

IEEE 802.11n/IEEE 802.11ac Digital Standard for R&S®Signal Generators Operating Manual



1171.5519.12 – 16

This document describes the following software options:

- R&S®AMU-K54/-K254/-K86/-K286
1402.9705.02, 1402.9757.02, 1403.0899.02, 1403.0918.02
- R&S®SMATE-K54/-K86
1404.7951.02, 1404.8864.02
- R&S®SMBV-K54/-K254/-K86/-K286
1415.8160.xx, 1415.8354.xx, 1415.8648.xx, 1415.8654.xx
- R&S®SMJ-K54/-K254/-K86/-K286
1409.2458.02, 1409.2506.02, 1409.3448.02, 1409.3460.02
- R&S®SMU-K54/-K254/-K86/-K286
1408.7562.02, 1408.7610.02, 1408.8552.02, 1408.8575.02
- R&S®SMW-K254/-K286
1413.5187.02, 1413.5687.02
- R&S®AFQ-K254/-K286
1401.5806.02, 1415.0299.02
- R&S®SFU-K254
2115.2350.02

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Trade names are trademarks of the owners.

The following abbreviations are used throughout this manual: R&S®AMU200A is abbreviated as R&S AMU, R&S®SMATE200a is abbreviated as R&S SMATE, R&S®SMBV100A is abbreviated as R&S SMBV, R&S®SMJ100A is abbreviated as R&S SMJ, R&S®SMU200A is abbreviated as R&S SMU, R&S®SMW200A is abbreviated as R&S SMW, R&S®WinIQSIM2™ is abbreviated as R&S WinIQSIM2

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1 Preface

1.1 Documentation Overview

The user documentation for the R&S Signal Generator consists of the following parts:

- Online Help system on the instrument,
- "Quick Start Guide" printed manual,
- Documentation CD-ROM with:
 - Online help system (*.chm) as a standalone help,
 - Operating Manuals for base unit and options,
 - Service Manual,
 - Data sheet and specifications,
 - Links to useful sites on the R&S internet.

Online Help

The Online Help is embedded in the instrument's firmware. It offers quick, context-sensitive access to the complete information needed for operation and programming. The online help contains help on operating the R&S Signal Generator and all available options.

Quick Start Guide

The Quick Start Guide is delivered with the instrument in printed form and in PDF format on the Documentation CD-ROM. It provides the information needed to set up and start working with the instrument. Basic operations and an example of setup are described. The manual includes also general information, e.g., Safety Instructions.

Operating Manuals

The Operating Manuals are a supplement to the Quick Start Guide. Operating Manuals are provided for the base unit and each additional (software) option.

These manuals are available in PDF format - in printable form - on the Documentation CD-ROM delivered with the instrument. In the Operating Manual for the base unit, all instrument functions are described in detail. Furthermore, it provides an introduction to remote control and a complete description of the remote control commands with programming examples. Information on maintenance, instrument interfaces and error messages is also given.

In the individual option manuals, the specific instrument functions of the option are described in detail. For additional information on default settings and parameters, refer to the data sheets. Basic information on operating the R&S Signal Generator is not included in the option manuals.

Service Manual

The Service Manual is available in PDF format - in printable form - on the Documentation CD-ROM delivered with the instrument. It describes how to check compliance with rated specifications, on instrument function, repair, troubleshooting and fault elimination. It contains all information required for repairing the instrument by the replacement of modules.

This manual can also be ordered in printed form (see ordering information in the data sheet).

Release Notes

The release notes describe new and modified functions, eliminated problems, and last minute changes to the documentation. The corresponding firmware version is indicated on the title page of the release notes. The current release notes are provided in the Internet.

Web Helps

Web helps are provided for the base unit and each additional (software) option. The content of the web helps correspond to the user manuals for the latest product versions.

The web help is an additional file format that offers quick online access. They are not intended to be downloaded but rather to access the required information directly from the R&S website.

Web helps are available at the R&S website, on the R&S Signal Generator product page at the "Downloads > Web Help" area.

1.2 Typographical Conventions

The following text markers are used throughout this documentation:

Convention	Description
"Graphical user interface elements"	All names of graphical user interface elements on the screen, such as dialog boxes, menus, options, buttons, and softkeys are enclosed by quotation marks.
KEYS	Key names are written in capital letters.
File names, commands, program code	File names, commands, coding samples and screen output are distinguished by their font.
<i>Input</i>	Input to be entered by the user is displayed in italics.
Links	Links that you can click are displayed in blue font.
"References"	References to other parts of the documentation are enclosed by quotation marks.

2 IEEE 802.11 WLAN Signal Generation

The R&S Signal Generator provides you with the ability to generate signals in accordance with the Wireless LAN standards IEEE 802.11a/b/g/n/ac.

The option R&S SMx/AMU-K54 offers signal generation according to IEEE 802.11n, additionally legacy modes of IEEE 802.11a/b/g are supported. For IEEE 802.11ac signal generation option R&S SMx/AMU-K86 is required. At least one R&S SMx/AMU-K54 option must be installed on the respective instrument as a prerequisite.

The R&S Signal Generator supports all mandatory and almost all optional features of the IEEE 802.11 standard.

The following list gives an overview of the main features:

- Support of up to eight Tx antennas
- 20 MHz and 40 MHz
- 80 MHz bandwidth with option R&S SMx/AMU-K86
- 160 MHz bandwidth with R&S WinIQSIM2 and option R&S AFQ-K286
- Support of all three operation modes (Legacy, Mixed Mode, Green Field)
- Support of all legacy transmission modes (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 SMx/AMU-K86 (VHT-20 MHz, VHT-40 MHz, VHT-80 MHz, VHT-80+80 MHz)
- Additional support of VHT-160 MHz with R&S WinIQSIM2 and option R&S AFQ-K286
- Additional support of the CCK and PBCC frames in accordance with IEEE 802.11a/b/g standard
- Support of STBC (Space Time Block Coding) 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, as well as 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 SMx/AMU-K74/-B14/-B15

2.1 Signal Overview

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. Additionally, 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, whereas the non-HT mode can be seen as the part of 802.11n, which is backwards compatible to 802.11a/g.

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. Additionally, 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.

2.1.1 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 802.11a/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 802.11a/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.

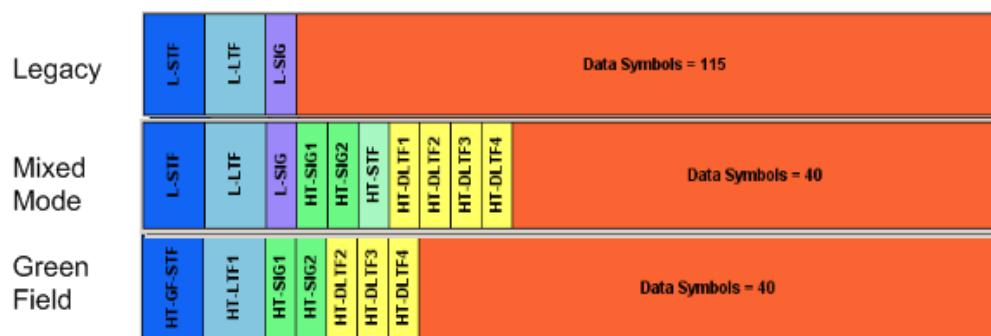


Fig. 2-1: PLCP Packet format for IEEE 802.11

The [table 2-1](#) 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 sub-carriers of the upper channel on the lower channel.

Table 2-1: Frequency Domain PHY Operation

LM	Legacy mode as in IEEE 802.11a/g Additionally 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 and 80 MHz, 1...8 spatial streams (option R&S SMx/AMU-K86 required)
VHT-Mode	Frequency 160 MHz, 1...8 spatial streams (R&S WinIQSIM2 and option R&S AFQ-K286 required)

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

2.1.2 Signal Generation

The generation of an IEEE 802.11n/ac 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 these configurable mapping is the possibility to generate a combined signal from different antennas in case of one path instrument or limited number of base-band paths.

Refer to [figure 2-2](#) for an overview of the signal flow for generation of such a signal in HT mode.

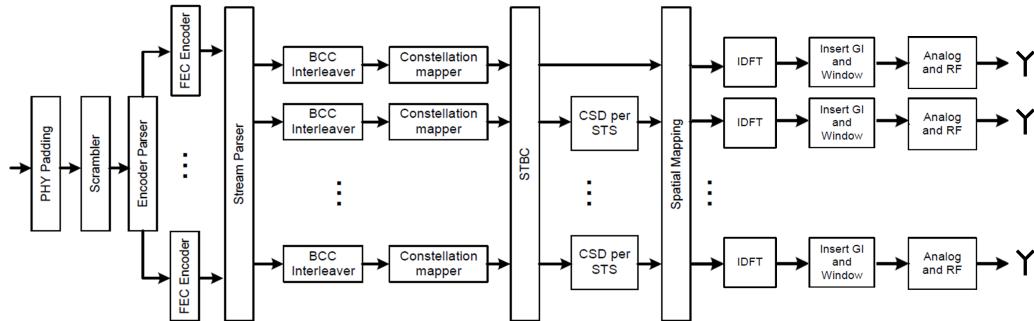


Fig. 2-2: IEEE 802.11 n/ac Transmission chain

2.2 Typical Workflows

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

The test scenarios require different number of baseband paths, i.e. instruments. For receiver test for example, the number of the Rx antenna to be simulated simultaneously determines the number of the required basebands of one or more instruments, since one baseband generates the signal of one Rx antenna. In case of transmitter test applications, the number of the Tx antenna to be simulated determines the number of the required basebands of one or more instruments, since one baseband generates the signal of one Tx antenna.

This chapter provides examples of some typical generic workflows and setups for working with this option.

2.2.1 Generating a 4xN or 3xN MIMO WLAN-n/ac Signal with two R&S Signal Generators for Transmitter Tests

This example shows the connection and configuration of two two-path instruments for the generation of WLAN-n/ac signal for transmitter tests. Signal generated in this way can be additionally fed to a fading simulator (requires option R&S SMU/AMU-K74/B14/B15) for the simulation of realistic MxN MIMO channel conditions.

This example shows the connection and configuration of two two-path instruments for the generation of WLAN-n/ac signal for transmitter tests. Signal generated in this way can be additionally fed to a fading simulator (requires option R&S SMU/AMU-K74/B14/B15) for the simulation of realistic MxN MIMO channel conditions (see [chapter 2.2.3, "Generating a Realistic MxN MIMO WLAN-n/ac Signal for Receiver Test under Real Word Conditions", on page 18](#)).

The 4xN and 3xN MIMO WLAN-n/ac signal generation scenario requires two two-path instruments.

The instruments have to be configured and connected as described in the following sections. Since the configuration and connection of the instruments is identical for both scenarios, only the 4xN MIMO case is explained.

Connecting two two-path R&S Signal Generators for 4xN MIMO WLAN-n/ac signal generation

Connect the instruments as follow:

1. To provide the instruments with reference frequency, connect either the inputs REF IN of both instruments to the external reference source or connect the output REF OUT of the first instrument (the R&S Signal Generator that will simulate Tx 1) to the input REF IN of the second one.
2. Provide an external trigger source to the inputs TRIGGER 1 for both paths of both instruments.

3. Avoid unnecessary cable lengths and branching points.

The figure below shows the cabling of two two-path R&S Signal Generators for generating a 4xN MIMO WLAN-n/ac signal.

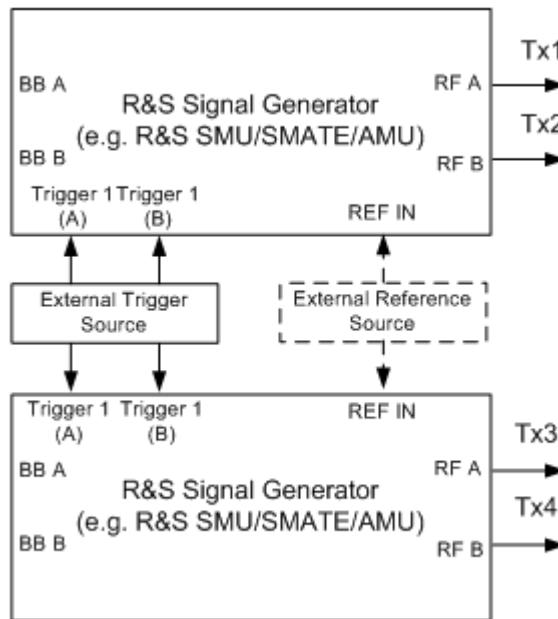
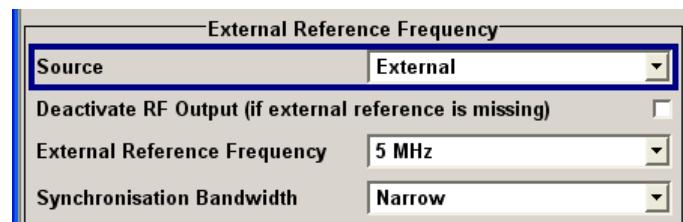


Fig. 2-3: Connecting two two-path R&S Signal Generators for the generation of 4xN MIMO WLAN-n/ac signal

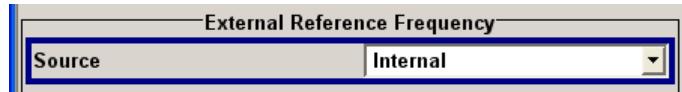
Configuring two R&S Signal Generators for MxN MIMO Simulation

1. Configure the Reference Oscillator Settings, depending on whether an External Reference Source or the Reference Signal (REF OUT) of the first instrument is used.
 - a) Select "External Reference Frequency Source" for both instruments and configure the Synchronization Bandwidth and the External Reference Frequency accordingly.



SCPI command: SOUR:ROSC:SOUR EXT

- b) Use the Reference Frequency of the first instrument, i.e. select an "Internal Reference Frequency Source" for the first instrument and an External one for the second instrument.



SCPI command (R&S Signal Generator #1):

SOUR:ROSC:SOUR INT

SCPI command (R&S Signal Generator #2):

SOUR:ROSC:SOUR EXT

2. For both instruments, select an "External Trigger Source".



SCPI command:

SOUR:BB:WLNN:TRIG:SOUR EXT | BEXT

3. Configure the first instrument to generate the desired WLAN-n/ac signal:

- a) In the WLAN-n/ac main menu of the first instrument, enable signal generation in coupling mode (enable parameter "Configure Baseband B from Baseband A").



SCPI command:

SOUR:BB:WLNN:PATH:COUP:STAT ON

- b) In the "Tx Antenna Setup" menu of the first instrument, select four "Antennas". The number of the Tx Antennas determines the value M in the MxN MIMO system and the number of the transmission chains.



SCPI command:

SOUR:BB:WLNN:ANT:MODE A4

- c) In the "Tx Antenna Setup" menu of the first instrument, enable the Baseband A of the instrument to generate the Tx 1 signal and respectively the Baseband B to generate the Tx 2 signal.

Use the default values of the transmission chain matrix.

	Output	File
O1	Baseband A	
O2	Baseband B	
O3	Off	
O4	Off	

SCPI command:

```
SOUR:BB:WLNN:ANT:TCH1:OUTP:DEST BB
SOUR:BB:WLNN:ANT:TCH2:OUTP:DEST BB_B
SOUR:BB:WLNN:ANT:TCH3:OUTP:DEST OFF
SOUR:BB:WLNN:ANT:TCH4:OUTP:DEST OFF
```

- d) To enable the R&S Signal Generator to generate a WLAN-n/ac 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.

SCPI command:

```
SOUR:POW -30
SOUR2:POW -20
```

- e) Use the default "Frame Block Configuration" settings or adjust them as required.
- f) Use the default "PPDU Configuration" settings or adjust them if necessary to, for instance, add redundancy.
- g) Enable signal generation.

SCPI command:

```
SOUR:BB:WLNN:STAT ON
```

4. Enable the second instrument to generate the Tx 3 and Tx 4 of the same WLAN-n/ac signal:

- a) Save the settings of the first instrument by means of the "Save/Recall" function and copy the settings file to USB stick, external USB HDD, or use a LAN connection to transfer the settings file.

SCPI command (R&S Signal Generator #1):

```
SOUR:BB:WLNN:SETT:STOR "c:/11n_Settings/wlann_settings1"
```

- b) Connect the USB stick or the USB HDD to USB connector of Instrument#2 and copy the settings file to the instrument's target directory, e.g. c:/11n_Instrument1.

- c) Load the settings file of R&S Signal Generator #1 to R&S Signal Generator #2.

SCPI command (R&S Signal Generator #2):

```
SOUR:BB:WLNN:SETT:STOR "c:
/11n_Instrument1/wlann_settings1"
```

- d) In the "Tx Antenna Setup" menu of the second instrument, enable the Baseband A of the instrument to generate the Tx 3 signal and respectively the Baseband B to generate the Tx 4 signal and activate the digital standard in the second one.

SCPI command (R&S Signal Generator #2):

```
SOUR:BB:WLNN:ANT:TCH3:OUTP:DEST BB
SOUR:BB:WLNN:ANT:TCH4:OUTP:DEST BB_B
SOUR:BB:WLNN:ANT:TCH1:OUTP:DEST OFF
SOUR:BB:WLNN:ANT:TCH2:OUTP:DEST OFF
SOUR:BB:WLNN:STAT ON
```

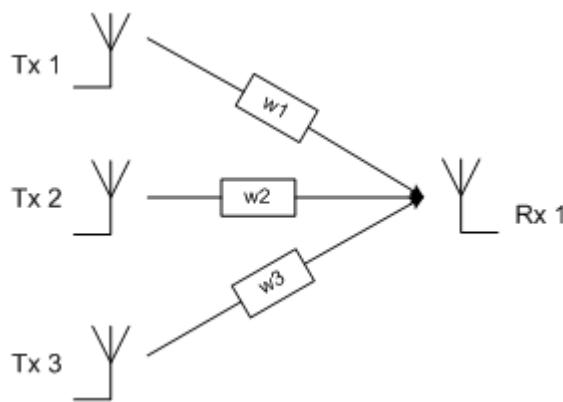
5. Send an external trigger signal.

2.2.2 Generating a Realistic MxN MIMO WLAN-n/ac Signal for Receiver Test under Static Conditions

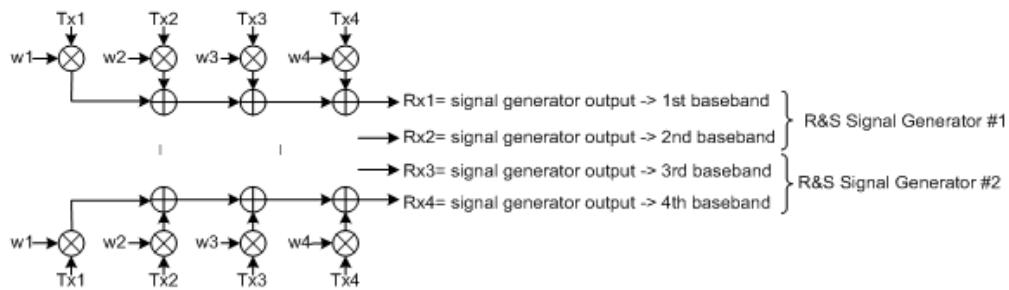
Generating a Realistic MxN MIMO WLAN-n/ac Signal for Receiver Test under Static Conditions

This example shows you how to enable the R&S Signal Generator to generate a WLAN-n/ac 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 Tx 1 .. Tx 3 and one receiving antenna Rx 1. The channel is represented by the weight coefficients w_1 .. w_3 .



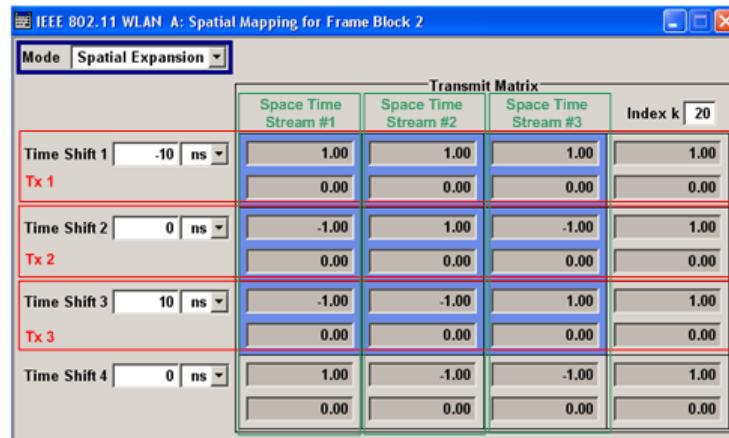
The R&S Signal Generator provides the possibility to weight, sum and map the generated Tx antenna signals to the output(s) of the signal generator, i.e. to simulate a frequency flat MIMO channel conditions for single carrier analysis e.g. BER tests.



The R&S Signal Generator generates the WLAN-n/ac signal of one Rx antenna per baseband path. Hence, two two-path instruments are required for the Mx4 MIMO receiver testing and respectively one two-path instrument or two one-path instruments for the Mx2 MIMO receiver testing.

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

1. Use the default "Frame Block Configuration" settings or adjust them as required.
2. Use the default "PPDU Configuration" settings or adjust them if necessary to, for instance, add redundancy.
3. In the "Tx 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.
SCPI command:
`SOUR:BB:WLNN:ANT:MODE A3`
4. Configure the subcarrier to be analyzed, i.e. configure the "Spatial Mapping Mode" and set the "Time Shifts".



SCPI commands:

`SOUR:BB:WLNN:FBL1:SMAP:MODE EXP`

`SOUR:BB:WLNN:FBL1:SMAP:TSH1 -10`

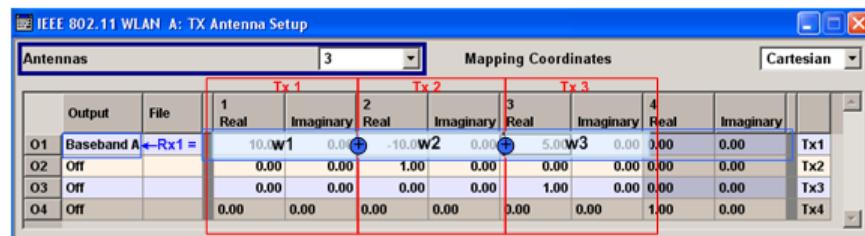
`SOUR:BB:WLNN:FBL1:SMAP:TSH3 10`

5. In the Tx Antenna Setup dialog, enable the Baseband A to generate the Rx 1 signal.

SCPI command:

```
SOUR:BB:WLNN:ANT:TCH1:OUTP:DEST BB
SOUR:BB:WLNN:ANT:TCH2|TCH3|TCH4:OUTP:DEST OFF
```

6. Select the mapping coordinates and adjust the weights of the Tx signals in the Transmission Chain Matrix.



SCPI command:

```
SOUR:BB:WLNN:ANT:SYST CART
SOUR:BB:WLNN:ANT:TCH1:TX1:REAL 10
SOUR:BB:WLNN:ANT:TCH1:TX2:REAL -10
SOUR:BB:WLNN:ANT:TCH1:TX3:REAL 5
SOUR:BB:WLNN:ANT:TCH1:TX1|TX2|TX3:IMAG 0
```

7. To enable the R&S Signal Generator to generate a WLAN-n/ac 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.

SCPI command:

```
SOUR:POW -30
SOUR2:POW -20
```

8. Enable signal generation.

SCPI command:

```
SOUR:BB:WLNN:STAT ON
```

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

2.2.3 Generating a Realistic MxN MIMO WLAN-n/ac Signal for Receiver Test under Real Word Conditions

for R&S SMU and R&S AMU instruments only

The simulation of real-time MIMO channel condition requires instruments equipped with the fading options R&S SMU/AMU-K74/-B14/-B15.

The instrument(s) have to be configured as follows:

1. Enable the instrument to generate a 2xN, 3xN or 4xN MIMO WLAN-n/ac signal as described in [chapter 2.2.1, "Generating a 4xN or 3xN MIMO WLAN-n/ac Signal with two R&S Signal Generators for Transmitter Tests", on page 12](#).
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.

2.2.4 Generating a 160MHz WLAN 11ac Signal

The [figure 2-4](#) shows an example test setup for generating a 160MHz WLAN 11ac signal.

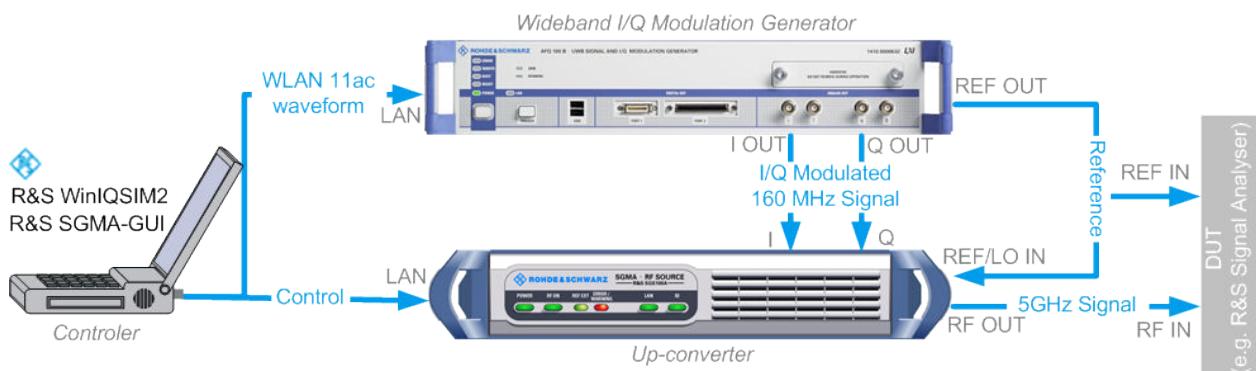


Fig. 2-4: Example test setup

The following equipment is required:

- 1 x R&S®AFQ100B equipped with latest firmware version and 1 x option R&S AFQ-K286.
- 1 x R&S®SGS100A equipped with option R&S SGS-B106V.
- Controller with installed R&S WinIQSIM2 for WLAN 11ac waveform generation and R&S®SGMA-GUI software tool for manual control of the R&S®SGS100A.

Overview of the required steps



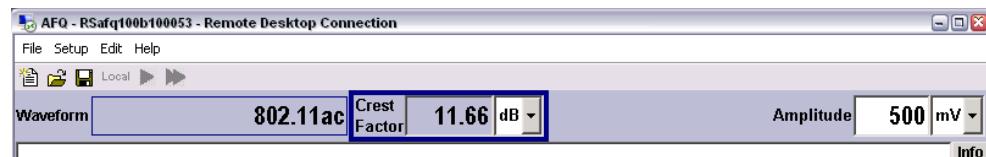
This description focus only on steps required for the generation of the waveform. For description and information on how to configure the R&S AFQ100B and the R&S SGS100A, refer to the User Manual of the corresponding instrument and respectively to the R&S WinIQSIM2 Software Manual.

1. Connect the test equipment and provide the wideband signal to be up-converted at the I and Q connectors of the R&S SGS.
2. Configure the R&S WinIQSIM2 to generate the WLAN 11ac waveform with 160 MHz bandwidth (see ["Creating waveform and transferring it to the R&S AFQ"](#) on page 20).
3. Transfer the generated waveform to the R&S AFQ.

4. Adjust the required R&S SGS settings, e.g.
 - a) set the RF frequency at the RF output connector to 5 GHz
 - b) set the RF Level to the value displayed in the "Crest Factor" field of the R&S AFQ, e.g. 11.66 dB to ensure correct R&S SGS output power with the corresponding crest factor.
 - c) adjust the I and Q offsets
 - d) enable signal generation, set "RF ON" and "Mod ON".

Creating waveform and transferring it to the R&S AFQ

1. In the R&S WinIQSIM2, select "Baseband > IEEE802.11" and set "Transmission Bandwidth > 160 MHz".
Adjust further setting as required.
2. In R&S WinIQSIM2 main dialog, select "Arb Sig Gen > Config > Instruments" and trigger "Scan".
The list of the "Available Instruments" is updated.
3. Select "Arb Sig Gen > Undefined" and scroll the list to select the connected R&S AFQ.
The "LAN" and "Remote Control" connections are established.
4. Select "Baseband > IEEE802.11 > State > ON".
5. In the R&S WinIQSIM2 main dialog, select "Transmission > Transmit".
6. In the Waveform Transmission to Arbitrary Waveform Generator" dialog, select "Source > Internal (WinIQSIM2)", "Destination > Instrument" and press "Transmit".
7. In the R&S WinIQSIM2 main dialog, select "Arb Sig Gen > Config > Remote Desktop" and connect to the R&S AFQ.



The instrument header confirms 802.11ac waveform processing and displays the "Crest Factor".

3 WLAN User Interface

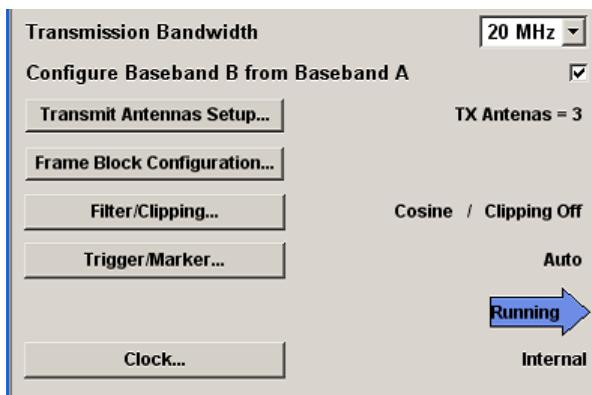
WLAN Standards
IEEE 802.11 a/b/g...
IEEE 802.11...

- To access the dialog, select "Baseband Block > IEEE 802.11"

The dialog is split into several sections for configuring the standard. The upper section of the dialog is where the IEEE 802.11 WLAN digital standard is enabled and the transmission bandwidth is selected. A button leads to dialogs for loading and saving the IEEE 802.11 WLAN configuration.



The buttons of the lower dialog section lead to dialogs for setting the transmission antennas and configuring the frame blocks.



The screenshots provided in this description show parameter values that have been selected to illustrate as much as possible of the provided functions and possible inter-dependencies between them.

These values are not necessarily representative of realistic test situations.

3.1 General Settings for WLAN Signals

This section describes the general IEEE 802.11 WLAN settings, like enabling the standard and configuring the transmission bandwidth.

State

Enables/disables the IEEE 802.11 WLAN standard.

Enabling this standard disables all the other digital standards and digital modulation modes (in case of two-path instruments, this affects the same path).

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:STATE](#) on page 87

Set to default

Calls the default settings. The following table gives an overview of the settings. The preset value for each parameter is specified in the description of the remote-control commands.

Parameter	Value
General Parameters	
State	Does not change
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
Space Time Streams	1
Extended Spatial Streams	0
Space Time Block Coding	inactive

Parameter	Value
Parameter Value	
MCS	1
Data Rate (Mbps)	13
Data Bits Per Symbol	52
Stream 1	QPSK
Channel Coding	BCC
Coding Rate	$\frac{1}{2}$
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

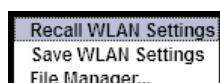
Remote command:

[\[:SOURce<hw>\] :BB:WLNN:PRESet on page 84](#)

Save/Recall

Calls the "Save/Recall" menu.

From the "Save/Recall" menu, the "File Select" windows for saving and recalling IEEE 802.11 WLAN configurations and the "File Manager" can be called.



IEEE 802.11 WLAN configurations are stored as files with the predefined file extension *.wlann. The file name and the directory they are stored in are user-definable.

The complete settings in the "IEEE 802.11 WLAN" menu are saved and recalled.

- "Recall WLAN setting" Opens the "File Select" window for loading a saved IEEE 802.11 WLAN configuration.
The configuration of the selected (highlighted) file is loaded by pressing the "Select" button.
- "Save WLAN setting" Opens the "File Select" window for saving the current IEEE 802.11 WLAN signal configuration.
The name of the file is specified in the "File name" entry field, the directory selected in the "save into" field. The file is saved by pressing the "Save" button.
The "Fast Save" checkbox determines whether the instrument performs an absolute or a differential storing of the settings. Enable this function to accelerate the saving process by saving only the settings with values different to the default ones. "Fast Save" is not affected by the "Preset" function.
- "File Manager" Calls the "File Manager".
The "File Manager" is used to copy, delete, and rename files and to create new directories.

Remote command:

[:SOURce<hw>] :BB:WLNN:SETTing:CATalog? on page 85
[:SOURce<hw>] :BB:WLNN:SETTing:LOAD on page 86
[:SOURce<hw>] :BB:WLNN:SETTing:STORe on page 86
[:SOURce<hw>] :BB:WLNN:SETTing:STORe:FAST on page 87
[:SOURce<hw>] :BB:WLNN:SETTing:DElete on page 86

Data List Management...

Calls the "Data List Management" menu. This menu is used to create and edit a data list.



All data lists are stored as files with the predefined file extension *.dm_iqd. The file name and the directory they are stored in are user-definable.

The data lists must be selected as a data source from the submenus under the individual function, e.g. in the channel table of the cells.

Note: All data lists are generated and edited by means of the SOURce:BB:DM subsystem commands. Files containing data lists usually end with *.dm_iqd. The data lists are selected as a data source for a specific function in the individual subsystems of the digital standard.

Example: Creating and editing the data list:

```
SOUR:BB:DM:DLIS:SEL 'd_list1'  
SOUR:BB:DM:DLIS:DATA #B1111010101000001111....  
SOUR:BB:DM:DLIS:DATA:APP #B1111010101000001111....
```

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:DATA on page 113](#)
[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:DATA:DSElection on page 113](#)

Generate Waveform File...

Calls the "Generate Waveform" menu. This menu is used to store the WLAN output stream with "Baseband" destination as ARB signal in a waveform file.

This file can be loaded in the "ARB" menu and processed as multi carrier or multi segment signal.

The file name is entered in the submenu. The file is stored with the predefined file extension *.wv. The file name and the directory it is stored in are user-definable.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:WAveform:CREate on page 87](#)

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 82](#)

Configure Baseband B from Baseband A

(The parameter is available only in path A of two-path instruments)

Enables/disables coupling of both baseband paths, i.e. control of both paths via the WLAN menu.

Note: For instruments with enabled parameter "Configure Baseband B from Baseband A", enabling the WLAN signal generation in path A disables all other digital standards and digital modulation modes in path B.

"ON"	<p>An active coupling mode is useful for MIMO signal setups. In this case, baseband B is controlled from baseband A and generates an identical setup.</p> <p>The assignment which baseband generates the signal of which antenna is done in the Generating a 4xN or 3xN MIMO WLAN-n/ac Signal with two R&S Signal Generators for Transmitter Tests.</p> <p>Provide an external common trigger source for both baseband paths. Triggering is performed automatically such that both basebands are aligned in time.</p> <p>Changing of any parameter restarts the signal generation in both paths.</p> <p>For description on how to enable two R&S Signal Generators to simulate an MIMO WLAN signal, see chapter 2.2.1, "Generating a 4xN or 3xN MIMO WLAN-n/ac Signal with two R&S Signal Generators for Transmitter Tests", on page 12.</p>
"OFF"	Corresponds to normal operation, i.e. independent configuration of both paths.

Remote command:

`[:SOURce<hw>] :BB:WLNN:PATH:COUpling[:STATe]` on page 84

Transmit Antennas Setup

Calls the menu for configuring the TX antennas.

The menu is described in [chapter 3.2, "Transmit Antenna Setup"](#), on page 27.

Remote command:

n.a.

Frame Block Configuration

Calls the menu for configuring the frame blocks.

The menu is described in [chapter 3.3, "Frame Block Configuration"](#), on page 29 .

Remote command:

n.a.

Filter/Clipping Settings

Calls the menu for setting baseband filtering and clipping. The current setting is displayed next to the button.

The filter settings are enabled for configuration only for [Transmission Bandwidth](#) to 20 MHz.

The menu is described in [chapter 3.9, "Filter / Clipping Settings"](#), on page 65.

Remote command:

n.a.

Trigger/Marker

(Trigger for R&S SMx and R&S AMU instruments only)

Calls the menu for selecting the trigger source, for configuring the marker signals and for setting the time delay of an external trigger signal (see [chapter 3.10, "Trigger/Marker/Clock Settings"](#), on page 69).

The currently selected trigger source is displayed to the right of the button.

Remote command:

n.a.

Execute Trigger

(R&S SMx and R&S AMU instruments only)

Executes trigger manually.

A manual trigger can be executed only when an internal trigger source and a trigger mode other than "Auto" have been selected.

Remote command:

[**:SOURce<hw>**] :BB:WLNN:TRIGGER:EXECUTE on page 95

Clock

(R&S SMx and R&S AMU instruments only)

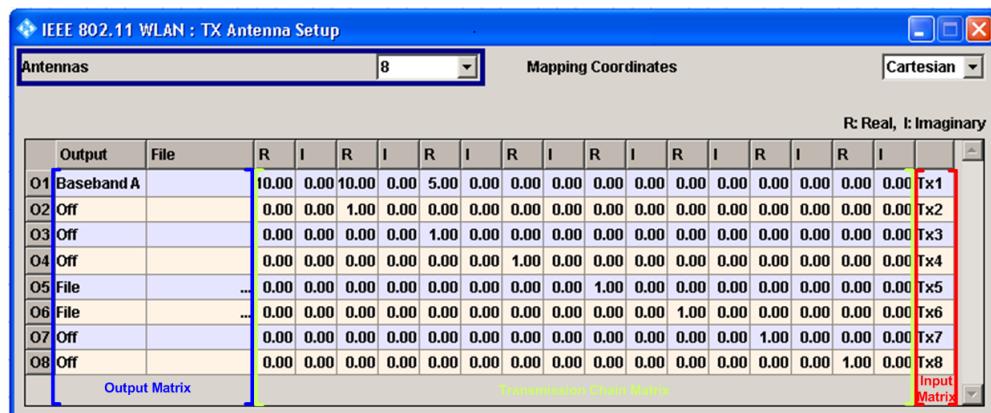
Calls the menu for selecting the clock source and for setting a delay (see [chapter 3.10, "Trigger/Marker/Clock Settings", on page 69](#)).

Remote command:

n.a.

3.2 Transmit Antenna Setup

- To access this dialog select "Main Menu > 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.

3.2.1 Antenna and Mapping Setting

Antennas

Selects the number of transmit antennas to be used.

For description on how to enable R&S Signal Generator to simulate an MIMO WLAN signal, see [chapter 2.2, "Typical Workflows", on page 12](#).

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:ANTenna:MODE on page 109](#)

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 109](#)

3.2.2 Transmission Chain Matrix

The transmission chain matrix can be used to adjust the channel coefficients.

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

Selects the destination of the calculated IQ chains.

"OFF" No mapping takes place.

"Baseband" The IQ chain is output to the selected baseband. Exactly one output A/B" 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 110](#)

[\[:SOURce<hw>\]:BB:WLNN:ANTenna:TChain<ch>:OUTPut:FSElect on page 110](#)

Real/Magnitude

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 110](#)

For Cylindrical mapping coordinates:

[\[:SOURce<hw>\]:BB:WLNN:ANTenna:TCHain<ch>:TX<dir>:MAGNitude](#)

on page 111

Imaginary/Phase

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](#)

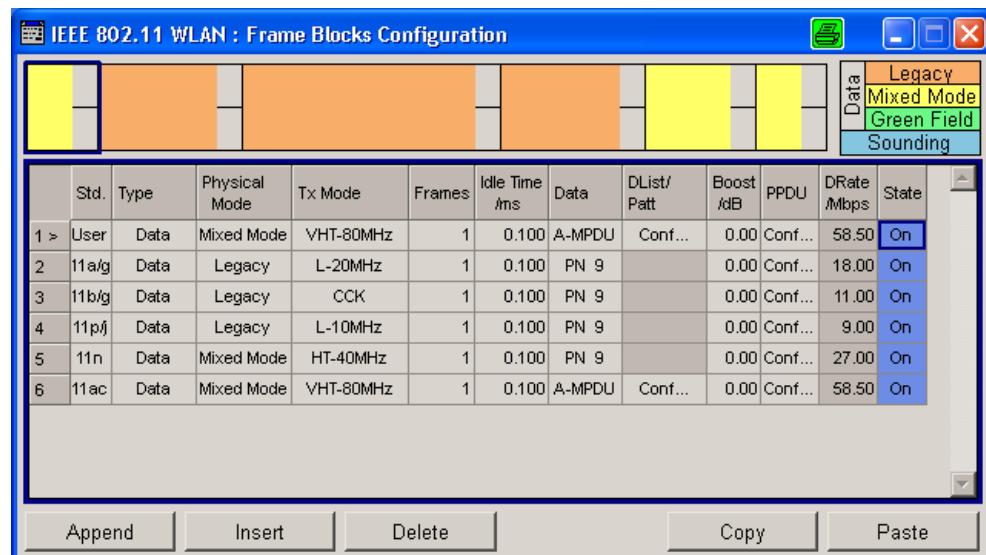
on page 111

For Cylindrical mapping coordinates:

[\[:SOURce<hw>\]:BB:WLNN:ANTenna:TCHain<ch>:TX<dir>:PHASE on page 111](#)

3.3 Frame Block Configuration

- To access this dialog select "Main Menu > Frame Block Configuration".



This tab comprises the settings for configuration of the selected frame block.

Provided are the following settings:

Standard

Selects the IEEE 802.11 WLAN standard. After you have set your standard only the for this standard relevant "Type", "Physical Mode" and "Tx Mode" are available, see [table 3-1](#).

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

Standard	Type	Physical Mode	Tx Mode
User	all	all	all
11a/g	Data/ Beacon	Legacy	L-20MHz
			L-Duplicate
			L-Upper
			L-Lower
11b/g	Data/ Beacon	Legacy	CCK
			PBCC
11p/j	Data/ Beacon	Legacy	L-10MHz
11n	Data/ Sounding/Beacon	Mixed Mode/ Green Field	HT-20MHz
			HT-40MHz
			HT-Duplicate
			HT-Upper
			HT-Lower
11ac	Data/ Sounding/ Beacon	Mixed Mode	VHT-20MHz
			VHT-40MHz
			VHT-80MHz
			VHT-80 + 80 MHz
			VHT-160MHz

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:STANDARD](#) on page 115

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.

Remote command:

[**:SOURce<hw>]:BB:WLNN:FBLOCK<ch>:TYPE** on page 116

Physical Mode

Selects the preamble design.

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

From 80 MHz transmission bandwidth in the frame block "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. Additionally, 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) and 802.11a/g OFDM devices.

"Green Field" For HT networks only.

Remote command:

[**:SOURce<hw>]:BB:WLNN:FBLOCK<ch>:PMODE** on page 115

Tx Mode

Sets the Tx mode.

The available Tx modes are dependent on the physical mode (see table below).

Type	Physical Mode	Tx Mode	Transmission Bandwidth			
			20 MHz	40 MHz	80 MHz	160 MHz
Data	Legacy	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
Data / Sound-ing	Mixed Mode	HT-20MHz	X	X	X	X
		HT-40MHz	-	X	X	X
		HT-Duplicate	-	X	X	X
		HT-Upper	-	X	X	X

Type	Physical Mode	Tx Mode	Transmission Bandwidth			
			20 MHz	40 MHz	80 MHz	160 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
Data	Green Field	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
Sounding	Green Field	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
Beacon	Legacy	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 116

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 112

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 114

Data

Selects the data source.

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 "Main Dialog > Data List Management".

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:DATA](#) on page 113

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:DATA:PATTern](#) on page 114

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:DATA:DSELection](#) on page 113

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 a 0 dB value for this gated power mode functionality to work properly.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:BOOST](#) on page 112

PPDU

Calls the dialog for PPDU configuration of the frame blocks.

The dialog is described in [chapter 3.4, "PPDU Configuration"](#), on page 34.

Remote command:

n.a.

Data Rate/Mbps

Indicates the PPDU data rate.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:DATA:RATE?](#) on page 114

State

Enables the corresponding frame block for transmission.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:STATE](#) on page 116

Append

Adds a default frame block behind the selected frame block.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock:APPend](#) on page 83

Insert

Adds a default frame block before the selected frame block.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:INSert](#) on page 83

Delete

Deletes the selected frame block.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:DELetE](#) on page 83

Copy

Copies the selected frame block.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:COPY](#) on page 83

Paste

Pastes the copied frame block behind the selected frame block.

Remote command:

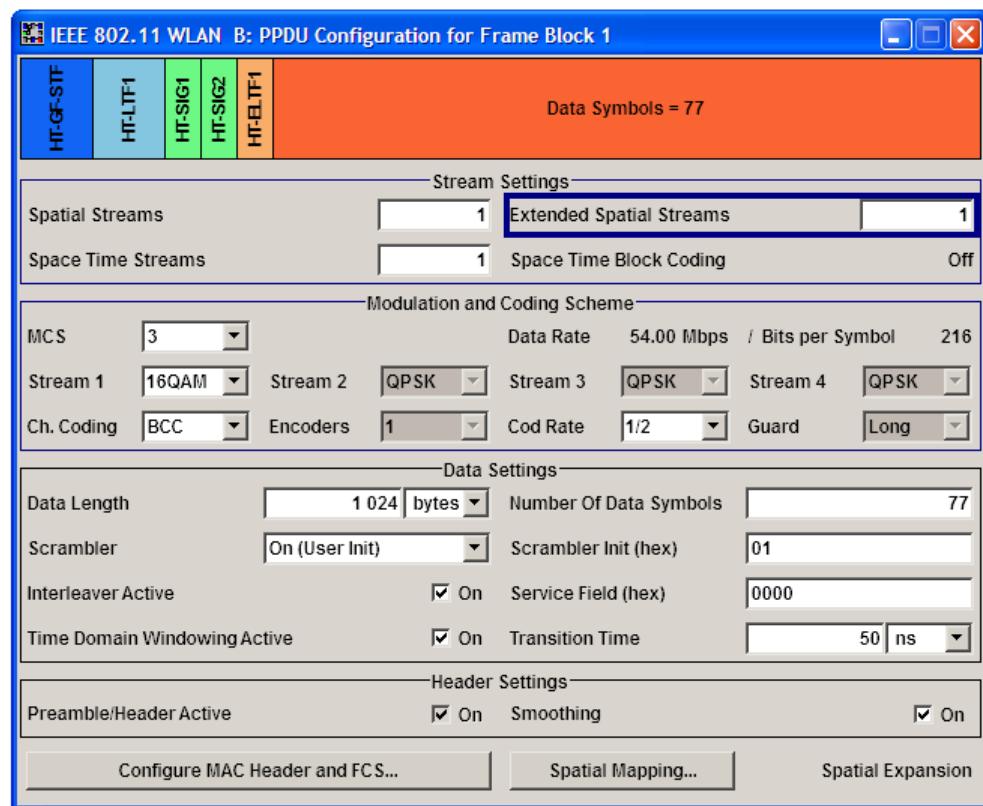
[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:PASTe](#) on page 84

3.4 PPDU Configuration

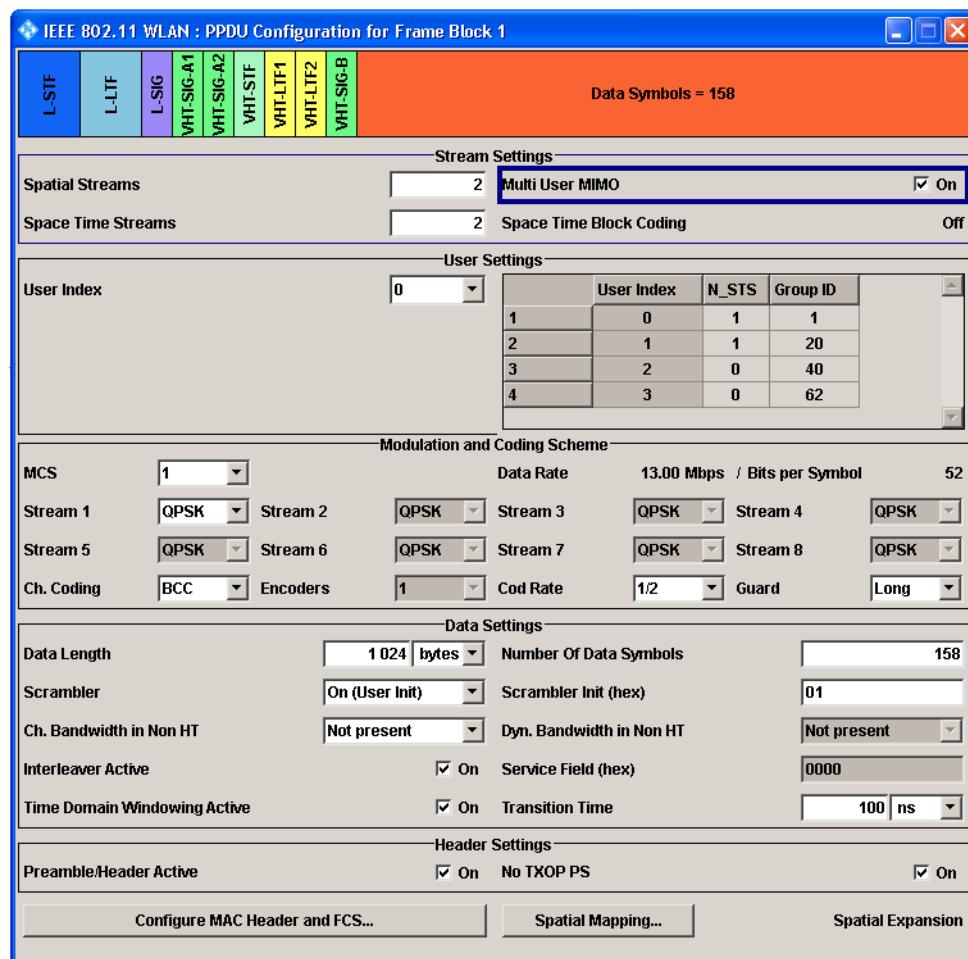
In the "PPDU Configuration" dialog, the PPDU configuration for all frames in the selected frame block is done.

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

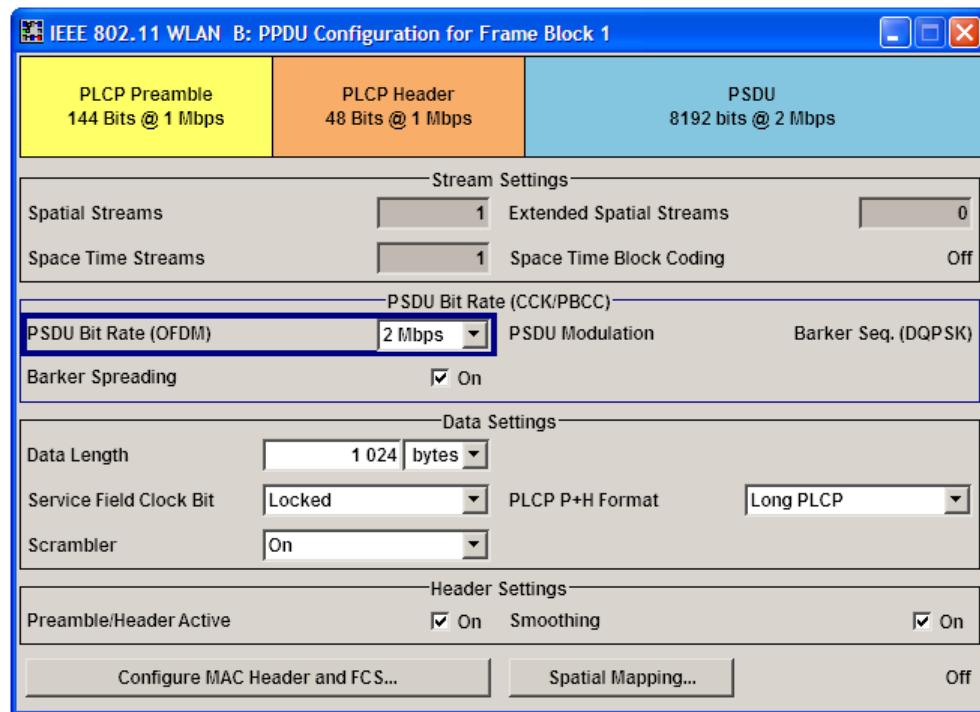
The figure below shows the settings of the "PPDU Configuration" for "Type > Sound-ing" and "Physical Mode > Green Field".



The following figure shows the parameters for a configuration of the "Type > Data" in "Physical Mode > Mixed Mode", and "Multi User MIMO" function.



The figure below shows the parameters of a "PPDU Configuration" for "Physical Mode > Legacy" and "Tx Mode > CCK/PBCC".



3.4.1 General Settings

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

3.4.1.1 Stream Settings

Provided are the following settings:

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 128

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 129

Extended Spatial Streams

Enters the value of the extended spatial streams. This field is active for "Type > Sound-ing" only to probe additional dimensions of the channel.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:ESSTream](#) on page 121

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 123

Segment

(available only for "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 or 160 MHz. Both segments can be only generated with bandwidth 160 MHz.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:SEGment](#) on page 127

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 129

3.4.1.2 User Settings

Provided are the following settings:

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 130

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 123

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:MU<st0>:GID](#) on page 123

3.4.1.3 Modulation and Coding Scheme

Provided are the following settings:

MCS

Selects the modulation and coding scheme for all spatial streams.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:MCS](#) on page 122

Data Rate/Mbps

Indicates the PPDU data rate.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:DATA:RATE?](#) on page 114

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 120

Stream n

Selects the modulation used for the selected spatial stream.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:MODulation<st>](#) on page 123

Channel Coding

Selects the channel coding.

"Off" No channel coding is used.

"BCC" Binary convolution code

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:CODing:TYPE](#) on page 119

Encoders

Displays the number of encoders to be used. This value depends on the data rate. For data rate \leq 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 119

Cod Rate

Selects the coding rate.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:CODing:RATE](#) on page 119

Guard

Selects whether a long or short guard interval is used for the OFDM guard. In "Physical Mode > Green Field /Legacy" only long guard intervals are possible. In this case, the field is read-only.

Remote command:

[:SOURce<hw>] :BB:WLNN:FBLOCK<ch>:GUARD on page 122

3.4.1.4 PSDU Bit Rate (CCK/PBCC)

Provided are the following settings:

PSDU Bit Rate

(available only for "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 125

PSDU Modulation

(available only for "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:PSDU:MODULATION? on page 85

Barker Spreading

(available only for "Tx Mode > CCK/PBCC")

Activates/deactivates Barker spreading (bit rates 1 Mbps or 2 Mbps only).

Remote command:

[:SOURce<hw>] :BB:WLNN:FBLOCK<ch>:PSDU:BSPReading:STATE on page 126

3.4.2 Data Settings

Data Length

Sets 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 "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 120

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 in case of 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 126

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 118

Interleaver Active

Activates/deactivates the interleaver of the data field.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:ILEaver:STATE](#) on page 122

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 129

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 and displays it at "Data Length".

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:DATA:SYMBols](#) on page 121

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 127

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 is capable of "Static" or "Dynamic" bandwidth operation.

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

"Static" The transmitter is capable of static bandwidth operation.

"Dynamic" The transmitter is capable of dynamic bandwidth operation.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:DBINonht](#) on page 121

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 128

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 130

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 this is the case (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 125

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 124

3.4.3 Header Settings

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 125

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 128

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 124

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 124

Configure MAC Header and FCS

Calls the menu of the MAC Header and FCS Configuration to configure the MAC of each frame in this frame block.

The menu is described in [chapter 3.6, "MAC Header and FCS Configuration for Frame Block"](#), on page 46.

Remote command:

n.a.

Spatial Mapping

Calls the menu for spatial mapping to configure the spatial mapping to be used for the selected frame block. The menu is described in [chapter 3.8, "Spatial Mapping"](#), on page 62.

Remote command:

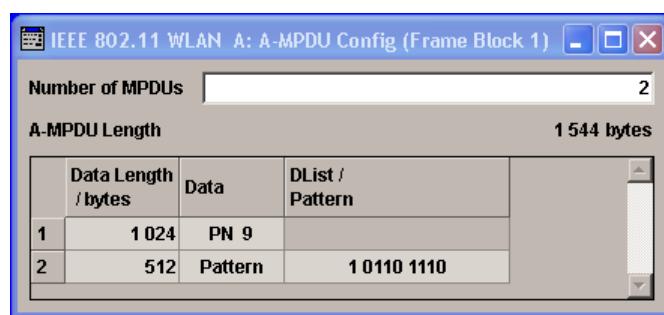
n.a.

3.5 A-MPDU Settings

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

1. To access this dialog select "IEEE 802.11... > Frame Block Configuration...".
2. Select "Type > Data".
3. Select "Data > A-MPDU".
4. Select "DList/Pattern > Config".

The "A-MPDU Config" dialog opens.



This dialog comprises the A-MPDU settings.

Number of MPDUs

Determines the number of MPDUs in the frame.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:MPDU:COUNT](#) on page 130

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 132

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 131

Data

Selects the data source.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:MPDU<st>:DATA:SOURce](#) on page 132

DList / Pattern

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

Remote command:

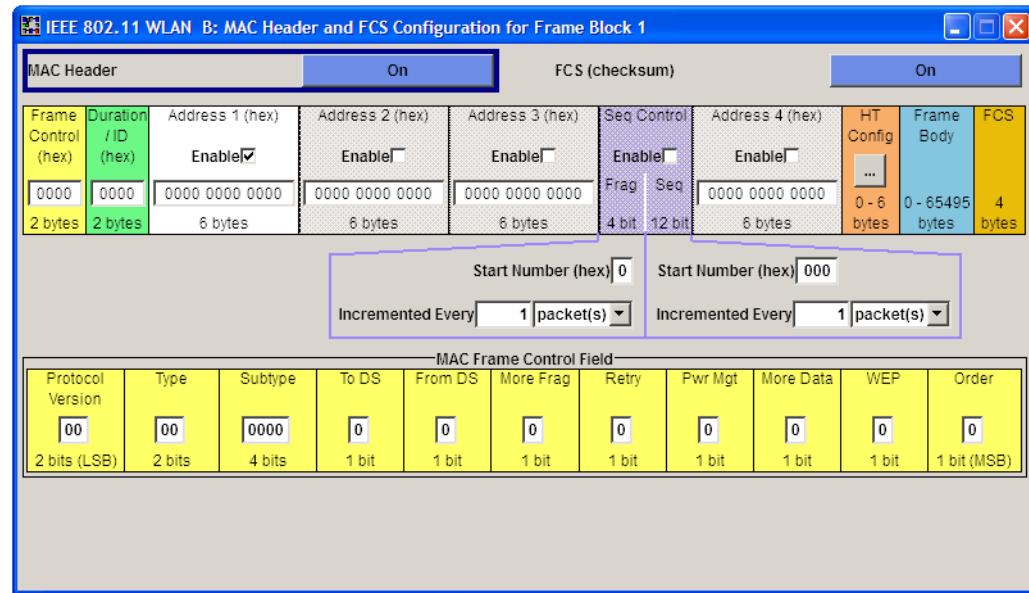
[:SOURce<hw>] :BB:WLNN:FBLock<ch>:MPDU<st>:DATA:DSElection

on page 131

[:SOURce<hw>] :BB:WLNN:FBLock<ch>:MPDU<st>:DATA:PATtern on page 131

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 prior to 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.



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 138

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 135

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

802.11 MAC Frame Control Field										
Protocol Version	Type	Subtype	To DS	From DS	More Frag	Retry	Pwr Mgt	More Data	WEP	Order
<input type="text" value="00"/> 2 bit (LSBits)	<input type="text" value="00"/> 2 bit	<input type="text" value="0000"/> 4 bit	<input type="text" value="0"/> 1 bit (MSBit)							

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 134

[:SOURce<hw>] :BB:WLNN:FBLock<ch>:MAC:FCONtrol:PVERsion on page 135

[:SOURce<hw>] :BB:WLNN:FBLock<ch>:MAC:FCONtrol:TYPE on page 135

[:SOURce<hw>] :BB:WLNN:FBLock<ch>:MAC:FCONtrol:SUBType on page 135

[:SOURce<hw>] :BB:WLNN:FBLock<ch>:MAC:FCONtrol:TDS on page 135

[:SOURce<hw>] :BB:WLNN:FBLock<ch>:MAC:FCONtrol:FDS on page 135

[:SOURce<hw>] :BB:WLNN:FBLock<ch>:MAC:FCONtrol:MFRgments on page 135

[:SOURce<hw>] :BB:WLNN:FBLock<ch>:MAC:FCONtrol:RETRY on page 135

[:SOURce<hw>] :BB:WLNN:FBLock<ch>:MAC:FCONtrol:PMANagement on page 135

[:SOURce<hw>] :BB:WLNN:FBLock<ch>:MAC:FCONtrol:MDATA on page 135

[:SOURce<hw>] :BB:WLNN:FBLock<ch>:MAC:FCONtrol:WEP on page 135

[:SOURce<hw>] :BB:WLNN:FBLock<ch>:MAC:FCONtrol:ORDer on page 135

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 134

MAC Address

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

The MAC header may contain up to four address fields, but not all of them 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 133

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 135

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 134

Sequence Control

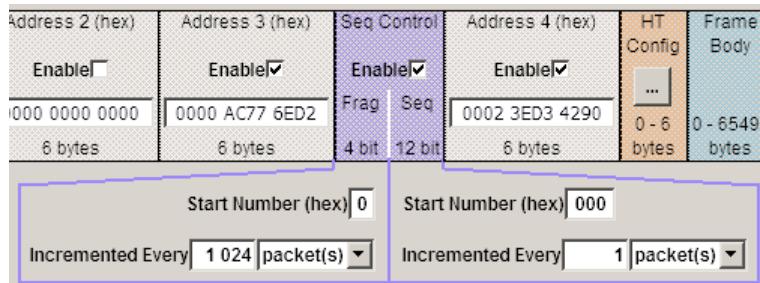
Activates/deactivates the sequence control field.

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) which 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. This allows the receiver to arrange the data packets in the correct order, 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 137
 [:SOURce<hw>] :BB:WLNN:FBLOCK<ch>:MAC:SCONTrol:FRAGment:START on page 136
 [:SOURce<hw>] :BB:WLNN:FBLOCK<ch>:MAC:SCONTrol:SEQUence:START on page 137
 [:SOURce<hw>] :BB:WLNN:FBLOCK<ch>:MAC:SCONTrol:FRAGment:INCREMENT on page 136
 [:SOURce<hw>] :BB:WLNN:FBLOCK<ch>:MAC:SCONTrol:SEQUence:INCREMENT on page 137

Start Number

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 136
 [:SOURce<hw>] :BB:WLNN:FBLOCK<ch>:MAC:SCONTrol:SEQUence:START on page 137

Increment Every

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 136
 [:SOURce<hw>] :BB:WLNN:FBLOCK<ch>:MAC:SCONTrol:SEQUence:INCREMENT on page 137

HT Config

Calls the menu for configuring the MAC HT (High Throughput).

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 and VHT Configuration"](#), on page 55.

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.

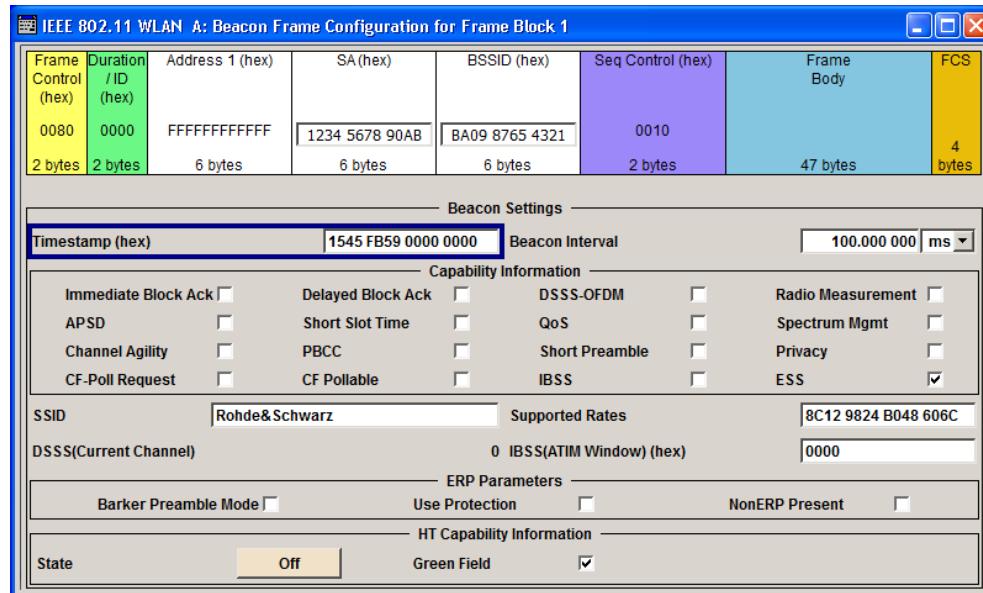
Remote command:

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.

- To access this dialog select IEEE 802.11... > "Frame Block Configuration" > "Beacon" > "Config..." > "Configure Beacon Frame...".



3.6.3.1 General Beacon Functions

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 149

Beacon Interval

Defines the time interval between two beacon transmissions in ms.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:BFConfiguration:BINTerval](#)
on page 147

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 148

SupportedRate

Contains the set of data rates that are 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 148](#)

DSSS(Current Channel)

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

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:BFConfiguration:DCCChannel? on page 148](#)

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 148](#)

3.6.3.2 Capability Information Parameters

The capability 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 will be informed that use of direct sequence spread spectrum - OFDM modulation (DSSS-OFDM) is allowed.

Capability Information							
Immediate Block Ack	<input type="checkbox"/> On	Delayed Block Ack	<input type="checkbox"/> On	DSSS-OFDM	<input type="checkbox"/> On	Radio Measurement	<input type="checkbox"/> On
APSD	<input type="checkbox"/> On	Short Slot Time	<input type="checkbox"/> On	QoS	<input type="checkbox"/> On	Spectrum Mgmt	<input type="checkbox"/> On
Channel Agility	<input type="checkbox"/> On	PBCC	<input type="checkbox"/> On	Short Preamble	<input type="checkbox"/> On	Privacy	<input type="checkbox"/> On
CF-Poll Request	<input type="checkbox"/> On	CF Pollable	<input type="checkbox"/> On	IBSS	<input type="checkbox"/> On	ESS	<input type="checkbox"/> On

Capability Information Parameters*Table 3-2: 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 151
"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 151
"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 152
"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 153
"APSD"	Automatic power save delivery (APSD) is supported (energy saving function).	[:SOURce<hw>]:BB:WLNN:FBLOCK<ch>:BFConfiguration:CAPability:APSD on page 149
"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 154
"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 152
"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 153
"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 150

Function name	If enabled this function indicates that:	SCPI command
"PBCC"	Packet binary convolutional coding (PBCC) is allowed (a modulationmode for IEEE 802.11g).	[:SOURce<hw>]:BB:WLNN:FBLOCK<ch>:BFConfiguration:CAPability:PBCC on page 152
"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:SPRreamble on page 153
"Privacy"	Privacy mode is enabled (thus encryption is required for all data frames).	[:SOURce<hw>]:BB:WLNN:FBLOCK<ch>:BFConfiguration:CAPability:PRIVacy on page 152
"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 150
"CF Pollable"	The node is capable of using 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 may broadcast.	[:SOURce<hw>]:BB:WLNN:FBLOCK<ch>:BFConfiguration:CAPability:CPOLlable on page 150
"IBSS"	The network is an independent basic service set (IBSS) type network. This is an operation mode of a WLAN. An IBSS doesn't 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 151
"ESS"	The network is an extended service set (ESS) type network (this 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 150

3.6.3.3 ERP Parameters

The extended rate PHY (ERP) parameters indicate special features/modes.

ERP Parameters			
Barker Preamble Mode <input type="checkbox"/> On	Use Protection	<input type="checkbox"/> On	NonERP Present <input type="checkbox"/> On

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 154
"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:UPProtection on page 155
"NonERP Present"	A Non ERP station is present in the network.	[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:ERP:NEPResent on page 155

3.6.3.4 HT Capability Information**State**

Activates/ deactivates the HT capability information element.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:BFConfiguration:HTCapability:STATE](#) on page 154

Green Field

If enabled this 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 154

3.7 MAC Header HT and VHT Configuration

The HT/VHT Control Field may be included in any frame except a non-QoS Data frame. The presence of the HT/VHT control 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.

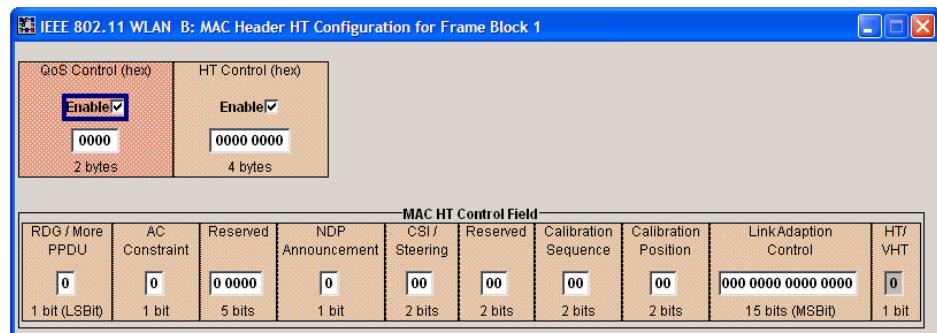


Fig. 3-1: IEEE 802.11 WLAN: MAC Header HT Configuration window

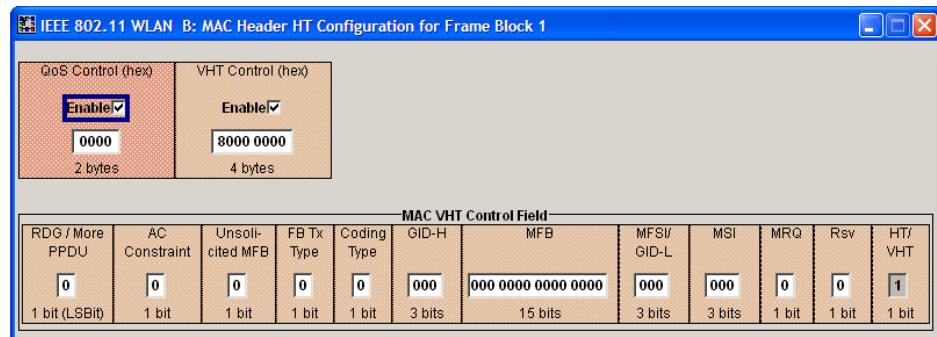


Fig. 3-2: IEEE 802.11 WLAN: MAC Header VHT Configuration window

3.7.1 Common Settings

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

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 136](#)
[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:MAC:QSControl on page 136](#)

HT/VHT Control

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

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:MAC:HTControl on page 138](#)
[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:MAC:VHTControl on page 143](#)
[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:MAC:HTControl:STATE on page 142](#)

3.7.2 MAC HT Configuration

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

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 141](#)

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:HTControl:ACConstraint on page 138](#)

Reserved

This signal field (5 bit) is currently 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 142](#)

ZLF Announcement

The ZLF Announcement (1 bit) indicates that a ZLF (Zero Length Frame) will be transmitted after the frame.

0 = no ZLF will follow

1 = ZLF will follow

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:MAC:HTControl:ZLF on page 142](#)

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 140

Feedback Request

Sets the type of feedback (2 bit):

00 = no request

01 = unsolicited feedback only

10 = immediate feedback

11 = aggregated feedback

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:MAC:HTControl:FREQuest](#)
on page 140

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 139

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 139

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 141

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 140

3.7.3 MAC VHT Configuration

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

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 146

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 143](#)

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 147](#)

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:FTTType on page 144](#)

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 144](#)

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 144](#)

MFB

MFB subfield is interpreted as defined in [table 3-3](#). This subfield contains the recommended MFB. The value of MCS=15 and VHT N_STS=7 indicates that no feedback is present.

Table 3-3: 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).
BW	Bandwidth of the recommended MCS	<p>MFB = 1</p> <p>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:</p> <ul style="list-style-type: none"> • 0 for 20 MHz • 1 for 40 MHz • 2 for 80 MHz • 3 for 160 MHz and 80+80 MHz <p>MFB = 0</p> <p>If the Unsolicited MFB subfield is set to 0, the BW subfield is reserved and set to 0.</p>
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 145

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 145

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 146

MRQ

0 = to request MCS feedback (solicited MFB).

1 = otherwise.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:MAC:VHTControl:MRQ on page 145](#)

Rsv

This signal field (1 bit) is currently 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 147](#)

HT/VHT

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

0 = indicates use of the HT format.

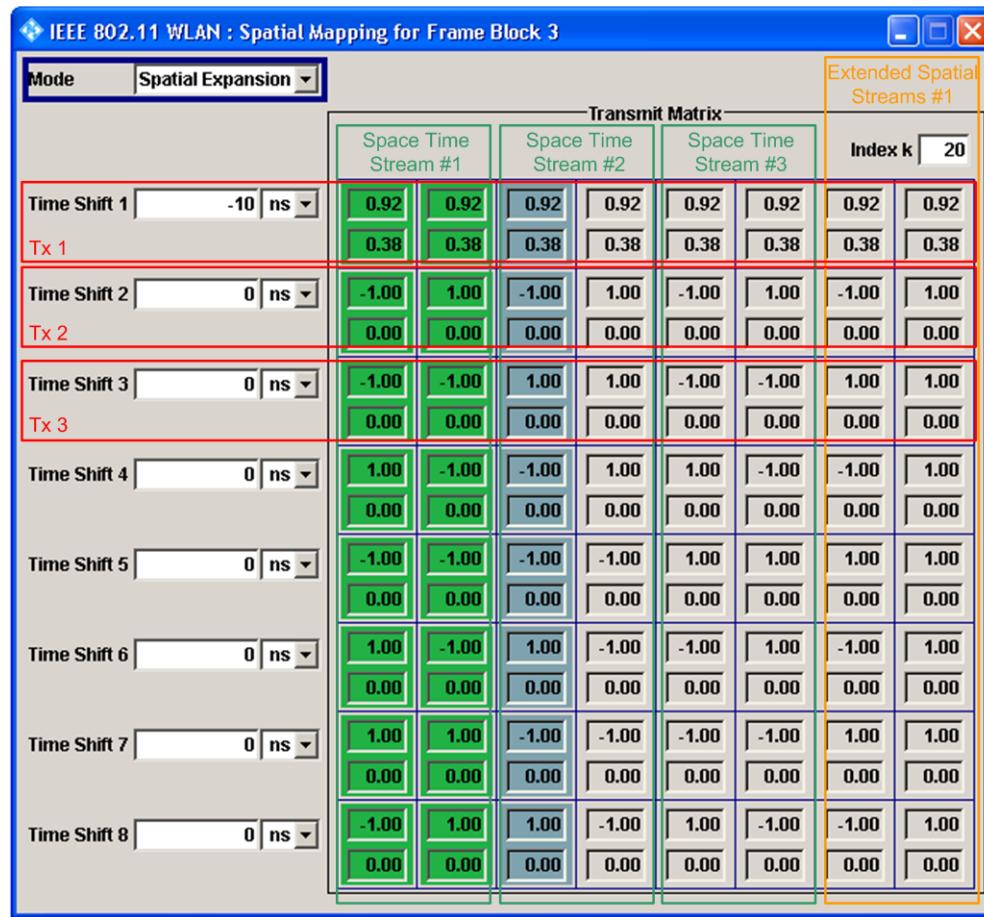
1 = indicates use of the VHT format.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:MAC:VHTControl:HVIndicator? on page 145](#)

3.8 Spatial Mapping

The Wireless LAN 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** will have 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. In case of physical layer mode SOUNDING, a second sub-matrix horizontally sided to the transmit matrix with N_{TX} rows and N_{ESS} columns (representing the number of extended spatial streams) will be used as a transmit matrix for the Extended Long Training Fields (ELTF). The values displayed for the transmit matrices are additionally normalized (internally) so that the expectation of IQ sum-power of all antennas is 0 dBr. Additionally for OFF, Direct, and Spatial Expansion, the expected IQ power is the same for all antennas and hence these modes can be intermixed (frame blocks for each) without caring about any power regulation issue. Relative RMS levels are displayed in the dialog for each antenna.

Mode

Selects the spatial mapping mode for the selected frame block. Except of the beam-forming mode, 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.
"Spatial Expansion"	(available only for "Physical Mode > Mixed Mode" or "Physical Mode > Green Field") In spatial 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.
"Beamforming"	(this feature will be supported in further release) Sets the spatial mapping to "Beamforming" mode. The transmit matrix is the product of a CSD matrix and the Hadamard unitary matrix. The "File" button is displayed to open a Browse popup. A file with source format *.bmf can be selected for the beamforming. The file must include 128 4*4 IQ elements (corresponding to the sub-carriers).

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:SMAPping:MODE on page 155](#)

[\[:SOURce<hw>\]:BB:WLNN:FBLock<ch>:SMAPping:BSELection on page 156](#)

Index k

Sets the index of the sub-carrier. A matrix is mapped to each sub-carrier.

With the exception of $k = 0$, 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 157](#)

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 157](#)

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 157

Q (Transmit Matrix)

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

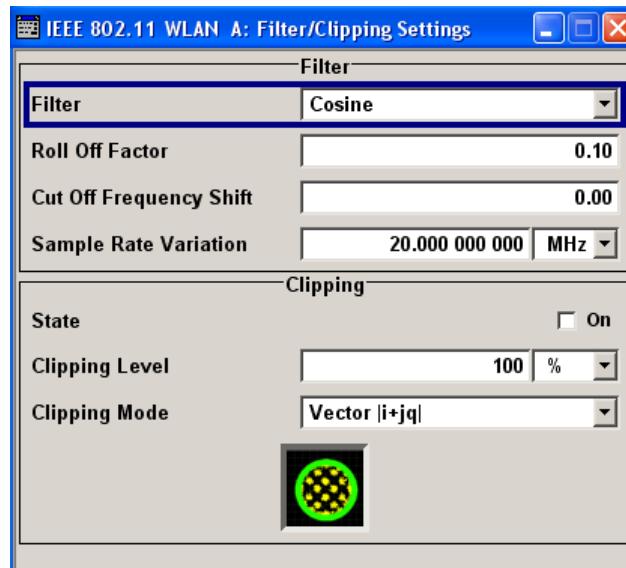
Remote command:

[:SOURce<hw>] :BB:WLNN:FBLock<ch>:SMAPping:ROW<st>:COL<dir>:Q?
on page 158

3.9 Filter / Clipping Settings

To access this dialog, select "General > Filter/Clipping Settings".

- To access this dialog, select "Main dialog > Filter/Clipping Settings".



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

3.9.1 Filter Settings



Filter settings are available only for Transmission Bandwidth set to 20 MHz.

Provided are the following settings for configuring the baseband filter:

Filter

Selects the baseband filter.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FILTER:TYPE](#) on page 89

Roll Off Factor or BxT

Enters the filter parameters. The filter parameter offered (Roll Off factor or BxT) depends on the currently selected filter type.

The Roll Off Factor affects the steepness of the filter flanks. A "Roll Off Factor" = 0 results in the steepest flanks; values near to 1 make the flanks more flat.

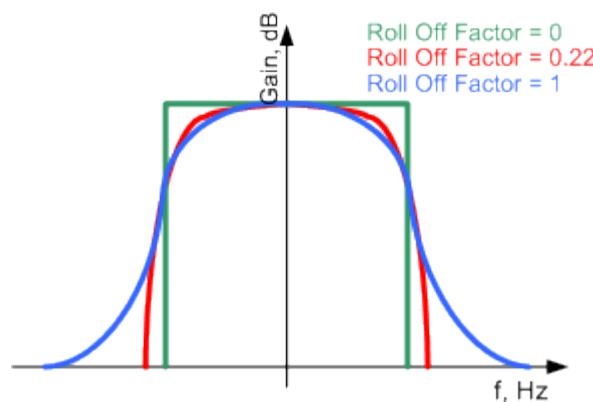


Fig. 3-3: Example of the frequency response of a filter with different Roll Off Factors

This parameter is always set to the default for each of the predefined filters.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FILTER:PARAmeter:APCO25](#) on page 91

[\[:SOURce<hw>\]:BB:WLNN:FILTER:PARAmeter:COSine](#) on page 91

[\[:SOURce<hw>\]:BB:WLNN:FILTER:PARAmeter:GAUss](#) on page 92

[\[:SOURce<hw>\]:BB:WLNN:FILTER:PARAmeter:PGauss](#) on page 92

[\[:SOURce<hw>\]:BB:WLNN:FILTER:PARAmeter:RCOSine](#) on page 93

[\[:SOURce<hw>\]:BB:WLNN:FILTER:PARAmeter:SPHase](#) on page 93

Cut Off Frequency Factor

Sets the value for the cut off frequency factor. The cut off frequency of the filter can be adjusted to reach spectrum mask requirements.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FILTER:PARAmeter:LPASS](#) on page 92

[\[:SOURce<hw>\]:BB:WLNN:FILTER:PARAmeter:LPASSEVM](#) on page 92

Cut Off Frequency Shift

(available for filter parameter Cosine only.)

The cut off 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 fil-

ter 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 cut off frequency and reach spectrum mask requirements.

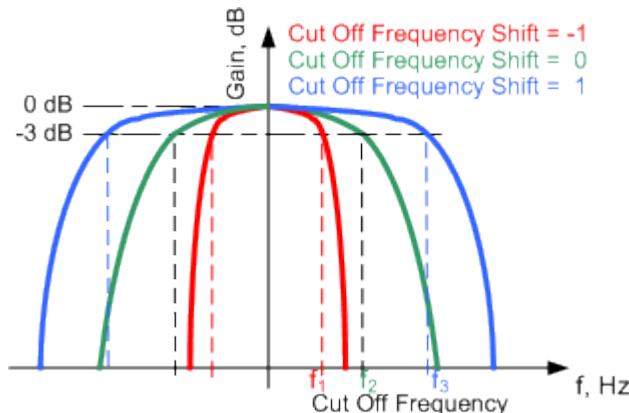


Fig. 3-4: Example of the frequency response of a filter with different Cut Off Frequency Shift

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FILTER:PARameter:COSSine:COFS](#) on page 91

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 94

Sample Rate

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

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:SRATE?](#) on page 93

Impulse Length

(For WinIQSIM2 only)

Displays the number of filter tabs. If the check box is activated, the most sensible parameter values are selected. The value depends on the coherence check. If the check box is deactivated, the values can be changed manually.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FILTER:ILENghth](#) on page 90

[\[:SOURce<hw>\]:BB:WLNN:FILTER:ILENghth:AUTO](#) on page 90

Oversampling

(For WinIQSIM2 only)

Determines the upsampling factor. If the check box is activated, the most sensible parameter values are selected. The value depends on the coherence check. If the check box is deactivated, the values can be changed manually.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:FILTER:OSAMpling on page 90](#)

[\[:SOURce<hw>\]:BB:WLNN:FILTER:OSAMpling:AUTO on page 90](#)

3.9.2 Clipping Settings

Provided are the following settings:

Clipping State

Switches baseband clipping on and off.

Baseband clipping is a very simple and effective way of reducing the crest factor of the WLAN signal.

WLAN signals may have very 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 prior to 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 89](#)

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 88](#)

Clipping Mode

Selects the clipping method. A graphic illustration of the way in which these two methods work is given in the menu.

"Vector $| I + q |$ " The limit is related to the amplitude $| I + q |$. The I and Q components are mapped together, the angle is retained (see "Clipping State").



"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 88

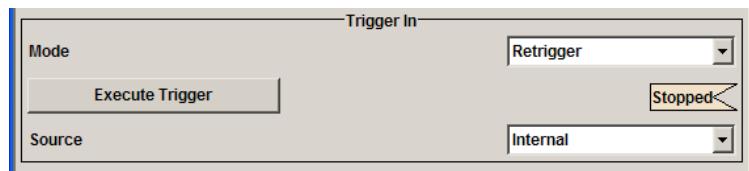
3.10 Trigger/Marker/Clock Settings



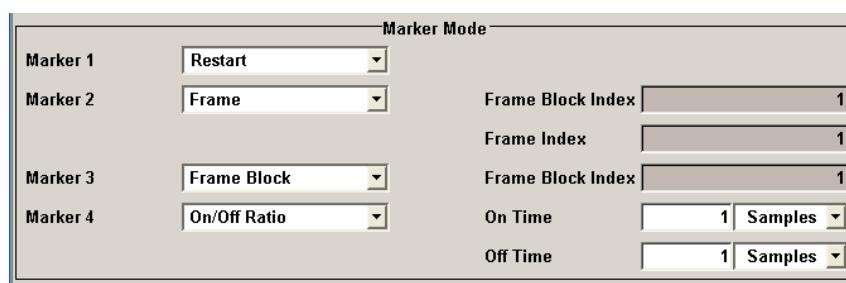
The trigger, clock, and marker delay functions are available for R&S SMx and R&S AMU instruments only.

To access this dialog, select "Main Menu > Trigger/Marker".

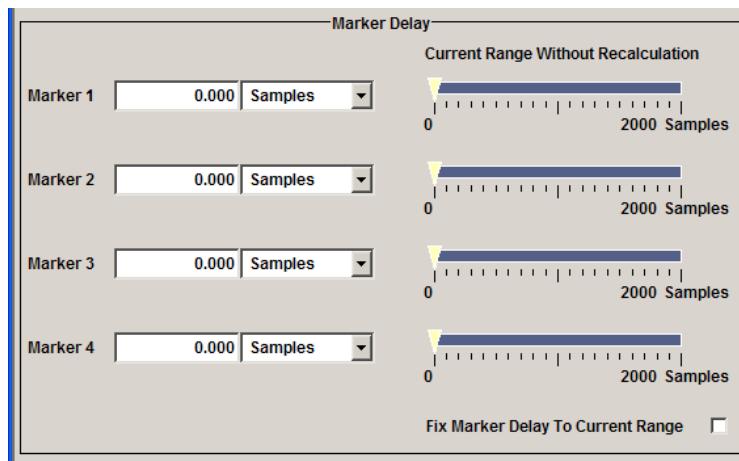
The "Trigger In" section is where the trigger for the signal is set. Various parameters will be provided for the settings, depending on which trigger source - internal or external - is selected. The current status of signal generation ("Running" or "Stopped") is indicated for all trigger modes.



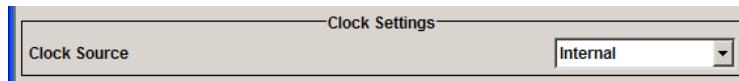
The "Marker Mode" section is where the marker signals at the MARKER output connectors are configured.



The "Marker Delay" section is where a marker signal delay can be defined, either without restriction or restricted to the dynamic section, i.e., the section in which it is possible to make settings without restarting signal and marker generation.



The "Clock Settings" section is where the clock source is selected and - in the case of an external source - the clock type.



The buttons in the last section lead to submenu for general trigger, clock and mapping settings.



3.10.1 Trigger In



The trigger functions are available for R&S SMx and R&S AMU instruments only.

The Trigger In section is where the trigger for the IEEE 802.11 WLAN signal is set. The current status of the signal generation is displayed for all trigger modes.

The "Trigger In" section is where the trigger for the signal is set. Various parameters will be provided for the settings, depending on which trigger source - internal or external - is selected. The current status of signal generation ("Running" or "Stopped") is indicated for all trigger modes.

Trigger Mode

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

- "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 with 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 with 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 99

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 98

Signal Duration

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

Use this parameter to deliberately output part of the signal, 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 97

Running/Stopped

For 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 97

Arm

For trigger modes "Armed Auto" and "Armed Retrigger", stops the signal generation until subsequent trigger event occurs.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:TRIGger:ARM:EXECute](#) on page 94

Execute Trigger

Executes trigger manually. A manual trigger can be executed only when an internal trigger source and a trigger mode other than "Auto" have been selected.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:TRIGger:EXECute](#) on page 95

Trigger Source

Selects trigger source. This setting is effective when a trigger mode other than "Auto" has been selected.

- "Internal"
The trigger event is executed by "Execute Trigger".
- "Internal (Baseband A/B)"
(two-path instruments)
The trigger event is the trigger signal from the second path
- "External (Trigger 1/2)"
The trigger event is the active edge of an external trigger signal, supplied at the TRIGGER 1/2 connector.
Use the "Global Trigger/Clock Settings" dialog to define the polarity, the trigger threshold and the input impedance of the trigger signal.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:TRIGger:SOURce](#) on page 98

Sync. Output to External Trigger

(enabled for Trigger Source External)

Enables/disables output of the signal synchronous to the external trigger event.

For R&S SMBV instruments:

For or two or more R&S SMBVs configured to work in a master-slave mode for synchronous signal generation, configure this parameter depending on the provided system trigger event and the properties of the output signal. See the table below for an overview of the required settings.

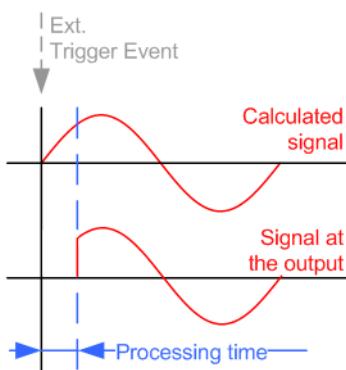
Table 3-4: Typical Applications

System Trigger	Application	"Sync. Output to External Trigger"
Common External Trigger event for the master and the slave instruments	All instruments are synchronous to the external trigger event	ON
	All instruments are synchronous among themselves but starting the signal from first symbol is more important than synchronicity with external trigger event	OFF
Internal trigger signal of the master R&S SMBV for the slave instruments	All instruments are synchronous among themselves	OFF

"On"

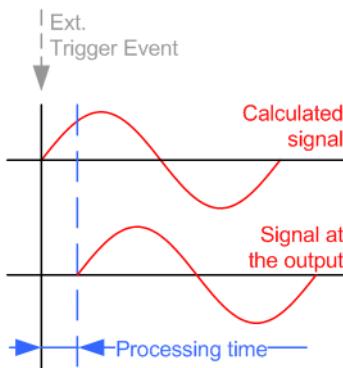
Corresponds to the default state of this parameter.

The signal calculation starts simultaneously with the external trigger event but because of the instrument's processing time the first samples are cut off and no signal is outputted. 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 and starts with sample 0, i.e. the complete signal is outputted. This mode is recommended for triggering of short signal sequences with signal duration comparable with the processing time of the instrument.



Remote command:

[\[:SOURce<hw>\]:BB:WLNN:TRIGger:EXTernal:SYNChronize:OUTPut on page 95](#)

Trigger Delay

Delays the trigger event of the signal from:

- the external trigger source
- the other path

Use this setting to:

- synchronize the instrument with the device under test (DUT) or other external devices

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:TRIGger\[:EXTernal<ch>\]:DELay on page 99](#)
[\[:SOURce<hw>\]:BB:WLNN:TRIGger:OBASEband:DELay on page 96](#)

Trigger Inhibit

Sets the duration for inhibiting a new trigger event subsequent to triggering. The input is to be expressed in samples.

In the "Retrigger" mode, every trigger signal causes signal generation to restart. This restart is inhibited for the specified number of samples.

This parameter is only available on external triggering or on internal triggering via the second path.

For two-path instruments, the trigger inhibit can be set separately for each of the two paths.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:TRIGger\[:EXTernal<ch>\]:INHibit on page 99](#)
[\[:SOURce<hw>\]:BB:WLNN:TRIGger:OBASEband:INHibit on page 96](#)

3.10.2 Marker Mode

The marker output signal for synchronizing external instruments is configured in the Marker settings section "Marker Mode".



The R&S SMBV supports only two markers.

Marker Mode

Selects a marker signal for the associated MARKER output.

"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.

Frame Block Index

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:TRIGger:OUTPut<ch>:FBIndex](#) on page 104

"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.

Frame Block Index

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:TRIGger:OUTPut<ch>:FINdex](#) on page 104

"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.

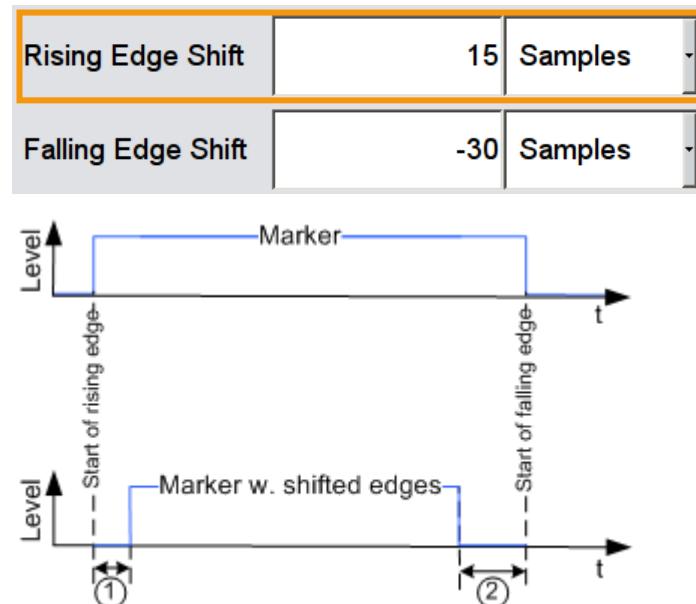


Fig. 3-5: "Frame active Part" marker and shifting of its rising/falling edges

1 = Marker shift rising edge
2 = Marker shift falling edge

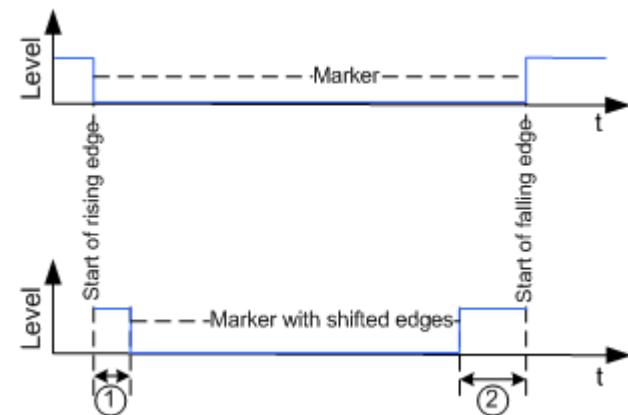


Fig. 3-6: "Frame Inactive Part" marker and shifting of its rising/falling edges

1 = Marker shift rising edge
2 = Marker shift falling edge

Remote command:

[[:SOURce<hw>\]:BB:WLNN:TRIGger:OUTPut<ch>:FESHift](#) on page 105
[\[:SOURce<hw>\]:BB:WLNN:TRIGger:OUTPut<ch>:RESHift](#) on page 105

"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.

Divider	2
Frequency	5.500 000 MHz

Remote command:

[[:SOURce<hw>\]:BB:WLNN:TRIGger:OUTPut<ch>:PULSE:DIVider](#) on page 106
[\[:SOURce<hw>\]:BB:WLNN:TRIGger:OUTPut<ch>:PULSE:FREQuency](#)?
 on page 106

"Pattern" A marker signal that is defined by a bit pattern is generated. The pattern has a maximum length of 32 bits and is defined in an input field that opens when "pattern" is selected.

0000 0000

Remote command:

[[:SOURce<hw>\]:BB:WLNN:TRIGger:OUTPut<ch>:PATTern](#) on page 105

"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.



The ON time and OFF time are each expressed as a number of chips and are set in an input field which opens when ON/OFF ratio is selected.

On Time	2	Sym
Off Time	3	Sym

Remote command:

[[:SOURce<hw>\]:BB:WLNN:TRIGger:OUTPut<ch>:ONTime](#) on page 104
[\[:SOURce<hw>\]:BB:WLNN:TRIGger:OUTPut<ch>:OFFTime](#) on page 104

Remote command:

[[:SOURce<hw>\]:BB:WLNN:TRIGger:OUTPut<ch>:MODE](#) on page 103

3.10.3 Marker Delay



The marker delay functions are available for R&S SMx and R&S AMU instruments only.

The delay of the signals on the MARKER outputs is set in the "Marker Delay" section.

The R&S SMBV supports only two markers.

Marker x Delay

Enters the delay between the marker signal at the marker outputs and the start of the frame or slot.

Note: The input is expressed as a number of symbols/samples. If the setting "Fix marker delay to dynamic range" is enabled, the setting range is restricted to the dynamic range. In this range the delay of the marker signals can be set without restarting the marker and signal.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:TRIGger:OUTPut<ch>:DELy on page 101](#)

Current Range without Recalculation

Displays the dynamic range within which the delay of the marker signals can be set without restarting the marker and signal.

The delay can be defined by moving the setting mark.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:TRIGger:OUTPut<ch>:DELy:MAXimum? on page 101](#)

[\[:SOURce<hw>\]:BB:WLNN:TRIGger:OUTPut<ch>:DELy:MINimum? on page 102](#)

Fix marker delay to current range

Restricts the marker delay setting range to the dynamic range. In this range the delay can be set without restarting the marker and signal.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:TRIGger:OUTPut:DELy:FIXed on page 101](#)

3.10.4 Clock Settings



The clock functions are available for R&S SMx and R&S AMU instruments only.

The Clock Settings is used to set the clock source and a delay if required.

Sync. Mode

(for R&S SMBV only)

Selects the synchronization mode.

This parameter is used to enable generation of very precise synchronous signal of several connected R&S SMBVs.

Note: If several instruments are connected, the connecting cables from the master instrument to the slave one and between each two consecutive slave instruments must have the same length and type.

Avoid unnecessary cable length and branching points.

"None" The instrument is working in stand-alone mode.

"Sync. Master" The instrument provides all connected instrument with its synchronisation (including the trigger signal) and reference clock signal.



"Sync. Slave" The instrument receives the synchronisation and reference clock signal from another instrument working in a master mode.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:CLOCK:SYNChronization:MODE](#) on page 108

Set Synchronization Settings

(for R&S SMBV only)

Performs automatically adjustment of the instrument's settings required for the synchronization mode, selected with the parameter "Sync. Mode".

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:CLOCK:SYNChronization:EXECute](#) on page 108

Clock Source

Selects the clock source.

"Internal" The internal clock reference is used to generate the sample clock.

"External" The external clock reference is fed in as the sample clock or multiple thereof via the CLOCK connector.

The sample rate must be correctly set to an accuracy of (2 % (see data sheet).

The polarity of the clock input can be changed with the aid of "Global Trigger/Clock Settings".

In the case of two-path instruments, this selection applies to path A

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:CLOCK:SOURce](#) on page 108

Clock Mode

Enters the type of externally supplied clock.

"Sample" A sample clock is supplied via the CLOCK connector.

"Multiple Sample" A multiple of the sample clock is supplied via the CLOCK connector; the sample clock is derived internally from this.

The Multiplier window provided allows the multiplication factor to be entered.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:CLOCK:MODE](#) on page 107

Chip Clock Multiplier

Enters the multiplication factor for clock type Multiple.

Remote command:

[\[:SOURce<hw>\]:BB:WLNN:CLOCK:MULTiplier](#) on page 107

Measured External Clock

Provided for permanent monitoring of the enabled and externally supplied clock signal.

Remote command:

[CLOCK:INPut:FREQuency?](#)

3.10.5 Global Settings

The buttons in this section lead to dialogs for general trigger, clock and mapping settings.

These settings are available for R&S SMx and R&S AMU instruments only.

Global Trigger/Clock Settings

Calls the "Global Trigger/Clock/Input Settings" dialog.

This dialog is used among other things for setting the trigger threshold, the input impedance and the polarity of the clock and trigger inputs.

In the case of two-path instruments, these settings are valid for both paths.

The parameters in this dialog affect all digital modulations and standards, and are described in chapter "Global Trigger/Clock/Input Settings" in the Operating Manual.

User Marker / AUX I/O Settings

Calls the "User Marker AUX I/O Settings" dialog, used to map the connector on the rear of the instruments.

See also "User Marker / AUX I/O Settings" in the Operating Manual.

4 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 Signal Generator has already been set up for remote operation in a network as described in the R&S Signal Generator documentation. A knowledge about the remote control operation and the SCPI command syntax are assumed.

The **SOURce:BB:WLNN** subsystem contains commands for the primary and general settings of the IEEE 802.11 WLAN standard. These settings concern activation and deactivation of the standard, setting the transmission direction, filter, clock, trigger and clipping settings, defining the frame duration and the sequence length, as well as the preset setting.

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.



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 Signal Generator operating manual.

Common Suffixes

The following common suffixes are used in remote commands:

Suffix	Value range	Description
SOURce<hw>	[1] 2	available baseband signals
OUTPut<ch>	1 .. 4	available markers R&S SMBV supports two markers
EXTernal<ch>	1 2	external trigger connectors
FBLOCK<ch>	[1]...100	available frame blocks
MPDU<st>	1...10	available MPDUs

Placeholder <root>

For commands that read out or save files in the default directory, the default directory is set using command **MMEM:CDIRECTORY**. The examples in this description use the place holder **<root>** in the syntax of the command.

- **D:** - for selecting the internal hard disk of a Windows instrument
- **E:** - for selecting the memory stick which is inserted at the USB interface of a Windows instrument
- **/var/user/** - for selecting the internal flash card of a Linux instrument
- **/usb/** - for selecting the memory stick which is inserted at the USB interface of a Linux instrument.



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

In particular, this includes:

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

For a description of such tasks, see the R&S Signal Generator operating manual.

The following commands specific to the IEEE 802.11 WLAN are described here:

4.1 General Commands

[:SOURce<hw>]:BB:WLNN:BWWidth.....	82
[:SOURce<hw>]:BB:WLNN:FBLock:APPend.....	83
[:SOURce<hw>]:BB:WLNN:IFBLock.....	83
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:INSert.....	83
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:COPY.....	83
[:SOURce<hw>]:BB:WLNN:CFBLock.....	83
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DELetE.....	83
[:SOURce<hw>]:BB:WLNN:DFBLock.....	83
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PASTe.....	84
[:SOURce<hw>]:BB:WLNN:PFBLock.....	84
[:SOURce<hw>]:BB:WLNN:PATH:COUpling[:STATe].....	84
[:SOURce<hw>]:BB:WLNN:PRESet.....	84
[:SOURce<hw>]:BB:WLNN:PSDU:MODulation?.....	85
[:SOURce<hw>]:BB:WLNN:SETTing:CATalog?.....	85
[:SOURce<hw>]:BB:WLNN:SETTing:DELetE.....	86
[:SOURce<hw>]:BB:WLNN:SETTing:LOAD.....	86
[:SOURce<hw>]:BB:WLNN:SETTing:STORE.....	86
[:SOURce<hw>]:BB:WLNN:SETTing:STORE:FAST.....	87
[:SOURce<hw>]:BB:WLNN:STATe.....	87
[:SOURce<hw>]:BB:WLNN:WAVEform:CREate.....	87

[:SOURce<hw>]:BB:WLNN:BWWidth <BWWidth>

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:

<BWWidth> BW20 | BW40 | BW80 | BW160
 *RST: BW20
 Default unit: MHz

Example:

BB:WLNN:BW BW40
 sets the transmission bandwidth to 40 MHz.

Manual operation: See "[Transmission Bandwidth](#)" on page 25

[:SOURce<hw>]:BB:WLNN:FBLock:APPend

The command appends a frame block to the end of the frame blocks list.

Example: BB:WLNN:FBL:APP
 appends a frame block to the end of the frame blocks list.

Usage: Event

Manual operation: See "[Append](#)" on page 34

[: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 34

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:COPY**[:SOURce<hw>]:BB:WLNN:CFBLock <CfBlock>**

The command copies the selected frame block.

Setting parameters:

<CfBlock> float
 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>**

The command deletes the selected frame block.

Setting parameters:

<DfBlock> float
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>

The command pastes the selected frame block.

Setting parameters:

<PfBlock> float
Range: 1 to 99

Example: BB:WLNN:PFBL 20
pastes the frame block to row 20.

Usage: Setting only

[:SOURce<hw>]:BB:WLNN:PATH:COUPLing[:STATe] <State>

Enables/disables coupling of both baseband paths.

Note: For instruments with enabled parameter "Configure Baseband B from Baseband A", enabling the WLAN signal generation in path A disables all other digital standards and digital modulation modes in path B.

Parameters:

<State> 0 | 1 | OFF | ON

ON

An active coupling mode is useful for MIMO signal setups. In this case, baseband B is controlled from baseband A and generates an identical setup.

OFF

Corresponds to normal operation, i.e. independent configuration of both paths.

*RST: OFF

Example: BB:WLNN:PATH:COUP ON
enables baseband coupling.

Manual operation: See "[Configure Baseband B from Baseband A](#)" on page 25

[:SOURce<hw>]:BB:WLNN:PRESet

The command produces a standardized default for the IEEE 802.11 standard. The settings correspond to the *RST values specified for the commands.

Example: BB:WLNN:PRES
resets all the IEEE 802.11 settings to default values.

Usage: Event

Manual operation: See "[Set to default](#)" on page 22

[:SOURce<hw>]:BB:WLNN:PSDU:MODulation?

(available only for CCK and PBCC transport modes)

The command 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
BB:WLNN:FBL5:PSDU:BRAT P2MBPS
sets the PSDU bit rate
BB:WLNN:PSDU:MOD?
queries the modulation mode.
Response: "DQPSK"

Usage: Query only

Manual operation: See "[PSDU Modulation](#)" on page 40

[:SOURce<hw>]:BB:WLNN:SETTING:CATalog?

The command reads out the files with IEEE 802.11 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 '<root>wlann'
sets the default directory to <root>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 23

[:SOURce<hw>]:BB:WLNN:SETTING:DELetE <Filename>

The command deletes 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` 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 23

[:SOURce<hw>]:BB:WLNN:SETTING:LOAD <Filename>

The command 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 23

[:SOURce<hw>]:BB:WLNN:SETTING:STORe <Filename>

The command stores the current IEEE 802.11 WLAN 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 802.11 WLAN settings are stored as files with the specific file extensions `*.wlann`.

Setting parameters:

<Filename> string

Example: `BB:WLNN:SETT:STOR 'wlann_1'`
stores the current settings into file 'wlann_1'.

Usage: Setting only

Manual operation: See "[Save/Recall](#)" on page 23

[:SOURce<hw>]:BB:WLNN:SETTING:STORe:FAST <Fast>

Determines whether the instrument performs an absolute or a differential storing of the settings.

Enable this function to accelerate the saving process by saving only the settings with values different to the default ones.

Note: This function is not affected by the "Preset" function.

Parameters:

<Fast>	0 1 OFF ON
	*RST: ON

Manual operation: See "[Save/Recall](#)" on page 23

[:SOURce<hw>]:BB:WLNN:STATe <State>

The command activates modulation in accordance with the IEE 802.11 WLAN standard. Activating this standard disables all the other digital standards and digital modulation modes (in case of two-path instruments, this affects the same path).

BB:WLNN:STAT ON deactivates the other standards and digital modulation.

Parameters:

<State>	0 1 OFF ON
	*RST: OFF

Example: BB:WLNN:STAT ON
activates modulation in accordance with the IEE 802.11 WLAN standard

Manual operation: See "[State](#)" on page 21

[:SOURce<hw>]:BB:WLNN:WAVeform:CREate <Filename>

This command creates a waveform using the current settings of the "WLAN" menu. The file name is entered with the command. The file is stored with the predefined file extension *.wv. The file name and the directory it is stored in are user-definable.

Setting parameters:

<Filename> string

Example: MMEM:CDIR '<root>waveform'
sets the default directory to <root>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 25

4.2 Filter/Clipping Settings

[:SOURce<hw>]:BB:WLNN:CLIPping:LEVel.....	88
[:SOURce<hw>]:BB:WLNN:CLIPping:MODE.....	88
[:SOURce<hw>]:BB:WLNN:CLIPping:STATe.....	89
[:SOURce<hw>]:BB:WLNN:FILTER:TYPE.....	89
[:SOURce<hw>]:BB:WLNN:FILTER:ILENghT.....	90
[:SOURce<hw>]:BB:WLNN:FILTER:ILENghT:AUTO.....	90
[:SOURce<hw>]:BB:WLNN:FILTER:OSAMpling.....	90
[:SOURce<hw>]:BB:WLNN:FILTER:OSAMpling:AUTO.....	90
[:SOURce<hw>]:BB:WLNN:FILTER:PARAmeter:APCO25.....	91
[:SOURce<hw>]:BB:WLNN:FILTER:PARAmeter:COSine.....	91
[:SOURce<hw>]:BB:WLNN:FILTER:PARAmeter:COSine:COFS.....	91
[:SOURce<hw>]:BB:WLNN:FILTER:PARAmeter:GAUSS.....	92
[:SOURce<hw>]:BB:WLNN:FILTER:PARAmeter:LPASs.....	92
[:SOURce<hw>]:BB:WLNN:FILTER:PARAmeter:LPASSEVM.....	92
[:SOURce<hw>]:BB:WLNN:FILTER:PARAmeter:PGAuss.....	92
[:SOURce<hw>]:BB:WLNN:FILTER:PARAmeter:RCOSine.....	93
[:SOURce<hw>]:BB:WLNN:FILTER:PARAmeter:SPHase.....	93
[:SOURce<hw>]:BB:WLNN:SRATe?.....	93
[:SOURce<hw>]:BB:WLNN:SRATe:VARiation.....	94

[:SOURce<hw>]:BB:WLNN:CLIPping:LEVel <Level>

The command 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 with the command `SOUR:BB:WLNN:CLIP:STAT ON`

Parameters:

<Level>	float
	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 68

[:SOURce<hw>]:BB:WLNN:CLIPping:MODE <Mode>

The command sets the method for level clipping (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 68

[:SOURce<hw>]:BB:WLNN:CLIPping:STATe <State>

The command activates level clipping (Clipping). The value is defined with the command [:SOURce:] BB:WLNN:CLIPping:LEVel, the mode of calculation with the command [:SOURce:] BB:WLNN:CLIPping:MODE.

Parameters:

<State>	0 1 OFF ON
	*RST: OFF

Example:

BB:WLNN:CLIP:STAT ON
activates level clipping.

Manual operation: See "[Clipping State](#)" on page 68

[: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 66

[:SOURce<hw>]:BB:WLNN:FILTER:ILENgh**t** <ILength>

The command sets the impulse length (number of filter tabs).

Parameters:

<ILength>	float
	Range: 1 to 128
	Increment: 1
	*RST: 10

Example: BB:WLNN:FI**L**IT:ILEN 10

sets the number of filter tabs to 10.

Manual operation: See "[Impulse Length](#)" on page 67

[:SOURce<hw>]:BB:WLNN:FILTER:ILENgh**t:AU**T**O** <Auto>

The command activates/deactivates the impulse length state. If activated, the most sensible parameter values are selected. The value depends on the coherence check.

Parameters:

<Auto>	0 1 OFF ON
	*RST: ON

Example: BB:WLNN:FI**L**IT:ILEN:AU**T**O ON

the most sensible parameters are selected automatically.

Manual operation: See "[Impulse Length](#)" on page 67

[:SOURce<hw>]:BB:WLNN:FILTER:OSAMpl**ing** <OSampling>

The command sets the upsampling factor.

Parameters:

<OSampling>	float
	Range: 1 to 32
	*RST: 32

Example: BB:WLNN:FI**L**IT:OSAM 32

sets the upsampling factor to 32.

Manual operation: See "[Oversampling](#)" on page 68

[:SOURce<hw>]:BB:WLNN:FILTER:OSAMpl**ing:AU**T**O** <Auto>

The command activates/deactivates the upsampling factor state. If activated, the most sensible parameter values are selected. The value depends on the coherence check. If deactivated, the values can be changed manually.

Parameters:

<Auto>	0 1 OFF ON
	*RST: ON

Example: BB:WLNN:FILT:OSAM:AUTO ON
the most sensible parameters are selected automatically.

Manual operation: See "[Oversampling](#)" on page 68

[:SOURce<hw>]:BB:WLNN:FILT:PAR:APCO25 <Apco25>

The command sets the roll-off factor for filter type APCO25.

Parameters:

<Apco25>	float
	Range: 0.05 to 0.99
	Increment: 0.01
	*RST: 0.20

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 66

[:SOURce<hw>]:BB:WLNN:FILT:PAR:COSSINE <Cosine>

The command sets the roll-off factor for the Cosine filter type.

Parameters:

<Cosine>	float
	Range: 0.00 to 1.0
	Increment: 0.01
	*RST: 0.35

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 66

[:SOURce<hw>]:BB:WLNN:FILT:PAR:COSSINE: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 66

[:SOURce<hw>]:BB:WLNN:FILTER:PARameter:GAUSSs <Gauss>

The command 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 66

[:SOURce<hw>]:BB:WLNN:FILTER:PARameter:LPASs <LPass>

The command sets the cut off frequency factor for the Lowpass (ACP optimization) filter type.

Parameters:

<LPass>

float

Range: 0.05 to 2.0

Increment: 0.01

*RST: 0.5

Example:

BB:WLNN:FILT:PAR:LPAS 0.5

the cut off frequency factor is set to 0.5.

Manual operation: See "[Cut Off Frequency Factor](#)" on page 66

[:SOURce<hw>]:BB:WLNN:FILTER:PARameter:LPASSEVM <LPassevm>

The command sets the cut off frequency factor for the Lowpass (EVM optimization) filter type.

Parameters:

<LPassevm>

float

Range: 0.05 to 2.0

Increment: 0.01

*RST: 0.5

Example:

BB:WLNN:FILT:PAR:LPASSEVM 0.5

the cut off frequency factor is set to 0.5.

Manual operation: See "[Cut Off Frequency Factor](#)" on page 66

[:SOURce<hw>]:BB:WLNN:FILTER:PARameter:PGauss <PGauss>

The command 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:WLNN: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 66

[:SOURce<hw>]:BB:WLNN:FILT:PAR:RCOSine <RCosine>

The command sets the roll-off factor for the Root Cosine filter type.

Parameters:

<RCosine> float
 Range: 0.00 to 1.0
 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 66

[:SOURce<hw>]:BB:WLNN:FILT:PAR:SPHase <SPhase>

The command sets B x T for the Split Phase filter type.

Parameters:

<SPhase> float
 Range: 0.15 to 2.5
 Increment: 0.01
 *RST: 2.00

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 66

[:SOURce<hw>]:BB:WLNN:SRATe?

Displays the sample rate specific for the selected bandwidth ([\[:SOURce<hw> \] :BB :WLNN :BWidht](#)).

Return values:

<SampRate> float
 20MHz for BW20, 60MHz for BW40.

Usage: Query only

Manual operation: See "["Sample Rate"](#) on page 67

[:SOURce<hw>]:BB:WLNN:SRATe:VARiation <Variation>**Parameters:**

<Variation> float

Range: 400 Hz to 40 MHz

Increment: 0.001 Hz

*RST: 2 MHz

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 67

4.3 Trigger Settings



The trigger settings are available for R&S SMx and R&S AMU instruments only.

EXTernal<ch>

The numeric suffix to EXTernal<ch> distinguishes between the external trigger via the TRIGGER 1 (suffix 1) and TRIGGER 2 (suffix 2) connector.

[:SOURce<hw>]:BB:WLNN:TRIGger:ARM:EXECute.....	94
[:SOURce<hw>]:BB:WLNN:TRIGger:EXECute.....	95
[:SOURce<hw>]:BB:WLNN:TRIGger:EXTernal:SYNChronize:OUTPUT.....	95
[:SOURce<hw>]:BB:WLNN:TRIGger:OBASeband:DELay.....	96
[:SOURce<hw>]:BB:WLNN:TRIGger:OBASeband:INHibit.....	96
[:SOURce<hw>]:BB:WLNN:TRIGger:RMODe?.....	97
[:SOURce<hw>]:BB:WLNN:TRIGger:SLENgth.....	97
[:SOURce<hw>]:BB:WLNN:TRIGger:SLUNit.....	98
[:SOURce<hw>]:BB:WLNN:TRIGger:SOURce.....	98
[:SOURce<hw>]:BB:WLNN:TRIGger[:EXTernal<ch>]:DELay.....	99
[:SOURce<hw>]:BB:WLNN:TRIGger[:EXTernal<ch>]:INHibit.....	99
[:SOURce<hw>]:BB:WLNN[:TRIGger]:SEQuence.....	99

[:SOURce<hw>]:BB:WLNN:TRIGger:ARM:EXECute

The command stops signal generation for trigger modes Armed_Auto and Armed_Retrigger. A subsequent internal or external trigger event restart signal generation.

Example:	BB:WLNN:TRIG:SOUR INT sets internal triggering. BB:WLNN:TRIG:SEQ ARET sets Armed_Retigger mode, i.e. every trigger event causes signal generation to restart. BB:WLNN:TRIG:EXEC executes a trigger, signal generation is started. BB:WLNN:TRIG:ARM:EXEC signal generation is stopped. BB:WLNN:TRIG:EXEC executes a trigger, signal generation is started again.
Usage:	Event
Manual operation:	See " Arm " on page 72

[:SOURce<hw>]:BB:WLNN:TRIGger:EXECute

The command 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 BB:WLNN:TRIG:SEQ.

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 27

[:SOURce<hw>]:BB:WLNN:TRIGger:EXTernal:SYNChronize:OUTPut <Output>

(enabled for Trigger Source External)

Enables/disables output of the signal synchronous to the external trigger event.

For R&S SMBV instruments:

See also "[Sync. Output to External Trigger](#)" on page 72 for a detailed description of the applications of this setting.

Parameters:

<Output> 0 | 1 | OFF | ON

ON

The signal calculation starts simultaneously with the external trigger event but because of the instrument's processing time the first samples are cut off and no signal is outputted. 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 and starts with sample 0, i.e. the complete signal is outputted. This mode is recommended for triggering of short signal sequences with signal duration comparable with the processing time of the instrument.

*RST: ON

Example:

BB:WLNN:TRIG:SOUR EXT

sets external triggering.

BB:WLNN:TRIG:EXT:SYNC:OUTP ON

enables synchronous output to external trigger

Manual operation: See "[Sync. Output to External Trigger](#)" on page 72

[:SOURce<hw>]:BB:WLNN:TRIGger:OBASeband:DELay <Delay>

The command 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 samples to 2^32-1 samples

Increment: 1 sample

*RST: 0 samples

Example:

BB:WLNN:TRIG:SOUR OBAS

sets for path A the internal trigger executed by the trigger signal from the second path (path B).

BB:WLNN:TRIG:OBAS:DEL 50

sets a delay of 50 samples for the trigger.

Manual operation: See "[Trigger Delay](#)" on page 74

[:SOURce<hw>]:BB:WLNN:TRIGger:OBASeband:INHibit <Inhibit>

The command 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> float
 Range: 0 samples to 2^32-1 samples
 Increment: 1 sample
 *RST: 0 samples

Example:

BB:WLNN:TRIG:SOUR OBAS
 sets for path A the internal trigger executed by the trigger signal
 from the second path (path B).
 BB:WLNN:TRIG:INH 200
 sets a restart inhibit for 200 samples following a trigger event.

Manual operation: See "[Trigger Inhibit](#)" on page 74

[: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 EXT
 sets external triggering.
 BB:WLNN:TRIG:MODE ARET
 selects the Armed_Retrigger mode.
 BB:WLNN:TRIG:RMODE?
 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 71

[:SOURce<hw>]:BB:WLNN:TRIGger:SLENgth <Slength>

The command defines the length of the signal sequence to be output in the "Single" trigger mode (SOUR:BB:WLNN:SEQ 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> float
 Range: 1 samples to 2^32-1 samples
 Increment: 1 sample
 *RST: 15360 samples

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 "[Signal Duration](#)" on page 71

[:SOURce<hw>]:BB:WLNN:TRIGger:SLUNit <Slunit>

The command defines the unit for the entry of the length of the signal sequence (SOUR:BB:WLNN:TRIG:SLEN) to be output in the Single trigger mode (SOUR:BB:WLNN:SEQ SING).

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 71

[:SOURce<hw>]:BB:WLNN:TRIGger:SOURce <Source>

Selects the trigger source.

Parameters:

<Source> INTernal|OBASeband|BEXTernal|EXTernal
INTernal
 manual trigger or *TRG.
EXTernal|BEXTernal
 trigger signal on the TRIGGER 1/2 connector.
OBASeband
 trigger signal from the other path
 *RST: INTernal

Example:

SOURce1:BB:WLNN:TRIGger:SOURce EXTernal
 sets external triggering via the TRIGGER 1 connector.

Manual operation: See "[Trigger Source](#)" on page 72

[:SOURce<hw>]:BB:WLNN:TRIGger[:EXTernal<ch>]:DELay <Delay>

Parameters:

<Delay> float
 Range: 0 samples to 2^32-1 samples
 Increment: 1 sample
 *RST: 0 samples

Example:

BB:WLNN:TRIG:SOUR EXT
 sets an external trigger via the TRIGGER 1 connector.
 BB:WLNN:TRIG:DEL 50
 sets a delay of 50 samples for the trigger.

Manual operation: See "[Trigger Delay](#)" on page 74

[:SOURce<hw>]:BB:WLNN:TRIGger[:EXTernal<ch>]:INHibit <Inhibit>

The command specifies the number of samples by which a restart is to be inhibited following a trigger event.

Parameters:

<Inhibit> float
 Range: 0 samples to 2^32-1 samples
 Increment: 1 sample
 *RST: 0 samples

Example:

BB:WLNN:TRIG:SOUR EXT
 selects an external trigger via the TRIGGER 1 connector.
 BB:WLNN:TRIG:INH 200
 sets a restart inhibit for 200 samples following a trigger event.

Manual operation: See "[Trigger Inhibit](#)" on page 74

[:SOURce<hw>]:BB:WLNN[:TRIGger]:SEQUence <Sequence>

Selects the trigger mode.

Parameters:

<Sequence>

AUTO | RETRigger | AAUTo | ARETrigger | SINGLE

AUTO

The modulation signal is generated continuously.

RETRigger

The modulation signal is generated continuously. A trigger event (internal or external) causes a restart.

AAUTo

The modulation signal is generated only when a trigger event occurs. After the trigger event the signal is generated continuously. Signal generation is stopped with command SOUR:BB:WLNN:TRIG:ARM:EXEC and started again when a trigger event occurs.

ARETrigger

The modulation signal is generated only when a trigger event occurs. The device automatically toggles to RETRIG mode.

Every subsequent trigger event causes a restart.

Signal generation is stopped with command

SOUR:BB:WLNN:TRIG:ARM:EXEC and started again when a trigger event occurs.

SINGle

The modulation signal is generated only when a trigger event occurs. Then the signal is generated once to the length specified with command SOUR:BB:WLNN:TRIG:SLEN. Every subsequent trigger event causes a restart.

*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 70

4.4 Marker Settings

This section lists the remote control commands, necessary to configure the markers.



The marker delay settings are available for R&S SMx and R&S AMU instruments only.

[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut:DELay:FIXed.....	101
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:DELay.....	101
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:DELay:MAXimum?.....	101
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:DELay:MINimum?.....	102
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:MODE.....	103

[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:ONTIme.....	104
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:OFFTime.....	104
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:FBINdex.....	104
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:FINdex.....	104
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:FESHift.....	105
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:RESHift.....	105
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:PATTern.....	105
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:PULSe:DIVider.....	106
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:PULSe:FREQuency?.....	106

[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut:DELay:FIXed <Fixed>

The command restricts the marker delay setting range to the dynamic range. In this range the delay can be set without restarting the marker and signal. If a delay is entered in setting ON but is outside this range, the maximum possible delay is set and an error message is generated.

Parameters:

<Fixed>	0 1 OFF ON
	*RST: OFF

Example:

BB:WLNN:TRIG:OUTP:DEL:FIX ON
restricts the marker signal delay setting range to the dynamic range.

Manual operation: See "Fix marker delay to current range" on page 78

[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:DELay <Delay>

Defines the delay between the signal on the marker outputs and the start of the signal, expressed in terms of samples. Command :BB:WLNN:TRIGger:OUTPut:DELay:FIXed can be used to restrict the range of values to the dynamic range, i.e. the range within which a delay of the marker signals can be set without restarting the marker and signal.

Parameters:

<Delay>	float
	Range: 0 samples to 2^32 -1samples
	Increment: 1 sample
	*RST: 0 samples

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 78

[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:DELay:MAXimum?

The command queries the maximum marker delay for setting :BB:WLNN:TRIG:OUTP:DEL:FIX ON.

Return values:

<Maximum> float

Example:

BB:WLNN:TRIG:OUTP:DEL:FIX ON
restricts the marker signal delay setting range to the dynamic range.
BB:WLNN:TRIG:OUTP:DEL:MAX
queries the maximum of the dynamic range.
Response: 2000
the maximum for the marker delay setting is 2000 samples.

Usage: Query only

Manual operation: See "[Current Range without Recalculation](#)" on page 78

[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:DELay:MINimum?

The command queries the minimum marker delay for setting :BB:WLNN:TRIGger:OUTPut:DELay:FIXed ON.

Return values:

<Minimum> float

Example:

BB:WLNN:TRIG:OUTP:DEL:FIX ON
restricts the marker signal delay setting range to the dynamic range.
BB:WLNN:TRIG:OUTP:DEL:MIN?
queries the minimum of the dynamic range.
Response: 0
the minimum for the marker delay setting is 0 samples.

Usage: Query only

Manual operation: See "[Current Range without Recalculation](#)" on page 78

[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:MODE <Mode>

Parameters:

<Mode>

REStart | FBLock | FRAMe | FAPart | PULSe | PATTern | RATio | FIPart | TRIGger

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.

TRIGger

A received internal or external trigger signal is output at the marker connector.

*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 75

[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:ONTime <OnTime>
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:OFFTime <OffTime>

The command sets the number of samples in a period (ON time + OFF time) during which the marker signal in setting `SOURce:BB:WLNN:TRIGger:OUTPut:MODE RATIO` on the marker outputs is OFF.

Parameters:

<OffTime> float
 Range: 1 sample to 2^24-1 samples
 Increment: 1 sample
 *RST: 1 sample

Example: `BB:WLNN:TRIG:OUTP:OFFT 200`
 sets an OFF time of 200 samples for the corresponding marker signal.

Manual operation: See "Marker Mode" on page 75

[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:FBIndex <FBIndex>

The command 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> float
 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 75

[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:FIndex <FIndex>

The command sets the frame index, that is, the frame to be marked in the frame block marked with command `BB:WLNN:TRIGger:OUTPut:FBIndex`. The maximum value depends on the number of frames set with command `BB:WLNN:FBLOCK:FCOUNT`. The maximum value is 1024.

Parameters:

<FIndex> float
 Range: 1 to 1024
 Increment: 1

Example: `BB:WLNN:TRIG:OUTP1:FIND 100`
 sets the frame index to 100.

Manual operation: See "Marker Mode" on page 75

[: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:	-100 to 100
*RST:	0

Example: BB:WLNN:TRIG:OUTP2:FESH 75

Manual operation: See "Marker Mode" on page 75

shifts the falling edge of the marker 2 about 75 samples.

[: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:	-100 to 100
*RST:	0

Example: BB:WLNN:TRIG:OUTP2:RESH -20

Manual operation: See "Marker Mode" on page 75

shifts back the rising edge of marker 2 about 20 samples.

[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:PATTern <Pattern>

The command defines the bit pattern used to generate the marker signal in the setting SOURce:BB:WLNN:TRIGger:OUTPut:MODE PATTern.

0 is marker off

1 is marker on

Parameters:

<Pattern>	integer
Range:	#B0,1 to #B111...1, 32
*RST:	#B0,1

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 75

[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:PULSe:DIVider <Divider>

The command sets the divider for Pulse marker mode (SOUR:BB:WLNN:TRIG:OUTP:MODE PULSe). The resulting pulse frequency is derived by dividing the symbol rate by the divider.

Parameters:

<Divider>	float
	Range: 2 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 75

[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:PULSe:FREQuency?

The command queries the pulse frequency of the pulsed marker signal in the setting SOURce:BB:WLNN:TRIGger:OUTPut:MODE PULSe. The pulse frequency is derived by dividing the symbol rate by the divider.

Return values:

<Frequency>	float
-------------	-------

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 75

4.5 Clock Settings

This section lists the remote control commands, necessary to configure the clock.



The clock settings are available for R&S SMx and R&S AMUinstruments only.

[:SOURce<hw>]:BB:WLNN:CLOCK:MODE	107
[:SOURce<hw>]:BB:WLNN:CLOCK:MULTiplier	107
[:SOURce<hw>]:BB:WLNN:CLOCK:SOURce	108
[:SOURce<hw>]:BB:WLNN:CLOCK:SYNChronization:EXECute	108
[:SOURce<hw>]:BB:WLNN:CLOCK:SYNChronization:MODE	108

[**:SOURce<hw>]:BB:WLNN:CLOCK:MODE <Mode>**

Sets the type of externally supplied clock.

For two-path instruments, the only numerical suffix allowed for SOURce is 1, since the external clock source is permanently allocated to path A.

Parameters:

<Mode> SAMPLe | MSAMPLe
*RST: SAMPLe

Example: SOURce1:BB:WLNN:CLOCK:MODE SAMPLE
selects clock type

Manual operation: See "Clock Mode" on page 79

[**:SOURce<hw>]:BB:WLNN:CLOCK:MULTiplier <Multiplier>**

Note: This command is available for clock source "External" and in clock mode "Multiple Sample" only.

The command specifies the multiplier for clock type "Multiplied" (:BB:WLNN:CLOCK:MODE MSAMple) in the case of an external clock source.

For two-path instruments, the only numerical suffix allowed for `SOURCE` is 1, since the external clock source is permanently allocated to path A.

Parameters:

<Multiplier> float
Range: 1 to 64
Increment: 1
*RST: 4

Example: SOURCE1:BB:WLNN:CLOCK:SOURce EXternal
selects the external clock source.
SOURCE1:BB:WLNN:CLOCK:MODE MSAMple
selects clock type "Multiplied", i.e. the supplied clock has a rate
which is a multiple of the sample rate.
SOURCE1:BB:WLNN:CLOCK:MULTIplier 12
the multiplier for the external clock rate is 12.

Manual operation: See "Chip Clock Multiplier" on page 80

[:SOURce<hw>]:BB:WLNN:CLOCK:SOURce <Source>

The command selects the clock source.

For two-path instruments, selecting **EXTernal** is only possible for path A, since the external clock source is permanently allocated to path A. Selection **AINternal** is only possible for path B.

Parameters:

<Source> INTernal | EXTernal | AINternal

INTernal

The internal clock reference is used.

EXTernal

The external clock reference is supplied to the CLOCK connector.

AINternal

The clock source of path A is used for path B.

*RST: INTernal

Example:

BB:WLNN:CLOC:SOUR EXT

selects an external clock reference. The clock is supplied via the CLOCK connector.

BB:WLNN:CLOC:MODE SAMP

specifies that a sample clock is supplied via the CLOCK connector.

Manual operation: See "[Clock Source](#)" on page 79

[:SOURce<hw>]:BB:WLNN:CLOCK:SYNChronization:EXECute

Performs automatically adjustment of the instrument's settings required for the synchronization mode, set with the command BB:WLNN:CLOC:SYNC:MODE.

Example:

BB:WLNN:CLOC:SYNC:MODE MAST

the instrument is configured to work as a master one.

BB:WLNN:CLOC:SYNC:EXEC

all synchronization's settings are adjusted accordingly.

Usage: Event

Manual operation: See "[Set Synchronization Settings](#)" on page 79

[:SOURce<hw>]:BB:WLNN:CLOCK:SYNChronization:MODE <Mode>

Selects the synchronization mode.

This parameter is used to enable generation of very precise synchronous signal of several connected R&S SMBVs.

Note: If several instruments are connected, the connecting cables from the master instrument to the slave one and between each two consecutive slave instruments must have the same length and type. Avoid unnecessary cable length and branching points.

Parameters:

<Mode>	NONE MASTer SLAVe
	NONE
	The instrument is working in stand-alone mode.
	MASTer
	The instrument provides all connected instrument with its synchronization (including the trigger signal) and reference clock signal.
	SLAVe
	The instrument receives the synchronization and reference clock signal from another instrument working in a master mode.
	*RST: NONE
Example:	BB:WLNN:CLOC:SYNC:MODE MAST the instrument is configured to work as a master one.
Manual operation:	See " Sync. Mode " on page 78

4.6 Antenna Configuration Settings

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[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:OUTPUT:DESTination.....	110
[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:OUTPUT:FSELect.....	110
[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:TX<dir>:REAL.....	110
[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:TX<dir>:IMAGinary.....	111
[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:TX<dir>:PHASE.....	111
[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:TX<dir>:MAGNitude.....	111

[: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 28
--------------------------	---

[:SOURce<hw>]:BB:WLNN:ANTenna:SYSTem <System>

The command 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 28

[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:OUTPut:DESTination
<Destination>

The command 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 28

[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:OUTPut:FSELect <FSelect>

The command saves the IQ chain in a file.

Suffix:

<ch> [1] .. 8

Parameters:

<FSelect> string

Example: BB:WLNN:ANT:TCH1:OUTP:FSEL '<root>wlnn_1.wv'
saves the IQ chain in the selected file.

Manual operation: See "[Output](#)" on page 28

[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:TX<dir>:REAL <Real>

The command enters the value for the Real coordinate.

Parameters:

<Real> float
Range: -999.99 to 999.99

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 29

[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:TX<dir>:IMAGinary
<Imaginary>

The command enters 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 29

[: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

Manual operation: See "[Imaginary/Phase](#)" on page 29

[: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

Manual operation: See "[Real/Magnitude](#)" on page 29

4.7 Frame Block Configuration

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BOSt.....	112
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[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DATA.....	113
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[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DATA:RATE?.....	114
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:ITIMe.....	114
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[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BOSt <Boost>

The command 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 dB to 0 dB
	*RST: 0 dB

Example: BB:WLNN:FBLOCK:BOSt -10.0

sets the power boost

Manual operation: See "Boost /dB" on page 33

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:FCOut <FCOut>

The command sets the number of frames to be transmitted in the current frame block.

Parameters:

<FCOut>	float
	Range: 1 to 20 000
	Increment: 1
	*RST: 1

Example: BB:WLNN:FBL5:FC0 1
sets the number of transmitted frames in the current frame block to 1.

Manual operation: See "[Frames](#)" on page 32

[: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 4.8.2, "MPDU Configuration"](#), on page 130

*RST: PN9

Example: BB:WLNN:FBL5:DATA PN9
sets PN9 as the data source.

Manual operation: See "[Data List Management...](#)" on page 24

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DATA:DSElection <DSelection>

The command selects the data list for the DLIST data source selection.

The lists are stored 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 '<root>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 <root>Lists_DM and have the file extension
 *.dm_iqd.

Manual operation: See "[Data List Management...](#)" on page 24

[:SOURce<hw>]:BB:WLNN:FBLOCK<ch>:DATA:PATTERn <Pattern>

The command determines the bit pattern for the PATTern selection. The maximum length is 64 bits.

Parameters:

<Pattern> integer

Example: BB:WLNN:FBL5:DATA:PATT #H3F,8
 sets the bit pattern.

Manual operation: See "[Data](#)" on page 33

[: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 33

[:SOURce<hw>]:BB:WLNN:FBLOCK<ch>:ITIMe <ITime>

The command 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.

The command 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 sec to 1.0 sec

Increment: 0.001 sec

*RST: 0 sec

Example: BB:WLNN:FBL5:ITIMe 2.5ms
sets the idle time to 2.5 msec.

Manual operation: See "[Idle Time / ms](#)" on page 32

[: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.
GRFIled
 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 31

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:STANDARD <Standard>

Sets the IEEE 802.11 WLAN standard.

Parameters:

<Standard> USER | WAG | WBG | WPJ | WN | WAC
USER
 Sets a user defined standard.
WAG
 Sets the IEEE 802.11a/g standard.
WBG
 Sets the IEEE 802.11b/g standard.
WCG
 Sets the IEEE 802.11c/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.
 *RST: USER

Example: BB:WLNN:FBL1:STAN WN
sets the IEEE 802.11n standard

Manual operation: See "[Standard](#)" on page 30

[:SOURce<hw>]:BB:WLNN:FBLOCK<ch>:STATe <State>

The command 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 34

[:SOURce<hw>]:BB:WLNN:FBLOCK<ch>:TMODE <TMode>

The command sets the Tx mode. The available Tx modes are dependent on the physical mode.

Parameters:

<TMode> L20 | L10 | LDUP | LUP | LLow | HT20 | HT40 | HTDup | HTUP | HTLow | CCK | PBCC | V20 | V40 | V80 | V160 | V8080
*RST: HT20

Example: BB:WLNN:FBL5:TMOD HT40
sets the Tx mode to HT 40 MHz.

Manual operation: See "[Tx Mode](#)" on page 31

[:SOURce<hw>]:BB:WLNN:FBLOCK<ch>:TYPE <Type>

The command selects the PPDU type.

Parameters:

<Type> DATA | SOUNDing | BEACon

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 30

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:COPY

Usage: Event

Manual operation: See "[Copy](#)" on page 34

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DELetE

Deletes the specified frame block.

Usage: Event

Manual operation: See "[Delete](#)" on page 34

[: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 34

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PASTe

Usage: Event

Manual operation: See "[Paste](#)" on page 34

[:SOURce<hw>]:BB:WLNN:FBLock:APPend

The command appends a frame block to the end of the frame blocks list.

Example: BB:WLNN:FBL:APP
appends a frame block to the end of the frame blocks list.

Usage: Event

Manual operation: See "[Append](#)" on page 34

4.8 Frame Configuration Settings

4.8.1 Frame Block PPDU Configuration

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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: Not Present
 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 41**[: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 \leq 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 39**[: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 39**[:SOURce<hw>]:BB:WLNN:FBLock<ch>:CODing:TYPE <Type>**

Selects the channel coding.

Parameters:

<Type> OFF | BCC
 *RST: BCC

Example:

BB:WLNN:FBL5:COD:TYPE OFF

no channel coding is used.

Manual operation: See "[Channel Coding](#)" on page 39

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DATA:BPSymbol?

The command queries the number of data bits sent by an OFDM symbol on all spatial streams.

Return values:

<BpSymbol> float

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 39

[: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 41

[: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 33

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DATA:SYMBols <Symbols>

The command 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> float
Range: 1 to Max

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 42

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DBINonht <DBINonht>

(available only for VHT Tx mode)

This command is used to modify 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: STAT

Example: BB:WLNN:FBL1:DBIN DYN

the transmitter is capable of dynamic bandwidth operation.

Manual operation: See "[Dyn. Bandwidth in Non HT](#)" on page 42

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:ESSTream <EsStream>

The command enters 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> float
Range: 1 to 4
Increment: 1
*RST: 0

Example: BB:WLNN:FBL5:ESSTR 4

sets the number of the extended spatial streams to 4.

Manual operation: See "[Extended Spatial Streams](#)" on page 38

[:SOURce<hw>]:BB:WLNN:FBLOCK<ch>:GUARD <Guard>

The command selects whether a long or short 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.

Parameters:

<Guard> SHORt | LONG
*RST: LONG

Example: BB:WLNN:FBLOCK5:GUARD LONG
sets a long guard interval.

Manual operation: See "[Guard](#)" on page 40

[: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:FBLOCK5:ILE:STAT ON
activates the interleaver.

Manual operation: See "[Interleaver Active](#)" on page 42

[:SOURce<hw>]:BB:WLNN:FBLOCK<ch>:MCS <MCS>

The command selects the modulation and coding scheme for all 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:FBLOCK1:MCS MCS8
selects MCS8 as the coding scheme used for the spatial stream.

Manual operation: See "[MCS](#)" on page 39

[:SOURce<hw>]:BB:WLNN:FBLOCK<ch>:MODulation<st> <Modulation>

The command selects the modulation used for the spatial stream.

Parameters:

<Modulation> BPSK | QPSK | QAM16 | QAM64 | QAM256
 *RST: QPSK; BPSK for Tx Mode HT-Duplicate

Example:

BB:WLNN:FBLOCK5:MOD1 BPSK

sets BPSK as the modulation mode used for the spatial stream.

Manual operation: See "[Stream n](#)" on page 39**[: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:FBLOCK1:MUM:STAT ON

activates Multi User MIMO.

Manual operation: See "[Multi User MIMO](#)" on page 38**[:SOURce<hw>]:BB:WLNN:FBLOCK<ch>:MU<st0>:GID <GID>**

Sets the group ID for all available users.

Parameters:

<GID> float
 Range: 1.0 to 62.0

Example:

BB:WLNN:BB:WLNN:FBLOCK1:MU1:GID 1.0

assigns group ID 1.0 to user 1.

Manual operation: See "[Multi User MIMO Settings Table](#)" on page 38**[:SOURce<hw>]:BB:WLNN:FBLOCK<ch>:MU<st0>:NSTS <NSTS>**

Sets the number of space time streams for each user.

Parameters:

<NSTS> float
 Range: 0.0 to Max

Example:

BB:WLNN:BB:WLNN:FBLOCK1:MU2:NSTS 8.0

sets 8 space time streams for user 2.

Manual operation: See "[Multi User MIMO Settings Table](#)" on page 38

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:NTPS <NTPS>

(available only for VHT Tx mode)

The command 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: ON*Example:** BB:WLNN:FBL1:NTPS ON
activates NTPS.**Manual operation:** See "[No TXOP PS](#)" on page 44**[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PAID:PATtern <Pattern>**

(available only for VHT Tx mode)

The command provides an abbreviated indication of the intended recipient(s) of the frame.

Parameters:**<Pattern>** integer**Example:** BB:WLNN:FBL1:PAID:PAT #H1FB, 9
sets the pattern.**Manual operation:** See "[Partial AID \(hex\)](#)" on page 44**[: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 43

[: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 43

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PREamble:STATe <State>

The command 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: ON

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 43

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PSDU:BRATe <BRate>

(available only for CCK and PBCC transport modes)

Sets the PSDU bit rate.

Parameters:

<BRate> P1MBPS | P2MBPS | P5.5MBPS | P11MBPS | P22MBPS
*RST: R11MBPS

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 P2MBPS
sets the PSDU bit rate

Manual operation: See "[PSDU Bit Rate](#)" on page 40

[: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 40

[: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: RAND

Example:

BB:WLNN:FBL5:SCR:MODE RAND

activates the scrambler with an random initialization value.

Manual operation: See "[Scrambler](#)" on page 41**[: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> integer

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 42**[:SOURce<hw>]:BB:WLNN:FBLOCK<ch>:SEGMENT <SEGMENT>**

Selects one of the two segments in VHT-80+80 MHz mode with transmission bandwidth 80 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:

<SEGMENT> SEG0 | SEG1 | BOTH
 *RST: SEG0

Example:

BB:WLNN:FBL1:SEGM BOTH
 selects both segments.

Manual operation: See "[Segment](#)" on page 38

[: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> integer

Example:

BB:WLNN:FBL5:SERV:PATT #H3F,16
 sets the value for the service field.

Manual operation: See "[Service Field \(hex\)](#)" on page 43

[: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: ON

Example:

BB:WLNN:FBL:SMO ON
 switches on smoothing.

Manual operation: See "[Smoothing](#)" on page 43

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SSTReam <SStrream>

The command 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:

<SSstream> float
 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 37

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:STBC:STATe?

The command 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 38

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:STSTream <Ststream>

The command 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> float
 Range: 1 to 8
 *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 37

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:TDWindowing:STATe <State>

The command 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: OFF

Example: BB:WLNN:FBL5:TDW:STAT ON
activates the time domain windowing.

Manual operation: See "[Time Domain Windowing Active](#)" on page 42

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:TTIMe <TTIme>

The command 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 ns 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 43

[: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 38

4.8.2 MPDU Configuration

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[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MPDU<st>:DATA:LENGTH.....	131
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MPDU<st>:DATA:PATtern.....	131
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MPDU<st>:DATA:SOURce.....	132
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MPDU:EOF.....	132

[: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 45

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MPDU<st>:DATA:DSELection

<Filename>

Selects the data list for the DLIS data source selection.

The lists are stored 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 '<root>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 46

[: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 45

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MPDU<st>:DATA:PATTern <Pattern>

Determines the bit pattern for the PATTern selection.

Parameters:

<Pattern> integer

*RST: 0

Example:

BB:WLNN:FBL1:MPDU1:DATA:PATT #B0101,4

Sets the bit pattern.

Manual operation: See "[DList / Pattern](#)" on page 46**[: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 45**[: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 45

4.8.3 MAC Header Configuration

4.8.3.1 Common Fields Commands

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:ADDRes<st>.....	133
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[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol.....	134
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[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:ORDer.....	135
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:PMANagement.....	135
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:PVERsion.....	135
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:RETRY.....	135
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:SUBType.....	135
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:TDS.....	135
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:TYPE.....	135
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:WEP.....	135
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SA.....	135
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[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SCONtrol:SEQuence:INCReMent.....	137
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SCONtrol:SEQuence:STARt.....	137
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SCONtrol:STATE.....	137
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:STATE.....	138

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:ADDRes<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 hexa-decimal 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 #HFFFFFFFFF,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>:MAC:ADDRes<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 48

[: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 48

[: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 #FFFF,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 47

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol <FCControl>

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:

<FCControl> integer
 Range: #H0000,16 to #FFFF,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 47

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:FDS <Fd>
 [:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:MDATa <MDATA>
 [:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:MFragments
 <MFragments>
 [:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:ORDer <Order>
 [:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:PMANagement
 <PMANagement>
 [:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:PVERsion <PVersion>
 [:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:RETRY <Retry>
 [:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:SUBType <Subtype>
 [:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:TDS <TDS>
 [:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:TYPE <Type>
 [: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 47

[: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 #FFFFFFFFFFFF,48
 Sets the value of the SA field to FFFFFFFFFF.

Manual operation: See "SA (hex)" on page 48

[: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 47

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:QSControl <QsControl>

The command 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.

Manual operation: See "[QoS Control](#)" on page 56

[: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 56

[: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>	float
	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 "[Sequence Control](#)" on page 48

[: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 "[Sequence Control](#)" on page 48

**[: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> float
 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 "[Sequence Control](#)" on page 48

**[: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 "[Sequence Control](#)" on page 48

[: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 48

[: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: OFF

Example: BB:WLNN:FBLOCK1:MAC:STAT ON
activates the generation of the MAC Header.

Manual operation: See "MAC Header" on page 46

4.8.3.2 MAC Header HT Configuration

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[:SOURce<hw>]:BB:WLNN:FBLOCK<ch>:MAC:HTControl:ZLF.....	142

[:SOURce<hw>]:BB:WLNN:FBLOCK<ch>:MAC:HTControl <HtControl>

The command sets the value for the HT control field.

Parameters:

<HtControl>	integer
	Range: #H00000000,32 to #HFFFFFFF,32
	*RST: #H00000000,32

Example: BB:WLNN:FBLOCK1:MAC:HTC #H5a5a5a5a,32
sets the value for the HT control field.

Manual operation: See "HT/VHT Control" on page 56

[:SOURce<hw>]:BB:WLNN:FBLOCK<ch>:MAC:HTControl:ACConstraint <AcConstraint>

The command 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 57

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:CALibration:POStion
 <Position>

The command 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 58

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:CALibration:SEQuence
 <Sequence>

The command 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 58

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:CSISteering <CsSteering>

The command sets the value for the CSI steering.

00 = CSI

01 = uncompressed Steering Matrix

10 = compressed Steering Matrix

11 = Reserved

Parameters:

<CsSteering> 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 57

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:FREQuest <FRequest>

The command 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 "[Feedback Request](#)" on page 58

[: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 59

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:LAControl <LaControl>

The command sets the value for the Link Adaption Control.

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'.

Parameters:

<LaControl> integer

Range: #H0000,16 to #FFFF,16

Example:

BB:WLNN:FBL1:MAC:HTC:LAC #H5A5A,16
sets the value for the Link AdaptionControl.

Manual operation: See "[Link Adaption Control](#)" on page 58

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:RDGMore <RdgMore>

The command 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.

Manual operation: See "[RDG/More PPDU](#)" on page 57

[: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 57

[: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 Control](#)" on page 56

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:ZLF <Zlf>

The command 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 "[ZLF Announcement](#)" on page 57

4.8.3.3 MAC Header VHT Configuration

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl.....	143
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:ACConstraint.....	143
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:CTYPe.....	144
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:FTTYpe.....	144
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:GIDH.....	144
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[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:MFB.....	145
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:MGL.....	145
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[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:MSI.....	146
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:RDGMore.....	146
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:UMFB.....	147
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:VREServed.....	147

[: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 #HFFFFFFF,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 Control" on page 56

[: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 59

[: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 60

[: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 60

[:SOURce<hw>]:BB:WLNN:FBLOCK<ch>:MAC:VHTControl:GIDH <GIDH>

The command 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
--------	---------

Example:

BB:WLNN:FBL:MAC:VHTC:GIDH #B111,3
sets the coding information for GID-H.

Manual operation: See "[GID-H](#)" on page 60

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:HVINdicator?

The command queries the used format (HT or VHT).

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 62

[: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 3-3](#) for definition of the MFB subfield.

Parameters:

<Mfb> integer

Example:

BB:WLNN:FBL:MAC:VHTC:MFB #B11111111111111,15

sets the information for the MFB subfield.

Manual operation: See "[MFB](#)" on page 60

[: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 61

[: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 61

[: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 61

[: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 59

[: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:FBLOCK:MAC:VHTC:UMFB #B1,1
 sets the information for the UMFB subfield.

Manual operation: See "[Unsolicited MFB](#)" on page 60

[: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 62

4.8.4 Beacon Configuration

4.8.4.1 General Beacon Functions

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:BINTerval	147
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:DCChannel?	148
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:IAWindow	148
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:SRATe	148
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:SSID	148
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:TSTamp	149

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:BINTerval <BIinterval>

Defines the time interval between two beacon transmissions.

Parameters:

<BIinterval> float
 Default unit: ms

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 51

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:DCCHannel? <DCCHannel>

Queries the current channel of the DSSS network.

Example: BB:WLNN:FBL1:BFC:DCCH?

Usage: Query only

Manual operation: See "[DSSS\(Current Channel\)](#)" on page 52

[: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

Example: BB:WLNN:FBL1:BFC:IAW #HFFFF,16

Manual operation: See "[IBSS\(ATIM Window\) \(hex\)](#)" on page 52

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:SRATe <SRATe>

Determines a set of data rates that are supported by the accesspoint (SupportedRates 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 accesspoint.

Manual operation: See "[SupportedRate](#)" on page 52

[: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 51

[: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 51

4.8.4.2 Capability Information Parameters

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:APSD	149
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:CAGility	150
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:CPOLable	150
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:CPRequest	150
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:ESS	150
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:IBACK	151
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:IBSS	151
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:DBACK	151
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:DOFDm	152
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:PBCC	152
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:PRIVacy	152
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:QOS	152
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:RMEasurement	153
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:SMGMMt	153
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:SPRreamble	153
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:SSTime	154
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:HTCapability:GFeld	154
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:HTCapability:STATE	154

[: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 53](#)

[: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 53](#)

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 53](#)

[: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 53](#)

[: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 53

**[: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 53

**[: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 53

**[: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 53

[: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 53

Informs the associated stations that Direct Sequence Spread Spectrum - OFDM is allowed.

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:PBCC
<PBCC>

Indicates 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 53

Informs the associated stations that PBCC is allowed.

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:PRIVacy
<PRIVacy>

Indicates 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 53

Informs the associated stations that encryption is required for all data frames.

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:QOS
<QOS>

Indicates 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 53

[: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 53

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 53

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:SPRamble <SPRamble>

Informs the associated stations if short preamble is allowed.

Parameters:

<SPRamble> 0 | 1 | OFF | ON
 *RST: 0

Example:

BB:WLNN:FBL1:BFC:CAP:SPR ON

Manual operation: See "[Capability Information Parameters](#)" on page 53

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:FB11:BFC:CAPability:SST ON

Informs the associated stations that short slot time is supported.

Manual operation: See "[Capability Information Parameters](#)" on page 53

[: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 55

[: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 55

4.8.4.3 ERP Parameters

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:ERP:BPMode	154
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[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:ERP:UPRotection	155

[: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 55

[: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 55

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:ERP:UPProtection
<EUPProtection>

Informs associated stations if they have to use protection.

Parameters:

<EUPProtection> 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 55

4.8.5 Spatial Mapping Configuration

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[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SMAPping:ROW<st>:COL<dir>:Q?	158

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SMAPping:MODE <Mode>

The command selects the spatial mapping mode for the selected frame block. Except of the Beamforming mode, the matrix element values are loaded through the use of 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.

BEAMforming

(this feature will be supported in further release)

The transmit matrix is the product of a CSD matrix and the Hadamard unitary matrix.

The File button is displayed to open a Browse popup. A file with source format *.bmf can be selected for the beamforming. The file must include 128 4*4 IQ elements (corresponding to the sub-carriers).

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 63

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SMAPping:BSELection <BSelection>

The command loads the selected file for beamforming.

Parameters:

<BSelection> string

Example:

BB:WLNN:FBL1:PMOD MIX

BB:WLNN:FBL1:SMAP:MODE BEAM

BB:WLNN:FBL1:SMAP:BSEL '<root>test_scpi.bmf'
loads the selected file for beamforming.

Manual operation: See "[Mode](#)" on page 63

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SMAPping:TShift<st> <TShift>

The command sets the spatial mapping time shift. This value is relevant for spatial mapping mode Direct and Spatial Expansion only.

Suffix:

<st> [1] .. 8

Parameters:

<TShift> float

Range: -32000 ns to 32000 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 64

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SMAPping:INDEX <Index>

The command sets the index of the sub-carrier. A matrix is mapped to each sub-carrier. With the exception of k=0, the index can be set in the value range of -64 to 63

Parameters:

<Index> float

Range: -64 to 63

*RST: 20

Example:

BB:WLNN:FBL1:SMAP:IND 30
sets the index of the sub-carrier to k = 30.

Manual operation: See "[Index k](#)" on page 64

[: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.

Suffix:

<st> [1] .. 8

<dir> [1] .. 8

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 65

[: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.

Suffix:

<st> [1] .. 8

<dir> [1] .. 8

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 65

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