To route and enable a marker signal, perform the following *general steps*:

- Define the shape of the generated marker, i.e. select the "Marker > Mode".
- Define the connector where the selected signal is provided.
  Use the Local and Global Connector Settings.

Settings

Marker Mode 101
Marker x Delay 104

Marker Mode

Marker configuration for up to 3 markers. The settings are used to select the marker mode defining the shape and periodicity of the markers. The contents of the dialog change with the selected marker mode.

"Restart" A marker signal is generated at the start of each signal sequence (period = all frame blocks).

"Frame Block" "Number of Frame Blocks" = 1, that is, a marker signal is generated at the start of each frame block. Otherwise a specific frame block index is given and the whole frame block is marked.

Remote command:

`[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:FBINdex` on page 128

"Frame" "Number of Frame Blocks" = 1, that is, a marker signal is generated at the start of each frame in the single frame block. Otherwise, the frame block and frame index are entered and the specific frame is masked.

Remote command:
`[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:FINDex` on page 129

"Frame Active Part / Frame Inactive Part"

A marker signal is generated to mark every active part of each frame. The active data transfer part (PPDU) of a frame period is marked with high, the inactive part (idle time) with low. This marker can be used to decrease the carrier leakage during inactive signal parts by feeding it into the pulse modulator.
Otherwise, the frame block and frame index are entered and the active part of the specific frame is masked.
The parameters "Rising Edge Shift / Falling Edge Shift" open when "Frame Active Part" or "Frame Inactive Part" is selected.
They shift the rising/falling edge of the marker the specified number of samples. Negative values result in a shift back of the marker edge.

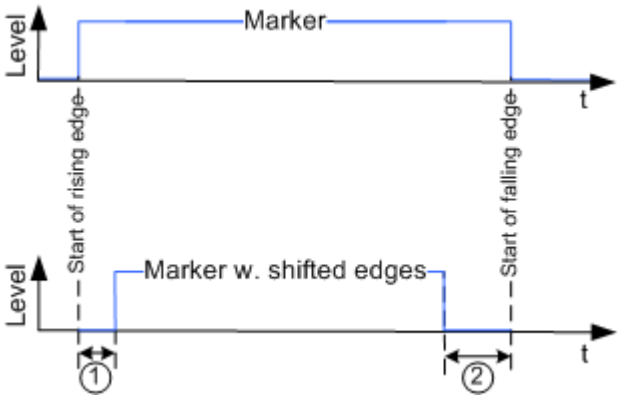


Figure 5-3: "Frame active Part" marker and shifting of its rising/falling edges

1 = Marker shift rising edge
2 = Marker shift falling edge

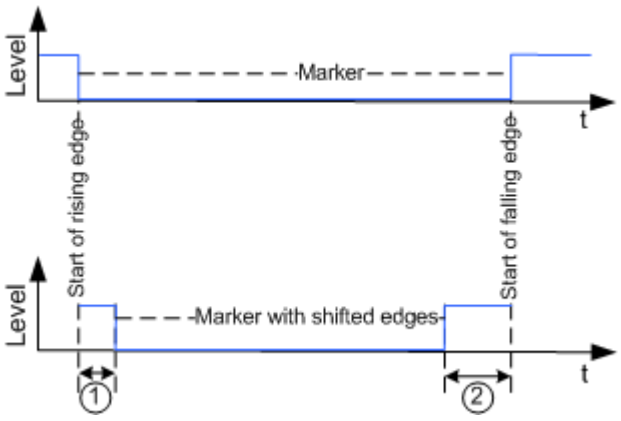


Figure 5-4: "Frame Inactive Part" marker and shifting of its rising/falling edges

1 = Marker shift rising edge
2 = Marker shift falling edge

Remote command:
`[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:FESHift` on page 129
`[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:RESHift` on page 129

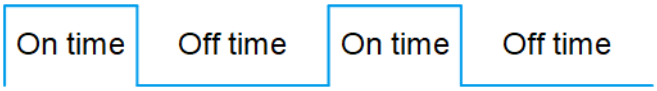
"Pulse" A regular marker signal is generated. The clock frequency is defined by entering a divider. The frequency is derived by dividing the chip rate by the divider. The input box for the divider opens when "Pulse" is selected, and the resulting pulse frequency is displayed below it.

Remote command:
`[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:PULSe:DIVider` on page 130
`[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:PULSe:FREQuency?` on page 130

"Pattern" A marker signal that is defined by a bit pattern is generated. The pattern has a maximum length of 32 bits.

Remote command:
`[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:PATTern` on page 130

"On/Off Ratio"
A regular marker signal that is defined by an On/Off ratio is generated. A period lasts one On and Off cycle.



Remote command:
`[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:ONTime` on page 128
`[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:OFFTime` on page 128

Remote command:
`[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:MODE` on page 127

Marker x Delay
Delays the marker signal at the marker output relative to the signal generation start.

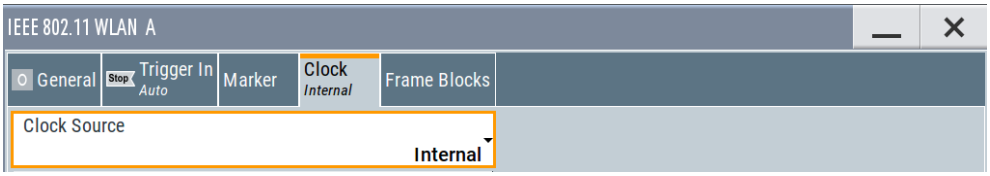
Variation of the parameter "Marker x Delay" causes signal recalculation.

Remote command:
`[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:DELay` on page 131

5.4 Clock Settings

Access:

► Select "Baseband > IEEE 802.11 > Clock".



This tab provides access to the settings necessary to select and configure the clock signal, like the clock source and clock mode.

This section focuses on the available settings.

For information on how these settings affect the signal, refer to section "Basics on ..." in the R&S SMW user manual.

Defining the clock

The provided clock signals are not dedicated to a particular connector. They can be mapped to one or more USER x and T/M/C connectors.

Use the Local and Global Connector Settings to configure the signal mapping, the polarity, the trigger threshold, and the input impedance of the input connectors.

To route and enable a trigger signal, perform the following *general steps*:

- Define the signal source, that is select the "Clock > Source".
- Define the connector where the selected signal is provided.
  Use the Local and Global Connector Settings.

Settings

Clock Source 105
Clock Mode 105
Measured External Clock 105

Clock Source

Selects the clock source.

- "Internal"
  The instrument uses its internal clock reference.
- "External Local Clock"
  Option: R&S SMW-B10
  The instrument expects an external clock reference at the local T/M/C connector.

"External Local Clock" requires R&S SMW-B10.

Remote command:

`[:SOURce<hw>]:BB:WLNN:CLOCk:SOURce` on page 132

Clock Mode

Option: R&S SMW-B10

Sets the type of externally supplied clock.

Remote command:

`[:SOURce<hw>]:BB:WLNN:CLOCk:MODE` on page 131

Measured External Clock

Provided for permanent monitoring of the enabled and externally supplied clock signal.

Remote command:

`CLOCk:INPut:FREQuency?`

5.5 Local and Global Connector Settings

Each of the "Trigger In", "Marker" and "Clock" dialogs and the "Trigger Marker Clock" dialog provides a quick access to the related connector settings.

See also chapter "Local and Global Connector Settings" in the user manual.

6 Remote-Control Commands

The following commands are required to perform signal generation with the IEEE 802.11 WLAN options in a remote environment. We assume that the R&S SMW has already been set up for remote operation in a network as described in the R&S SMW documentation. A knowledge about the remote control operation and the SCPI command syntax is assumed.

Conventions used in SCPI command descriptions

For a description of the conventions used in the remote command descriptions, see section "Remote Control Commands" in the R&S SMW user manual.

The `SOURce:BB:WLNN` subsystem contains commands for the primary and general settings of the IEEE 802.11 WLAN standard. With these settings, you can activate the standard, set the transmission direction, filter, clock, trigger and clipping settings and do a preset.

The commands for defining the frame configuration for physical layer modes OFDM and CCK/PBCC are described in the next section. The commands are divided up in this way to make the comprehensive `SOURce:BB:WLNN` subsystem clearer.

Common suffixes

The following common suffixes are used in remote commands:

Suffix	Value range	Description
`ENTity<ch>`	1 to 4	entity in a multiple entity configuration `ENTity3|4` require option R&S SMW-K76
`SOURce<hw>`	[1] to 4	available baseband signals
`OUTPut<ch>`	1 to 3	available markers R&S SMBV supports two markers
`FBLock<ch>`	[1]...100	available frame blocks
`MPDU<st>`	1...10	available MPDUs
`USER<di>`	1...9	available users
`UINFo<st0>`	1...37	available trigger frame users

Using SCPI command aliases for advanced mode with multiple entities

You can address multiple entities configurations by using the SCPI commands starting with the keyword `SOURce` or the alias commands starting with the keyword `ENTity`.

Note that the meaning of the keyword `SOURce<hw>` changes in the second case.

For details, see section "SCPI Command Aliases for Advanced Mode with Multiple Entities" in the R&S SMW user manual.

The following commands specific to the IEEE 802.11 WLAN are described here:

- Programming Examples....108
- General Commands....111
- Filter/Clipping Settings....115
- Trigger Settings....121
- Marker Settings....127
- Clock Settings....131
- Antenna Configuration Settings....132
- Frame Block Configuration....135
- Frame Configuration Settings....141

6.1 Programming Examples

The following sections provide programming examples for the IEEE 802.11 Wlan options.

The purpose of the examples is to present **all** commands for a given task. In real applications, one would rather reduce the examples to an appropriate subset of commands.

The programming examples have been tested with a software tool which provides an environment for the development and execution of remote tests. To keep the example as simple as possible, only the "clean" SCPI syntax elements are reported. Non-executable command lines (e.g. comments) start with two // characters.

At the beginning of the most remote control program, an instrument reset is recommended to set the instrument to a definite state. The commands `*RST` and `SYSTem:PRESet` are equivalent for this purpose. `*CLS` also resets the status registers and clears the output buffer.

6.1.1 Trigger Settings

```
// ********************************************************************
// Configure trigger in automatic mode.
// ********************************************************************
SOURce1:BB:WLNN:TRIGger:SEQuence AUTo

/ ********************************************************************
// Alternatively configure trigger in retrigger mode, source
// internal. Start signal generation via executing the trigger.
// ********************************************************************
SOURce1:BB:WLNN:TRIGger:SEQuence RETR
SOURce1:BB:WLNN:TRIGger:SOURce INTernal
SOURce1:BB:WLNN:TRIGger:EXEcute

*********************************************************************
// Alternatively configure trigger in retrigger mode, use
// the internal trigger signal from the other path.
// Set inhibit duration, specify delay in samples
```

```
// ********************************************************************
SOURce1:BB:WLNN:TRIGger:SEQuence RETR
SOURce1:BB:WLNN:TRIGger:SOURce INTB
SOURce1:BB:WLNN:TRIGger:OBASeband:INHibit 10
SOURce1:BB:WLNN:TRIGger:DELay:UNIT SAMP
SOURce1:BB:WLNN:TRIGger:OBASeband:DELay 25

/ ********************************************************************
// Alternatively set and query delay in seconds.
// ********************************************************************
SOURce1:BB:WLNN:TRIGger:DELay:UNIT TIME
SOURce1:BB:WLNN:TRIGger:OBASeband:TDELay 0.00001
SOURce1:BB:WLNN:TRIGger:OBASeband:RDELay?


 ********************************************************************
// Alternatively configure trigger in armed retrigger mode, use
// external global trigger. Enable synchronization output.
// Set inhibit duration, specify delay in samples.
// ********************************************************************
SOURce1:BB:WLNN:TRIGger:SEQuence ARET
SOURce1:BB:WLNN:TRIGger:SOURce EGT1
SOURce1:BB:WLNN:TRIGger:EXTernal:SYNChronize:OUTPut 1
SOURce1:BB:WLNN:TRIGger:EXTernal:INHibit 10
SOURce1:BB:WLNN:TRIGger:DELay:UNIT SAMP
SOURce1:BB:WLNN:TRIGger:EXTernal:DELay 25

/ ********************************************************************
// Alternatively set and query delay in seconds.
// ********************************************************************
SOURce1:BB:WLNN:TRIGger:DELay:UNIT TIME
SOURce1:BB:WLNN:TRIGger:EXTernal:TDELay 0.00001
SOURce1:BB:WLNN:TRIGger:EXTernal:RDELay?

// ********************************************************************
// Configure trigger in single mode. Set the output of
// the current waveform to the first sample after
// the next trigger event. Execute the trigger.
// ********************************************************************
SOURce1:BB:WLNN:TRIGger:SEQuence SINGle
SOURce1:BB:WLNN:TRIGger:SLUNit SAMP
SOURce1:BB:WLNN:TRIGger:SLENgth 1
SOURce1:BB:WLNN:TRIGger:EXEcute

/ ********************************************************************
// Alternatively configure internal trigger in armed retrigger
// mode. Start signal generation via executing the trigger.
// Stop signal generation via arming the trigger.
// Execute the trigger again to restarts signal generation.
// ********************************************************************
```

```
SOURce1:BB:WLNN:TRIGger:SEQuence ARETrigger
SOURce1:BB:WLNN:TRIGger:SOURce INTernal
SOURce1:BB:WLNN:TRIGger:EXEcute
SOURce1:BB:WLNN:TRIGger:ARM:EXECute
SOURce1:BB:WLNN:TRIGger:EXEcute

// *****************************************************************
// Query trigger signal generation status.
// *****************************************************************
SOURce1:BB:WLNN:TRIGger:RMODe?
```

6.1.2 Marker Settings

Example: Marker configuration

```
// *****************************************************************
// Query marker mode, set rising and falling offsets.
// *****************************************************************
SOURce:BB:WLNN:TRIGger:OUTPut2:MODE?
// RESTart
SOURce:BB:WLNN:TRIGger:OUTPut2:FOFFset 10
SOURce:BB:WLNN:TRIGger:OUTPut2:ROFFset 20

// *****************************************************************
// Set delay.
// *****************************************************************
SOURce:BB:WLNN:TRIGger:OUTPut3:DELay 16
```

6.1.3 Clock Settings

This section is not relevant for R&S WinIQSIM2.

Example: Clock configuration

```
// *****************************************************************
// Select internal clock.
// *****************************************************************
SOURce1:BB:WLNN:CLOCk:SOURce INTernal

// *****************************************************************
// Alternatively select external clock. Set its mode and query
// input frequency.
// *****************************************************************
SOURce:BB:WLNN:CLOCk:SOURce EXT
SOURce:BB:WLNN:CLOCk:MODE SAMP
CLOCk:INPUt:FREQuency?
```

6.2 General Commands

[:SOURce<hw>]:BB:WLNN:BWidth ... 111
[:SOURce<hw>]:BB:WLNN:FBLock:APPend ... 111
[:SOURce<hw>]:BB:WLNN:IFBLock ... 111
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:INSert ... 111
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:COPY ... 112
[:SOURce<hw>]:BB:WLNN:CFBLock ... 112
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DELete ... 112
[:SOURce<hw>]:BB:WLNN:DFBLock ... 112
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PASTe ... 112
[:SOURce<hw>]:BB:WLNN:PFBLock ... 112
[:SOURce<hw>]:BB:WLNN:PRESet ... 112
[:SOURce<hw>]:BB:WLNN:SETTing:CATalog? ... 113
[:SOURce<hw>]:BB:WLNN:SETTing:DELete ... 113
[:SOURce<hw>]:BB:WLNN:SETTing:LOAD ... 113
[:SOURce<hw>]:BB:WLNN:SETTing:STORe ... 114
[:SOURce<hw>]:BB:WLNN:STATe ... 114
[:SOURce<hw>]:BB:WLNN:WAVeform:CREate ... 114

[:SOURce<hw>]:BB:WLNN:BWidth <BWidth>

The command selects the transmission bandwidth. Whenever the bandwidth changes from a higher to a lower one, the frame blocks are validated because some of them could be invalid in the lower bandwidth (invalid TX Mode).

Parameters:

<BWidth> BW20 | BW40 | BW80 | BW160 | BW320
*RST: BW20
Default unit: MHz

Example: `BB:WLNN:BW BW40`
sets the transmission bandwidth to 40 MHz.

Manual operation: See " Transmission Bandwidth " on page 19

[:SOURce<hw>]:BB:WLNN:FBLock:APPend

Appends a frame block to the end of the frame blocks list.

Example: `BB:WLNN:FBL:APP`

Usage: Event

Manual operation: See " Append" on page 28

[:SOURce<hw>]:BB:WLNN:IFBLock <IfBlock>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:INSert

The command adds a default frame block before the selected frame block.

Example: `BB:WLNN:FBL2:INS`
inserts a default frame block before the selected frame block.

Usage: Event

Manual operation: See " Insert" on page 28

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:COPY
[:SOURce<hw>]:BB:WLNN:CFBLock <CfBlock>

Copies the selected frame block.

Setting parameters:
<CfBlock> integer
Range: 1 to 100

Example: `BB:WLNN:CFBL 5`
copies frame block 5 for later insertion.

Usage: Setting only

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DELete
[:SOURce<hw>]:BB:WLNN:DFBLock <DfBlock>

Deletes the selected frame block.

Setting parameters:
<DfBlock> integer
Range: 1 to 100

Example: `BB:WLNN:DFBL 10`
deletes the selected frame block.

Usage: Setting only

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PASTe
[:SOURce<hw>]:BB:WLNN:PFBLock <PfBlock>

Pastes the selected frame block.

Setting parameters:
<PfBlock> integer
Range: 1 to 99

Example: `BB:WLNN:PFBL 20`
pastes the frame block to row 20.

Usage: Setting only

[:SOURce<hw>]:BB:WLNN:PRESet

Sets the parameters of the digital standard to their default values (`*RST` values specified for the commands).

Not affected is the state set with the command SOURce<hw>:BB:WLNN:STATe.

Example: SOURce:BB:WLNN:PRESet

Usage: Event

Manual operation: See "Set to Default" on page 17

[:SOURce<hw>]:BB:WLNN:SETTing:CATalog?

Reads out the files with IEEE 802.11a/b/g/n/ac settings in the default directory. The default directory is set using command MMEM:CDIRectory. Only files with the file extension *.wlann will be listed.

Return values:
<Catalog> string

Example: MMEM:CDIR '/var/user/temp/wlann'
Sets the default directory to /var/user/temp/wlann.
BB:WLNN:SETT:CAT?
Reads out all the files with IEEE 802.11 settings in the default directory.
Response: 'wlann_1','wlann_2'
The files "wlann1' and 'wlann2" are available.

Usage: Query only

Manual operation: See "Save/Recall" on page 18

[:SOURce<hw>]:BB:WLNN:SETTing:DELete <Filename>

Deletes the selected file with IIEEE 802.11a/b/g/n/ac settings. The directory is set using command MMEM:CDIRectory. A path can also be specified, in which case the files in the specified directory are read. The file extension may be omitted. Only files with the file extension *.wlann are listed and can be deleted.

Setting parameters:
<Filename> string

Example: BB:WLNN:SETT:DEL 'wlann_1'
Deletes file 'wlann_1'.

Usage: Setting only

Manual operation: See "Save/Recall" on page 18

[:SOURce<hw>]:BB:WLNN:SETTing:LOAD <Filename>

Loads the selected file with IEEE 802.11 WLAN settings. The directory is set using command MMEM:CDIRectory. A path can also be specified, in which case the files in the specified directory are read. The file extension may be omitted. Only files with the file extension *.wlann will be loaded.

Setting parameters:
<Filename> string

Example: `BB:WLNN:SETT:LOAD 'wlann_1'`
Loads file '`wlann_1`'.

Usage: Setting only

Manual operation: See "Save/Recall" on page 18

[:SOURce<hw>]:BB:WLNN:SETTing:STORe <Filename>

Saves the current IEEE 802.11a/b/g/n/ac settings into the selected file. The directory is set using command `MMEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. Only the file name has to be entered. IEEE 802.11a/b/g/n/ac/ax settings are saved as files with file extension `*.wlann`.

Setting parameters:
<Filename> string

Example: `:SOURce1:BB:WLNN:SETT:STOR 'wlann_1'`
Saves the current settings into file '`wlann_1`'.

Usage: Setting only

Manual operation: See "Save/Recall" on page 18

[:SOURce<hw>]:BB:WLNN:STATe <State>

Activates the standard and deactivates all the other digital standards and digital modulation modes in the same path.

Parameters:
<State> 0 | 1 | OFF | ON
*RST: 0

Example: `SOURce1:BB:WLNN:STATe ON`
Activates the standard.

Manual operation: See "State" on page 17

[:SOURce<hw>]:BB:WLNN:WAVeform:CREate <Filename>

Creates a waveform using the current settings of the "WLAN" menu. The file name is entered with the command. The file is saved with the predefined file extension `*.wv`. The file name and the directory it is saved in are user-definable.

Setting parameters:
<Filename> string

Example: `MMEM:CDIR '/var/user/temp/waveform'`
Sets the default directory to /var/user/temp/waveform.
`BB:WLNN:WAV:CRE 'wlann_1'`
Creates the waveform file `wlann_1.wv` in the default directory.

Usage: Setting only

Manual operation: See "Generate Waveform File" on page 19

6.3 Filter/Clipping Settings

[:SOURce<hw>]:BB:WLNN:CLIPping:LEVel....115
[:SOURce<hw>]:BB:WLNN:CLIPping:MODE....116
[:SOURce<hw>]:BB:WLNN:CLIPping:STATe....116
[:SOURce<hw>]:BB:WLNN:FILTer:DEFSetting:STATe....116
[:SOURce<hw>]:BB:WLNN:FILTer:IUPSampling....117
[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:APCO25....117
[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:COSine....117
[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:COSine:COFS....117
[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:GAUSs....118
[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:LPASs....118
[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:LPASSEVM....118
[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:PGAuss....119
[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:RCOSine....119
[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:SPHase....119
[:SOURce<hw>]:BB:WLNN:FILTer:TYPE....119
[:SOURce<hw>]:BB:WLNN:SRATe?....120
[:SOURce<hw>]:BB:WLNN:SRATe:VARiation....120

[:SOURce<hw>]:BB:WLNN:CLIPping:LEVel <Level>

Sets the limit for level clipping. This value indicates at what point the signal is clipped. It is specified as a percentage, relative to the highest level. 100% indicates that clipping does not take place.

Level clipping is activated if `[:SOURce<hw>]:BB:WLNN:CLIPping:STATe` is set to `ON`.

Parameters:

<Level> integer

Range: 1 PCT to 100 PCT
Increment: 1 PCT
*RST: 100 PCT

Example: `BB:WLNN:CLIP:LEV 80PCT`
Sets the limit for level clipping to 80% of the maximum level.
`BB:WLNN:CLIP:STAT ON`
Activates level clipping.

Manual operation: See "Clipping Level" on page 95

[:SOURce<hw>]:BB:WLNN:CLIPping:MODE <Mode>

Sets the method for level clipping.

Parameters:

<Mode> VECTor | SCALar

VECTor
The reference level is the amplitude | i+jq |.

SCALar
The reference level is the absolute maximum of the I and Q values.

*RST: VECTor

Example: `BB:WLNN:CLIP:MODE SCAL`
Selects the absolute maximum of all the I and Q values as the reference level.
`BB:WLNN:CLIP:LEV 80PCT`
Sets the limit for level clipping to 80% of this maximum level.
`BB:WLNN:CLIP:STAT ON`
Activates level clipping.

Manual operation: See "Clipping Mode" on page 96

[:SOURce<hw>]:BB:WLNN:CLIPping:STATe <State>

Activates level clipping (Clipping). The value is defined with `[:SOURce<hw>]:BB:WLNN:CLIPping:LEVel`, the mode of calculation with `[:SOURce<hw>]:BB:WLNN:CLIPping:MODE`.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `BB:WLNN:CLIP:STAT ON`
Activates level clipping.

Manual operation: See "Clipping State" on page 95

[:SOURce<hw>]:BB:WLNN:FILTer:DEFSetting:STATe <UseDefaultFilte>

Activates the WLAN default filter settings.

Parameters:

<UseDefaultFilte> 0 | 1 | OFF | ON

*RST: 1

Example: `SOURce1:BB:WLNN:FILTer:DEFSetting:STATe 1`
Activates the WLAN default filter settings.

Manual operation: See "Use Default Wlan Filter" on page 92

[:SOURce<hw>]:BB:WLNN:FILTer:IUPSampling <IFFTUpsampling>

Activates inverted Fast Fourier Transformation (IFFT) upsampling.

Parameters:

<IFFTUpsampling> 0 | 1 | OFF | ON
*RST: 1

Example: `SOURce1:BB:WLNN:FILTer:IUPSampling ON`
Activates IFFT upsampling.

Manual operation: See "IFFT Upsampling" on page 94

[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:APCO25 <Apco25>

Sets the roll-off factor for filter type APCO25.

Parameters:

<Apco25> float
Range: 0.05 to 0.99
Increment: 0.01
*RST: 0.2

Example: `BB:WLNN:PAR:APCO25 0.2`
Sets the roll-off factor to 0.2 for filter type APCO25.

Manual operation: See " Roll Off Factor or BxT " on page 92

[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:COSine <Cosine>

Sets the roll-off factor for the cosine filter type.

Parameters:

<Cosine> float
Range: 0 to 1
Increment: 0.01
*RST: 0.1

Example: `BB:WLNN:PAR:COS 0.35`
Sets the roll-off factor to 0.35 for filter type cosine.

Manual operation: See " Roll Off Factor or BxT " on page 92

[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:COSine:COFS <CoFs>

The command sets the "cut of frequency shift' value for the Cosine filter type.

Parameters:

<CoFs> float
Range: -1 to 1
Increment: 0.01
*RST: 0

Example: `BB:WLNN:FILT:PAR:COS:COFS 0.04`
the "cut of frequency shift" value is set to 0.04.

Manual operation: See " Cut Off Frequency Shift " on page 93

[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:GAUSs <Gauss>

Sets the roll-off factor for the Gauss filter type.

Parameters:
<Gauss> float

Range: 0.15 to 2.5
Increment: 0.01
*RST: 0.5

Example: `BB:WLNN:PAR:GAUS 0.5`
Sets B x T to 0.5 for the Gauss filter type.

Manual operation: See " Roll Off Factor or BxT " on page 92

[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:LPASs <LPass>

Sets the cut off frequency factor for the Lowpass (ACP optimization) filter type.

Parameters:
<LPass> float

Range: 0.05 to 2
Increment: 0.01
*RST: 0.5

Example: `BB:WLNN:FILT:PAR:LPAS 0.5`
The cut of frequency factor is set to 0.5.

Manual operation: See "Cut Off Frequency Factor" on page 93

[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:LPASSEVM <LPassevm>

Sets the cut off frequency factor for the Lowpass (EVM optimization) filter type.

Parameters:
<LPassevm> float

Range: 0.05 to 2
Increment: 0.01
*RST: 0.5

Example: `BB:WLNN:FILT:PAR:LPASSEVM 0.5`
The cut of frequency factor is set to 0.5.

Manual operation: See "Cut Off Frequency Factor" on page 93

[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:PGAuss <PGauss>

Sets the roll-off factor for the pure gauss filter type.

Parameters:

<PGauss> float

Range: 0.15 to 2.5
Increment: 0.01
*RST: 0.5

Example: `BB:WLLN:FILT:PAR:PGAUS 0.5`
Sets B x T to 0.5 for the pure gauss filter type.

Manual operation: See " Roll Off Factor or BxT " on page 92

[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:RCOSine <RCosine>

Sets the roll-off factor for the root cosine filter type.

Parameters:

<RCosine> float

Range: 0 to 1
Increment: 0.01
*RST: 0.22

Example: `BB:WLNN:PAR:RCOS 0.22`
Sets the roll-off factor to 0. 22 for filter type root cosine.

Manual operation: See " Roll Off Factor or BxT " on page 92

[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:SPHase <SPhase>

Sets B x T for the Split Phase filter type.

Parameters:

<SPhase> float

Range: 0.15 to 2.5
Increment: 0.01
*RST: 2

Example: `BB:WLNN:PAR:SPH 0.5`
Sets B x T to 0.5 for the Split Phase filter type.

Manual operation: See " Roll Off Factor or BxT " on page 92

[:SOURce<hw>]:BB:WLNN:FILTer:TYPE <Type>

The command selects the filter type.

Parameters:

<Type> RCOSine | COSine | GAUSs | LGAuss | CONE | COF705 | COEQualizer | COFequalizer | C2K3x | APCO25 | SPHase | RECTangle | PGAuss | LPASs | DIRac | ENPShape | EWPShape | LPASSEVM

*RST: Depends on layer mode

Example: `BB:WLNN:FILT:TYPE COS`
sets the filter type COSine.

Manual operation: See "Filter" on page 92

[:SOURce<hw>]:BB:WLNN:SRATe?

Displays the sample rate specific for the selected bandwidth (`[:SOURce<hw>]:BB:WLNN:BWidth`).

Return values:

<SampRate> float

20MHz for BW20, 60MHz for BW40.

Usage: Query only

Manual operation: See " Sample Rate " on page 19

[:SOURce<hw>]:BB:WLNN:SRATe:VARiation <Variation>

Sets the sample rate of the signal.

Parameters:

<Variation> float

Range: 400 to 40000000
Increment: 0.001
*RST: 20000000
Default unit: Hz (c/s)

Example: `BB:WLNN:SRAT:VAR 4000000`
Sets the output sample rate to 4 MHz.

Manual operation: See " Sample Rate Variation " on page 94

6.4 Trigger Settings

Example: Configure and enable triggering

```
SOURce1:BB:WLNN:TRIGger:SEQuence SINGle
SOURce1:BB:WLNN:TRIGger:SLENgth 200
// the first 200 samples of the current waveform will be output after
// the next trigger event


SOURce1:BB:WLNN:TRIGger:SOURce INTB
// the internal trigger signal from the other path must be used
SOURce1:BB:WLNN:TRIGger:OBASeband:DELay 25
SOURce1:BB:WLNN:TRIGger:OBASeband:INHibit 10

SOURce1:BB:WLNN:TRIGger:SOURce INT
SOURce1:BB:WLNN:TRIGger:SEQuence ARETrigger
SOURce1:BB:WLNN:STAT ON
SOURce1:BB:WLNN:TRIGger:EXEcute
// executes a trigger, signal generation starts
SOURce1:BB:WLNN:TRIGger:ARM:EXECute
// signal generation stops
SOURce1:BB:WLNN:TRIGger:EXEcute
// executes a trigger, signal generation starts again
```

Example: Specifying delay and inhibit values in time units

```
SOURce1:BB:WLNN:CLOCk 1000000
SOURce1:BB:WLNN:TRIGger:SEQuence AAUT
SOURce1:BB:WLNN:TRIGger:SOURce EGT1
// external trigger signal must be provided at the USER connector
// SOURce1:BB:WLNN:TRIGger:EXTernal:SYNChronize:OUTPut 1
SOURce1:BB:WLNN:TRIGger:DELay:UNIT SAMP
SOURce1:BB:WLNN:TRIGger:EXTernal:DELay 100
SOURce1:BB:WLNN:TRIGger:EXTernal:RDELay?
// Response: 100

SOURce1:BB:WLNN:TRIGger:DELay:UNIT TIME
SOURce1:BB:WLNN:TRIGger:EXTernal:TDELay 0.00001
SOURce1:BB:WLNN:TRIGger:EXTernal:RDELay?
// Response: 0.00001

SOURce1:BB:WLNN:TRIGger:DELay:UNIT SAMP
SOURce1:BB:WLNN:TRIGger:EXTernal:DELay 10
```

[:SOURce<hw>]:BB:WLNN:TRIGger:ARM:EXECute....122
[:SOURce<hw>]:BB:WLNN:TRIGger:EXECute....122
[:SOURce<hw>]:BB:WLNN:TRIGger:EXTernal:SYNChronize:OUTPut....122
[:SOURce<hw>]:BB:WLNN:TRIGger:OBASeband:DELay....123
[:SOURce<hw>]:BB:WLNN:TRIGger:OBASeband:INHibit....123

[:SOURce<hw>]:BB:WLNN:TRIGger:RMODe? 123
[:SOURce<hw>]:BB:WLNN:TRIGger:SLENgth 124
[:SOURce<hw>]:BB:WLNN:TRIGger:SLUNit 124
[:SOURce<hw>]:BB:WLNN:TRIGger:SOURce 125
[:SOURce<hw>]:BB:WLNN:TRIGger[:EXTernal]:DELay 125
[:SOURce<hw>]:BB:WLNN:TRIGger[:EXTernal]:INHibit 126
[:SOURce<hw>]:BB:WLNN[:TRIGger]:SEQuence 126

[:SOURce<hw>]:BB:WLNN:TRIGger:ARM:EXECute

Stops signal generation for trigger modes armed auto and armed retrigger. A subsequent internal or external trigger event restart signal generation.

Example: See Example "Configure and enable triggering" on page 121

Usage: Event

Manual operation: See "Arm" on page 98

[:SOURce<hw>]:BB:WLNN:TRIGger:EXECute

Executes a trigger. The internal trigger source must be selected using the command `BB:WLNN:TRIG:SOUR INT` and a trigger mode other than AUTO must be selected using the command `[:SOURce<hw>]:BB:WLNN[:TRIGger]:SEQuence`.

Example:
```
BB:WLNN:TRIG:SOUR INT
```
Sets internal triggering.
```
BB:WLNN:TRIG:SEQ RETR
```
Sets retrigger mode, i.e. every trigger event causes signal generation to restart.
```
BB:WLNN:TRIG:EXEC
```
Executes a trigger.

Usage: Event

Manual operation: See "Execute Trigger" on page 98

[:SOURce<hw>]:BB:WLNN:TRIGger:EXTernal:SYNChronize:OUTPut <Output>

Enables signal output synchronous to the trigger event.

Parameters:

<Output> 0 | 1 | OFF | ON

OFF

*RST: 1

Example:
```
BB:WLNN:TRIG:SOUR EGT1
```
Sets external triggering.
```
BB:WLNN:TRIG:EXT:SYNC:OUTP ON
```
Enables synchronous output to external trigger.

Manual operation: See "Sync. Output to External Trigger/Sync. Output to Trigger" on page 99

[:SOURce<hw>]:BB:WLNN:TRIGger:OBASeband:DELay <Delay>

Specifies the trigger delay (expressed as a number of samples) for triggering by the trigger signal from the second path.

Parameters:

<Delay> float

Range: 0 to 2147483647
Increment: 0.01
*RST: 0

Example: `BB:WLNN:TRIG:SOUR INTB`
The internal trigger signal from the other path must be used
`BB:WLNN:TRIG:INH 200`
Sets a restart inhibit for 200 samples following a trigger event.

Manual operation: See "Trigger Delay" on page 100

[:SOURce<hw>]:BB:WLNN:TRIGger:OBASeband:INHibit <Inhibit>

Specifies the number of samples by which a restart is to be inhibited following a trigger event. This command applies only for triggering by the second path.

Parameters:

<Inhibit> integer

Range: 0 to 67108863
*RST: 0

Example: `BB:WLNN:TRIG:SOUR INTB`
the internal trigger signal from the other path must be used.
`BB:WLNN:TRIG:OBAS:INH 200`
sets a restart inhibit for 200 samples following a trigger event.

Manual operation: See "External Trigger Inhibit" on page 100

[:SOURce<hw>]:BB:WLNN:TRIGger:RMODe?

The command queries the current status of signal generation for all trigger modes with IEEE 802.11 WLAN modulation on.

Return values:

<RMode> RUN | STOP

RUN
the signal is generated. A trigger event occurred in the triggered mode.

STOP
the signal is not generated. A trigger event did not occur in the triggered modes, or signal generation was stopped by the command `:BB:WLNN:TRIG:ARM:EXECute` (armed trigger modes only).

Example: `BB:WLNN:TRIG:SOUR EGT1`
sets external triggering.
`BB:WLNN:TRIG:MODE ARET`
selects the Armed_Retrigger mode.
`BB:WLNN:TRIG:RMOD?`
queries the current status of signal generation.
`Response: RUN`
the signal is generated, an external trigger was executed.

Usage: Query only

Manual operation: See "Running/Stopped" on page 98

[:SOURce<hw>]:BB:WLNN:TRIGger:SLENgth <Slength>

The command defines the length of the signal sequence to be output in the "Single" trigger mode (`[:SOURce<hw>]:BB:WLNN[:TRIGger]:SEQuence` is set to `SING`). The input is made in terms of samples.

It is possible to output deliberately just part of the frame, an exact sequence of the frame, or a defined number of repetitions of the frame.

Parameters:

<Slength> integer

Range: 1 to (2^32) - 1
*RST: 1
Default unit: sample

Example: `BB:WLNN:SEQ SING`
Sets trigger mode single.
`BB:WLNN:TRIG:SLEN 200`
Sets a sequence length of 200 samples. The first 200 samples of the current frame will be output after the next trigger event.

Manual operation: See "Trigger Signal Duration" on page 98

[:SOURce<hw>]:BB:WLNN:TRIGger:SLUNit <Slunit>

Defines the unit for the entry of the length of the signal sequence (`[:SOURce<hw>]:BB:WLNN:TRIGger:SLENgth`) to be output in the single trigger mode (`[:SOURce<hw>]:BB:WLNN[:TRIGger]:SEQuence` is set to `SINGle`).

Parameters:

<Slunit> SAMPle | SEQuence

SAMPle
Unit Sample. A single sample is generated after a trigger event.

SEQuence
Unit Sequence Length. A single sequence is generated after a trigger event.

*RST: SEQuence

Example: `BB:WLNN:SEQ SING`
Sets trigger mode single.
`BB:WLNN:TRIG:SLUN SEQ`
Sets unit sequence for the entry of sequence length.
`BB:WLNN:TRIG:SLEN 2`
Sets a sequence length of 2 sequences. Two sequences will be output after the next trigger event.

Manual operation: See "Signal Duration Unit" on page 98

[:SOURce<hw>]:BB:WLNN:TRIGger:SOURce <Source>

Selects the trigger signal source and determines the way the triggering is executed. Provided are:

- Internal triggering by a command (`INTernal`)
- External trigger signal via one of the local or global connectors
  - `EGT1|EGT2`: External global trigger
  - `EGC1|EGC2`: External global clock
  - `ELTRigger`: External local trigger
  - `ELCLock`: External local clock
- Internal triggering by a signal from the other basebands (`INTA|INTB`)
- In master-slave mode, the external baseband synchronization signal (`BBSY`)
- `OBASeband|BEXTernal|EXTernal`: Setting only
  Provided only for backward compatibility with other Rohde & Schwarz signal generators.
  The R&S SMW accepts these values and maps them automatically as follows:
  `EXTernal = EGT1, BEXTernal = EGT2, OBASeband = INTA or INTB`
  (depending on the current baseband)

Parameters:

<Source> INTB|INTernal|OBASeband|EGT1|EGT2|EGC1|EGC2|ELTRigger|INTA|ELCLock|BEXTernal|EXTernal | BBSY

*RST: INTernal

Example: See Example "Configure and enable triggering" on page 121.

Options: ELTRigger|ELCLock require R&S SMW-B10
BBSY require R&S SMW-B9

Manual operation: See "Trigger Source" on page 99

[:SOURce<hw>]:BB:WLNN:TRIGger[:EXTernal]:DELay <Delay>

Sets the trigger delay.

Parameters:

<Delay> float

Range: 0 to 2147483647
Increment: 0.01
*RST: 0
Default unit: samples

Example: See Example "Configure and enable triggering" on page 121.

Manual operation: See "Trigger Delay" on page 100

[:SOURce<hw>]:BB:WLNN:TRIGger[:EXTernal]:INHibit <Inhibit>

Specifies the number of samples by which a restart is to be inhibited following an external trigger event.

Parameters:

<Inhibit> integer

Range: 0 to 21.47*sampRate
*RST: 0

Example: See Example "Configure and enable triggering" on page 121.

Manual operation: See "External Trigger Inhibit" on page 100

[:SOURce<hw>]:BB:WLNN[:TRIGger]:SEQuence <Sequence>

Selects the trigger mode:

- `AUTO` = auto
- `RETRigger` = retrigger
- `AAUTo` = armed auto
- `ARETrigger` = armed retrigger
- `SINGle` = single

Parameters:

<Sequence> AUTO | RETRigger | AAUTo | ARETrigger | SINGle

*RST: AUTO

Example: `BB:WLNN:SEQ AAUT`
Sets the Armed_auto trigger mode; the device waits for the first trigger (e.g. with *TRG) and then generates the signal continuously.

Manual operation: See "Trigger Mode" on page 97

6.5 Marker Settings

[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:MODE 127
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:ONTime 128
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:OFFTime 128
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:FBINdex 128
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:FINDex 129
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:FESHift 129
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:RESHift 129
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:PATTern 130
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:PULSe:DIVider 130
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:PULSe:FREQuency? 130
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:DELay 131

[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:MODE <Mode>

Defines the signal for the selected marker output.

Parameters:

<Mode> RESTart | FBLock | FRAMe | FAPart | PULSe | PATTern | RATio | FIPart

RESTart
A marker signal is generated at the start of each signal sequence (period = all frame blocks).

FRAMe
Number of Frame Blocks = 1, that is, a marker signal is generated at the start of each frame in the single frame block. Otherwise, the frame block and frame index are entered and the specific frame is masked.

FBLock
Number of Frame Blocks = 1, that is, a marker signal is generated at the start of each frame block. Otherwise, a specific frame block index is given and the whole frame block is marked.

FAPart
Number of Frame Blocks = 1, that is, a marker signal is generated to mark every active part of each frame.
The active data transfer part (PPDU) of a frame period is marked with high, the inactive part (idle time) with low. This marker can be used to decrease the carrier leakage during inactive signal parts by feeding it into the pulse modulator.
Otherwise, the frame block and frame index are entered and the active part of the specific frame is masked.

PATTern
A marker signal is generated according to the user defined pattern (command `SOURce:BB:WLNN:TRIGger:OUTPut:PATTern`).

PULSe
A pulsed marker signal is generated. The pulse frequency (= symbol rate/divider) is defined with the `SOUR:BB:WLNN:TRIG:OUTP:PULSe:DIVider` command and can be queried with the `SOUR:BB:WLNN:TRIG:OUTP:PULSe:FREQuency?` command.

RATio
A marker signal corresponding to the Time Off / Time On specifications in the commands `SOURce:BB:WLNN:TRIGger:OUTPut:OFFT` and "SOURce:BB:WLNN:TRIGger:OUTPut:ONT" is generated.

*RST: RESTart

Example: `BB:WLNN:TRIG:OUTP:MODE FRAM`
selects the frame marker for the corresponding marker signal.

Manual operation: See "Marker Mode" on page 101

[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:ONTime <OnTime>
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:OFFTime <OffTime>

Sets the duration during which the marker output is on or off.

*) If R&S SMW-B9 is installed, the minimum marker duration depends on the sample/symbol rate.

See chapter "Basics on ..." in the R&S SMW user manual.

Parameters:
<OffTime> integer

Range: 1 (R&S SMW-B10) / 1* (R&S SMW-B9) to 16777215
*RST: 1

Example: `BB:WLNN:TRIG:OUTP:OFFT 200`

Manual operation: See "Marker Mode" on page 101

[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:FBINdex <FbIndex>

Sets the frame block index. For this/these frame block(s), a marker signal is generated. The maximum value depends on the number of the currently active frame blocks (max = 100).

Parameters:
<FbIndex> integer

Range: 0 to 100
Increment: 1
*RST: 1

Example: `BB:WLNN:TRIG:OUTP1:FBIN 5`
Sets the frame block index to 5.

Manual operation: See "Marker Mode" on page 101

[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:FINDex <FIndex>

Sets the frame index, that is, the frame to be marked in the frame block marked with `[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:FBINdex`. The maximum value depends on the number of frames set with command `[:SOURce<hw>]:BB:WLNN:FBLock<ch>:FCOunt` . The maximum value is 1024.

Parameters:

<FIndex> integer

Range: 1 to 1024
Increment: 1
*RST: 1

Example: `BB:WLNN:TRIG:OUTP1:FIND 100`
Sets the frame index to 100.

Manual operation: See "Marker Mode" on page 101

[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:FESHift <Shift>

Shifts the falling edge of the marker the specified number of samples. Negative values result in a shift back of the marker edge.

Parameters:

<Shift> integer

Range: -1000 to 1000
*RST: 0

Example: `BB:WLNN:TRIG:OUTP2:FESH 75`
shifts the falling edge of the marker 2 about 75 samples.

Manual operation: See "Marker Mode" on page 101

[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:RESHift <Shift>

Shifts the rising edge of the marker the specified number of samples. Negative values result in a shift back of the marker edge.

Parameters:

<Shift> integer

Range: -1000 to 1000
*RST: 0

Example: `BB:WLNN:TRIG:OUTP2:RESH -20`
shifts back the rising edge of marker 2 about 20 samples.

Manual operation: See "Marker Mode" on page 101

[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:PATTern <Pattern>

Defines the bit pattern used to generate the marker signal if `[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:MODE` is set to `PATTern`.

Parameters:

<Pattern> 64 bits

0 = marker off, 1 = marker on

*RST: #H2,2

Example: `BB:WLNN:TRIG:OUTP2:PATT #B000000011111111,15`

Sets a bit pattern.

`BB:WLNN:TRIG:OUTP:MODE PATT`

Activates the marker signal according to a bit pattern for the corresponding marker signal.

Manual operation: See "Marker Mode" on page 101

[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:PULSe:DIVider <Divider>

Sets the divider for the pulsed marker signal.

*) If R&S SMW-B9 is installed, the minimum marker duration depends on the sample/symbol rate.

See chapter "Basics on ..." in the R&S SMW user manual.

Parameters:

<Divider> integer

Range: 2 (R&S SMW-B10) / 2* (R&S SMW-B9) to 1024
Increment: 1
*RST: 2

Example: `BB:WLNN:TRIG:OUTP:PULS:DIV 2`

Sets the divider to 2 for the corresponding marker signal.

`BB:WLNN:TRIG:OUTP2:FREQ?`

Queries the resulting pulse frequency of the marker signal.

`Response: 66 000`

The resulting pulse frequency is 66 kHz.

Manual operation: See "Marker Mode" on page 101

[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:PULSe:FREQuency?

Queries the pulse frequency of the pulsed marker signal (`[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:MODE PULSe`). The pulse frequency is derived by dividing the symbol rate by the divider.

Return values:

<Frequency> float

Range: 0.0 to max

Example: `BB:WLNN:TRIG:OUTP:PULS:DIV 2`
Sets the divider marker signal of the corresponding marker signal to the value 2.
`BB:WLNN:TRIG:OUTP:MODE PULS`
Enables the pulsed marker signal.
`BB:WLNN:TRIG:OUTP:PULS:FREQ?`
Queries the pulse frequency of the marker signal.
`Response: 33 000`
The resulting pulse frequency is 33 kHz.

Usage: Query only

Manual operation: See "Marker Mode" on page 101

[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:DELay <Delay>

Defines the delay between the signal on the marker outputs and the start of the signals.

Parameters:
<Delay> float
Range: 0 to 16777215
Increment: 0.001
*RST: 0

Example: `BB:WLNN:TRIG:OUTP:DEL 1600`
Sets a delay of 1600 samples for the corresponding marker signal.

Manual operation: See "Marker x Delay" on page 104

6.6 Clock Settings

[:SOURce<hw>]:BB:WLNN:CLOCk:MODE 131
[:SOURce<hw>]:BB:WLNN:CLOCk:SOURce 132

[:SOURce<hw>]:BB:WLNN:CLOCk:MODE <Mode>

Sets the type of externally supplied clock.

Parameters:
<Mode> SAMPle | MSAMple
*RST: SAMPle

Example: `SOURce1:BB:WLNN:CLOCk:MODE SAMPle`
Selects clock type

Options: R&S SMW-B10

Manual operation: See "Clock Mode" on page 105

[:SOURce<hw>]:BB:WLNN:CLOCk:SOURce <Source>

Selects the clock source.

Parameters:

<Source> INTernal|ELCLock|EXTernal
*RST: INTernal

Example: `BB:WLNN:CLOC:SOUR INT`
Selects an internal clock reference.

Options: ELCLock requires R&S SMW-B10

Manual operation: See "Clock Source" on page 105

6.7 Antenna Configuration Settings

[:SOURce<hw>]:BB:WLNN:ANTenna:CMODe?....132
[:SOURce<hw>]:BB:WLNN:ANTenna:MODE....132
[:SOURce<hw>]:BB:WLNN:ANTenna:NOBB?....133
[:SOURce<hw>]:BB:WLNN:ANTenna:SYSTem....133
[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:OUTPut:DESTination....133
[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:OUTPut:FSELect....134
[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:TX<dir>:REAL....134
[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:TX<dir>:IMAGinary....134
[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:TX<dir>:PHASe....134
[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:TX<dir>:MAGNitude....135

[:SOURce<hw>]:BB:WLNN:ANTenna:CMODe?

Queries the coupling state of transmit antennas.

If enabled, the transmit antennas are coupled, i.e. they transmit the same frame blocks data.

Return values:

<CMODe> 0 | 1 | OFF | ON
*RST: 0

Usage: Query only

[:SOURce<hw>]:BB:WLNN:ANTenna:MODE <Mode>

The command selects the number of transmit antennas to be used.

Parameters:

<Mode> A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8
*RST: A1

Example: `BB:WLNN:ANT:MODE A1`
one antenna is used for transmission.

Manual operation: See " Antennas " on page 20

[:SOURce<hw>]:BB:WLNN:ANTenna:NOBB?

Queries the number of basebands required for the transmit antenna setup.

Return values:
<NOBB> NBB1 | NBB2 | NBB4 | NBB3 | NBB8
*RST: NBB1

Usage: Query only

[:SOURce<hw>]:BB:WLNN:ANTenna:SYSTem <System>

Selects the coordinate system of the transmission chain matrix.

Parameters:
<System> CARTesian | CYLindrical
*RST: CARTesian

Example: `BB:WLNN:ANT:SYST CART`
Sets the coordinate system of the transmission chain matrix to Cartesian.

Manual operation: See " Mapping Coordinates " on page 20

[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:OUTPut:DESTination <Destination>

Selects the destination of the calculated IQ chains.

Parameters:
<Destination> OFF | BB | BB_B | FILE

OFF
No mapping takes place.

BB
The IQ chain is output to the baseband A. Exactly one output stream can be mapped as "Baseband A".

BB_B
The IQ chain is output to the baseband B. Exactly one output stream can be mapped as "Baseband B".

FILE
The IQ chain is saved in a file.

*RST: OFF (for antenna 2 .. 8); Baseband (for antenna 1)

Example: `BB:WLNN:ANT:TCH1:OUTP:DEST BB`
The IQ chain is saved in a file.

Manual operation: See " Output " on page 21

[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:OUTPut:FSELect <FSelect>

The command saves the IQ chain in a file.

Parameters:

<FSelect> string

Example: `BB:WLNN:ANT:TCH1:OUTP:FSEL '/var/user/temp/wlnn_1.wv'`
saves the IQ chain in the selected file.

Manual operation: See " Output " on page 21

[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:TX<dir>:REAL <Real>

Sets the value for the Real coordinate.

Parameters:

<Real> float

Range: -1000 to 1000
Increment: 0.01

Example: `BB:WLNN:ANT:TCH1:TX2:REAL 500`
sets the real coordinate for the selected transmission chain to 500.

Manual operation: See " Real/Magnitude " on page 21

[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:TX<dir>:IMAGinary <Imaginary>

Sets the value for the Imaginary coordinate.

Parameters:

<Imaginary> float

Range: -999.99 to 999.99
Increment: 0.01
*RST: 0

Example: `BB:WLNN:ANT:TCH1:TX2:IMAG 500`
sets the imaginary coordinate for the selected transmission chain to 500.

Manual operation: See " Imaginary/Phase " on page 21

[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:TX<dir>:PHASe <Phase>

Sets the phase when cylindrical mapping coordinates are selected.

Parameters:

<Phase> float

Range: 0 to 359.99
Increment: 0.01
*RST: 0

Example: `:BB:WLNN:ANT:TCH1:TX1:PHAS 10`
Sets the phase to 10°.

Manual operation: See " Imaginary/Phase " on page 21

[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:TX<dir>:MAGNitude
<Magnitude>

Sets the magnitude when cylindrical mapping coordinates are selected.

Parameters:

<Magnitude> float

Range: 0 to 999.99
Increment: 0.01
*RST: 0

Example: `:BB:WLNN:ANT:TCH1:TX1:MAGN 100`
Sets the magnitude to 100.

Manual operation: See " Real/Magnitude " on page 21

6.8 Frame Block Configuration

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[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BCSMoothing <BCSmoothing>

Activates beam change and smoothing.

Parameters:

<BCSmoothing> 0 | 1 | OFF | ON
*RST: 1

Example: `SOURce1:BB:WLNN:FBL1:BCSMoothing 1`

Example: Beam change and smoothing is activated.

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BOOSt <Boost>

Assigns a specific RMS power boost/attenuation to the corresponding frame block modulation.

The power level of a frame block modulation is calculated as sum of the power boost and the power level set in the header of the instrument.

Note: At least one frame block should have a power boost set to 0 dB value for this gated power mode functionality to work properly.

Parameters:

<Boost> float
Range: -80 to 0
Increment: 0.01
*RST: 0
Default unit: dB

Example: `BB:WLNN:FBL5:BOOS -10.0`
Sets the power boost

Manual operation: See " Boost /dB" on page 27

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:FCOunt <FCount>

Sets the number of frames to be transmitted in the current frame block.

Parameters:

<FCount> integer
Range: 1 to 20 000
Increment: 1
*RST: 1

Example: `BB:WLNN:FBL5:FCO 1`
Sets the number of transmitted frames in the current frame block to 1.

Manual operation: See " Frames" on page 26

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DATA <Data>

Selects the data source.

Parameters:

<Data> ZERO | ONE | PATTern | PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | AMPDU

PNxx
The pseudo-random sequence generator is used as the data source. Different random sequence lengths can be selected.

DLISt
A data list is used. The data list is selected with the command `BB:WLNN:FBLocks:DATA:DSEL`

ZERO | ONE
Internal 0 and 1 data is used.

PATTern
Internal data is used. The bit pattern for the data is defined by the command `BB:WLNN:FBLocks:DATA:PATTern`.

AMPDU
Aggregated mac protocol data unit (A-MPDU) data is used as configured with the commands in Chapter 6.9.4, "MPDU Configuration", on page 166

*RST: PN9

Example: `BB:WLNN:FBL5:DATA PN9`
sets PN9 as the data source.

Manual operation: See " Data" on page 27

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DATA:DSELection <DSelection>

Selects the data list for the `DLISt` data source selection.

The lists are saved as files with the fixed file extensions `*.dm_iqd` in a directory of the user's choice. The directory applicable to the following commands is defined with the command `MMEMory:CDIR`. To access the files in this directory, you only have to give the file name without the path and the file extension.

Parameters:

<DSelection> string

Example: `BB:WLNN:FBL5:DATA DLIS`
Selects the data lists data source.
`MMEM:CDIR '/var/user/temp/Lists_DM'`
Selects the directory for the data lists.
`BB:WLNN:FBL5:DATA:DSEL 'dlist1'`
Selects file '`dlist1`' as the data source. This file must be in the directory `/var/user/temp/Lists_DM` and have the file extension `*.dm_iqd`.

Manual operation: See " Data" on page 27

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DATA:PATTern <Pattern>

Determines the bit pattern for the `PATTern` selection. The maximum length is 64 bits.

Parameters:

<Pattern> 64 bits

*RST: #H0,1

Example: `BB:WLNN:FBL5:DATA:PATT #H3F,8`
Sets the bit pattern.

Manual operation: See " Data" on page 27

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DATA:RATE?

The command queries the PPDU data rate.

Return values:

<Rate> float

Example: `BB:WLNN:FBL5:DATA:RATE?`
queries the data rate.

Usage: Query only

Manual operation: See " Data Rate /Mbps" on page 28

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:ITIMe <ITime>

Sets the time interval separating two frames in this frame block. The default unit for the time interval are seconds. However, the time interval can be set in milliseconds. In this case the unit has to be set.

Parameters:

<ITime> float

Range: 0 to 1
Increment: 100E-6
*RST: 100E-6

Example: `BB:WLNN:FBL5:ITIMe 0.0025`
sets the idle time to 2.5 msec.

Manual operation: See " Idle Time /ms" on page 26

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PMODe <PMode>

Selects the preamble design.

For physical type SOUNDING, only GREEN FIELD is available.

Parameters:

<PMode> LEGacy | MIXed | GFIeld

LEGacy
Compatible with 802.11 a/g OFDM devices.

MIXed
For High Throughput (HT) and 802.11a/g OFDM devices.

GFIeld
For HT only networks.

*RST: MIXed

Example: `BB:WLNN:FBL5:PMOD LEG`
Sets the physical mode to LEGACY.

Manual operation: See " Physical Mode" on page 24

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:STANdard <Standard>

Sets the IEEE 802.11 WLAN standard.

Parameters:
<Standard> USER | WAG | WBG | WPJ | WN | WAC | WAX | WBE

USER
Sets a user defined standard.

WAG
Sets the IEEE 802.11a/g standard.

WBG
Sets the IEEE 802.11b/g standard.

WPJ
Sets the IEEE 802.11p/j standard.

WN
Sets the IEEE 802.11n standard.

WAC
Sets the IEEE 802.11a/c standard.

WAX
Sets the IEEE 802.11ax standard.

WBE
Sets the IEEE 802.11be standard.

*RST: USER

Example: `:SOURce1:BB:WLNN:FBL1:STAN WN`
Sets the IEEE 802.11n standard

Manual operation: See "Std." on page 22

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:STATe <State>

Enables the corresponding frame block for transmission.

Parameters:
<State> 0 | 1 | OFF | ON

*RST: ON

Example: `BB:WLNN:FBL5:STAT ON`
Enables frame block 5 for transmission.

Manual operation: See " State" on page 28

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:TMODe <TMode>

Sets the Tx mode. The available Tx modes are dependent on the physical mode.

Parameters:

<TMode> L20 | LDUP | LUP | LLOW | HT20 | HT40 | HTDup | HTUP | HTLow | CCK | PBCC | V20 | V40 | V80 | V160 | V8080 | L10 | S1 | S2 | S4 | S16 | HE20 | HE40 | HE80 | HE8080 | HE160 | EHT320 | L20 | LDUP | LUP | LLOW | HT20 | HT40 | HTDup | HTUP | HTLow | CCK | PBCC | V20 | V40 | V80 | V160 | V8080 | L10 | S1 | S2 | S4 | S16 | HE20 | HE40 | HE80 | HE8080 | HE160 | EHT320

*RST: HT20

Example: `BB:WLNN:FBL5:TMOD HT40`
Sets the Tx mode to HT 40 MHz.

Manual operation: See " Tx Mode" on page 24

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:TYPE <Type>

The command selects the PPDU type.

Parameters:

<Type> DATA | SOUNding | BEACon | TRIGger

DATA
Only Data Long Training Fields are used to probe the channel.

SOUNding
Staggered preambles are used to probe additional dimension of the MIMO channel. Only Physical Layer Mode GREEN FIELD is available.

BEACon
Frame type "Beacon" is used to probe the channel.

*RST: DATA

Example: `BB:WLNN:FBL5:TYPE DATA`
sets the PPDU type data.

Manual operation: See " Type" on page 23

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:COPY

Copies the specified frame block.

Usage: Event

Manual operation: See " Copy" on page 28

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DELete

Deletes the specified frame block.

Usage: Event

Manual operation: See " Delete" on page 28

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:INSert

The command adds a default frame block before the selected frame block.

Example: `BB:WLNN:FBL2:INS`
inserts a default frame block before the selected frame block.

Usage: Event

Manual operation: See " Insert" on page 28

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PASTe

Pastes the copied frame block behind the selected frame block.

Usage: Event

Manual operation: See " Paste" on page 28

[:SOURce<hw>]:BB:WLNN:FBLock:APPend

Appends a frame block to the end of the frame blocks list.

Example: `BB:WLNN:FBL:APP`

Usage: Event

Manual operation: See " Append" on page 28

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[:SOURce<hw>]:BB:WLNN:FBLock<ch>:CBINonht <CBINonht>

(Available only for VHT Tx mode)

The command is used to modify the first 7 bits of the scrambling sequence to indicate the duplicated bandwidth of the PPDU.

Parameters:

<CBINonht> B20 | B40 | B80 | B160 | OFF

B20|B40|B80|B160
Indicates 20 MHz, 40MHz, 80MHz or 160 (80+80) MHz channel bandwidth of the transmitted packet.

OFF
Channel bandwidth in Non HT is not present.

*RST: OFF
Default unit: MHz

Example: `BB:WLNN:FBL1:CBIN B80`
Selects 80 MHz channel bandwidth of the transmitted packet.

Manual operation: See " Ch. Bandwidth in Non HT " on page 46

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:CODing:ENCoder?
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:CODing:ENCoder?

Queries the number of encoders to be used. This value depends on the data rate. For data rate ≤ 300 Mps, this value is 1. Otherwise the number of encoders is 2.

Return values:

<Encoder> E1 | E2 | E3 | E6 | E7 | E8 | E9 | E12 | E4 | E5 | E10 | E11

Example: `BB:WLNN:FBL5:COD:ENC?`
queries the number of encoders to be used.

Usage: Query only

Manual operation: See " Encoders" on page 33

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:CODing:RATE <Rate>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:CODing:RATE <Rate>

This command selects the coding rate.

Parameters:
<Rate> CR1D2 | CR2D3 | CR3D4 | CR5D6
*RST: CR1D2

Example: `BB:WLNN:FBL5:COD:RATE CR1D2`
sets the coding rate to CR1D2.

Manual operation: See " Cod Rate" on page 33

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:CODing:TYPE <Type>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:CODing:TYPE <Type>

Selects the channel coding.

Parameters:
<Type> OFF | BCC | LDPC
*RST: BCC

Example: `BB:WLNN:FBL5:COD:TYPE OFF`
no channel coding is used.

Manual operation: See " Channel Coding" on page 33

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:USER<di>:DCM <DCM>

Enables dual carrier modulation.

Parameters:
<DCM> 0 | 1 | OFF | ON
*RST: 0

Manual operation: See " DCM" on page 33

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:DATA:BPSymbol?
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DATA:BPSymbol?

Queries the number of data bits sent by an OFDM symbol on all spatial streams.

Return values:
<BpSymbol> integer
*RST: 0

Example: `BB:WLNN:FBL5:DATA:BPS?`
queries the number of data bits sent by an OFDM symbol on all spatial streams.

Usage: Query only

Manual operation: See " Data Bits Per Symbol" on page 32

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DATA:DCYCle?

Queries the duty cycle, i.e. the ratio of frame duration and total signal length.

Frame duration and duty cycle are related to data length and number of data symbols. Whenever one of them changes, the frame duration and duty cycle are updated.

Return values:

<DutyCycle> float

Range: 0.1 to 1
Increment: 0.0001
*RST: 0.1

Example:
```
SOURce1:BB:WLNN:FBLock1:DATA:DCYCle?
Response: 1
```
The frame duration and the total signal length are equal.

Usage: Query only

Manual operation: See "Duty Cycle" on page 47

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DATA:FDURation?

Queries the duration of the frame in milliseconds, i.e. the WLAN burst length.

Frame duration and duty cycle are related to data length and number of data symbols. Whenever one of them changes, the frame duration and duty cycle are updated.

Return values:

<FrameDuration> float

Range: 0 to 1000
Increment: 0.0001
*RST: 0.1

Example:
```
SOURce1:BB:WLNN:FBLock1:DATA:FDURation?
Response: 0.676
```
The WLAN burst has a length of 0.676 ms.

Usage: Query only

Manual operation: See "Frame Duration" on page 46

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:DATA:LENGth <Length>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DATA:LENGth <Length>

The command enters the size of the data field in bytes.

For Data Length = 0, no data field will be generated for the case of a sounding frame.

The maximum data length depends on the physical mode: In LEGACY mode, the maximum value is 4061 Bytes. In MIXED MODE and GREEN FIELD, the maximum value is 65495 Bytes.

The data length is related to the number of data symbols. Whenever the data length changes, the number of data symbols is updated and vice versa.

Parameters:

<Length> integer

Range: 0 to Max
*RST: 1024 (for LEGACY); 1048575 (for GREEN FIELD or MIXED MODE)

Example: `BB:WLNN:FBL5:DATA:LENG 500`
sets the data length to 500 Bytes.

Manual operation: See " Data Length " on page 45

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:DATA:RATE?
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DATA:RATE?

The command queries the PPDU data rate.

Return values:

<Rate> float

Example: `BB:WLNN:FBL5:DATA:RATE?`
queries the data rate.

Usage: Query only

Manual operation: See " Data Rate /Mbps" on page 28

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:DATA:SYMBols <Symbols>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DATA:SYMBols <Symbols>

Sets the number of data symbols per frame block.

If the number of OFDM data symbols is changed, the generator calculates the data field length as a function of the set PPDU bit rate and displays it at Data Length.

Parameters:

<Symbols> integer

Range: 1 to Max
*RST: 158

Example: `BB:WLNN:FBL5:DATA:SYMB 1`
sets the number of data symbols per frame block to 1.

Manual operation: See " Number Of Data Symbols " on page 47

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DBINonht <DBINonht>

(available only for VHT Tx mode)

Modifys the first 7 bits of the scrambling sequence to indicate if the transmitter is capable of "Static" or "Dynamic" bandwidth operation.

Parameters:

<DBINonht> STAT | DYN | OFF

STAT
The transmitter is capable of static bandwidth operation.

DYN
The transmitter is capable of dynamic bandwidth operation.

OFF
Dynamic bandwidth in Non HT is not present.

*RST: OFF

Example: `BB:WLNN:FBL1:DBIN DYN`
The transmitter is capable of dynamic bandwidth operation.

Manual operation: See " Dyn. Bandwidth in Non HT " on page 48

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:DPNSeed:STATe <DefaultPNSeed>

Activates the default PN seed. The seed is used initially to generate the pseudo-random noise sequence.

Parameters:
<DefaultPNSeed> 0 | 1 | OFF | ON
*RST: 1

Example: See `[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:PNSeed` on page 151.

Manual operation: See "Default PN Seed" on page 47

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:ESSTream <EsStream>

Sets the value of the extended spatial streams. This field is active for frame block type sounding only to probe additional dimensions to the channel.

Parameters:
<EsStream> integer
Range: 1 to dynamic
Increment: 1
*RST: 1

Example: `BB:WLNN:FBL5:ESSTR 4`
Sets the number of the extended spatial streams to 4.

Manual operation: See " Extended Spatial Streams" on page 30

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:GUARd <Guard>

Selects which guard interval is used for the OFDM guard.

In physical mode green field or legacy, only long guard intervals are possible. In this case, the field is read-only.

`GD08`, `GD16` and `GD32` are available only for the IEEE 802.11ax standard.

Parameters:

<Guard> SHORt | LONG | GD08 | GD16 | GD32

*RST: LONG

Example: `BB:WLNN:FBL5:GUAR LONG`
Sets a long guard interval.

Manual operation: See " Guard " on page 33

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:ILEaver:STATe <State>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:ILEaver:STATe <State>

The command activates/deactivates the interleaver of the data field.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: ON

Example: `BB:WLNN:FBL5:ILE:STAT ON`
activates the interleaver.

Manual operation: See " Interleaver Active " on page 47

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MCS <MCS>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MCS <MCS>

Selects the modulation and coding scheme for the spatial streams.

Parameters:

<MCS> MCS0 | MCS1 | MCS2 | MCS3 | MCS4 | MCS5 | MCS6 | MCS7 | MCS8 | MCS9 | MCS10 | MCS11 | MCS12 | MCS13 | MCS14 | MCS15 | MCS16 | MCS17 | MCS18 | MCS19 | MCS20 | MCS21 | MCS22 | MCS23 | MCS24 | MCS25 | MCS26 | MCS27 | MCS28 | MCS29 | MCS30 | MCS31 | MCS32 | MCS33 | MCS34 | MCS35 | MCS36 | MCS37 | MCS38 | MCS39 | MCS40 | MCS41 | MCS42 | MCS43 | MCS44 | MCS45 | MCS46 | MCS47 | MCS48 | MCS49 | MCS50 | MCS51 | MCS52 | MCS53 | MCS54 | MCS55 | MCS56 | MCS57 | MCS58 | MCS59 | MCS60 | MCS61 | MCS62 | MCS63 | MCS64 | MCS65 | MCS66 | MCS67 | MCS68 | MCS69 | MCS70 | MCS71 | MCS72 | MCS73 | MCS74 | MCS75 | MCS76

*RST: MCS1

Example: `BB:WLNN:FBL1:MCS MCS8`
selects MCS8 as the coding scheme used for the spatial stream.

Manual operation: See " MCS" on page 32

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MODulation<st> <Modulation>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MODulation<st> <Modulation>

Selects the modulation used for the spatial stream.

Parameters:

<Modulation> BPSK | QPSK | QAM16 | QAM64 | QAM256 | QAM1024 | QAM4096

*RST: QPSK; BPSK for Tx Mode > HT-Duplicate

Example: `BB:WLNN:FBL5:MOD1 BPSK`
sets BPSK as the modulation mode used for the spatial stream.

Options: QAM256|QAM1024|QAM4096 require R&S SMW-K86

Manual operation: See " Stream n" on page 32

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MUMimo:STATe <MUMimo>

Activates Multi User MIMO. This function applies to "Spatial Streams">1.

Parameters:

<MUMimo> 0 | 1 | OFF | ON

*RST: 0

Example: `BB:WLNN:BB:WLNN:FBL1:MUM:STAT ON`
activates Multi User MIMO.

Manual operation: See " Multi User MIMO" on page 30

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MU<st0>:GID <GID>

Sets the group ID for all available users.

Parameters:

<GID> integer

Range: 1 to 62
*RST: 1

Example: `BB:WLNN:BB:WLNN:FBL1:MU1:GID 1.0`
assigns group ID 1.0 to user 1.

Manual operation: See "Multi User MIMO Settings Table" on page 31

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MU<st0>:NSTS <NSTS>

Sets the number of space time streams for each user.

Parameters:

<NSTS> integer

Range: 0 to Max
*RST: 1

Example: `BB:WLNN:BB:WLNN:FBL1:MU2:NSTS 8.0`
sets 8 space time streams for user 2.

Manual operation: See "Multi User MIMO Settings Table" on page 31

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:NTPS <NTPS>

(Available only for VHT Tx mode)

Indicates whether VHT AP allows VHT non-AP STAs in TXOP power save mode to enter during TXOP.

Parameters:

<NTPS> OFF | ON

ON
Indicates that the VHT AP allows VHT non-AP STAs to enter doze mode during a TXOP.

OFF
Indicates that the VHT AP does not allow VHT non-AP STAs to enter doze mode during a TXOP.

*RST: 1

Example: `BB:WLNN:FBL1:NTPS ON`
Activates NTPS.

Manual operation: See " No TXOP PS " on page 50

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PAID:PATTern <Pattern>

(avaliable only for VHT Tx mode)

The command provides an abbreviated indication of the intended recipient(s) of the frame.

Parameters:

<Pattern> 9 bits

Range: #H000,9 to #H1FF,9
*RST: #H000,9

Example: `BB:WLNN:FBL1:PAID:PAT #H1FB,9`
Sets the 9 bits pattern `1FB`.

Manual operation: See " Partial AID (hex) " on page 50

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PLCP:FORMat <Format>

(available only for CCK and PBCC transport modes)

Selects the packet type (PPDU format) with long or short PLCP (physical layer convergence protocol).

Depending on the format selected, the structure, modulation and data rate of the PLCP preamble and header are modified.

Parameters:
<Format> LONG | SHORt
*RST: LONG

Example: `BB:WLNN:FBL5:PMOD LEG`
sets the physical mode to LEGACY.
`BB:WLNN:FBL5:TMOD CCK`
sets the transport mode
`BB:WLNN:FBL5:PLCP:FORM SHOR`
sets the PLCP Format

Manual operation: See " PLCP P+H Format " on page 48

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PLCP:LCBit:STATe <State>

(available only for CCK and PBCC transport modes)

Sets the Locked Clock Bit in Service Field of the PLCP Header.

Parameters:
<State> 0 | 1 | OFF | ON
*RST: ON

Example: `BB:WLNN:FBL5:PMOD LEG`
sets the physical mode to LEGACY.
`BB:WLNN:FBL5:TMOD CCK`
sets the transport mode
`BB:WLNN:FBL5:PLCP:LCB:STAT OFF`
sets the Locked Clock Bit

Manual operation: See " Service Field Clock Bit " on page 48

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PREamble:STATe <State>

Activates/deactivates the preamble and signal fields of the frames in the current frame block. For data type = SOUNDING, the preamble and signal field are always activated and cannot be deactivated.

Parameters:
<State> 0 | 1 | OFF | ON
*RST: 1

Example: `BB:WLNN:FBL5:PRE:STAT ON`
Activates the preamble and signal fields of the frames in the current frame block.

Manual operation: See " Preamble/Header Active " on page 49

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:PNSeed <PNSeed>

Sets the PN seed. Use this setting, if you don't use the default PN seed.

Parameters:

<PNSeed> 24 bits | 24 bit

Range: #H000001,24 to #H7FFFFF,24
*RST: #H000001,24

Example: `SOURce1:BB:WLNN:FBL5:DATA PN9`
Sets "PN9" as the data source.
`BB:WLNN:FBL5:DPNSeed:STATe 0`
Deactivates the default PN seed.
`BB:WLNN:FBL5:PNSeed #H47FFFF,24`
Sets a PN seed value of 47FFFF. The value is internally corrected to the maximum 9 bit PN seed value of 1FF.

Manual operation: See "PN Seed" on page 49

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PSDU:BRATe <BRate>

(available only for CCK and PBCC transport modes)

Sets the PSDU bit rate.

Parameters:

<BRate> integer

Range: 0 to 22E6
*RST: 11E6

Example: `BB:WLNN:FBL5:PMOD LEG`
sets the physical mode to LEGACY
`BB:WLNN:FBL5:TMOD CCK`
sets the transport mode
`BB:WLNN:FBL5:PSDU:BRAT 2E6`
sets the PSDU bit rate of 2 Mbps

Manual operation: See " PSDU Bit Rate" on page 34

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PSDU:BSPReading:STATe <State>

(available only for CCK and PBCC transport modes)

Enables/disables Barker spreading.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 1

Example: `BB:WLNN:FBL5:PMOD LEG`
sets the physical mode to LEGACY.
`BB:WLNN:FBL5:TMOD CCK`
sets the transport mode
`BB:WLNN:FBL5:PSDU:BRAT 2MBPS`
sets the PSDU bit rate
`BB:WLNN:FBL5:PSDU:BSPR:STAT ON`
enables spreading

Manual operation: See " Barker Spreading" on page 35

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PSDU:MODulation?

(available only for CCK and PBCC Tx modes)

Queries the modulation type. The modulation mode depends on the selected PSDU bit rate which depends on the selected physical layer mode (`SOUR:BB:WLNN:MODE`).

Return values:

<Modulation> BPSK | QPSK | DBPSK | DQPSK | CCK | PBCC

*RST: CCK

Example:

```
BB:WLNN:FBL5:PMOD LEG
```
Sets the physical mode to legacy.
```
BB:WLNN:FBL5:TMOD CCK
```
Sets the transport mode to CCK.
```
BB:WLNN:FBL5:PSDU:BRAT P2MBPS
```
Sets the PSDU bit rate to 2 mbps.
```
BB:WLNN:PSDU:MOD?
```
Queries the modulation mode.
```
Response: "DQPSK"
```

Usage: Query only

Manual operation: See " PSDU Modulation" on page 34

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:SCRambler:MODE <Mode>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SCRambler:MODE <Mode>

The command selects the different options for the scrambler.

Parameters:

<Mode> OFF | RANDom | USER | ON | PREamble

OFF
The scrambler is deactivated.

RANDom
(not for CCK/PBCC)
The scrambler is activated.
The initialization value of the scrambler is selected at random. Each frame has a different random initialization value. This value is also different in case of successive recalculations with the same setting parameters so that different signals are generated for each calculation.

USER
(not for CCK/PBCC)
The scrambler is activated.
The initialization value of the scrambler is set to a fixed value that is set using the command BB:WLNN:FBL5:SCR:PATT. This value is then identical in each generated frame.

ON
(CCK/PBCC only)
The scrambler is activated.

PREamble
(CCK/PBCC only)
The scrambler is activated. Only the preamble is scrambled.

*RST: USER

Example: `BB:WLNN:FBL5:SCR:MODE RAND`
activates the scrambler with an random initialization value.

Manual operation: See " Scrambler " on page 46

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:SCRambler:PATTern <Pattern>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SCRambler:PATTern <Pattern>

The command sets the initialization value for scrambling mode User. This value is then identical in each generated frame.

Parameters:
<Pattern> 8 bits
*RST: #H01,8

Example: `BB:WLNN:FBL5:SCR:PATT #H3F,8`
sets the user defined initialization value for the scrambler.

Manual operation: See " Scrambler Init (hex) " on page 47

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:RIGHt106tone <Right106toneRu>

If enabled, indicates that the right 106-tone RU is within the primary 20 MHz.

Parameters:
<Right106toneRu> 0 | 1 | OFF | ON
*RST: 0

Manual operation: See "Right 106-Tone RU" on page 37

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SEGMent

Selects one of the two segments in VHT-80+80 MHz mode with transmission bandwidth 80 MHz or 160 MHz. Both segments can only be generated with bandwidth 160 MHz.

This parameter applies to VHT-80+80 MHz Tx mode only.

Parameters:
 SEG0 | SEG1 | BOTH
*RST: SEG0

Example: `BB:WLNN:FBL1:SEGM BOTH`
Selects both segments.

Manual operation: See " Segment" on page 30

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:SERVice:PATTern <Pattern>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SERVice:PATTern <Pattern>

The command sets the value of the service field. The standard specifies a default value of 0. Other values can be entered in hexadecimal form for test purposes or future extensions.

Parameters:
<Pattern> 16 bits
*RST: #H0000,16

Example: `BB:WLNN:FBL5:SERV:PATT #H3F,16`
sets the value for the service field.

Manual operation: See " Service Field (hex) " on page 48

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SMOothing <SMOothing>

(available for all Tx modes, except VHT)

This command indicates to the receiver whether frequency-domain smoothing is recommended as part of channel estimation.

Parameters:
<SMOothing> OFF | ON

ON
Indicates that channel estimate smoothing is recommended.

OFF
Indicates that only per-carrier independent channel (unsmoothed) estimate is recommended.

*RST: 1

Example: `BB:WLNN:FBL:SMO ON`
switches on smoothing.

Manual operation: See " Smoothing " on page 50

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SSTReam <SStream>

Sets the number of the spatial streams. For physical mode LEGACY, only value 1 is valid. For Tx Mode "HT-Duplicate", only value 1 is valid. In all other cases, the number of spatial streams depends on the number of antennas configured with command `SOURce:BB:WLNN:ANTenna:MODE`.

Parameters:

<SStream> integer

Range: 1 to 8
*RST: 1

Example: `BB:WLNN:FBL5:SSTR 4`
Sets the number of spatial streams to 4.

Manual operation: See " Spatial Streams" on page 30

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:STBC:STATe?

Queries the status of the space time block coding.

Return values:

<State> INACtive | ACTive

Example: `BB:WLNN:FBL5:STBC:STAT?`
Queries the status of the space time block coding.

Usage: Query only

Manual operation: See " Space Time Block Coding" on page 30

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:STSTream <Ststream>

Sets the number of the space time streams. This value depends on the number of spatial streams defined with command `SOURce:BB:WLNN:FBLock:SSTReam`. Changing the number of the Spatial Streams immediately changes the value of the Space Time Streams to the same value.

Parameters:

<Ststream> integer

Range: 1 to dynamic
*RST: 1

Example: `BB:WLNN:FBL5:STBC:STAT?`
Queries the status of the space time block coding.

Manual operation: See " Space Time Streams" on page 30

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:TDWindowing:STATe <State>

Activates/deactivates the time domain windowing. Time domain windowing is a method to influence the spectral characteristics of the signal, which is not stipulated by the standard. However, it does not replace oversampling and subsequent signal filtering.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: `BB:WLNN:FBL5:TDW:STAT ON`
Activates the time domain windowing.

Manual operation: See " Time Domain Windowing Active " on page 36

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:TTIMe <TTime>

Sets the transition time when time domain windowing is active.

The transition time defines the overlap range of two OFDM symbols. At a setting of 100 ns and if BW = 20 MHz, one sample overlaps.

Parameters:

<TTime> float

Range: 0 to 1000 ns
Increment: 1 ns
*RST: 100 ns

Example: `BB:WLNN:FBL5:TTIM 100`
Sets the transition time to 100 ns.

Manual operation: See " Transition Time " on page 37

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:UINDex <UIND>

Defines the currently generated user. In activated Multi User MIMO only, one user can be generated at a time. This parameter selects the generated one out of four available users.

Parameters:

<UIND> UIDX0 | UIDX1 | UIDX2 | UIDX3

*RST: UIDX0

Example: `BB:WLNN:BB:WLNN:FBL1:UIND UIDX1`
Selects the generated user with index 1.

Manual operation: See "User Index" on page 31

6.9.2 HE Configuration

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BCHG....158
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BDCM....158
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BMCS....158
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BSSColor....159
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:CURPe?....159
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DOPPler....159
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:LINK....159
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:LOGFile?....160
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:LOGGing....160
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAXPe....160
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PED?....160
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PFORmat....161
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PFPFactor?....161
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PPUNcturing:BW....161

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PPUNcturing:STATe 162
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SPAReuse<st> 162
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SYMDuration 162
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:TXOPduration 162

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BCHG <BeamChange>

If enabled, the beam is changed between pre-HE and HE modulated fields.

Parameters:
<BeamChange> OFF | ON | 1 | 0

Example: `:BB:WLNN:FBL1 BCHG ON`
Enables that the beam is changed between the pre-HE and HE modulated fields.

Manual operation: See "Beam change" on page 36

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BDCM <SIGBDCM>

Enables the use of dual carrier modulation (DCM) in a signal B field.

Parameters:
<SIGBDCM> OFF | ON | 1 | 0

Example: `:BB:WLNN:FBL1:BDCM OFF`
Disables DCM in the signal B field.

Manual operation: See "SIG-B DCM" on page 37

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BMCS <SIGBMCS>

Sets the modulation and coding scheme (MCS) for the signal B field.

Parameters:
<SIGBMCS> MCS0 | MCS1 | MCS2 | MCS3 | MCS4 | MCS5 | MCS6 | MCS7 | MCS8 | MCS9 | MCS10 | MCS11 | MCS12 | MCS13 | MCS14 | MCS15 | MCS16 | MCS17 | MCS18 | MCS19 | MCS20 | MCS21 | MCS22 | MCS23 | MCS24 | MCS25 | MCS26 | MCS27 | MCS28 | MCS29 | MCS30 | MCS31 | MCS32 | MCS33 | MCS34 | MCS35 | MCS36 | MCS37 | MCS38 | MCS39 | MCS40 | MCS41 | MCS42 | MCS43 | MCS44 | MCS45 | MCS46 | MCS47 | MCS48 | MCS49 | MCS50 | MCS51 | MCS52 | MCS53 | MCS54 | MCS55 | MCS56 | MCS57 | MCS58 | MCS59 | MCS60 | MCS61 | MCS62 | MCS63 | MCS64 | MCS65 | MCS66 | MCS67 | MCS68 | MCS69 | MCS70 | MCS71 | MCS72 | MCS73 | MCS74 | MCS75 | MCS76

Example: `:BB:WLNN:FBL1:BMCS MCS1`
Sets the SIG-B MCSs to modulation scheme 1.

Manual operation: See "SIG-B MCS" on page 37

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BSSColor <BSSColor>

Sets the BSS color, an identifier of the basic service sets (BSS) field. This parameter helps to check if a detected frame is coming form an overlapping station.

Parameters:

<BSSColor> integer

Range: 0 to 63
*RST: 0

Example: `BB:WLNN:FBL1:BSSC 5`
Sets the BSS color to 5.

Manual operation: See "BSS Color" on page 38

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:CURPe?

Queries the current PE duration for all users.

Return values:

<CurrentPe> integer

Range: 0 to 16
*RST: 0

Usage: Query only

Manual operation: See "Cur PE Duration" on page 37

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DOPPler <DOPPLER>

If switched on, the Doppler effect is used for the PPDU.

Parameters:

<DOPPLER> OFF | ON | 1 | 0

Example: `:BB:WLNN:FBLock1:DOPP ON`
Enables the Doppler effect to be used for the PPDU.

Manual operation: See "Doppler" on page 39

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:LINK <LinkDirection>

Sets the link direction.

Parameters:

<LinkDirection> DOWN | UP

*RST: DOWN

Example: `:BB:WLNN:FBL1:LINK DOWN`
Set the downlink link direction.

Manual operation: See "Link Direction" on page 36

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:LOGFile?

Queries the fixed file path used for logging the contents of HE-SIG-A and HE-SIG-B fields, if `[:SOURce<hw>]:BB:WLNN:FBLock<ch>:LOGGing` is set to `ON`.

Return values:
<LogFile> string

Usage: Query only

Manual operation: See "Output File" on page 41

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:LOGGing <LoggingState>

If enabled (`ON`), the contents of HE-SIG-A and HE-SIG-B fields are written to a file in a text form. The location of the file can be queried with `[:SOURce<hw>]:BB:WLNN:FBLock<ch>:LOGGing`.

Parameters:
<LoggingState> 0 | 1 | OFF | ON

Manual operation: See "Logging State" on page 41

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAXPe <MaxPeDuration>

Sets the maximum packet extension (PE) duration.

Parameters:
<MaxPeDuration> PE0 | PE8 | PE16

`PE0`: 0 us
`PE8`: 8 us
`PE16`: 16 us

*RST: PE0

Example: `:BB:WLNN:FBL1:MAXP PE0`
Set the maximum packet extension to 0 us.

Manual operation: See "Max PE Duration" on page 36

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PED?

Queries the disambiguity in the number of sybmbols occuring due to the packet extension.

Return values:
<PEDisambiguity> integer

Range: 0 to 1
*RST: 0

Usage: Query only

Manual operation: See "PE Disambiguity" on page 39

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PFORmat <PpduFormat>

Sets the PPDU format.

Parameters:

<PpduFormat> SU | MU | SUEXt | TRIG

SU
HE SU (single-user) carries a single PSDU. The HE Signal A (HE-SIG-A) field is not repeated.

MU
HE MU (multi-user) carries multiple PSDUs to one or more users.

SUEXt
Carries a single PSDU. The HE-SIG-A field is repeated.

TRIG
Carries a single PSDU. It is send as a response to a PPDU that contains a trigger frame.

*RST: SU

Example: `:BB:WLNN:FBL1:PFOR SU`
Sets the PPDU format to HE single user.

Manual operation: See "PPDU Format" on page 36

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PFPFactor?

Queries the pre-FEC padding factor.

Return values:

<PreFECPadding> integer

Range: 0 to 3
*RST: 0

Usage: Query only

Manual operation: See "pre-FEC Padding Factor" on page 39

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PPUNcturing:BW <PreamblePuncBw>

Sets the bandwidth mode of preamble puncturing.

Parameters:

<PreamblePuncBw> 4 | 5 | 6 | 7

4|5
Sets the bandwidth mode for `HE80` channels.

6|7
Sets the bandwidth mode for `HE8080` channels.

*RST: 4

Example: See `[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PPUNcturing:STATe` on page 162.

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PPUNcturing:STATe <PreamblePunc>

Enables preamble puncturing of the HE MU PPDU in 80 MHz or (80+80)/160 MHz channels.

Parameters:

<PreamblePunc> 0 | 1 | OFF | ON

*RST: 0

Example:
```
BB:WLNN:FBL1:TMODe HE8080
BB:WLNN:FBL1:PPUNcturing:STATe 1
BB:WLNN:FBL1:PPUNcturing:BW 6
```

Manual operation: See "Preamble Puncturing" on page 38

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SPAReuse<st> <SpatialReuse>

Indicates if the spatial reuse is allowed (value set to `1`) or not (value set to `0`).

Parameters:

<SpatialReuse> integer

Range: 0 to 15
*RST: 0

Manual operation: See "Spatial Reuse" on page 39

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SYMDuration <HeLtfSymDur>

Selects the duration of the HE long training field (LTF).The symbol duration value does not include the guard interval.

Parameters:

<HeLtfSymDur> SD32 | SD64 | SD128

*RST: SD64

Manual operation: See "HE-LTF Symb Duration" on page 37

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:TXOPduration <TXOPDuraion>

If transmission opportunity (TXOP) is set to `127`, it indicates no duration information. If it is set to any other value, it indicates duration information for network allocation vector (NAV) parameter and that the TXOP is protected.

Parameters:

<TXOPDuraion> integer

Range: 0 to 127
*RST: 127

Example: `:BB:WLNN:FBL1:TXOP 127`
Sets the transmission opportunity duration to 127.

Manual operation: See "TXOP Duration" on page 39

6.9.3 User Configuration

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:CCH1:RUSelection<st> 163
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:CCH2:RUSelection<st> 163
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[:SOURce<hw>]:BB:WLNN:FBLock<ch>:USER<di>:RUTYpe? 165
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:USER<di>:STAid 165
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:USER<di>:STATe 165
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:USER<di>:TXBF 166

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:CCH1:RUSelection<st> <RuSelCh1>

Sets the the resource unit of the first content channel for the respective channel and station.

Parameters:

<RuSelCh1> RU0 | RU1 | RU2 | RU3 | RU4 | RU5 | RU6 | RU7 | RU8 | RU9 | RU10 | RU11 | RU12 | RU13 | RU14 | RU15 | RU18 | RU19 | RU20 | RU21 | RU22 | RU23 | RU24 | RU25 | RU34 | RU35 | RU36 | RU37 | RU38 | RU16 | RU17 | RU26 | RU27 | RU28 | RU29 | RU30 | RU31 | RU32 | RU33

*RST: RU34

Manual operation: See "RU Selection" on page 42

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:CCH2:RUSelection<st> <RuSelCh2>

Sets the the resource unit of the second content channel for the respective channel and station.

Parameters:

<RuSelCh2> RU0 | RU1 | RU2 | RU3 | RU4 | RU5 | RU6 | RU7 | RU8 | RU9 | RU10 | RU11 | RU12 | RU13 | RU14 | RU15 | RU18 | RU19 | RU20 | RU21 | RU22 | RU23 | RU24 | RU25 | RU34 | RU35 | RU36 | RU37 | RU38 | RU16 | RU17 | RU26 | RU27 | RU28 | RU29 | RU30 | RU31 | RU32 | RU33

*RST: RU34

Manual operation: See "RU Selection" on page 42

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:CCH2:MUNum<st> <MuNumCh2>

Sets the number of MU-MIMO users for each RU and station of the second content channel.

Parameters:

<MuNumCh2> integer

Range: 0 to 8
*RST: 1

Manual operation: See "Number of MU-MIMO users" on page 42

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:CCH1:MUNum<st> <MuNumCh1>

Sets the number of MU-MIMO users for each RU and station of the first content channel.

Parameters:

<MuNumCh1> integer

Range: 0 to 8
*RST: 1

Manual operation: See "Number of MU-MIMO users" on page 42

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:CENRu<st> <Center26toneRU>

For full bandwidth 80 MHz: if enabled, indicates that center 26 -tone RU is allocated in the common block fields of both SIGB content channels with same value.

For full bandwidth 160/80+80 MHz: if enabled, indicates that center 26 -tone RU is allocated for one individual 80 MHz in Common Block fields of both SIGB content channels.

Parameters:

<Center26toneRU> OFF | ON | 1 | 0

Manual operation: See "Center 26-tone RU" on page 43

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:USER<di>:GAIN <Gain>

Sets the user gain.

Parameters:

<Gain> float

Range: -80 to 0
Increment: 0.01
*RST: 0

Manual operation: See "Gain / dB" on page 44

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:USER<di>:MUMimo:STATe?

Queries if the MU-MIMO is used for current user.

Return values:
<MuMimoState> 0 | 1 | OFF | ON
*RST: 0

Usage: Query only

Manual operation: See "MU MIMO" on page 43

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:USER<di>:NSTS <UserNsts>

Sets the number of spatial streams, the number of space time streams minus 1.

Parameters:
<UserNsts> integer
Range: 1 to 8
*RST: 1

Manual operation: See "Nsts" on page 43

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:USER<di>:RUTYpe?

Queries the resource unit type for the current user.

Return values:
<RuType> 26 | 52 | 106 | 242 | 484 | 996 | 2996 | C26
*RST: 242

Usage: Query only

Manual operation: See "RU Type" on page 43

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:USER<di>:STAid <StaId>

Sets the station ID for the current user, the 11 least significant bits of the association identifier (AID).

Parameters:
<StaId> integer
Range: 0 to 2047
*RST: 1

Manual operation: See "STA Id" on page 43

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:USER<di>:STATe <UserState>

Switches the current user on and off.

Parameters:
<UserState> 0 | 1 | OFF | ON
*RST: 1

Manual operation: See "State" on page 44

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:USER<di>:TXBF <TXBF>

If switched on, indicates that the beamforming matrix is applied to the waveform.

Parameters:
<TXBF> 0 | 1 | OFF | ON

Manual operation: See "TxBF" on page 44

6.9.4 MPDU Configuration

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MPDU:COUNt ... 166
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MPDU:COUNt ... 166
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MPDU<st>:DATA:DSELection ... 166
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MPDU<st>:DATA:DSELection ... 166
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MPDU<st>:DATA:LENGth ... 167
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MPDU<st>:DATA:LENGth ... 167
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MPDU<st>:DATA:PATTern ... 167
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MPDU<st>:DATA:PATTern ... 167
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MPDU<st>:DATA:SOURce ... 168
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MPDU<st>:DATA:SOURce ... 168
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MPDU:EOF ... 168
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MPDU:EOF ... 168

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MPDU:COUNt <Count>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MPDU:COUNt <Count>

Determines the number of MPDUs in the frame.

Parameters:
<Count> integer
Range: 1 to 64
*RST: 1

Example: `BB:WLNN:FBL1:MPDU:COUN 3`
Determines the number of MPDUs in the frame.

Manual operation: See "Number of MPDUs" on page 51

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MPDU<st>:DATA:DSELection <Filename>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MPDU<st>:DATA:DSELection <Filename>

Selects the data list for the DLISt data source selection.

The lists are saved as files with the fixed file extensions `*.dm_iqd` in a directory of the user's choice.

Parameters:
<Filename> string

Example: `BB:WLNN:FBL1:MPDU1:DATA DLIS`
Selects the Data Lists data source.
`MMEM:CDIR '/var/user/temp/Lists'`
Selects the directory for the data lists.
`BB:WLNN:FBL1:MPDU1:DATA:DSEL 'dlist1'`
Selects the 'dlist1' as the data source. This file must be in the directory specified above. It must have the file extension `*.dm_iqd`.

Manual operation: See "DList / Pattern" on page 52

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MPDU<st>:DATA:LENGth <Length>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MPDU<st>:DATA:LENGth <Length>

Determines the size of the data field in bytes.

Parameters:
<Length> integer
Range: 0 to 16384
*RST: 1024

Example: `BB:WLNN:FBL1:MPDU1:DATA:LENG 1024`
Determines the size of the data field.

Manual operation: See "Data Length / bytes " on page 51

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MPDU<st>:DATA:PATTern <Pattern>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MPDU<st>:DATA:PATTern <Pattern>

Determines the bit pattern for the PATTern selection.

Parameters:
<Pattern> 64 bits
*RST: #H0,1

Example: `BB:WLNN:FBL1:MPDU1:DATA:PATT #B0101,4`
Sets the bit pattern.

Manual operation: See "DList / Pattern" on page 52

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MPDU<st>:DATA:SOURce <Source>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MPDU<st>:DATA:SOURce <Source>

Selects the data source.

Parameters:

<Source> ZERO | ONE | PATTern | PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt

PNxx
The pseudo-random sequence generator is used as the data source. Different random sequence lengths can be selected.

DLISt
A data list is used. The data list is selected with the command `BB:WLNN:FBL<ch>:MPDU<st>:DATA:DSEL`

ZERO | ONE
Internal 0 or 1 data is used.

PATTern
Internal data is used. The bit pattern for the data is defined by the command `BB:WLNN:FBL<ch>:MPDU<st>:DATA:PATT`.

*RST: PN9

Example: `BB:WLNN:FBL1:MPDU1:DATA:SOUR PATT`
Selects the data source.

Manual operation: See "Data" on page 51

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MPDU:EOF <EOF>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MPDU:EOF <EOF>

Sets the EOF value for the A-MPDU.

Parameters:

<EOF> DEFault | E0 | E1

*RST: DEFault

Manual operation: See "EOF" on page 51

6.9.5 MAC Header Configuration

6.9.5.1 Common Fields Commands

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:ADDRess<st> 170
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:ADDRess<st> 170
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:ADDRess<st>:STATe 170
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:ADDRess<st>:STATe 170
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:DID 170
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:DID 170

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:BSSid 171
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol 171
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol 171
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:FDS 171
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:FDS 171
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:MDATa 171
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:MDATa 171
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:MFRagments 171
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:MFRagments 171
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:ORDer 171
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:ORDer 171
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:PMANagement 171
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:PMANagement 171
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:PVERsion 171
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:PVERsion 171
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:RETRy 171
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:RETRy 172
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:SUBType 172
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:SUBType 172
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:TDS 172
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:TDS 172
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:TYPE 172
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:TYPE 172
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:WEP 172
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:WEP 172
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SA 172
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCS:STATe 172
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCS:STATe 172
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:QSControl 173
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:QSControl 173
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:QSControl:STATe 173
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:QSControl:STATe 173
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:SCONtrol:FRAGment:
INCRement 173
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SCONtrol:FRAGment:INCRement 173
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:SCONtrol:FRAGment:STARt 174
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SCONtrol:FRAGment:STARt 174
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:SCONtrol:SEQuence:
INCRement 174
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SCONtrol:SEQuence:INCRement 174
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:SCONtrol:SEQuence:STARt 174
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SCONtrol:SEQuence:STARt 174
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:SCONtrol:STATe 175
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SCONtrol:STATe 175
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:STATe 175
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:STATe 175

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:ADDRess<st> <Address>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:ADDRess<st> <Address>

The command enters the value of the address fields 1 ... 4. Exactly 48 bits must be entered. Each address is 6 bytes (48 bit) long. The addresses can be entered in hexadecimal form in the entry field of each address field. The least significant byte (LSB) is in left notation.

Parameters:

<Address> integer

Range: #H000000000000,48 to #HFFFFFFFFFFFF,48
*RST: #H000000000000,48

Example: `BB:WLNN:FBL1:MAC:ADDR2 #H124836C7EA54,48`
set the value for address field 2.

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:ADDRess<st>:STATe <State>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:ADDRess<st>:STATe <State>

The command activates/deactivates the selected address field.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: OFF

Example: `BB:WLNN:FBL1:MAC:ADDR2:STAT ON`
activates generation of address field 2.

Manual operation: See " MAC Address " on page 55

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:DID <Did>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:DID <Did>

The command enters the value of the duration ID field. Depending on the frame type, the 2-byte field Duration/ID is used to transmit the association identity of the station transmitting the frame or it indicates the duration assigned to the frame type. Exactly 16 bit must be entered.

Parameters:

<Did> integer

Range: #H0000,16 to #HFFFF,16
*RST: #H0000,16

Example: `BB:WLNN:FBL1:MAC:DID #HA5A5,16`
sets the value of the duration ID field.

Manual operation: See " Duration Id " on page 54

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:BSSid <Bssid>

Sets the value of the basic service set identification (BSSID) field.

Parameters:

<Bssid> integer

Example: BB:WLNN:FBL1:MAC:BSS #H124836C7EA54,48
Sets the value of the BSSID field to 124836C7EA54

Manual operation: See "BSSID (hex)" on page 55

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol <FControl>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol <FControl>

The command enters the value of the frame control field. The frame control field has a length of 2 bytes (16 bits) and is used to define the protocol version, the frame type, and its function, etc.. As an alternative, the individual bits can be set with the following commands.

Parameters:

<FControl> integer

Range: #H0000,16 to #HFFFF,16
*RST: #H0000,16

Example: `BB:WLNN:FBL1:MAC:FCON #H100A,16`
sets the value of the frame control field.

Manual operation: See " Frame Control " on page 53

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:FDS <Fds>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:FDS <Fds>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:MDATa <MData>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:MDATa <MData>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:MFRagments <MFragments>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:MFRagments <MFragments>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:ORDer <Order>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:ORDer <Order>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:PMANagement <PManagement>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:PMANagement <PManagement>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:PVERsion <PVersion>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:PVERsion <PVersion>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:RETRy <Retry>

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:RETRy <Retry>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:SUBType <Subtype>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:SUBType <Subtype>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:TDS <Tds>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:TDS <Tds>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:TYPE <Type>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:TYPE <Type>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCONtrol:WEP <Wep>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:WEP <Wep>

The command enters the value of the individual bits of the frame control field.

Parameters:
<Wep> integer
Range: #H0,1 to #H1,1
*RST: #H0,1

Example: `BB:WLNN:FBL1:MAC:FCON:MDAT #H1,1`
sets the value of the More Data bit.

Manual operation: See " Frame Control " on page 53

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SA <Sa>

Sets the value of the source address (SA) field.

Parameters:
<Sa> integer

Example: BB:WLNN:FBL1:MAC:SA #HFFFFFFFFFFFF,48
Sets the value of the SA field to FFFFFFFFFFFF.

Manual operation: See "SA (hex)" on page 55

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:FCS:STATe <State>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCS:STATe <State>

Activates/deactivates the calculation of the FCS (frame check sequence). The standard defines a 32-bit (4-byte) checksum to protect the MAC header and the user data (frame body).

Parameters:
<State> 0 | 1 | OFF | ON
*RST: OFF

Example: `BB:WLNN:FBL1:MAC:FCS:STAT ON`
activates the calculation of the FCS.

Manual operation: See " FCS (checksum) " on page 53

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:QSControl <QsControl>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:QSControl <QsControl>

Sets the value for the QoS control field.

Parameters:

<QsControl> integer
Range: #H0000,16 to #HFFFF,16

Example: `BB:WLNN:FBL1:MAC:QSC #H5A5A,16`
Sets the value for the QoS field to#H5A5A,16.

Manual operation: See " QoS Control " on page 72

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:QSControl:STATe <State>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:QSControl:STATe <State>

The command enables/disables the QoS control.

Parameters:

<State> 0 | 1 | OFF | ON
*RST: ON

Example: `BB:WLNN:FBL1:MAC:QSC:STAT ON`
enables the QoS control.

Manual operation: See " QoS Control " on page 72

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:SCONtrol:FRAGment:INCRement <Increment>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SCONtrol:FRAGment:INCRement <Increment>

Defines the number of packets required to increment the counter of the fragment bits of the sequence control.

Parameters:

<Increment> integer
Range: 0 to 1024
*RST: 1

Example: `BB:WLNN:FBL1:MAC:SCON:FRAG:INCR 2`
two packets are required to increment the counter of the fragment bits.

Manual operation: See " Increment Every " on page 57

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:SCONtrol:FRAGment:STARt <Start>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SCONtrol:FRAGment:STARt <Start>

The command enters the start number of the fragment bits of the sequence control.

Parameters:

<Start> integer

Range: #H0,4 to #HF,4
*RST: #H0,4

Example: `BB:WLNN:FBL1:MAC:SCON:FRAG:STAR #H4,4`
sets the start value of the fragment bits of the sequence control.

Manual operation: See " Start Number " on page 56

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:SCONtrol:SEQuence:INCRement <Increment>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SCONtrol:SEQuence:INCRement <Increment>

Defines the number of packets required to increment the counter of the sequence bits of the sequence control.

Parameters:

<Increment> integer

Range: 0 to 1024
*RST: 1

Example: `BB:WLNN:FBL1:MAC:SCON:FRAG:INCR 2`
two packets are required to increment the counter of the sequence bits.

Manual operation: See " Increment Every " on page 57

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:SCONtrol:SEQuence:STARt <Start>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SCONtrol:SEQuence:STARt <Start>

The command enters the start number of the fragment bits of the sequence control.

Parameters:

<Start> integer

Range: #H000,12 to #HFFF,12
*RST: #H000,12

Example: `BB:WLNN:FBL1:MAC:SCON:SEQ:STAR #H444,12`
sets the start value of the sequence bits of the sequence control.

Manual operation: See " Start Number " on page 56

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:SCONtrol:STATe <State>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SCONtrol:STATe <State>

The command activates/deactivates the sequence control.

Parameters:
<State> 0 | 1 | OFF | ON
*RST: OFF

Example: `BB:WLNN:FBL1:MAC:SCON:STAT ON`
activates the sequence control field.

Manual operation: See " Sequence Control " on page 55

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:STATe <State>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:STATe <State>

The command activates/deactivates the generation of the MAC Header.

Parameters:
<State> 0 | 1 | OFF | ON
*RST: 0

Example: `BB:WLNN:FBL1:MAC:STAT ON`
activates the generation of the MAC Header.

Manual operation: See " MAC Header " on page 53

6.9.5.2 MAC Header HT Configuration

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl ... 175
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:ACConstraint ... 176
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:CALibration:POSition ... 176
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:CALibration:SEQuence ... 177
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:CSISteering ... 177
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:FREQuest ... 177
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:VHTControl:HVINdicator? ... 178
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:HVINdicator? ... 178
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:LAControl ... 178
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:NDP ... 179
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:RDGMore ... 179
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:REServed ... 179
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:SREServed ... 180
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:HTControl:STATe ... 180
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:STATe ... 180
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:ZLF ... 180

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl <HtControl>

Sets the value for the HT control field.

Parameters:

<HtControl> integer

Range: #H00000000,32 to #HFFFFFFFF,32
*RST: #H00000000,32

Example: `BB:WLNN:FBL1:MAC:HTC #H5a5a5a5a,32`
Sets the value for the HT control field to #H5a5a5a5a,32.

Manual operation: See " HT/VHT/HE Control " on page 72

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:ACConstraint
<AcConstraint>

Sets the value for the AC signal field.

0 = The response may contain data from any TID (Traffic Identifier).

1 = The response may contain data only from the same AC as the last Data received from the initiator.

Parameters:

<AcConstraint> integer

Range: #H0,1 to #H1,1
*RST: 0

Example: `BB:WLNN:FBL1:MAC:HTC:ACC #H0,1`
Sets the AC signal field to 0 (The response may contain data from any TID)

Manual operation: See " AC Constraint " on page 73

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:CALibration:POSition
<Position>

Sets the value for the calibration position.

00 = Not a calibration frame (Default setting)

01 = Calibration Start

10 = Sounding Response

11 = Sounding Complete

Parameters:

<Position> integer

Range: #H0,2 to #H3,2

Example: `BB:WLNN:FBL1:MAC:HTC:CAL:POS #H0,2`
Sets the calibration position signal field to 00 (not a calibration frame).

Manual operation: See " Calibration Position " on page 74

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:CALibration:SEQuence <Sequence>

Sets the value for the calibration sequence.

Parameters:

<Sequence> integer
Range: #H0,2 to #H3,2

Example: `BB:WLNN:FBL1:MAC:HTC:CAL:SEQ #H3,2`
Sets the value for the calibration sequence.

Manual operation: See " Calibration Sequence " on page 74

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:CSISteering <CsiSteering>

Sets the value for the CSI steering.

00 = CSI

01 = uncompressed Steering Matrix

10 = compressed Steering Matrix

11 = Reserved

Parameters:

<CsiSteering> integer
Range: #H0,2 to #H3,2

Example: `BB:WLNN:FBL1:MAC:HTC:CSIS #H1,2`
Sets the value for the CSI steering to 01 (uncompressed Steering Matrix).

Manual operation: See " CSI Steering " on page 74

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:FREQuest <FRequest>

Sets the value for the feedback request.

00 = no request

01 = unsolicited feedback only

10 = immediate feedback

11 = aggregated feedback

Parameters:

<FRequest> integer
Range: #H0,2 to #H3,2

Example: `BB:WLNN:FBL1:MAC:HTC:FREQ #H2,2`
Sets the value for the feedback request to 10 (immediate feedback).

Manual operation: See " Reserved " on page 74

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:VHTControl:HVINdicator?
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:HVINdicator?

The command queries the used format (HT or VHT).

Return values:
<HTVHT> integer

Example: `BB:WLNN:FBL:MAC:HTC:HVIN?`
Response: `1`
HT format is used.

Usage: Query only

Manual operation: See " HT/VHT " on page 75

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:LAControl <LaControl>

Sets the value for the link adaption control.

B0 (1bit) MA - MA payload

When the MA field is set to 1, the payload of the QoS Null Data MPDU is interpreted as a payload of the management action frame.

B1 (1bit) TRQ - Sounding Request

1 = Request to the responder to transmit a sounding PPDU.

B2 (1bit) MRQ - MCS Request

1 = Request for feedback of MCS.

B3-B5 (3bit) MRS - MRQ Sequence Identifier

Set by sender to any value in the range '000'-'110' to identify MRQ. = Invalid if MRQ = 0

B6-B8 (3bit) MFS - MFB Sequence Identifier

Set to the received value of MRS. Set to '111' for unsolicited MFB.

B9-B15 (7bit) MFB - MCS Feedback

Link adaptation feedback containing the recommended MCS. When a responder is unable to provide MCS feedback or the feedback is not available, the MFB is set to 'all-ones' (default value) and also MFS is set to '1'.

Parameters:
<LaControl> integer
Range: #H0000,16 to #HFFFF, 16

Example: `BB:WLNN:FBL1:MAC:HTC:LAC #H5A5A,16`
Sets the value for the link adaption control to #H5A5A,16.

Manual operation: See " Link Adaption Control " on page 74

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:NDP <Ndp>

Sets the value of the Null Data Packet (NDP) announcement.

0 = no NDP will follow

1 = NDP will follow

Parameters:
<Ndp> integer

Example: `BB:WLNN:FBL1:MAC:HTC:NDP #H1,1`
Sets the value for the NDP announcement to 1 (NDP will follow).

Manual operation: See " NDP Announcement " on page 73

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:RDGMore <RdgMore>

Sets the value for the RDG/More PPDU.

Transmitted by Initiator

0 = No reverse grant.

1 = A reverse grant is present, as defined by the Duration/ID field.

Transmitted by Responder

0 = The PPDU carrying the MPDU is the last transmission by the responder.

1 = The PPDU carrying the frame is followed by another PPDU.

Parameters:
<RdgMore> integer
Range: #H0,1 to #H1,1

Example: `BB:WLNN:FBL1:MAC:HTC:RDGM #H0,1`
Sets the value for the RDG/More PPDU to #H0,1.

Manual operation: See " RDG/More PPDU " on page 73

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:REServed <Reserved>

This signal field is currently defined, but not used. It is set to zero by the transmitter and ignored by the receiver.

Parameters:
<Reserved> integer
Range: #H0,5 to #H5,2

Manual operation: See " Reserved " on page 73

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:SREServed <Reserved>

This signal field is currently defined, but not used.

Parameters:
<Reserved> integer

Manual operation: See " Reserved " on page 74

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:HTControl:STATe <State>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:STATe <State>

The command enables/disables HT Control.

Parameters:
<State> 0 | 1 | OFF | ON
*RST: OFF

Example: `BB:WLNN:FBL1:MAC:HTC:STAT ON`
enables HT Control.

Manual operation: See " HT/VHT/HE Control " on page 72

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:ZLF <Zlf>

Sets the value for the ZLF announcement.

0 = no ZLF will follow

1 = ZLF will follow

Parameters:
<Zlf> integer
Range: #H0,1 to #H1,1

Example: `BB:WLNN:FBL1:MAC:HTC:ZLF #H1,1`
Sets the value for the ZLF announcement to 1 (ZLF will follow).

Manual operation: See " NDP Announcement " on page 73

6.9.5.3 MAC Header VHT Configuration

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl 181
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:ACConstraint 181
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:CTYPe 181
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:FTTYpe 182
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:GIDH 182
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:HVINdicator? 182
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:MFB 183
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:MGL 183
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:MRQ 183
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:MSI 184

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:RDGMore.....184
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:UMFB.....184
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:VREServed.....185

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl <VHTContol>

The command sets the value for the VHT control field.

Parameters:

<VHTContol> integer

Range: #H00000000,32 to #HFFFFFFFF,32
*RST: #H00000000,32

Example: `BB:WLNN:FBL1:MAC:VHTC #H5a5a5a5a,32`
sets the value for the VHT control field.

Manual operation: See " HT/VHT/HE Control " on page 72

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:ACConstraint <VhtAcConstraint>

The command sets the value for the AC signal field. It indicates the access point of the responder (1 bit).

Parameters:

<VhtAcConstraint> integer

0
The response may contain data from any TID (Traffic Identifier)

1
The response may contain data only from the same AC as the last data received from the initiator.

Example: `BB:WLNN:FBL:MAC:VHTC:ACC 0`
the response may contain data from any TID.

Manual operation: See " AC Constraint " on page 76

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:CTYPe <CTYPe>

The command sets the coding information. If the Unsolicited MFB subfield is set to 1, the Coding Type subfield contains the Coding information (set to 0 for BCC and set to 1 for LDPC) to which the unsolicited MFB refers.

Parameters:

<CTYPe> integer

0
BCC

1
LDPC

Example: `BB:WLNN:FBL:MAC:VHTC:CTYP 1`
sets the coding information for LPDC.

Manual operation: See " Coding Type " on page 77

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:FTTYpe <FbTxType>

The command sets the FB Tx Type subfield.

0 = If the Unsolicited MFB subfield is set to 1 and FB Tx Type subfield is set to 0, the unsolicited MFB refers to either an unbeamformed VHT PPDU or transmit diversity using an STBC VHT PPDU.

1 = If the Unsolicited MFB subfield is set to 1 and the FB Tx Type subfield is set to 1, the unsolicited MFB refers to a beamformed SU-MIMO VHT PPDU.

Otherwise this subfield is reserved.

Parameters:
<FbTxType> integer

Example: `BB:WLNN:FBL1:PAID:FTTY #B1,1`
sets the FTTY subfield.

Manual operation: See " FB Tx Type " on page 77

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:GIDH <GIDH>

Sets GID-H subfield. If the Unsolicited MFB subfield is set to 1, the GID-H subfield contains the highest 3 bits of Group ID of the PPDU to which the unsolicited MFB refers.

Otherwise this subfield is reserved.

Parameters:
<GIDH> integer
*RST: #H0

Example: `BB:WLNN:FBL:MAC:VHTC:GIDH #B111,3`
sets the coding information for GID-H.

Manual operation: See " GID-H " on page 77

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:HVINdicator?

Queries the used format (HT or VHT). The command returns `0` for the HT format and `1` for the VHT format.

Return values:
<HtVhtIndicator> integer

Example: `BB:WLNN:FBL:MAC:VHTC:HVIN?`
Response: `1`
VHT format is used.

Usage: Query only

Manual operation: See " HT/VHT " on page 79

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:MFB <Mfb>

The command sets the MFB subfield. This subfield contains the recommended MFB. The value of MCS=15 and VHT N_STS=7 indicates that no feedback is present.

See also Table 3-10 for definition of the MFB subfield.

Parameters:

<Mfb> integer

Example: `BB:WLNN:FBL:MAC:VHTC:MFB #B111111111111111,15`
sets the information for the MFB subfield.

Manual operation: See " MFB " on page 77

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:MGL <MfsiGidL>

The command determines the information of the MFSI/GID-L subfield.

MFB = 0

If the Unsolicited MFB subfield is set to 0, the MFSI/GID-L subfield contains the received value of MSI contained in the frame to which the MFB information refers.

MFB = 1

The MFSI/GID-L subfield contains the lowest 3 bits of Group ID of the PPDU to which the unsolicited MFB refers.

Parameters:

<MfsiGidL> integer

Example: `BB:WLNN:FBL:MAC:VHTC:MGL #B111,3`
sets the information for the MFSI/GID-L subfield.

Manual operation: See " MFSI/GID-L " on page 78

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:MRQ <Mrq>

The command determines the information of the MRQ subfield.

Parameters:

<Mrq> integer

0
requests MCS feedback (solicited MFB).

1
otherwise

Example: `BB:WLNN:FBL:MAC:VHTC:MRQ #B1,1`
sets the information for the MRQ subfield.

Manual operation: See " MRQ " on page 78

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:MSI <Msi>

The command sets the MSI subfield.

MRQ = 0

When the MRQ subfield is set to 0, the MSI subfield is reserved.

MRQ = 1

When the MRQ subfield is set to 1, the MSI subfield contains a sequence number in the range 0 to 6 that identifies the specific request.

Parameters:

<Msi> integer

Example: `BB:WLNN:FBL:MAC:VHTC:MSI #B111,3`
sets the information for the MFSI/GID-L subfield.

Manual operation: See " MSI " on page 78

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:RDGMore <VhtRdgMore>

The command issues the reverse direction grant. When transmitted by an initiator or a responder, this field is interpreted differently.

Transmitted by Initiator

0 = No reverse grant.

1 = A reverse grant is present, as defined by the Duration/ID field.

Transmitted by Responder

0 = The PPDU carrying the MPDU is the last transmission by the responder.

1 = The PPDU carrying the frame is followed by another PPDU.

Parameters:

<VhtRdgMore> integer

Example:
```
BB:WLNN:FBL:MAC:HTC #H80000000,32
BB:WLNN:FBL:MAC:VHTC:RDGM #B1,1
```
sets the value for the RDG/More PPDU.

Manual operation: See " RDG/More PPDU " on page 76

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:UMFB <UnsolicitedMfb>

The command sets the Unsolicited MFB subfield.

Parameters:

<UnsolicitedMfb> integer

0
if the MFB is a response to an MRQ.

1
if the MFB is not a response to an MRQ.

Example: `BB:WLNN:FBL:MAC:VHTC:UMFB #B1,1`
sets the information for the UMFB subfield.

Manual operation: See " Unsolicited MFB " on page 76

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:VREServed
<VhtReserved>

This signal field is currently defined, but not used. It is set to zero by the transmitter and ignored by the receiver.

Parameters:
<VhtReserved> integer

Manual operation: See " Rsv " on page 79

6.9.5.4 MAC Header HE Configuration

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:HEControl 185
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:HEControl:ACONtrol 185
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:HEControl:HEINdicator? 185

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:HEControl
<HEControl>

Sets the value with the length of 4 bytes of the HE control field.

Parameters:
<HEControl> integer

Manual operation: See " HT/VHT/HE Control " on page 72

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:HEControl:ACONtrol
<AggregatedCtrl>

Sets the value for the aggregated control field. The length of this value may vary according to the selected control ID subfield.

Parameters:
<AggregatedCtrl> integer

Manual operation: See " Aggregated control " on page 79

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:HEControl:HEINdicator?

Indicates the use of the HE format, if `[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:MAC:VHTControl:HVINdicator?` is set to `1`. The command returns `1` if the HE format is used and `0` if not.

Return values:
<HEIndicator> integer

Usage: Query only

Manual operation: See " HE " on page 80

6.9.5.5 Trigger Frame Settings

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:BW 186
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:CINDication 186
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:CSRequired 186
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:DOPPler 186
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:GILTf 186
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:HREServed 186
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:LEN 186
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:LESSeg 187
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:MLTFmode 187
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:NHLSym 187
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:PEXTension 187
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:RSV 187
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:SPAReuse 187
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:STBC 187
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:TTYPe? 187
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:TXPow 187
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:NUINfo 187
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:UINFo<st0>:AID 187
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:UINFo<st0>:CODType 187
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:UINFo<st0>:DCM 187
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:UINFo<st0>:MCS 187
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:UINFo<st0>:RSV 187
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:UINFo<st0>:RUALlocation 187
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:UINFo<st0>:SSALlocation 187
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:UINFo<st0>:TDUSerinfo 187
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:UINFo<st0>:TRSSi 187

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:BW <BW>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:CINDication <CascadeInd>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:CSRequired <CSRequired>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:DOPPler <Doppler>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:GILTf <GILTF>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:HREServed <HESIGAReserved>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:LEN <Length>

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:LESSeg <LDPCExtSymSeg>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:MLTFmode <MUMIMOLTFMode>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:NHLSym <NumHeLtfSym>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo: PEXTension <PacketExtension>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:RSV <Reserved>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:SPAReuse <SpatialReuse>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:STBC <STBC>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:TTYPe?
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:CINFo:TXPow <APTxPower>

Sets the value bits of the common info field.

Parameters:
<APTxPower> 6 bits

Manual operation: See "AP Tx Power" on page 67

[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:NUINfo <NoUserInfo>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:UINFo<st0>:AID <AID12>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:UINFo<st0>: CODType <CodingType>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:UINFo<st0>:DCM <DCM>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:UINFo<st0>:MCS <MCS>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:UINFo<st0>:RSV <Reserved>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:UINFo<st0>: RUALlocation <RUAllocation>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:UINFo<st0>: SSALlocation <SSAllocation>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:UINFo<st0>: TDUSerinfo <TrigDepUserInfo>
[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:UINFo<st0>: TRSSi <TargetRssi>

Sets the value bits of the user info field.

You can configure the user info for up to 37 users with the command `[:SOURce<hw>]:BB:WLNN:FBLock<ch>[:USER<di>]:TFConfig:NUINfo`.

Parameters:
<TargetRssi> 7 bits

Manual operation: See "Target RSSI" on page 70

6.9.6 Beacon Configuration

6.9.6.1 General Beacon Functions

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:BINTerval 188
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:DCCHannel? 188
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:IAWindow 188
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:SRATe 189
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:SSID 189
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:TSTamp 189

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:BINTerval <BInterval>

Defines the time interval between two beacon transmissions.

Parameters:
<BInterval> float

Range: 0 to 65
Increment: 1E-9
*RST: 0.1
Default unit: s

Example: `BB:WLNN:FBL1:BFC:BINT 200ms`
Sets the time interval between two beacon transmissions to 200 ms.

Manual operation: See "Beacon Interval" on page 59

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:DCCHannel?

Queries the current channel of the DSSS network.

Return values:
<DCCHannel> integer

Example: `BB:WLNN:FBL1:BFC:DCCH?`

Usage: Query only

Manual operation: See "DSSS(Current Channel)" on page 59

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:IAWindow <IAWindow>

Sets the parameters necessary to support an IBSS (2 bytes). The Information field contains the ATIM Window parameter.

Parameters:
<IAWindow> integer
*RST: #H0000

Example: BB:WLNN:FBL1:BFC:IAW #HFFFF,16

Manual operation: See "IBSS(ATIM Window) (hex)" on page 59

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:SRATe <SRATe>

Determines a set of data rates that are supported by the access point (Supported Rates field).

Parameters:
<SRATe> integer

Example: BB:WLNN:FBL1:BFC:SRAT #H06090C1218243036,64
Determines the following set of supported data rates: Hex numbers 06 09 0C 12 18 24 30 36.
This means: 6 Mbps, 9 Mbps, 12 Mbps, 18 Mbps, 24 Mbps, 36 Mbps, 48 Mbps and 54 Mbps are supported by the access point.

Manual operation: See "Supported Rates" on page 59

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:SSID <Ssid>

Specifies the desired SSID or the wildcard SSID.

Parameters:
<Ssid> string
Range: 0 char to 32 char

Example: `BB:WLNN:FBL1:BFC:SSID "Rohde&Schwarz"`
Sets the SSID to "Rohde&Schwarz".

Manual operation: See "SSID" on page 59

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:TSTamp <TStamp>

Sets the value of the TSF timer (Timing Synchronization Function of a frame's source).

Parameters:
<TStamp> integer

Example: `BB:WLNN:FBL1:BFC:TST #H1414AFAE891254BC, 64`
Sets the value of the TSF timer to 1414AFAE891254BC.

Manual operation: See "Timestamp (hex)" on page 59

6.9.6.2 Capability Information Parameters

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:APSD 190
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:CAGility 190
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:CPOLlable 191
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:CPRequest 191
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:ESS 191
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:IBACk 191
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:IBSS 192
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:DBACk 192
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:DOFDm 192
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:PBCC 193
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:PRIVacy 193
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:QOS 193
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:RMEasurement 193
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:SMGMt 194
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:SPReamble 194
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:SSTime 194
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:HTCapability:GFIeld 195
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:HTCapability:STATe 195

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:APSD
<CAPSd>

Informs the associated stations if automatic power save delivery (APSD, energy saving function) is supported.

Parameters:

<CAPSd> 0 | 1 | OFF | ON
*RST: 0

Example: `BB:WLNN:FBLock1:BFC:CAP:APSD ON`
Informs the associated stations that automatic power save delivery (APSD, energy saving function) is supported.

Manual operation: See "Capability Information Parameters" on page 61

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:CAGility
<CCAGility>

Informs the associated stations if channel agility is used.

Parameters:

<CCAGility> 0 | 1 | OFF | ON
*RST: 0

Example: BB:WLNN:FBL1:BFC:CAP:CAG ON

Manual operation: See "Capability Information Parameters" on page 61

Informs the associated stations that channel agility is used.

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:CPOLlable <CCPollable>

Informs the associated stations if contention free is pollable.

Parameters:

<CCPollable> 0 | 1 | OFF | ON

*RST: 0

Example: `BB:WLNN:FBL1:BFC:CAP:CPOL ON`
Informs the associated stations that contention free is pollable.

Manual operation: See "Capability Information Parameters" on page 61

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:CPRequest <CCPRequest>

Indicates if contention free poll (CF-poll) is requested.

Parameters:

<CCPRequest> 0 | 1 | OFF | ON

*RST: 0

Example: `BB:WLNN:FBL1:BFC:CAP:CPR ON`
Tells the associated stations that contention free poll (CF-poll) is requested.

Manual operation: See "Capability Information Parameters" on page 61

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:ESS <CESS>

Informs the associated stations if the network is an ESS type network.

Parameters:

<CESS> 0 | 1 | OFF | ON

*RST: 1

Example: `BB:WLNN:FBL1:BFC:CAP:ESS ON`
Informs the associated stations that the network is an ESS type network.

Manual operation: See "Capability Information Parameters" on page 61

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:IBACk <IBACk>

Informs the associated stations if immediate block Ack is allowed.

Parameters:

<IBACk> 0 | 1 | OFF | ON

*RST: 0

Example: `BB:WLNN:FBL1:BFC:CAP:IBACk ON`
Informs the associated stations that immediate block Ack is allowed.

Manual operation: See "Capability Information Parameters" on page 61

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:IBSS
<CIBSs>

Informs the associated stations if the network is an IBSS type network.

Parameters:
<CIBSs> 0 | 1 | OFF | ON
*RST: 0

Example: `BB:WLNN:FBL1:BFC:CAP:IBSS ON`
Informs the associated stations that the network is an IBSS type network.

Manual operation: See "Capability Information Parameters" on page 61

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:DBACk
<CDBAck>

Informs the associated stations if delayed block Ack is allowed.

Parameters:
<CDBAck> 0 | 1 | OFF | ON
*RST: 0

Example: `BB:WLNN:FBL1:BFC:CAP:DBAC ON`
Informs the associated stations that delayed block Ack is allowed.

Manual operation: See "Capability Information Parameters" on page 61

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:DOFDm
<CDOFdm>

Indicates if Direct Sequence Spread Spectrum - OFDM is allowed.

Parameters:
<CDOFdm> 0 | 1 | OFF | ON
*RST: 0

Example: BB:WLNN:FBL1:BFC:CAP:DOFD

Manual operation: See "Capability Information Parameters" on page 61

Informs the associated stations that Direct Sequence Spread Spectrum - OFDM is allowed.

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:PBCC <PBCC>

Informs the associated stations if PBCC is allowed.

Parameters:

<PBCC> 0 | 1 | OFF | ON

*RST: 0

Example: BB:WLNN:FBL1:BFC:CAP:PBCC ON

Manual operation: See "Capability Information Parameters" on page 61

Informs the associated stations that PBCC is allowed.

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:PRIVacy <PRIVacy>

Informs the associated stations if encryption is required for all data frames.

Parameters:

<PRIVacy> 0 | 1 | OFF | ON

*RST: 0

Example: BB:WLNN:FBL1:BFC:CAP:PRIV ON

Manual operation: See "Capability Information Parameters" on page 61

Informs the associated stations that encryption is required for all data frames.

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:QOS <QOS>

Informs the associated stations if quality of service (QoS) is supported.

Parameters:

<QOS> 0 | 1 | OFF | ON

*RST: 0

Example: `SOUR:BB:WLNN:FBL1:BFC:CAP:QOS ON`
Informs the associated stations that quality of service (QoS) is supported.

Manual operation: See "Capability Information Parameters" on page 61

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:RMEasurement <RMEasurement>

Informs the associated stations if radio measurement is supported.

Parameters:

<RMEasurement> 0 | 1 | OFF | ON

*RST: 0

Example: SOUR:BB:WLNN:FBL1:BFC:CAP:RME ON

Manual operation: See "Capability Information Parameters" on page 61

Informs the associated stations that radio measurement is supported.

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:SMGMt
<SMGMt>

Informs the associated stations if spectrum management is enabled.

Parameters:
<SMGMt> 0 | 1 | OFF | ON
*RST: 0

Example: `SOUR:BB:WLNN:FBL1:BFC:CAP:SMGM ON`
Informs the associated stations that spectrum management is enabled.

Manual operation: See "Capability Information Parameters" on page 61

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:SPReamble
<SPReamble>

Informs the associated stations if short preamble is allowed.

Parameters:
<SPReamble> 0 | 1 | OFF | ON
*RST: 0

Example: BB:WLNN:FBL1:BFC:CAP:SPR ON

Manual operation: See "Capability Information Parameters" on page 61

Informs the associated stations that short preamble is allowed.

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:SSTime
<SSTime>

Informs the associated stations if short slot time is supported.

Parameters:
<SSTime> 0 | 1 | OFF | ON
*RST: 0

Example: `BB:WLNN:FBL1:BFC:CAPability:SST ON`
Informs the associated stations that short slot time is supported.

Manual operation: See "Capability Information Parameters" on page 61

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:HTCapability:GFIeld
<GreenField>

Enables/disables the support for the reception of PPDUs with HT Greenfield format.

Parameters:
<GreenField> 0 | 1 | OFF | ON
*RST: 0

Manual operation: See "Green Field" on page 64

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:HTCapability:STATe
<State>

Activates/ deactivates the HT capability information element.

Parameters:
<State> 0 | 1 | OFF | ON
*RST: 0

Manual operation: See "State" on page 64

6.9.6.3 ERP Parameters

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:ERP:BPMode..... 195
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:ERP:NEPResent..... 195
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:ERP:UPRotection..... 196

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:ERP:BPMode
<EBPMode>

Informs associated stations whether to use the long or the short preamble.

Parameters:
<EBPMode> 0 | 1 | OFF | ON
*RST: 0

Example: `BB:WLNN:FBL1:BFC:ERP:BPM ON`
Informs associated stations that they should use the long preamble.

Manual operation: See "ERP Parameters" on page 63

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:ERP:NEPResent
<ENEPresent>

Sets Non-ERP Present on. This is needed if there is a non-ERP MU associated to the AP.

Parameters:
<ENEPresent> 0 | 1 | OFF | ON
*RST: 0

Example: `BB:WLNN:FBL1:BFC:ERP:NEPR ON`
Sets on Non-ERP Present.

Manual operation: See "ERP Parameters" on page 63

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:ERP:UPRotection <EUPRotection>

Informs associated stations if they have to use protection.

Parameters:
<EUPRotection> 0 | 1 | OFF | ON
*RST: 0

Example: `BB:WLNN:FBL1:BFC:ERP:UPR ON`
Informs associated stations that they have to use protection.

Manual operation: See "ERP Parameters" on page 63

6.9.7 Spatial Mapping Configuration

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SMAPping:MODE 196
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SMAPping:TSHift<st> 197
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SMAPping:INDex 197
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SMAPping:ROW<st>:COL<dir>:I? 198
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SMAPping:ROW<st>:COL<dir>:Q? 198

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SMAPping:MODE <Mode>

Selects the spatial mapping mode for the selected frame block. Except of the beamforming mode, the matrix element values are loaded by using info class methods.

Parameters:
<Mode> OFF | DIRect | EXPansion | BEAMforming | INDirect

OFF
(only "LEGACY" mode)
The spatial mapping mode is switched off automatically.

DIRect
(only active with physical modes MIXED MODE or GREEN FIELD when $N_{TX} = N_{STS}$)
The transmit matrix is a CSD matrix, that is, diagonal matrix of unit magnitude and complex values that represent cyclic shifts in the time domain.

EXPansion
(only active with physical modes MIXED MODE or GREEN FIELD)
The transmit matrix is the product of a CSD matrix and a square matrix formed of orthogonal columns, as defined in the IEEE 802.11n specification.

INDirect
(only active with physical modes MIXED MODE or GREEN FIELD)
The transmit matrix is the product of a CSD matrix and the Hadamard unitary matrix.

*RST: EXPansion

Example: `BB:WLNN:FBL1:SMAP:MODE OFF`
Sets the spatial mapping mode to OFF, that is, the spatial mapping mode is switched off automatically.

Manual operation: See " Mode " on page 82

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SMAPping:TSHift<st> <TShift>

Sets the spatial mapping time shift. This value is relevant for spatial mapping mode direct and spatial expansion only.

Parameters:
<TShift> float

Range: -32000 ns to 32000 ns
Increment: 1 ns
*RST: 0 ns

Example: `BB:WLNN:FBL1:SMAP:MODE TSH 1000`
Sets the spatial mapping time shift to 1000 ns.

Manual operation: See " Time Shift " on page 82

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SMAPping:INDex <Index>

Sets the index of the subcarrier. A matrix is mapped to each subcarrier. Except for k=0, the index can be set in the value range of -64 to 63

Parameters:
<Index> integer

Range: depends on TxMode to depends on TxMode
*RST: 20

Example: `BB:WLNN:FBL1:SMAP:IND 30`
Sets the index of the subcarrier to k = 30.

Manual operation: See " Index k " on page 82

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SMAPping:ROW<st>:COL<dir>:I?

Queries the time shift value of element I of the selected row and column of the spatial transmit matrix.

Return values:
<I> float

Example: `BB:WLNN:FBL1:SMAP:ROW2:COL2:I?`
queries the time shift value of element I for row 2, column 2.

Usage: Query only

Manual operation: See " I (Transmit Matrix) " on page 82

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SMAPping:ROW<st>:COL<dir>:Q?

Queries the time shift value of element Q of the selected row and column of the spatial transmit matrix.

Return values:
<Q> float

Example: `BB:WLNN:FBL1:SMAP:ROW2:COL2:Q?`
queries the time shift value of element Q for row 2, column 2.

Usage: Query only

Manual operation: See " Q (Transmit Matrix) " on page 83

List of commands

[:SOURce<hw>]:BB:WLNN:ANTenna:CMODe?....132
[:SOURce<hw>]:BB:WLNN:ANTenna:MODE....132
[:SOURce<hw>]:BB:WLNN:ANTenna:NOBB?....133
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