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

Operating Manual

1171.5519.12 ─ 20

Test & Measurement

Operating Manual

ROHDE&SCHWARZ

This document describes the following software options:

- R&S®SMBV-K54/-K86
  1415.8160.xx 1415.8648.xx
- R&S®SMU-K54/-K86
  1408.7562.02, 1408.8552.02
- R&S®AMU-K54/-K86
  1402.9705.02, 1403.0899.02
- R&S®SMATE-K54/-K86
  1404.7951.02, 1404.8864.02
- R&S®SMJ-K54/-K86
  1409.2458.02, 1409.3448.02

This manual version corresponds to firmware version:
FW 3.20.281.xx and later of the R&S®SMBV100A
FW 3.20.286.xx and later of the R&S®SMU200A, R&S®SMATE200A, R&S®SMJ100A and R&S®AMU200A

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The following abbreviations are used throughout this manual: R&S®SMBV100A is abbreviated as R&S SMBV, R&S®SMU200A is abbreviated as R&S SMU, R&S®AMU200A is abbreviated as R&S AMU, R&S®SMATE200A is abbreviated as R&S SMATE, R&S®SMJ100A is abbreviated as R&S SMJ, R&S®WinIQSIM2™ is abbreviated as R&S WinIQSIM2; the license types 02/03/07/11/13/16/12 are abbreviated as xx.

Contents

1 Preface

1.1 Documentation Overview

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

- Quick start guide, printed manual
- Online help system on the instrument
- Operating manuals and online manual for base unit and options provided on the product page
- Service manual provided for registered users, or on the product page
- Instrument security procedures provided on the product page
- Release notes provided on the product page
- Data sheet and brochures provided on the product page
- Application notes provided on the Rohde & Schwarz website

You find the user documentation on the mainly on the R&S Signal Generator product page.

Additional download paths are stated directly in the following abstracts of the documentation types.

Quick Start Guide

Introduces the R&S Signal Generator and describes how to set up and start working with the product. Includes basic operations, typical measurement examples, and general information, e.g. safety instructions, etc.

Online Help

Offers quick, context-sensitive access to the information needed for operation and programming. It contains the description for the base unit and the software options.

Operating Manuals and Online Manual

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

- **Base unit** manual
  Contains the description of the graphical user interface, an introduction to remote control, the description of all SCPI remote control commands, programming examples, and information on maintenance, instrument interfaces and error messages. Includes the contents of the Quick Start Guide manual.
- **Software option** manuals
  Describe the specific functions of this option. Basic information on operating the base unit is not included.

The **online manual** provides the contents of the operating manual for immediate display on the internet.

Service Manual

Describes the performance test for checking the rated specifications, module replacement and repair, firmware update, troubleshooting and fault elimination, and contains mechanical drawings and spare part lists.

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

Instrument Security Procedures

Deals with security issues when working with the R&S Signal Generator in secure areas.

Data Sheet and Brochures

The data sheet contains the technical specifications of the software options, see "Digital Standards for Signal Generators - Data sheet" on the web site.

Release Notes

Describes the firmware installation, new and modified features and fixed issues according to the current firmware version. You find the latest version at the product page of the corresponding instrument > "Download" > "Firmware".

Application Notes, Application Cards, White Papers, etc.

These documents deal with special applications or background information on particular topics, see http://www.rohde-schwarz.com/appnotes.

1.2 Conventions Used in the Documentation

1.2.1 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.
Input	Input to be entered by the user is displayed in italics.

Convention	Description
Links	Links that you can click are displayed in blue font.
"References"	References to other parts of the documentation are enclosed by quotation marks.

1.2.2 Notes on Screenshots

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

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

1.2.3 Naming of Software Options

In this operating manual, we explicitly refer to options required for specific functions of the digital standard.

The name of software options for signal generators vary in the name of the instrument, but the option name is identical. Therefore we use in this manual the placeholder R&S SMx/AMU.

Example:

Naming for an option of the vector signal generator R&S SMBV100A, e.g:

- R&S SMx/AMU-K99, stands for R&S SMBV-K99

The particular software options available for the corresponding instruments are listed on the back of the title page.

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.

To playback a signal from a waveform file created by the simulation software R&S WinIQSIM2, the corresponding R&S WinIQSIM2 digital standard option must be installed.

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
- 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 the CCK and PBCC frames in accordance with IEEE 820.11a/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. a/g standard. The mode is also known as Non-HT mode.
- Mixed Mode
  A legacy preamble and header (L-STF, L-LTF and L-SIG) are wrapping the HT part of the frame so that the frame is complying with OFDM-PHY and ERP-OFDM-PHY corresponding to 802.11 a/g respectively.
- Green Field
  In this mode, frames are being transmitted in a new high throughput format that does not comply with the legacy mode. Green Field is an optional mode.

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

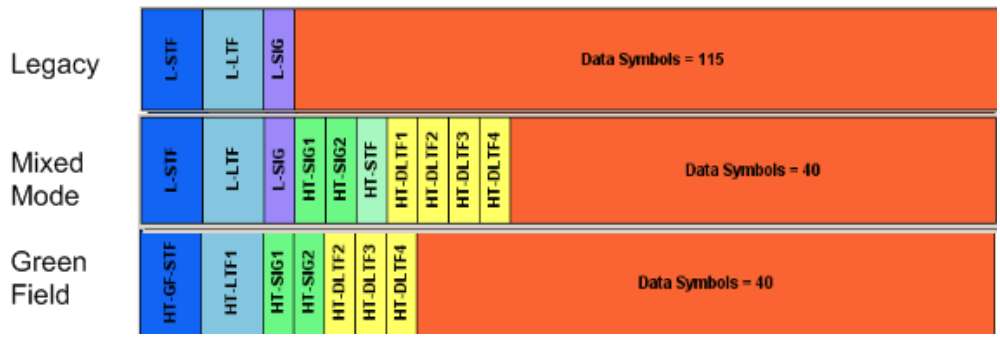


Figure 2-1: PLCP Packet format for IEEE 802.11

The Table 2-1 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)

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 baseband paths.

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

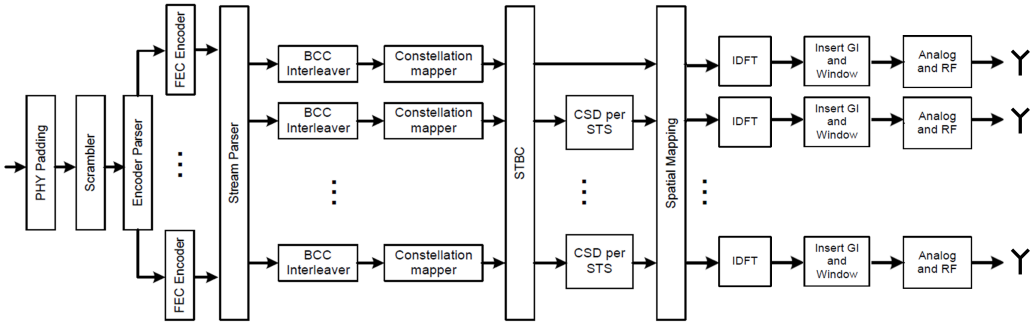


Figure 2-2: IEEE 802.11 n/ac Transmission chain

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 802.11n/ac/p Signal for Receiver Test under Real Word Conditions", on page 20).

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.

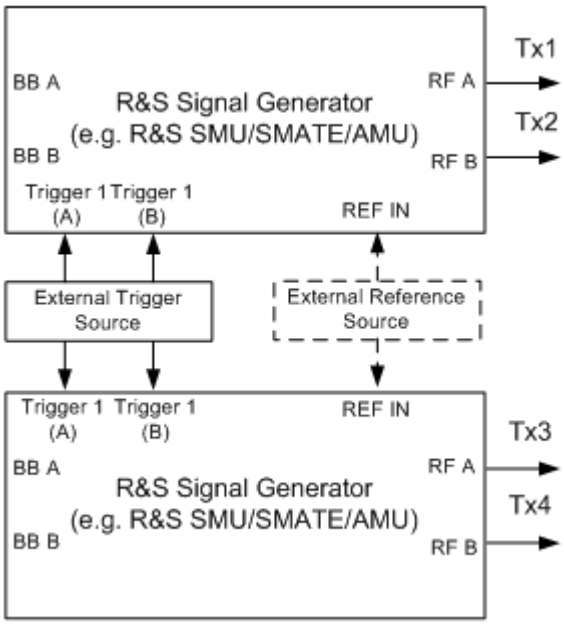
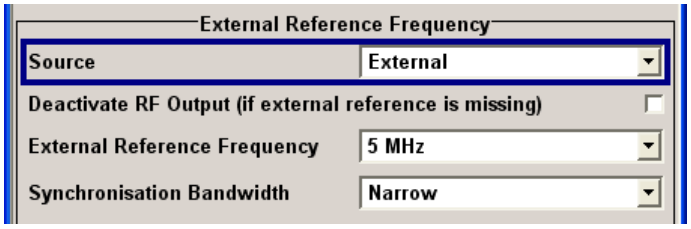


Figure 2-3: Connecting two two-path R&S Signal Generators for the generation of 4xN MIMO WLAN-n/ac signal

Configuring two R&S Signal Generators for MxN MIMO Simulation

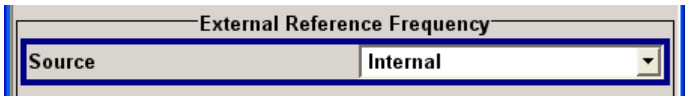
1. Configure the Reference Oscillator Settings, depending on whether an External Reference Source or the Reference Signal (REF OUT) of the first instrument is used.

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".

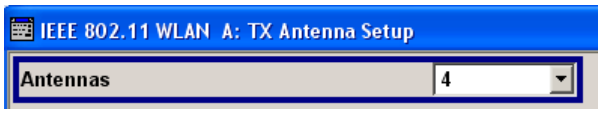
SCPI command:
`SOUR:BB:WLNN:TRIG:SOUR EXT | BEXT`

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)".

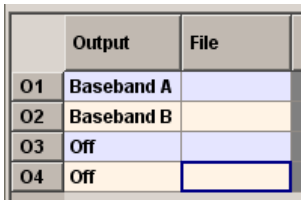
SCPI command:
`SOUR:BB:WLNN:PATH:COUP:STAT ON`

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.



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):

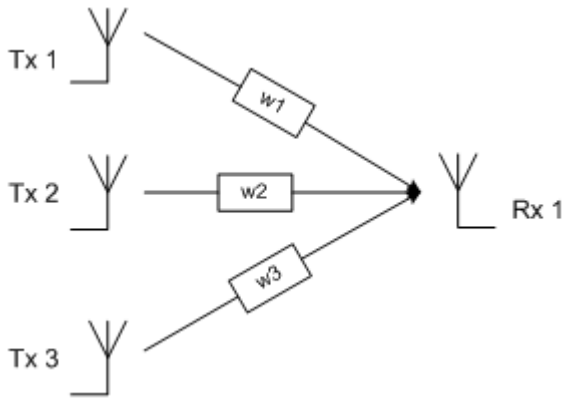
```
SOUR:BB:WLNN:ANT:TCH3:OUTP:DEST BB
SOUR:BB:WLNN:ANT:TCH4:OUTP:DEST BB_B
SOUR:BB:WLNN:ANT:TCH1:OUTP:DEST OFF
SOUR:BB:WLNN:ANT:TCH2:OUTP:DEST OFF
SOUR:BB:WLNN:STAT ON
```

5. Send an external trigger signal.

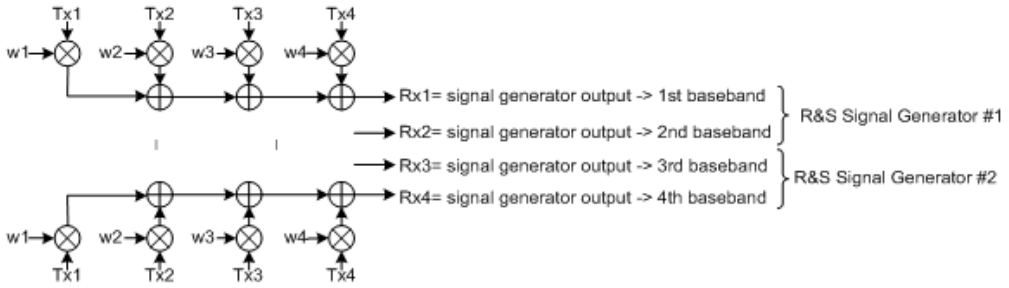
2.2.2 Generating a Realistic MxN MIMO WLAN 802.11n/ac/p Signal for Receiver Test under Static Conditions

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

The figure below shows an example of a simple diversity scenario with three transmission antennas Tx 1 .. Tx 3 and one receiving antenna Rx 1. The channel is represented by the weight coefficients w1 .. w3.



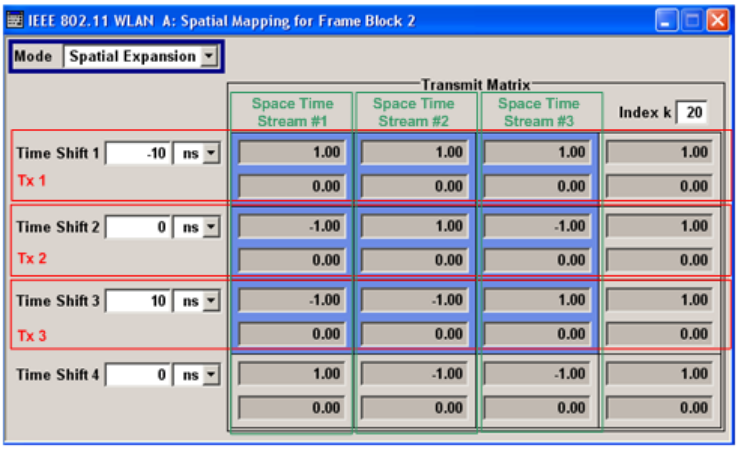
The R&S Signal Generator provides the possibility to weight, sum and map the generated Tx antenna signals to the output(s) of the signal generator, i.e. to simulate a frequency flat MIMO channel conditions for single carrier analysis e.g. BER tests.



The R&S Signal Generator generates the WLAN 802.11n/802.11ac/802.11p 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 802.11n/802.11ac/802.11p MIMO signal under static conditions, configure the instrument(s) as follows:

1. In the "Frame Block Configuration" dialog set the "Std." for the required standard.
2. Use the default "Frame Block Configuration" settings or adjust them as required.
3. Use the default "PPDU Configuration" settings or adjust them if necessary to, for instance, add redundancy.
4. In the "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`
5. Configure the subcarrier to be analyzed, i.e. configure the "Spatial Mapping Mode" and set the "Time Shifts".

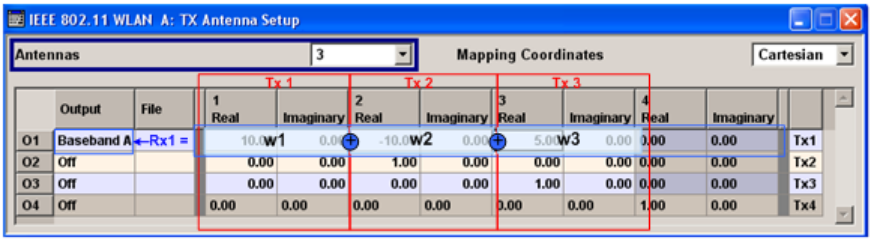


SCPI commands:

```
SOUR:BB:WLNN:FBL1:SMAP:MODE EXP
SOUR:BB:WLNN:FBL1:SMAP:TSH1 -10
SOUR:BB:WLNN:FBL1:SMAP:TSH3 10
```

6. In the Tx Antenna Setup dialog, enable the Baseband A to generate the Rx 1 signal.
   SCPI commands:
   ```
   SOUR:BB:WLNN:ANT:TCH1:OUTP:DEST BB
   SOUR:BB:WLNN:ANT:TCH2|TCH3|TCH4:OUTP:DEST OFF
   ```

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



   SCPI commands:
   ```
   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
   ```

8. To enable the R&S Signal Generator to generate a WLAN 802.11n/802.11ac/802.11p signal of antennas with different power level, set the power level of the corresponding path to the desired level in the header display of the instrument.
   SCPI commands:
   ```
   SOUR:POW -30
   SOUR2:POW -20
   ```

9. 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 802.11n/ac/p 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 802.11n/802.11ac/802.11p 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 14.

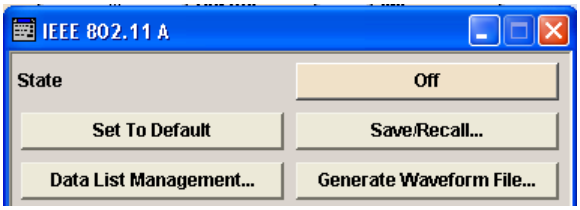
2. Enable the instrument to generate 2xN, 3xN or 4xN MIMO fading signal. Refer to section "Multiple Input Multiple Output" in the description of the Fading Simulator.

3 WLAN User Interface

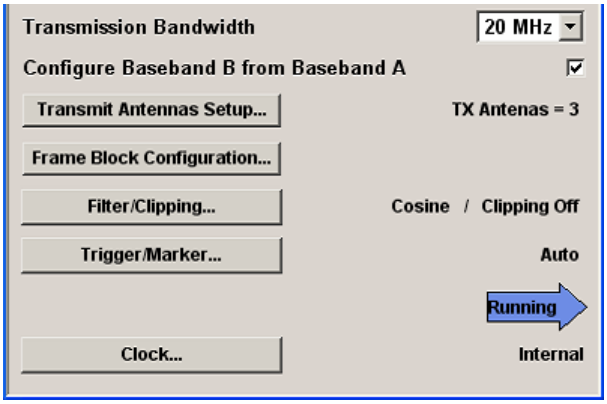
WLAN Standards
IEEE 802.11 a/b/g...
IEEE 802.11...

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

Remote command:
[:SOURce<hw>]:BB:WLNN:STATe on page 86

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

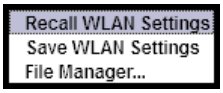
Parameter	Value
General Parameters	
State	Not affected by "Set to Default"
Transmission Bandwidth	20 MHz
Configure Baseband B from Baseband A	Off
Tx Antennas	1
Filter	Cosine
Clipping	Off
Frame Blocks Configuration	
Frame Blocks	1
Frame Block Type	DATA
Frame Blocks State	On
Physical Mode	MIXED MODE
Tx Mode	HT-20 MHz
Frames	1
Idle Time	0.1 ms
Data Source	PN9
TX Antenna Setup	
Antennas	1
Mapping Coordinates	Cartesian
Output	First set Baseband, rest is set to Off
Matrix Elements (Real, Imaginary, Magnitude, Phase)	All zero but diagonal = 1
PPDU Configuration	
Spatial Streams	1
Space Time Streams	1
Extended Spatial Streams	0
Space Time Block Coding	inactive
Parameter Value	
MCS	1

Parameter	Value
Data Rate (Mbps)	13
Data Bits Per Symbol	52
Stream 1	QPSK
Channel Coding	BCC
Coding Rate	½
Guard	Long
Data Length	1024 bytes
Number of Data Symbols	158
Scrambler	ON (User Init)
Scrambler Init	01
Interleaver Active	ON
Service Field	0000
Time Domain Windowing Active	On
Transition Time	100 ns
Preamble/Header Active	ON
Smoothing	ON
Spatial Mapping	
Mode	Spatial Expansion
Index k	20

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

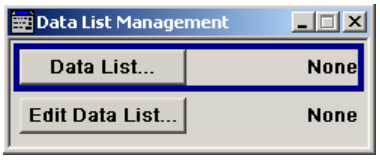
"Recall WLAN setting" Opens the "File Select" window for loading a saved IEEE 802.11 WLAN configuration.
The configuration of the selected (highlighted) file is loaded by pressing the "Select" button.

"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 85
`[:SOURce<hw>]:BB:WLNN:SETTing:STORe` on page 86
`[:SOURce<hw>]:BB:WLNN:SETTing:STORe:FAST` on page 86
`[:SOURce<hw>]:BB:WLNN:SETTing:DELete` on page 85

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 111
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DATA:DSELection` on page 111

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 86

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" 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.
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.
Provide an external common trigger source for both baseband paths. Triggering is performed automatically such that both basebands are aligned in time.
Changing of any parameter restarts the signal generation in both paths.
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 14.

"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 29.

Remote command:
n.a.

Frame Block Configuration
Calls the menu for configuring the frame blocks.

The menu is described inChapter 3.3, "Frame Block Configuration", on page 31 .

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 seTransmission Bandwidtht to 20 MHz.

The menu is described in Chapter 3.9, "Filter / Clipping Settings", on page 66.

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 70.

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 93

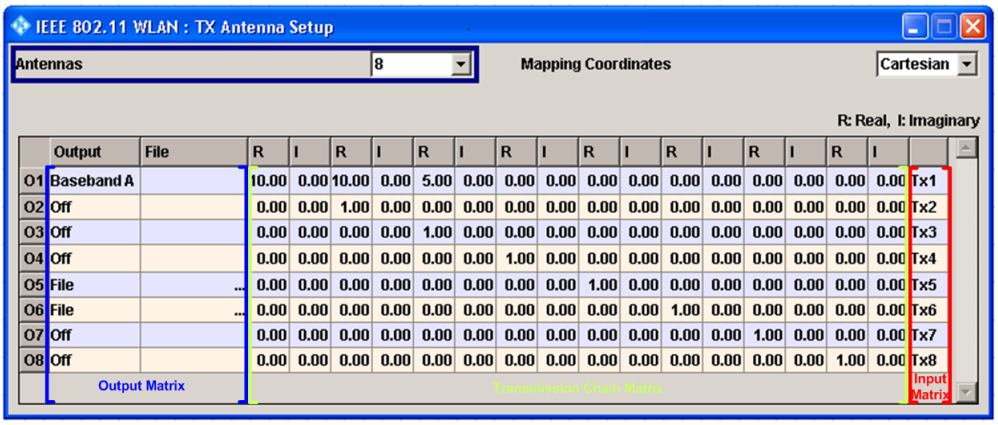
Clock
(R&S SMx and R&S AMU instruments only)

Calls the menu for selecting the clock source and for setting a delay (see Chapter 3.10, "Trigger/Marker/Clock Settings", on page 70).

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.

Remote command:
`[:SOURce<hw>]:BB:WLNN:ANTenna:MODE` on page 107

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 107

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

Remote command:
`[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:OUTPut:DESTination` on page 108
`[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:OUTPut:FSELect` on page 108

Real/Magnitude
Enters the value of the real or the magnitude coordinates.

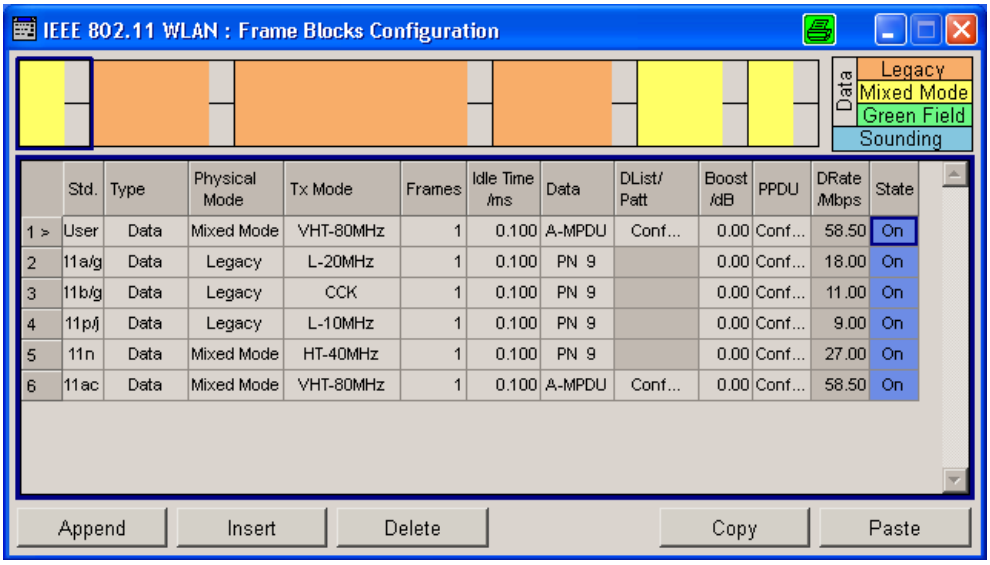
Remote command:
For Cartesian mapping coordinates:
`[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:TX<dir>:REAL` on page 108
For Cylindrical mapping coordinates:
`[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:TX<dir>:MAGNitude` on page 109

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 109
For Cylindrical mapping coordinates:
`[:SOURce<hw>]:BB:WLNN:ANTenna:TCHain<ch>:TX<dir>:PHASe` on page 109

3.3 Frame Block Configuration

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



	Std.	Type	Physical Mode	Tx Mode	Frames	Idle Time /ms	Data	DList/ Patt	Boost /dB	PPDU	DRate /Mbps	State
1 >	User	Data	Mixed Mode	VHT-80MHz	1	0.100	A-MPDU	Conf...	0.00	Conf...	58.50	On
2	11a/g	Data	Legacy	L-20MHz	1	0.100	PN 9		0.00	Conf...	18.00	On
3	11b/g	Data	Legacy	CCK	1	0.100	PN 9		0.00	Conf...	11.00	On
4	11p/j	Data	Legacy	L-10MHz	1	0.100	PN 9		0.00	Conf...	9.00	On
5	11n	Data	Mixed Mode	HT-40MHz	1	0.100	PN 9		0.00	Conf...	27.00	On
6	11ac	Data	Mixed Mode	VHT-80MHz	1	0.100	A-MPDU	Conf...	0.00	Conf...	58.50	On

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

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 113

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 114

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 113

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
		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

Type	Physical Mode	Tx Mode	Transmission Bandwidth			
			20 MHz	40 MHz	80 MHz	160 MHz
		CCK	X	X	X	X
		PBCC	X	X	X	X

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:TMODe on page 114

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 110

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 112

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 111
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DATA:PATTern on page 112
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DATA:DSELection on page 111

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 110

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

The dialog is described in Chapter 3.4, "PPDU Configuration", on page 36.

Remote command:
n.a.

Data Rate/Mbps
Indicates the PPDU data rate.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DATA:RATE?` on page 112

State
Enables the corresponding frame block for transmission.

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

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.

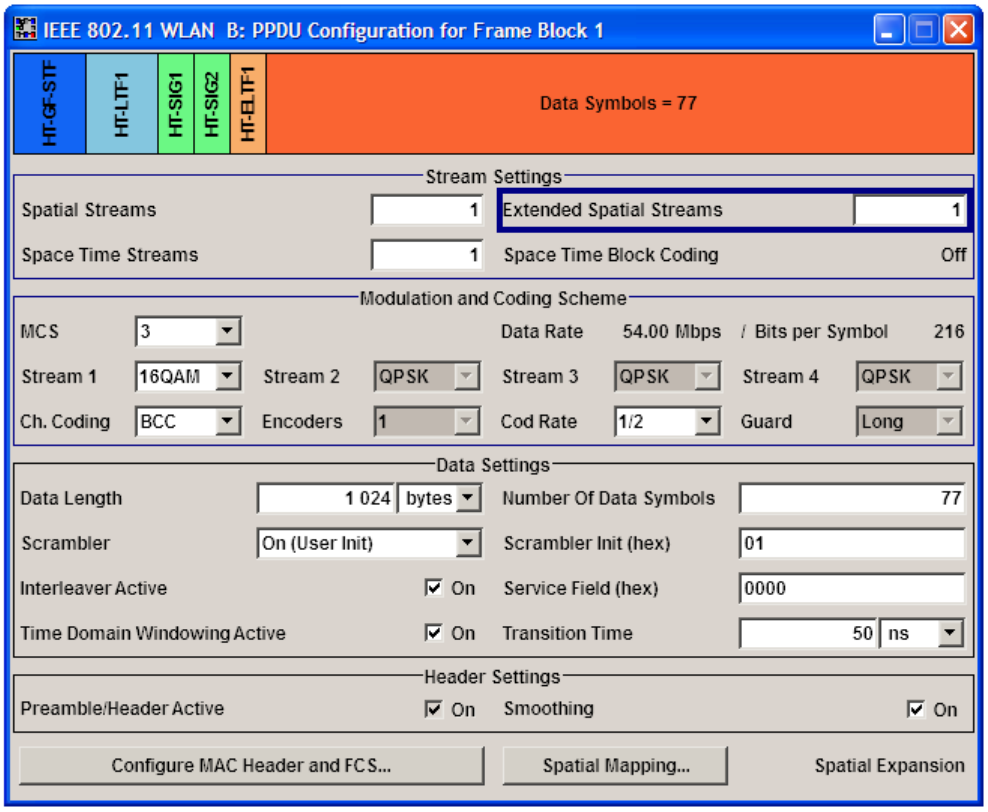
Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PASTe on page 84

3.4 PPDU Configuration

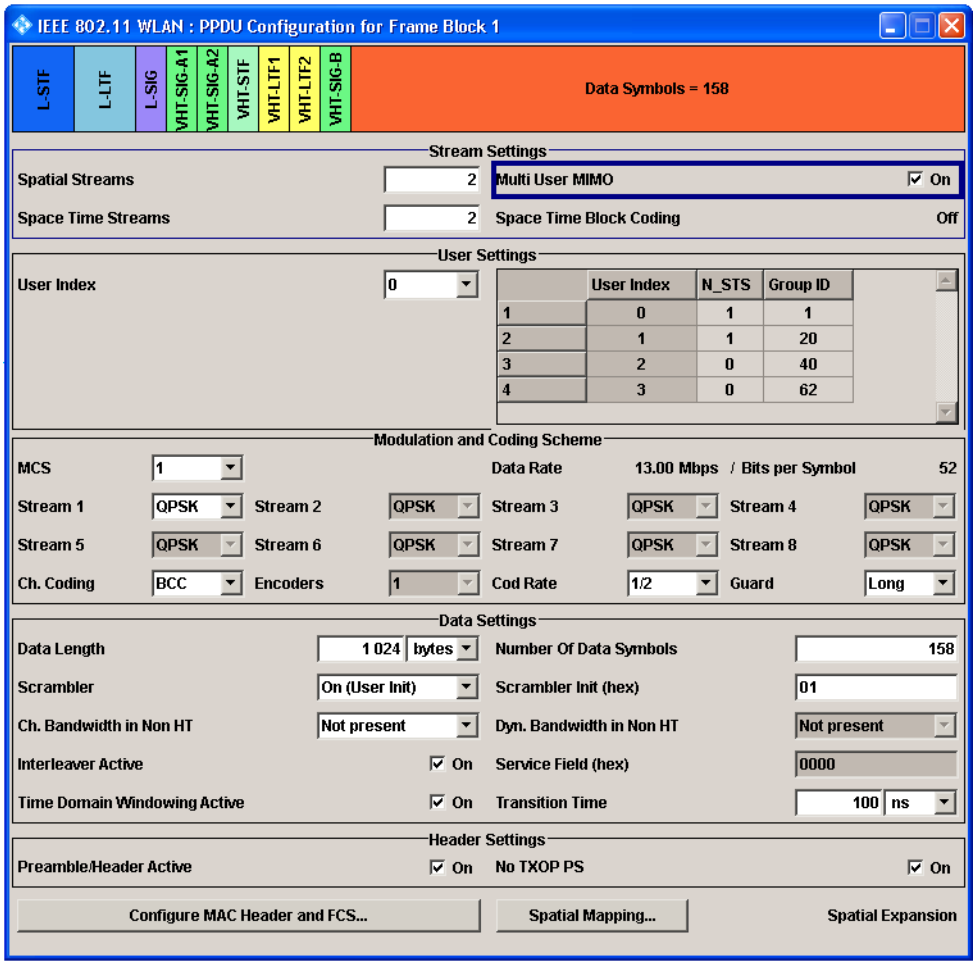
In the "PPDU Configuration" dialog, the PPDU configuration for all frames in the selected frame block is done.

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

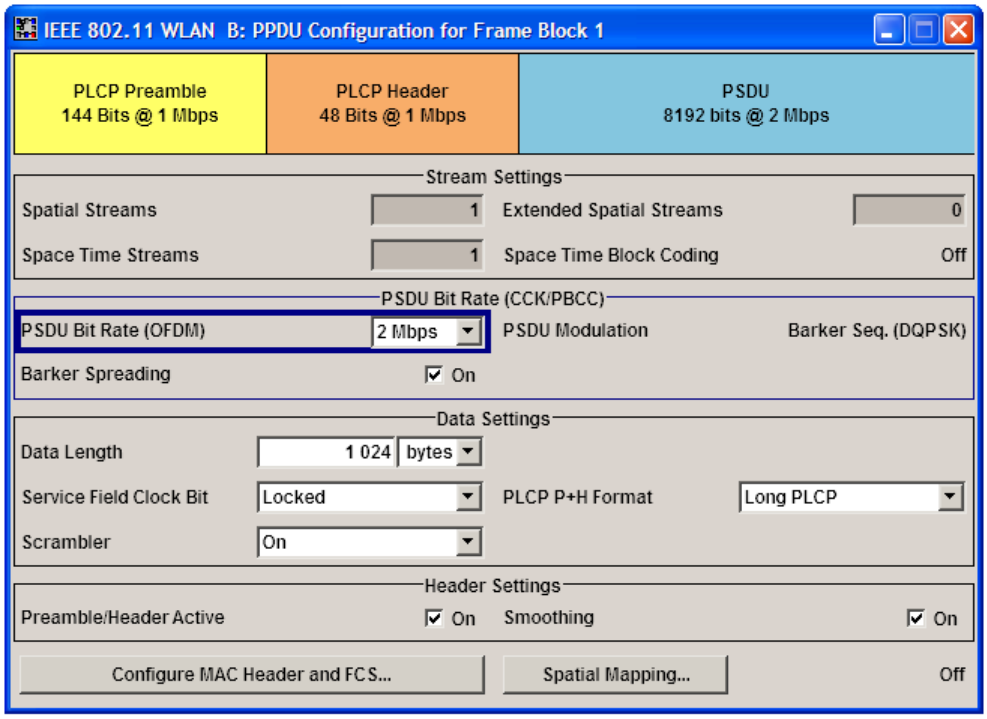
The figure below shows the settings of the "PPDU Configuration " for "Type > Sounding " and "Physical Mode > Green Field" .



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 127

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 127

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

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:ESSTream` on page 119

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 121

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 126

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 127

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 128

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 121
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MU<st0>:GID` on page 121

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 120

Data Rate/Mbps
Indicates the PPDU data rate.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DATA:RATE?` on page 112

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 118

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

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MODulation<st>` on page 121

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 117

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

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:CODing:ENCoder?` on page 117

Cod Rate
Selects the coding rate.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:CODing:RATE` on page 117

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 120

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 123

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:FBLock<ch>:PSDU:MODulation? on page 124

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 124

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 118

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 125

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 116

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

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:ILEaver:STATe on page 120

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 128

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 119

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 126

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 119

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 126

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 128

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 123

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 122

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 123

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 126

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 122

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 122

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 47.

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 63.

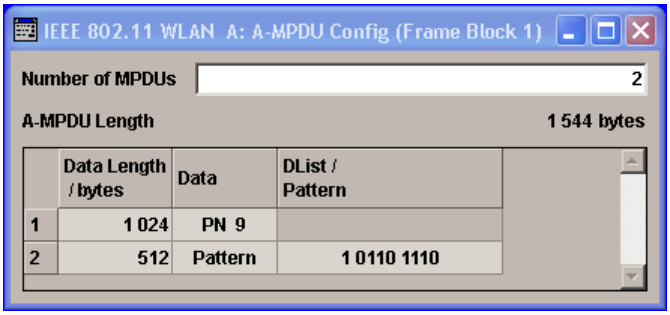
Remote command:
n.a.

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 129

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 131

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 130

Data
Selects the data source.

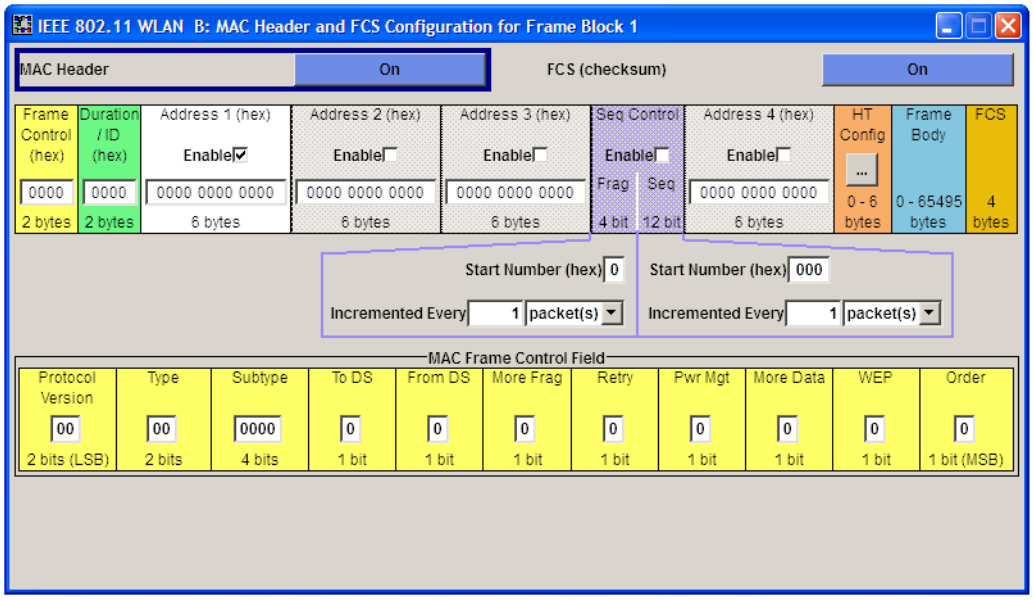
Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MPDU<st>:DATA:SOURce` on page 130

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 129
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MPDU<st>:DATA:PATTern` on page 130

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 136

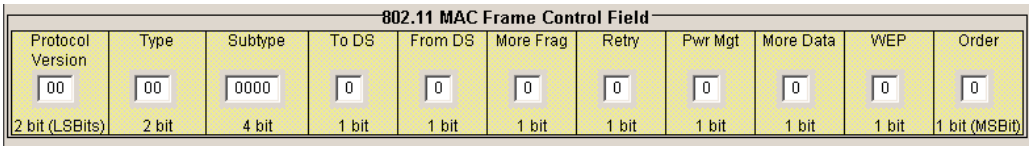
FCS (checksum)
Activates/deactivates the calculation of the FCS (frame check sequence). The standard defines a 32-bit (4-byte) checksum to protect the MAC header and the user data (frame body).

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCS:STATe on page 134

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



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 133
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:PVERsion on page 133
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:TYPE on page 133
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:SUBType on page 133
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:TDS on page 133
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:FDS on page 133
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:MFRagments
on page 133
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:RETRy on page 133
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:PMANagement
on page 133
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:MDATa on page 133
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:WEP on page 133
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:ORDer on page 133

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 132

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 132

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

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

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SA` on page 133

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 132

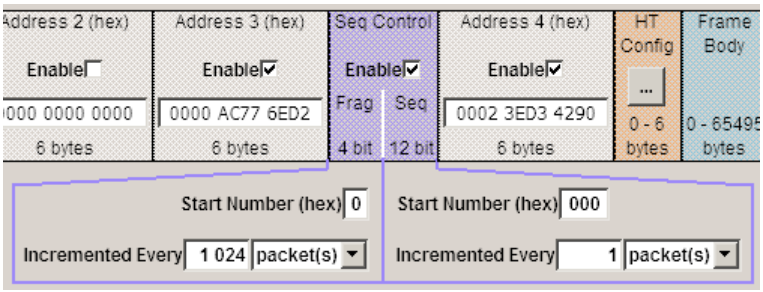
Sequence Control
Activates/deactivates the sequence control field.

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 136
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SCONtrol:FRAGment:STARt` on page 135
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SCONtrol:SEQuence:STARt` on page 136
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SCONtrol:FRAGment:INCRement` on page 135
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SCONtrol:SEQuence:INCRement` on page 135

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 135
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SCONtrol:SEQuence:STARt` on page 136

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 135
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SCONtrol:SEQuence:INCRement` on page 135

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 56.

Remote command:
n.a.

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

Remote command:
n.a.

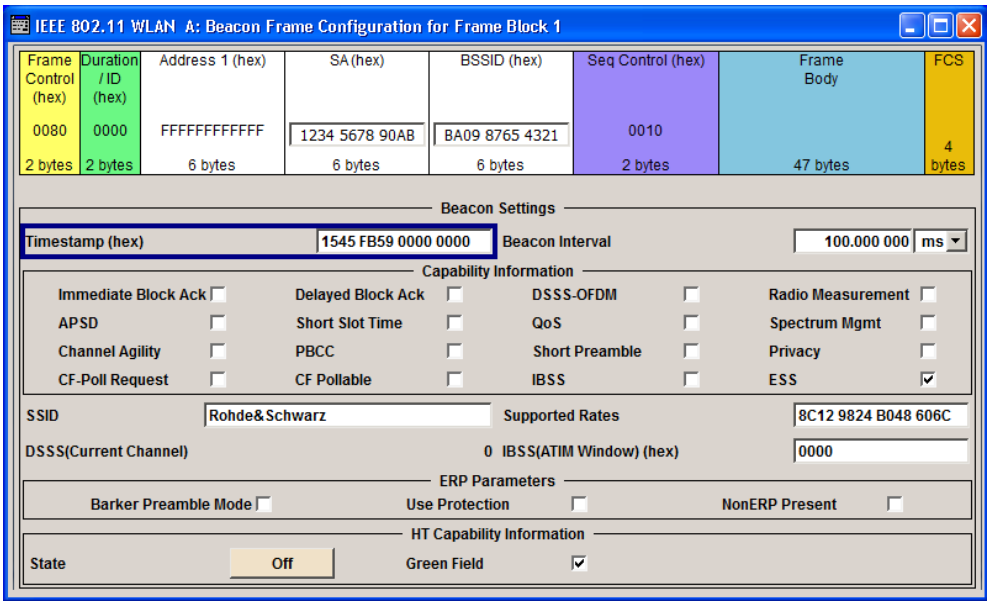
FCS
Indicates the length of the check sum.

Remote command:
n.a.

3.6.3 Beacon Settings

A beacon frame is a managment 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 148

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

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

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 147

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

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:DCCHannel?
on page 147

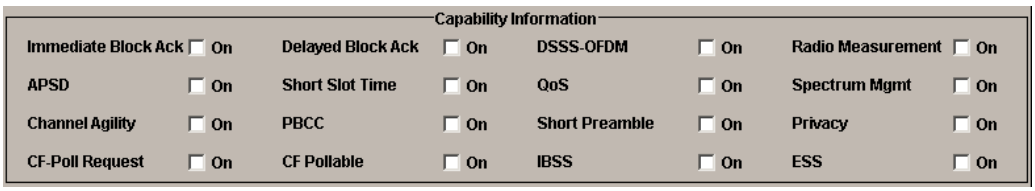
IBSS(ATIM Window) (hex)
Contains the set of parameters necessary to support an independent basic service set (IBSS). The Information field contains the announcement traffic indication message (ATIM) Window parameter.

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

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 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 150
"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 150

Function name	If enabled this function indicates that:	SCPI command
"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 151
"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 152
"APSD"	Automatic power save delivery (APSD) is supported (energy saving function).	[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:APSD on page 148
"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 153
"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 152
"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 149
"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 151
"Short Preamble"	Short preamble is allowed (uses 56 instead of 128 bits for the "sync" field. Created to improve WLAN efficiency).	[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:SPReamble on page 152
"Privacy"	Privacy mode is enabled (thus encryption is required for all data frames).	[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BFConfiguration:CAPability:PRIVacy on page 151

Function name	If enabled this function indicates that:	SCPI command
"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 149
"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 149
"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 150
"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

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

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 153

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 153

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/VHTcontrol field in frames carried in a HT/VHT PPDU is indicated by setting the order bit in the MAC header. The HT/VHT Control Field appears last in the MAC Header, excluding any security fields.

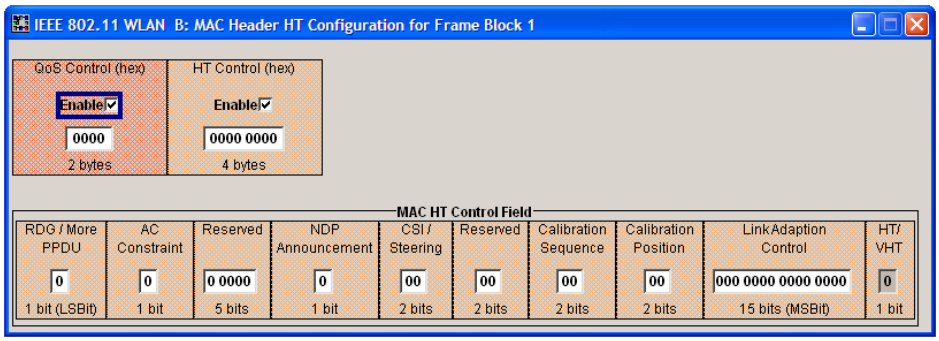


Figure 3-1: IEEE 802.11 WLAN: MAC Header HT Configuration window

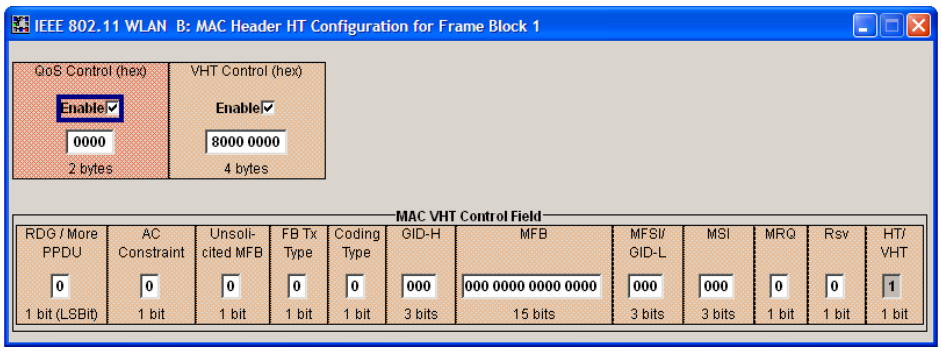


Figure 3-2: IEEE 802.11 WLAN: MAC Header VHT Configuration window

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 134
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:QSControl` on page 134

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 137
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl` on page 142
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:STATe` on page 141

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 140

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 137

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 141

NDP Announcement
The NDP Announcement (1 bit) indicates that a Null Data Packet (NDP) will be transmitted after the frame.

0 = no NDP will follow

1 = NDP will follow

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:NDP` on page 140
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:ZLF` on page 141

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 138

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

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:SREServed
on page 141
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:FREQuest
on page 138

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 138

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 137

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 139

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 139

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 145

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 142

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 146

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

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

Otherwise this subfield is reserved.

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

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 143

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 143

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).

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

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:MFB` on page 144

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 144

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 145

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

1 = otherwise.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:MRQ` on page 144

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 146

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

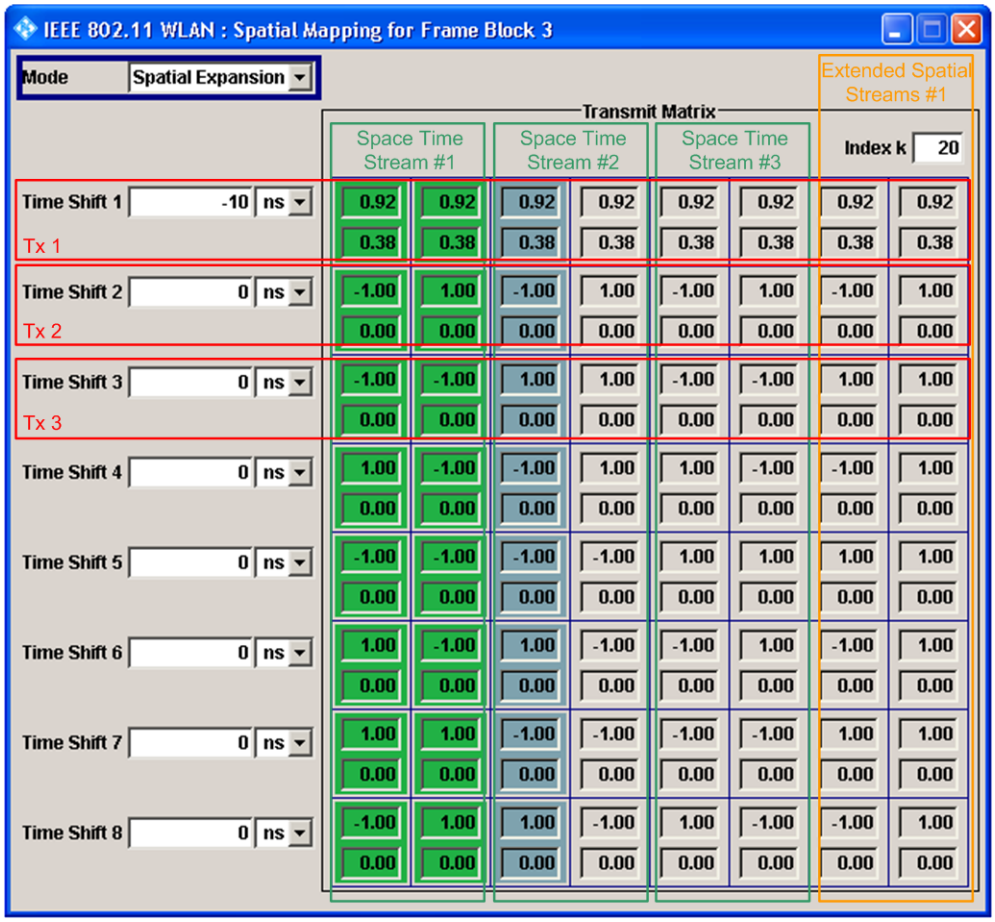
0 = indicates use of the HT format.

1 = indicates use of the VHT format.

Remote command:
`[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:HVINdicator?`
on page 144

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 beamforming 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 othogonal 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 155

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 156

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 156

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 156

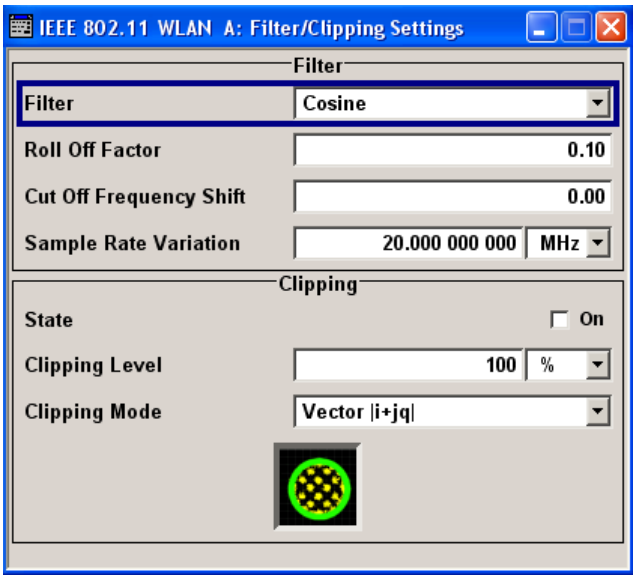
Q (Transmit Matrix)
Displays the time shift value of element Q of the selected row and column of the spatial transmit matrix.

Remote command:
[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SMAPping:ROW<st>:COL<dir>:Q?
on page 157

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 filterand 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 88

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

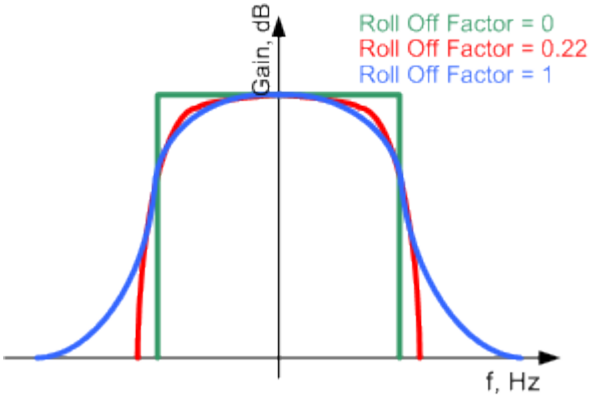


Figure 3-3: Example of the frequency response of a filter with different Roll Off Factors

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 89
[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:COSine on page 89
[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:GAUSs on page 89
[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:PGAuss on page 90
[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:RCOSine on page 91
[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:SPHase on page 91

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 90
[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:LPASSEVM on page 90

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 filter flanks are "moved" and the transition band increases by "Cut Off Frequency Shift"*"Sample Rate".

- A "Cut Off Frequency Shift" = -1 results in a very narrow-band filter

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

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

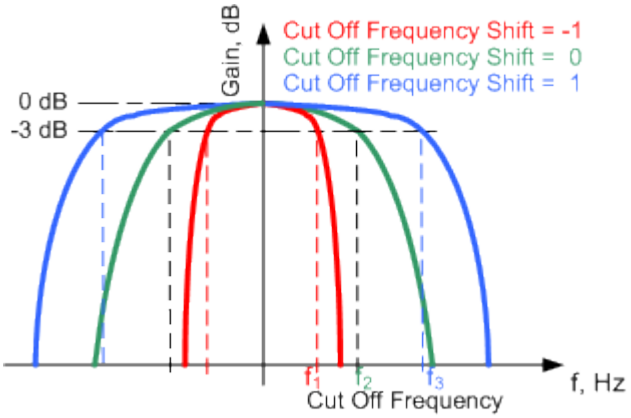


Figure 3-4: Example of the frequency response of a filter with different Cut Off Frequency Shift

Remote command:
`[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:COSine:COFS` on page 89

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 91

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

Remote command:
`[:SOURce<hw>]:BB:WLNN:SRATe?` on page 91

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 88

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 87

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.

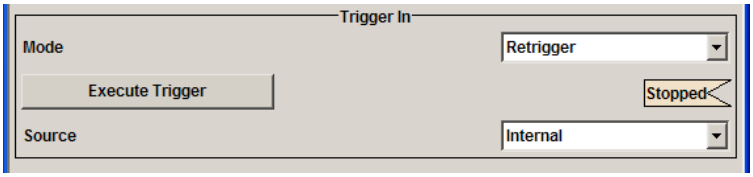
Remote command:
`[:SOURce<hw>]:BB:WLNN:CLIPping:MODE` on page 88

3.10 Trigger/Marker/Clock Settings

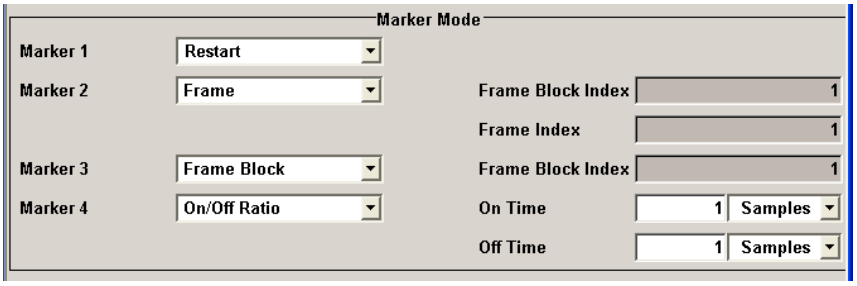
The trigger, clock, and marker delay functions are available for R&S SMx and R&S AMU instruments only.

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

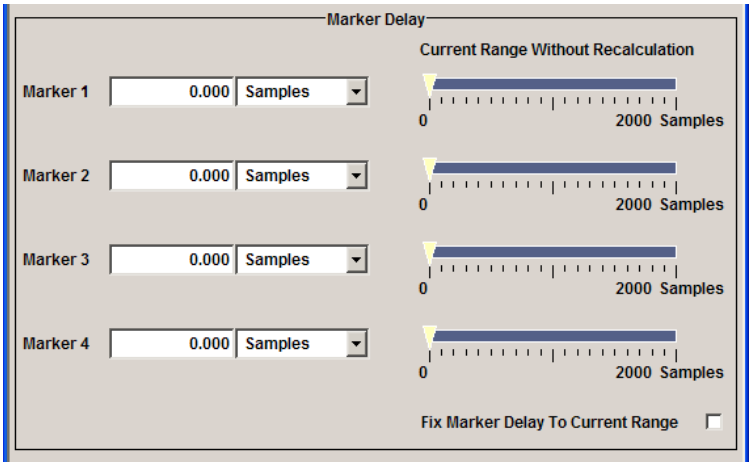
The "Trigger In" section is where the trigger for the signal is set. Various parameters will be provided for the settings, depending on which trigger source - internal or external - is selected. The current status of signal generation ("Running" or "Stopped") is indicated for all trigger modes.



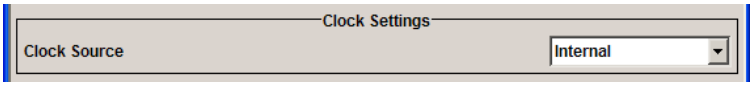
The "Marker Mode" section is where the marker signals at the MARKER output connectors are configured.



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 97

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 96

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 95

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 95

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 92

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 93

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 96

Sync. Output to External Trigger
(enabled for Trigger Source External)

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

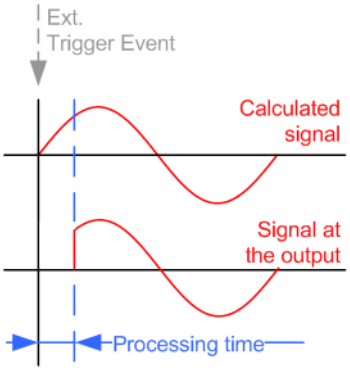
For R&S SMBV instruments:

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.

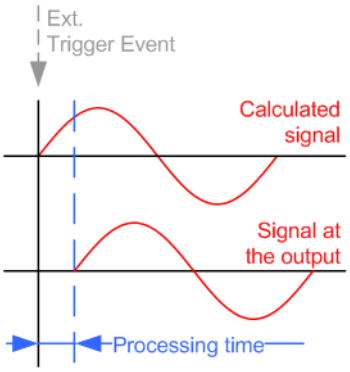
Table 3-4: Typical Applications

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 93

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 97
`[:SOURce<hw>]:BB:WLNN:TRIGger:OBASeband:DELay` on page 94

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 97
`[:SOURce<hw>]:BB:WLNN:TRIGger:OBASeband:INHibit` on page 94

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.

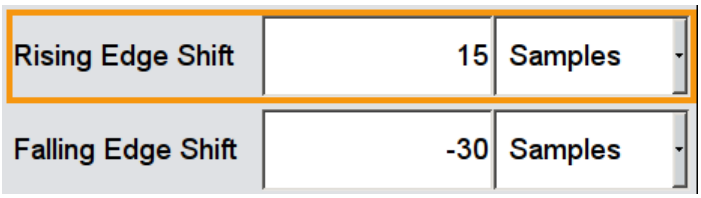
Remote command:
`[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:FBINdex` on page 102

"Frame" Number of Frame Blocks = 1, that is, a marker signal is generated at the start of each frame in the single frame block. Otherwise, the frame block and frame index are entered and the specific frame is masked.

Remote command:
`[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:FINDex` on page 102

"Frame Active Part / Frame Inactive Part"

A marker signal is generated to mark every active part of each frame. The active data transfer part (PPDU) of a frame period is marked with high, the inactive part (idle time) with low. This marker can be used to decrease the carrier leakage during inactive signal parts by feeding it into the pulse modulator.
Otherwise, the frame block and frame index are entered and the active part of the specific frame is masked.
The parameters "Rising Edge Shift / Falling Edge Shift" open when "Frame Active Part" or "Frame Inactive Part" is selected.
They shift the rising/falling edge of the marker the specified number of samples. Negative values result in a shift back of the marker edge.



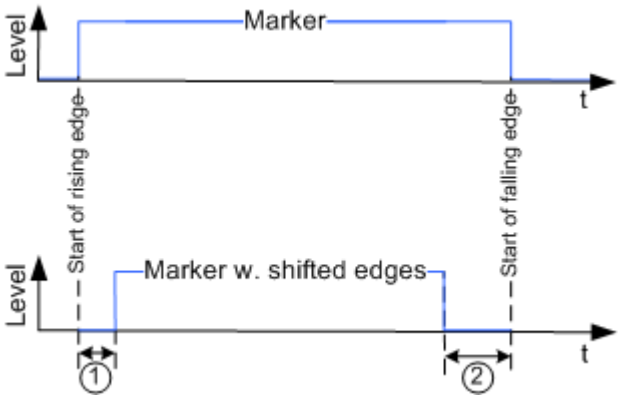


Figure 3-5: "Frame active Part" marker and shifting of its rising/falling edges

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

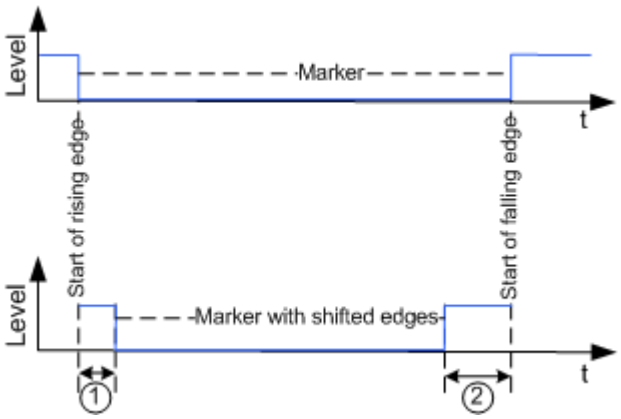


Figure 3-6: "Frame Inactive Part" marker and shifting of its rising/falling edges

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

Remote command:
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:FESHift on page 103
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:RESHift on page 103

"Pulse" A regular marker signal is generated. The clock frequency is defined by entering a divider. The frequency is derived by dividing the chip rate by the divider. The input box for the divider opens when Pulse is selected, and the resulting pulse frequency is displayed below it.

Remote command:
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:PULSe:DIVider on page 104
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:PULSe:FREQuency? on page 104

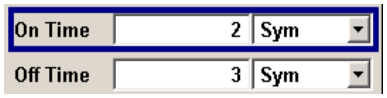
"Pattern" A marker signal that is defined by a bit pattern is generated. The pattern has a maximum length of 32 bits and is defined in an input field that opens when "pattern" is selected.

Remote command:
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:PATTern on page 103

"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.



Remote command:
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:ONTime on page 102
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:OFFTime on page 102

Remote command:
[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:MODE on page 101

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>:DELay` on page 99

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>:DELay:MAXimum?`
on page 100
`[:SOURce<hw>]:BB:WLNN:TRIGger:OUTPut<ch>:DELay:MINimum?`
on page 100

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:DELay:FIXed` on page 99

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.

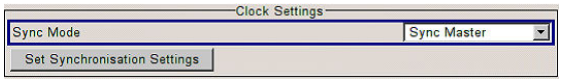
This parameter is used to enable generation of very precise synchronous signal of several connected R&S SMBVs.

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 106

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 106

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 106

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 105

Chip Clock Multiplier
Enters the multiplication factor for clock type Multiple.

Remote command:
[:SOURce<hw>]:BB:WLNN:CLOCk:MULTiplier on page 105

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.

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.

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.

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.

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.

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:BWidth <BWidth>

The command selects the transmission bandwidth. Whenever the bandwidth changes from a higher to a lower one, the frame blocks are validated because some of them could be invalid in the lower bandwidth (invalid TX Mode).

Parameters:

<BWidth> BW20 | BW40 | BW80 | BW160

*RST: BW20
Default unit: MHz

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

Manual operation: See "Transmission Bandwidth" on page 27

[: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 35

[: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 35

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

Copies the selected frame block.

Setting parameters:
<CfBlock> integer
Range: 1 to 100

Example: `BB:WLNN:CFBL 5`
copies frame block 5 for later insertion.

Usage: Setting only

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:DELete
[:SOURce<hw>]:BB:WLNN:DFBLock <DfBlock>

Deletes the selected frame block.

Setting parameters:
<DfBlock> integer
Range: 1 to 100

Example: `BB:WLNN:DFBL 10`
deletes the selected frame block.

Usage: Setting only

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

Pastes the selected frame block.

Setting parameters:

<PfBlock> integer
Range: 1 to 99

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

Usage: Setting only

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

Enables/disables coupling of both baseband paths.

Note: For instruments with enabled parameter "Configure Baseband B form 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: 0

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

Manual operation: See "Configure Baseband B from Baseband A" on page 27

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

Sets the parameters of the digital standard to their default values (`*RST` values specified for the commands).

Not affected is the state set with the command `SOURce<hw>:BB:WLNN:STATe`.

Example: `SOURce:BB:WLNN:PRESet`

Usage: Event

Manual operation: See "Set to default" on page 24

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

The command reads out the files with IEEE 802.11a/b/g/n/ac settings in the default directory. The default directory is set using command `MMEM:CDIRectory`. Only files with the file extension `*.wlann` will be listed.

Return values:
<Catalog> string

Example: `MMEM:CDIR '<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 25

[:SOURce<hw>]:BB:WLNN:SETTing:DELete <Filename>

Deletes the selected file with IIEEE 802.11a/b/g/n/ac settings. The directory is set using command `MMEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. The file extension may be omitted. Only files with the file extension `*.wlann` are listed and can be deleted.

Setting parameters:
<Filename> string

Example: `BB:WLNN:SETT:DEL 'wlann_1'`
deletes file '`wlann_1`'.

Usage: Setting only

Manual operation: See "Save/Recall" on page 25

[: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 25

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

The command stores the current IEEE 802.11a/b/g/n/ac settings into the selected file. The directory is set using command `MMEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. Only the file name has to be entered. IEEE 802.11a/b/g/n/ac 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 25

[: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: 1

Manual operation: See "Save/Recall" on page 25

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

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

Parameters:
<State> 0 | 1 | OFF | ON
*RST: 0

Example: `SOURce1:BB:WLNN:STATe ON`

Manual operation: See "State" on page 23

[: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 27

4.2 Filter/Clipping Settings

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

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

Level clipping is activated with the command `SOUR:BB:WLNN:CLIP:STAT ON`

Parameters:
<Level> integer

Range: 1 PCT to 100 PCT
Increment: 1 PCT
*RST: 100 PCT

Example: `BB:WLNN:CLIP:LEV 80PCT`
sets the limit for level clipping to 80% of the maximum level.
`BB:WLNN:CLIP:STAT ON`
activates level clipping.

Manual operation: See "Clipping Level" on page 69

[: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 69

[: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: 0

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 67

[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:APCO25 <Apco25>

Sets the roll-off factor for filter type APCO25.

Parameters:

<Apco25> float

Range: 0.05 to 0.99
Increment: 0.01
*RST: 0.2

Example: `BB:WLNN:PAR:APCO25 0.2`
sets the roll-off factor to 0.2 for filter type APCO25.

Manual operation: See "Roll Off Factor or BxT" on page 67

[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:COSine <Cosine>

Sets the roll-off factor for the Cosine filter type.

Parameters:

<Cosine> float

Range: 0 to 1
Increment: 0.01
*RST: 0.1

Example: `BB:WLNN:PAR:COS 0.35`
sets the roll-off factor to 0.35 for filter type Cosine.

Manual operation: See "Roll Off Factor or BxT" on page 67

[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:COSine:COFS <CoFs>

The command sets the "cut of frequency shift' value for the Cosine filter type.

Parameters:

<CoFs> float

Range: -1 to 1
Increment: 0.01
*RST: 0

Example: `BB:WLNN:FILT:PAR:COS:COFS 0.04`
the "cut of frequency shift" value is set to 0.04.

Manual operation: See "Cut Off Frequency Shift" on page 67

[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:GAUSs <Gauss>

Sets the roll-off factor for the Gauss filter type.

Parameters:

<Gauss> float

Range: 0.15 to 2.5
Increment: 0.01
*RST: 0.5

Example: `BB:WLNN:PAR:GAUS 0.5`
sets B x T to 0.5 for the Gauss filter type.

Manual operation: See "Roll Off Factor or BxT" on page 67

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

Sets the cut off frequency factor for the Lowpass (ACP optimization) filter type.

Parameters:

<LPass> float

Range: 0.05 to 2
Increment: 0.01
*RST: 0.5

Example: `BB:WLNN:FILT:PAR:LPAS 0.5`
the cut of frequency factor is set to 0.5.

Manual operation: See "Cut Off Frequency Factor" on page 67

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

Sets the cut off frequency factor for the Lowpass (EVM optimization) filter type.

Parameters:

<LPassevm> float

Range: 0.05 to 2
Increment: 0.01
*RST: 0.5

Example: `BB:WLNN:FILT:PAR:LPASSEVM 0.5`
the cut of frequency factor is set to 0.5.

Manual operation: See "Cut Off Frequency Factor" on page 67

[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:PGAuss <PGauss>

Sets the roll-off factor for the Pure Gauss filter type.

Parameters:

<PGauss> float

Range: 0.15 to 2.5
Increment: 0.01
*RST: 0.5

Example: `BB:WLLN:FILT:PAR:PGAUS 0.5`
sets B x T to 0.5 for the Pure Gauss filter type.

Manual operation: See "Roll Off Factor or BxT" on page 67

[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:RCOSine <RCosine>

Sets the roll-off factor for the Root Cosine filter type.

Parameters:
<RCosine> float

Range: 0 to 1
Increment: 0.01
*RST: 0.22

Example: `BB:WLNN:PAR:RCOS 0.22`
sets the roll-off factor to 0. 22 for filter type Root Cosine.

Manual operation: See "Roll Off Factor or BxT" on page 67

[:SOURce<hw>]:BB:WLNN:FILTer:PARameter:SPHase <SPhase>

Sets B x T for the Split Phase filter type.

Parameters:
<SPhase> float

Range: 0.15 to 2.5
Increment: 0.01
*RST: 2

Example: `BB:WLNN:PAR:SPH 0.5`
sets B x T to 0.5 for the Split Phase filter type.

Manual operation: See "Roll Off Factor or BxT" on page 67

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

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

Return values:
<SampRate> float

20MHz for BW20, 60MHz for BW40.

Usage: Query only

Manual operation: See "Sample Rate" on page 68

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

Sets the sample rate of the signal.

Parameters:

<Variation> float

Range: 400 to 40000000
Increment: 0.001
*RST: 20000000
Default unit: Hz (c/s)

Example: `BB:WLNN:SRAT:VAR 4000000`
sets the output sample rate to 4 MHz.

Manual operation: See "Sample Rate Variation" on page 68

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

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_Retrigger 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 28

[: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 73 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 synchrounous output to external trigger

Manual operation: See "Sync. Output to External Trigger" on page 73

[: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 to 65535
Increment: 0.01
*RST: 0

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>

Specifies the number of samples by which a restart is to be inhibited following a trigger event. This command applies only for triggering by the second path.

Parameters:

<Inhibit> integer

Range: 0 to 67108863
*RST: 0

Example: `BB:WLNN:TRIG:SOUR 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:RMOD?`
queries the current status of signal generation.
`Response: RUN`
the signal is generated, an external trigger was executed.

Usage: Query only

Manual operation: See "Running/Stopped" on page 72

[: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> integer

Range: 1 to (2^32) - 1
*RST: 1
Default unit: sample

Example: `BB:WLNN:SEQ SING`
sets trigger mode Single.
`BB:WLNN:TRIG:SLEN 200`
sets a sequence length of 200 samples. The first 200 samples of the current frame will be output after the next trigger event.

Manual operation: See "Signal Duration" on page 72

[: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 72

[: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 to 65535
Increment: 0.01
*RST: 0

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> integer

Range: 0 to 67108863
*RST: 0

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 71

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 <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 to (2^32) -1
Increment: 1E-3
*RST: 0
Default unit: sample

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> integer

Range: 1 to 16777215
*RST: 1

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> integer

Range: 0 to 100
Increment: 1
*RST: 1

Example: `BB:WLNN:TRIG:OUTP1:FBIN 5`
sets the frame block index to 5.

Manual operation: See "Marker Mode" on page 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> integer

Range: 1 to 1024
Increment: 1
*RST: 1

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

Manual operation: See "Marker Mode" on page 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: -1000 to 1000
*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: -1000 to 1000
*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> 64 bits

*RST: #H2,2

Example: `BB:WLNN:TRIG:OUTP2:PATT #B000000011111111,15`
sets a bit pattern.
`BB:WLNN:TRIG:OUTP:MODE PATT`
activates the marker signal according to a bit pattern for the corresponding marker signal.

Manual operation: See "Marker Mode" on page 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> integer

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 <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.

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> integer

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 79

[: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

[: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 29

[: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 29

[: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 30

[: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 30

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

Sets the value for the Real coordinate.

Parameters:

<Real> float

Range: -1000 to 1000
Increment: 0.01

Example: `BB:WLNN:ANT:TCH1:TX2:REAL 500`
sets the real coordinate for the selected transmission chain to 500.

Manual operation: See "Real/Magnitude" on page 30

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

Sets the value for the Imaginary coordinate.

Parameters:

<Imaginary> float

Range: -999.99 to 999.99
Increment: 0.01
*RST: 0

Example: `BB:WLNN:ANT:TCH1:TX2:IMAG 500`
sets the imaginary coordinate for the selected transmission chain to 500.

Manual operation: See "Imaginary/Phase" on page 30

[: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 30

[: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 30

4.7 Frame Block Configuration

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:BOOSt <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 to 0
Increment: 0.01
*RST: 0
Default unit: dB

Example: `BB:WLNN:FBL5:BOOS -10.0`
sets the power boost

Manual operation: See "Boost /dB" on page 34

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:FCOunt <FCount>

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

Parameters:

<FCount> integer

Range: 1 to 20 000
Increment: 1
*RST: 1

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

Manual operation: See "Frames" on page 34

[: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 129

*RST: PN9

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

Manual operation: See "Data List Management…" on page 26

[: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 26

[: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> 64 bits
*RST: #H0,1

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

Manual operation: See "Data" on page 34

[: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 35

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

Sets the time interval separating two frames in this frame block. The default unit for the time interval are seconds. However, the time interval can be set in milliseconds. In this case the unit has to be set.

Parameters:
<ITime> float
Range: 0 to 1
Increment: 100E-6
*RST: 100E-6

Example: `BB:WLNN:FBL5:ITIMe 0.0025`
sets the idle time to 2.5 msec.

Manual operation: See "Idle Time / ms" on page 34

[: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 32

[: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 31

[: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 35

[: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 | LDUP | LUP | LLOW | HT20 | HT40 | HTDup | HTUP | HTLow | CCK | PBCC | V20 | V40 | V80 | V160 | V8080 | L10
*RST: HT20

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

Manual operation: See "Tx Mode" on page 32

[: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 32

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

Copies the specified frame block.

Usage: Event

Manual operation: See "Copy" on page 35

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

Deletes the specified frame block.

Usage: Event

Manual operation: See "Delete" on page 35

[: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 35

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

Pastes the copied frame block behind the selected frame block.

Usage: Event

Manual operation: See "Paste" on page 35

[: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 35

4.8 Frame Configuration Settings

4.8.1 Frame Block PPDU Configuration

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

(avaliable only for VHT Tx mode)

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

Parameters:

<CBINonht> B20 | B40 | B80 | B160 | OFF

B20|B40|B80|B160
Indicates 20 MHz, 40MHz, 80MHz or 160 (80+80) MHz channel bandwidth of the transmitted packet.

OFF
Channel bandwidth in Non HT is not present.

*RST: OFF
Default unit: MHz

Example: `BB:WLNN:FBL1:CBIN B80`
selects 80 MHz channel bandwidth of the transmitted packet.

Manual operation: See "Ch. Bandwidth in Non HT" on page 42

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:CODing:ENCoder?

Queries the number of encoders to be used. This value depends on the data rate. For data rate ≤ 300 Mps, this value is 1. Otherwise the number of encoders is 2.

Return values:

<Encoder> E1 | E2 | E3 | E6 | E7 | E8 | E9 | E12 | E4 | E5 | E10 | E11

Example: `BB:WLNN:FBL5:COD:ENC?`
queries the number of encoders to be used.

Usage: Query only

Manual operation: See "Encoders" on page 40

[: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 40

[: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 40

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

Queries the number of data bits sent by an OFDM symbol on all spatial streams.

Return values:
<BpSymbol> integer
*RST: 0

Example: `BB:WLNN:FBL5:DATA:BPS?`
queries the number of data bits sent by an OFDM symbol on all spatial streams.

Usage: Query only

Manual operation: See "Data Bits Per Symbol" on page 40

[: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 42

[: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 35

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

Sets the number of data symbols per frame block.

If the number of OFDM data symbols is changed, the generator calculates the data field length as a function of the set PPDU bit rate and displays it at Data Length.

Parameters:

<Symbols> integer

Range: 1 to Max
*RST: 158

Example: `BB:WLNN:FBL5:DATA:SYMB 1`
sets the number of data symbols per frame block to 1.

Manual operation: See "Number Of Data Symbols" on page 43

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

(avaliable 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: OFF

Example: `BB:WLNN:FBL1:DBIN DYN`
the transmitter is capable of dynamic bandwidth operation.

Manual operation: See "Dyn. Bandwidth in Non HT" on page 43

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

Sets the value of the extended spatial streams. This field is active for frame block type SOUNDING only to probe additional dimensions to the channel.

Parameters:

<EsStream> integer

Range: 1 to dynamic
Increment: 1
*RST: 1

Example: `BB:WLNN:FBL5:ESSTR 4`
sets the number of the extended spatial streams to 4.

Manual operation: See "Extended Spatial Streams" on page 39

[: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:FBL5:GUAR 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:FBL5:ILE:STAT ON`
activates the interleaver.

Manual operation: See "Interleaver Active" on page 43

[: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:FBL1:MCS MCS8`
selects MCS8 as the coding scheme used for the spatial stream.

Manual operation: See "MCS" on page 40

[: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:FBL5:MOD1 BPSK`
sets BPSK as the modulation mode used for the spatial stream.

Manual operation: See "Stream n" on page 40

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

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

Parameters:

<MUMimo> 0 | 1 | OFF | ON

*RST: 0

Example: `BB:WLNN:BB:WLNN:FBL1:MUM:STAT ON`
activates Multi User MIMO.

Manual operation: See "Multi User MIMO" on page 39

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MU<st0>:GID <GID>

Sets the group ID for all available users.

Parameters:

<GID> integer

Range: 1 to 62
*RST: 1

Example: `BB:WLNN:BB:WLNN:FBL1:MU1:GID 1.0`
assigns group ID 1.0 to user 1.

Manual operation: See "Multi User MIMO Settings Table" on page 39

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MU<st0>:NSTS <NSTS>

Sets the number of space time streams for each user.

Parameters:

<NSTS> integer

Range: 0 to Max
*RST: 1

Example: `BB:WLNN:BB:WLNN:FBL1:MU2:NSTS 8.0`
sets 8 space time streams for user 2.

Manual operation: See "Multi User MIMO Settings Table" on page 39

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

(avaliable 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: 1

Example: `BB:WLNN:FBL1:NTPS ON`
activates NTPS.

Manual operation: See "No TXOP PS" on page 45

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:PAID:PATTern <Pattern>

(avaliable only for VHT Tx mode)

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

Parameters:

<Pattern> 9 bits

*RST: #H000,9

Example: `BB:WLNN:FBL1:PAID:PAT #H1FB,9`
sets the pattern.

Manual operation: See "Partial AID (hex)" on page 45

[: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 44

[: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 44

[: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: 1

Example: `BB:WLNN:FBL5:PRE:STAT ON`
activates the preamble and signal fields of the frames in the current frame block.

Manual operation: See "Preamble/Header Active" on page 44

[: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: 11E6

Example: `BB:WLNN:FBL5:PMOD LEG`
sets the physical mode to LEGACY.
`BB:WLNN:FBL5:TMOD CCK`
sets the transport mode
`BB:WLNN:FBL5:PSDU:BRAT P2MBPS`
sets the PSDU bit rate

Manual operation: See "PSDU Bit Rate" on page 41

[: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 41

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

(available only for CCK and PBCC Tx 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 41

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

The command selects the different options for the scrambler.

Parameters:

<Mode> OFF | RANDom | USER | ON | PREamble

OFF
The scrambler is deactivated.

RANDom
(not for CCK/PBCC)
The scrambler is activated.
The initialization value of the scrambler is selected at random. Each frame has a different random initialization value. This value is also different in case of successive recalculations with the same setting parameters so that different signals are generated for each calculation.

USER
(not for CCK/PBCC)
The scrambler is activated.
The initialization value of the scrambler is set to a fixed value that is set using the command BB:WLNN:FBL5:SCR:PATT. This value is then identical in each generated frame.

ON
(CCK/PBCC only)
The scrambler is activated.

PREamble
(CCK/PBCC only)
The scrambler is activated. Only the preamble is scrambled.

*RST: USER

Example: `BB:WLNN:FBL5:SCR:MODE RAND`
activates the scrambler with an random initialization value.

Manual operation: See "Scrambler" on page 42

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SCRambler:PATTern <Pattern>

The command sets the initialization value for scrambling mode User. This value is then identical in each generated frame.

Parameters:

<Pattern> 8 bits

*RST: #H01,8

Example: `BB:WLNN:FBL5:SCR:PATT #H3F,8`
sets the user defined initialization value for the scrambler.

Manual operation: See "Scrambler Init (hex)" on page 43

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

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

 SEG0 | SEG1 | BOTH

*RST: SEG0

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

Manual operation: See "Segment" on page 39

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SERVice:PATTern <Pattern>

The command sets the value of the service field. The standard specifies a default value of 0. Other values can be entered in hexadecimal form for test purposes or future extensions.

Parameters:

<Pattern> 16 bits

*RST: #H0000,16

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

Manual operation: See "Service Field (hex)" on page 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: 1

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

Manual operation: See "Smoothing" on page 44

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

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:

<SStream> integer

Range: 1 to 8
*RST: 1

Example: `BB:WLNN:FBL5:SSTR 4`
sets the number of spatial streams to 4.

Manual operation: See "Spatial Streams" on page 38

[: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 39

[: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> integer

Range: 1 to dynamic
*RST: 1

Example: `BB:WLNN:FBL5:STBC:STAT?`
queries the status of the space time block coding.

Manual operation: See "Space Time Streams" on page 38

[: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: 0

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

Manual operation: See "Time Domain Windowing Active" on page 43

[: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 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 44

[: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 avaliable 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 39

4.8.2 MPDU Configuration

[: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 46

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

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.

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 46

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

Determines the bit pattern for the PATTern selection.

Parameters:

<Pattern> 64 bits

*RST: #H0,1

Example: `BB:WLNN:FBL1:MPDU1:DATA:PATT #B0101,4`
Sets the bit pattern.

Manual operation: See "DList / Pattern" on page 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 46

[: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 46

4.8.3 MAC Header Configuration

4.8.3.1 Common Fields Commands

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:ADDRess<st> <Address>

The command enters the value of the address fields 1 ... 4. Exactly 48 bits must be entered. Each address is 6 bytes (48 bit) long. The addresses can be entered in hexadecimal form in the entry field of each address field. The least significant byte (LSB) is in left notation.

Parameters:

<Address> integer

Range: #H000000000000,48 to #HFFFFFFFFFFFF,48
*RST: #H000000000000,48

Example: `BB:WLNN:FBL1:MAC:ADDR2 #H124836C7EA54,48`
set the value for address field 2.

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:ADDRess<st>:STATe <State>

The command activates/deactivates the selected address field.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: OFF

Example: `BB:WLNN:FBL1:MAC:ADDR2:STAT ON`
activates generation of address field 2.

Manual operation: See "MAC Address" on page 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 49

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:DID <Did>

The command enters the value of the duration ID field. Depending on the frame type, the 2-byte field Duration/ID is used to transmit the association identity of the station transmitting the frame or it indicates the duration assigned to the frame type. Exactly 16 bit must be entered.

Parameters:

<Did> integer

Range: #H0000,16 to #HFFFF,16
*RST: #H0000,16

Example: `BB:WLNN:FBL1:MAC:DID #HA5A5,16`
sets the value of the duration ID field.

Manual operation: See "Duration Id" on page 48

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

The command enters the value of the frame control field. The frame control field has a length of 2 bytes (16 bits) and is used to define the protocol version, the frame type, and its function, etc.. As an alternative, the individual bits can be set with the following commands.

Parameters:

<FControl> integer

Range: #H0000,16 to #HFFFF,16
*RST: #H0000,16

Example: `BB:WLNN:FBL1:MAC:FCON #H100A,16`
sets the value of the frame control field.

Manual operation: See "Frame Control" on page 48

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:FCONtrol:FDS <Fds>
[: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 48

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SA <Sa>

Sets the value of the source adress (SA) field.

Parameters:
<Sa> integer

Example: BB:WLNN:FBL1:MAC:SA #HFFFFFFFFFFFF,48
Sets the value of the SA field to FFFFFFFFFFFF.

Manual operation: See "SA (hex)" on page 49

[: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`
stets the value for the QoS field.

Manual operation: See "QoS Control" on page 57

[: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 57

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SCONtrol:FRAGment:INCRement
<Increment>

Defines the number of packets required to increment the counter of the fragment bits of the sequence control.

Parameters:

<Increment> integer

Range: 0 to 1024
*RST: 1

Example: `BB:WLNN:FBL1:MAC:SCON:FRAG:INCR 2`
two packets are required to increment the counter of the fragment bits.

Manual operation: See "Sequence Control" on page 49

[: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 49

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:SCONtrol:SEQuence:INCRement
<Increment>

Defines the number of packets required to increment the counter of the sequence bits of the sequence control.

Parameters:

<Increment> integer

Range: 0 to 1024
*RST: 1

Example: `BB:WLNN:FBL1:MAC:SCON:FRAG:INCR 2`
two packets are required to increment the counter of the sequence bits.

Manual operation: See "Sequence Control" on page 49

[: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 49

[: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 49

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

The command activates/deactivates the generation of the MAC Header.

Parameters:

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

Example: `BB:WLNN:FBL1:MAC:STAT ON`
activates the generation of the MAC Header.

Manual operation: See "MAC Header" on page 47

4.8.3.2 MAC Header HT Configuration

[: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 #HFFFFFFFF,32
*RST: #H00000000,32

Example: `BB:WLNN:FBL1:MAC:HTC #H5a5a5a5a,32`
sets the value for the HT control field.

Manual operation: See "HT/VHT Control" on page 57

[: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 58

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:CALibration:POSition <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 59

[: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 59

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

The command sets the value for the CSI steering.

00 = CSI

01 = uncompressed Steering Matrix

10 = compressed Steering Matrix

11 = Reserved

Parameters:

<CsiSteering> integer

Range: #H0,2 to #H3,2

Example: `BB:WLNN:FBL1:MAC:HTC:CSIS #H1,2`
sets the value for the CSI steering to 01 (uncompressed Steering Matrix).

Manual operation: See "CSI Steering" on page 58

[: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 "Reserved" 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 60

[: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 #HFFFF,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 59

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:NDP <Ndp>

Sets the value of the Null Data Packet (NDP) announcement.

0 = no NDP will follow

1 = NDP will follow

Parameters:

<Ndp> integer

Example: `BB:WLNN:FBL1:MAC:HTC:NDP #H1,1`
sets the value for the NDP announcement to 1 (NDP will follow).

Manual operation: See "NDP Announcement" on page 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 58

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:HTControl:SREServed <Reserved>

This signal field is currently defined, but not used.

Parameters:

<Reserved> integer

Manual operation: See "Reserved" on page 58

[: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 57

[: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 "NDP Announcement" on page 58

4.8.3.3 MAC Header VHT Configuration

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

The command sets the value for the VHT control field.

Parameters:

<VHTContol> integer

Range: #H00000000,32 to #HFFFFFFFF,32
*RST: #H00000000,32

Example: `BB:WLNN:FBL1:MAC:VHTC #H5a5a5a5a,32`
sets the value for the VHT control field.

Manual operation: See "HT/VHT Control" on page 57

[: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 60

[: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 61

[: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 61

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

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

Otherwise this subfield is reserved.

Parameters:

<GIDH> integer

*RST: #H0

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

Manual operation: See "GID-H" on page 61

[: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 63

[: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 #B111111111111111,15`
sets the information for the MFB subfield.

Manual operation: See "MFB" on page 61

[: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 62

[: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 62

[: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 62

[: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 60

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:MAC:VHTControl:UMFB <UnsolicitedMfb>

The command sets the Unsolicited MFB subfield.

Parameters:

<UnsolicitedMfb> integer

0
if the MFB is a response to an MRQ.

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

Example: `BB:WLNN:FBL:MAC:VHTC:UMFB #B1,1`
sets the information for the UMFB subfield.

Manual operation: See "Unsolicited MFB" on page 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 63

4.8.4 Beacon Configuration

4.8.4.1 General Beacon Functions

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

Defines the time intervall between two beacon transmissions.

Parameters:

<BInterval> float

Range: 0 to 65
Increment: 1E-9
*RST: 0.1
Default unit: s

Example: `BB:WLNN:FBL1:BFC:BINT 200ms`
Sets the time intervall between two beacon transmissions to 200 ms.

Manual operation: See "Beacon Interval" on page 52

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

Queries the current channel of the DSSS network.

Return values:

<DCCHannel> integer

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

Usage: Query only

Manual operation: See "DSSS(Current Channel)" on page 53

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

Sets the parameters necessary to support an IBSS (2 bytes). The Information field contains the ATIM Window parameter.

Parameters:

<IAWindow> integer

*RST: #H0000

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

Manual operation: See "IBSS(ATIM Window) (hex)" on page 53

[: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 52

[: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 52

4.8.4.2 Capability Information Parameters

[: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>

Informs the associated stations if PBCC is allowed.

Parameters:
<PBCC> 0 | 1 | OFF | ON
*RST: 0

Example: BB:WLNN:FBL1:BFC:CAP:PBCC ON

Manual operation: See "Capability Information Parameters" on page 53

Informs the associated stations that PBCC is allowed.

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

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

Parameters:
<PRIVacy> 0 | 1 | OFF | ON
*RST: 0

Example: BB:WLNN:FBL1:BFC:CAP:PRIV ON

Manual operation: See "Capability Information Parameters" on page 53

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

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

Informs the associated stations if quality of service (QoS) is supported.

Parameters:

<QOS> 0 | 1 | OFF | ON

*RST: 0

Example: `SOUR:BB:WLNN:FBL1:BFC:CAP:QOS ON`
Informs the associated stations that quality of service (QoS) is supported.

Manual operation: See "Capability Information Parameters" on page 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:SPReamble <SPReamble>

Informs the associated stations if short preamble is allowed.

Parameters:
<SPReamble> 0 | 1 | OFF | ON
*RST: 0

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

Manual operation: See "Capability Information Parameters" on page 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:FBL1: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 56

[: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 56

4.8.4.3 ERP Parameters

[: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:UPRotection
<EUPRotection>

Informs associated stations if they have to use protection.

Parameters:
<EUPRotection> 0 | 1 | OFF | ON
*RST: 0

Example: `BB:WLNN:FBL1:BFC:ERP:UPR ON`
Informs associated stations that they have to use protection.

Manual operation: See "ERP Parameters" on page 55

4.8.5 Spatial Mapping Configuration

[: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 othogonal colums, 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 64

[: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 64

[: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.

Parameters:

<TShift> float

Range: -32000 ns to 32000 ns
Increment: 1 ns
*RST: 0 ns

Example: `BB:WLNN:FBL1:SMAP:MODE TSH 1000`
sets the spatial mapping time shift to 1000 ns.

Manual operation: See "Time Shift" on page 65

[:SOURce<hw>]:BB:WLNN:FBLock<ch>:SMAPping:INDex <Index>

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> integer

Range: depends on TxMode to depends on TxMode
*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 65

[: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 66

List of Commands

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