R&S®SMBVB-K149
HRP UWB 802.15.4
User Manual

1179209002
Version 05

ROHDE&SCHWARZ
Make ideas real

This document describes the following software options:

- R&S®SMBVB-K149 HRP UWB (1423.8889.xx)

This manual describes firmware version FW 5.30.047.xx and later of the R&S®SMBV100B.

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1179.2090.02 | Version 05 | R&S®SMBVB-K149

The following abbreviations are used throughout this manual: R&S®SMBV100B is abbreviated as R&S SMBVB, 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 Welcome to the HRP UWB option

The R&S SMBVB-K149 is a firmware application that adds functionality to generate signals in accordance with the HRP UWB standard. The standard is specified in 802.15.4.z specification.

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

All functions not discussed in this manual are the same as in the base unit and are described in the R&S SMBV100B user manual. The latest version is available at:

www.rohde-schwarz.com/manual/SMBV100B

Installation

You can find detailed installation instructions in the delivery of the option or in the R&S SMBV100B service manual.

1.1 Key features

The option R&S SMBVB-K149 HRP UWB features:

- HRP UWB 802.15.4 signal generation compliant with HRP non-ERDEV mode
- HRP UWB 802.15.4z signal generation compliant with HRP-ERDEV base pulse repetition frequency (BPRF) mode
- HRP UWB 802.15.4z signal generation compliant with HRP-ERDEV higher pulse repetition frequency (HPRF) mode

1.2 Accessing the HRP UWB dialog

To open the dialog with HRP UWB settings

► In the block diagram of the R&S SMBV100B, select "Baseband > HRP UWB".

A dialog box opens, that displays the provided general settings.

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

1.3 What's new

This manual describes firmware version FW 5.30.047.xx and later of the R&S®SMBV100B.

Compared to the previous version, it provides the new features listed below:

- Added time based trigger function, see "Time Based Trigger" on page 40

1.4 Documentation overview

This section provides an overview of the R&S SMBV100B user documentation. Unless specified otherwise, you find the documents at:

www.rohde-schwarz.com/manual/smbv100b

1.4.1 Getting started manual

Introduces the R&S SMBV100B and describes how to set up and start working with the product. Includes basic operations, typical measurement examples, and general information, e.g. safety instructions, etc. A printed version is delivered with the instrument.

1.4.2 User manuals and help

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

- Base unit manual
  Contains the description of all instrument modes and functions. It also provides an introduction to remote control, a complete description of the remote control commands with programming examples, and information on maintenance, instrument interfaces and error messages. Includes the contents of the getting started manual.
- Software option manual
  Contains the description of the specific functions of an option. Basic information on operating the R&S SMBV100B is not included.

The contents of the user manuals are available as help in the R&S SMBV100B. The help offers quick, context-sensitive access to the complete information for the base unit and the software options.

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

1.4.3 Service manual

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

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

https://gloris.rohde-schwarz.com

1.4.4 Instrument security procedures

Deals with security issues when working with the R&S SMBV100B in secure areas. It is available for download on the internet.

1.4.5 Printed safety instructions

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

1.4.6 Data sheets and brochures

The data sheet contains the technical specifications of the R&S SMBV100B. It also lists the options and their order numbers and optional accessories.

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

See www.rohde-schwarz.com/brochure-datasheet/smbv100b

1.4.7 Release notes and open source acknowledgment (OSA)

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

The software makes use of several valuable open source software packages. An open-source acknowledgment document provides verbatim license texts of the used open source software.

See www.rohde-schwarz.com/firmware/smbv100b

1.4.8 Application notes, application cards, white papers, etc.

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

See www.rohde-schwarz.com/application/smbv100b

1.4.9 Videos

Find various videos on Rohde & Schwarz products and test and measurement topics on YouTube: https://www.youtube.com/@RohdeundSchwarz

On the menu bar, search for your product to find related videos.

Figure 1-1: Product search on YouTube

1.5 Scope

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

In particular, it includes:

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

For a description of such tasks, see the R&S SMBV100B user manual.

1.6 Notes on screenshots

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

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

2 About the HRP UWB option

2.1 Required options

The equipment layout for generating HRP UWB signals includes:

- Base unit
- Baseband real-time extension (R&S SMBVB-K520)
- Option HRP UWB (R&S SMBVB-K149)
- Option baseband extension to 240 MHz RF bandwidth (R&S SMBVB-K523)
- Option baseband extension to 500 MHz RF bandwidth (R&S SMBVB-K524)

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

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

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

For more information, see data sheet.

2.2 HRP UWB signal properties

HRP UWB PHY signals employ short, band-limited pulses sent at high rate pulse repetition frequencies (HRP).

2.2.1 Frame structure

An HRP UWB PHY frame consists of a preamble part that contains the synchronization header (SHR) and a data part that contains a PHY header (PHR) and a PHY payload. The SHR in the preamble comprises the synchronization (SYNC) field and a start-of-frame delimiter (SFD) field.

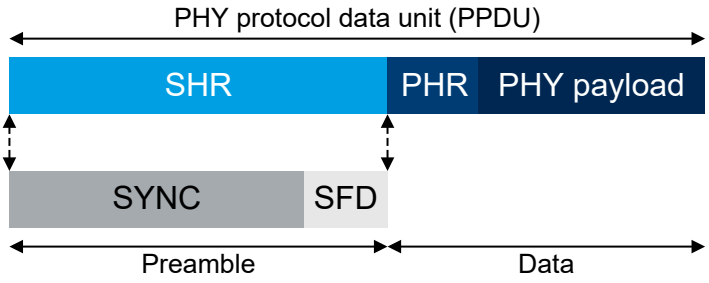


Figure 2-1: HRP UWB PHY frame structure

HRP-ERDEV

P802.15.4z/D07 introduced optional modes and a ciphered scramble time stamp (STS) sequence into the PHY to improve timestamp robustness and security and to increase the accuracy of ranging measurements.

A device incorporating these modes is referred to as a higher rate pulse repetition frequency UWB PHY based enhanced ranging capable device (HRP-ERDEV) and defined in P802.15.4z/D07, chapter 16.1, "General". Operation at the nominal 64 MHz pulse repetition frequency (PRF) is referred to as the base pulse repetition frequency (BPRF) mode. Operation at a higher PRF than the BPRF mode, is referred to as the higher pulse repetition frequency (HPRF) mode.

The frame structure of HRP-ERDEV is shown in the following figure, with the STS in different positions. The arrow shows the RMARKER reference position for each configuration, which is the peak pulse location associated with the first chip following the SFD.

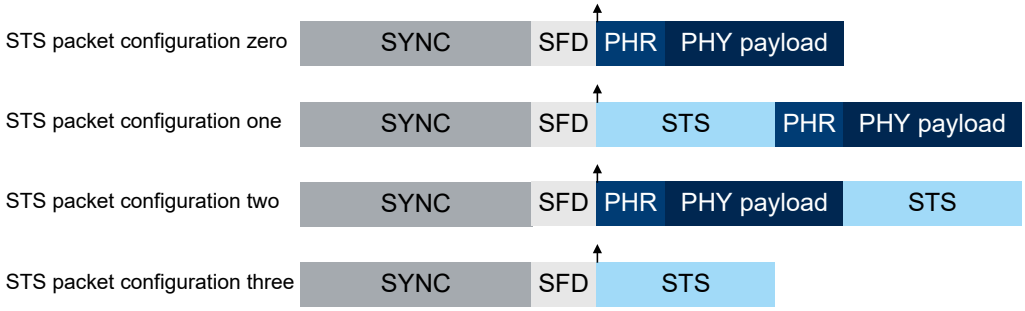


Figure 2-2: HRP-ERDEV frame structures with RMARKER position

2.2.1.1 Preamble

The SYNC and SFD fields in the preamble consist of repetitions of a preamble symbol S_i. A preamble symbol is constructed from a ternary code sequence $C_i = \{-1,0,1\}$ by inserting several chip durations between code symbols. The supported code sequence lengths are 31 and 127 as defined in IEEE Std 802.15.4-2015 chapter 16.2.4, "Preamble timing parameters". In addition, code sequence length 91 is supported as defined in P802.15.4z/D07, chapter 16.2.5, "SYNC field". The number of inserted chip durations is also called delta length and depends on the length of the code sequence and channel number.

The admissible values for the preamble timing parameters that result from the different code lengths and pulse repetition frequencies are defined in IEEE Std 802.15.4-2015, chapter 16.2.4, "Preamble timing parameters".

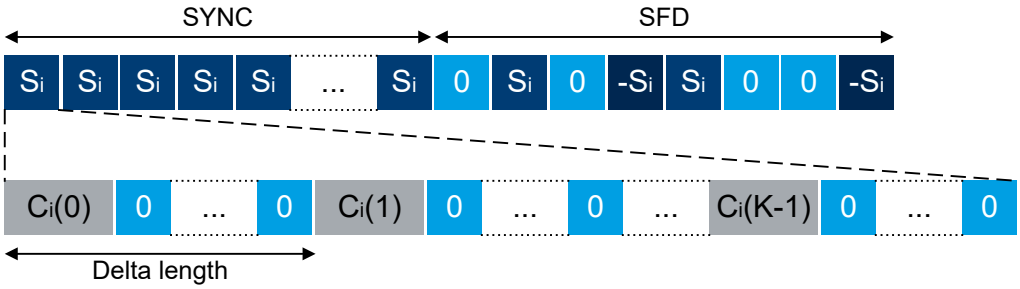


Figure 2-3: Construction of preamble symbols from a code sequence

SYNC field

The SYNC field portion of the SHR contains simple repetitions of the preamble symbol. The number of preamble symbol repetitions are 16, 64, 1024 and 4096 as defined in IEEE Std 802.15.4-2015, chapter 16.2.4, "Preamble timing parameters". In HPRF mode, the HRP-ERDEV supports 32 and 64 preamble symbol repetitions as defined in P802.15.4z/D07, chapter 16.2.5.1, "SYNC Field".

SFD field

The SFD field is spread by the preamble symbols. Each of the preamble symbols is multiplied by a sequence of {-1, 0, 1}. The supported SFD lengths are 8 (short) and 64 (long) as defined in IEEE Std 802.15.4-2015, chapter 16.2.5.2, "SFD field". In addition, the SFD sequences corresponding to the BPRF and HPRF modes are supported as defined in P802.15.4z/D07, chapter 16.2.5.2, "SFD Field".

2.2.1.2 Data

The PHR and PHY payload symbols are modulated using a combination of burst position modulation (BPM) and binary phase-shift keying (BPSK). Each symbol is composed of an active burst of UWB pulses and can carry two bits of information. One bit is used to determine the position of a burst of pulses, while an additional bit is used to modulate the phase (polarity) of this same burst. The various data rates are supported by using variable-length bursts.

PHR field

The PHR field conveys the information necessary to decode the packet to the receiver, including the following:

- data rate used to transmit the PHY payload
- length of PHY payload field
- preamble duration

The PHR is modulated using BPM-BPSK at either 850 kb/s or 110 kb/s. For the BPRF mode, the PHR is modulated using BPM-BPSK at 850 kb/s (or optionally at 6.8 Mb/s).

PHY payload field

The PHY payload field is sent at the data rate indicated in the PHR. Due to the variable code sequence lengths and the different corresponding pulse repetition frequencies (PRFs) in the preamble, there are several admissible data rates the UWB PHY can support. The supported data rates are defined in IEEE Std 802.15.4-2015, chapter 16.2.6, "PHR field" and P802.15.4z/D07, chapter 16.2.6.2 "PHR field for HRP-ERDEV in BPRF mode".

2.3 Operating frequency bands

The carrier center frequencies for UWB signals are defined in IEEE Std 802.15.4-2015, chapter 16.4.1, "Operating frequency bands". The table below provides an overview of the supported channels by R&S SMBV100B.

Table 2-1: HRP UWB PHY band allocation

Band group	Channel	Frequency / MHz	Bandwidth / MHz	Mandatory/optional
0	0	499.2	499.2	Mandatory below 1 GHz
1 (low band)	1	3494.4	499.2	Optional
	2	3993.6	499.2	Optional
	3	4492.8	499.2	Mandatory in low band
	4	3993.6	1331.2	Optional
2 (high band)	5	6489.6	499.2	Optional
	6	6988.8	499.2	Optional
	7	6489.6	1081.6	Optional
	8	7488.0	499.2	Optional
	9	7987.2	499.2	Mandatory in high band
	10	8486.4	499.2	Optional
	11	7987.2	1331.2	Optional
	12	8985.6	499.2	Optional
	13	9484.8	499.2	Optional
	14	9984.0	499.2	Optional
	15	9484.8	1354.97	Optional

3 HRP UWB configuration and settings

Access:

► Select "Baseband > HRP UWB 802.15.4".

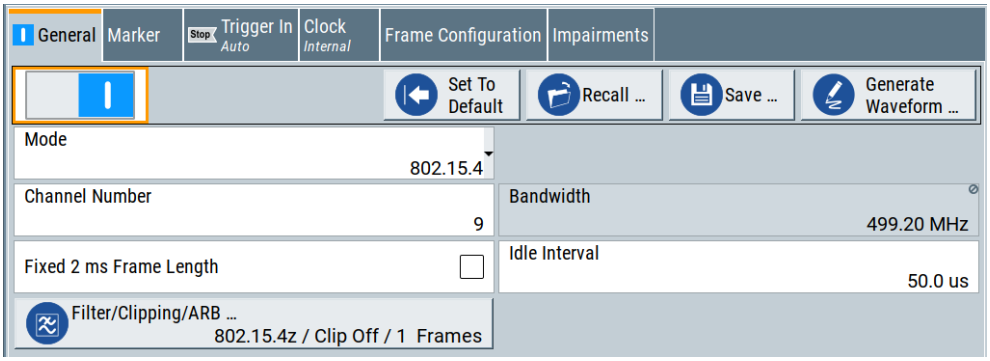
The remote commands required to define these settings are described in Chapter 5, "Remote control commands", on page 47.

Settings:

3.1 General settings

Access:

► Select "Baseband > HRP UWB 802.15.4".



The dialog provides the standard general settings, the default and the "Save/ Recall" settings. Also, it provides access to dialogs with further settings.

Settings:

State
Enables the HRP UWB standard.

Enabling this standard disables all the other digital standards and digital modulation modes in the same baseband.

Remote command:
[:SOURce<hw>]:BB:HUWB:STATe on page 49

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

Parameter	Value
"State"	Not affected by the "Set to Default"
HRP UWB "Mode"	"802.15.4"
"Channel Num"	"0"
"Bandwidth"	"499.20 MHz"
"Fixed 2 ms Frame Length"	Not activated
"Idle Interval"	"50.0 µs"
"Filter"	"802.15.4z"
Clipping "State"	"Off"
ARB "Sequence Length"	"1 Frames"
"Trigger"	"Auto"
"Marker"	"Restart(ARB)"
"Clock"	"Internal"

Remote command:
[:SOURce<hw>]:BB:HUWB:PRESet on page 49

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

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

See also, chapter "File and Data Management" in the R&S SMBV100B user manual.

Remote command:
[:SOURce<hw>]:BB:HUWB:SETTing:CATalog on page 49
[:SOURce<hw>]:BB:HUWB:SETTing:DELete on page 50
[:SOURce<hw>]:BB:HUWB:SETTing:LOAD on page 50
[:SOURce<hw>]:BB:HUWB:SETTing:STORe on page 50

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

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

Remote command:
`[:SOURce<hw>]:BB:HUWB:WAVeform:CREate` on page 51

Mode
Sets the HRP UWB mode.

"802.15.4" Enables HRP non-ERDEV mode.

"802.15.4z-BPRF"
Enables HRP-ERDEV base pulse repetition frequency (BPRF) mode.

"802.15.4z-HPRF"
Enables HRP-ERDEV higher pulse repetition frequency (HPRF) mode.

Remote command:
`[:SOURce<hw>]:BB:HUWB:STD` on page 52

Channel Number
Sets the channel number that is a 4-bit value in decimal representation.

The channel number determines the bandwidth and the code index.

Channel number	Bandwidth / MHz	Code index[1)]
0, 1, 8, 12	499.2	1, 2, 9 to 16, 21 to 32
2, 5, 9, 13	499.2	3, 4, 9 to 16, 21 to 32
3, 6, 10, 14	499.2	5, 6, 9 to 16, 21 to 32
4, 11	1331.2	7, 8, 13 to 32
7	1081.6	7, 8, 13 to 32
15	1354.97	7, 8, 13 to 32

[1)] Code indexes 25 to 32 require "Mode > 802.15.4z-HPRF".

Remote command:
`[:SOURce<hw>]:BB:HUWB:CNUMber` on page 51

Bandwidth
Displays the bandwidth of the HRP UWB signal.

The bandwidth depends on the channel number, see "Channel Number" on page 15.

Remote command:
`[:SOURce<hw>]:BB:HUWB:BWIDth?` on page 51

Fixed 2 ms Frame Length
Sets the frame length of a generated waveform shorter than 2 ms to a fixed value of 2 ms.

If activated, the "Idle Interval" is set to 0.0 µs by default which means the frames are sent successively without separation.

Generated waveforms longer than 2 ms remain unaffected.

Remote command:
`[:SOURce<hw>]:BB:HUWB:F2MS` on page 51

Idle Interval
Sets the length of the idle interval.

Remote command:
`[:SOURce<hw>]:BB:HUWB:IINTerval` on page 52

Filter/Clipping/ARB
Accesses a dialog to set baseband filtering, clipping and the sequence length of the arbitrary waveform component, see Chapter 4.1, "Filter/Clipping/ARB settings", on page 32.

3.2 Frame configuration settings

Access:

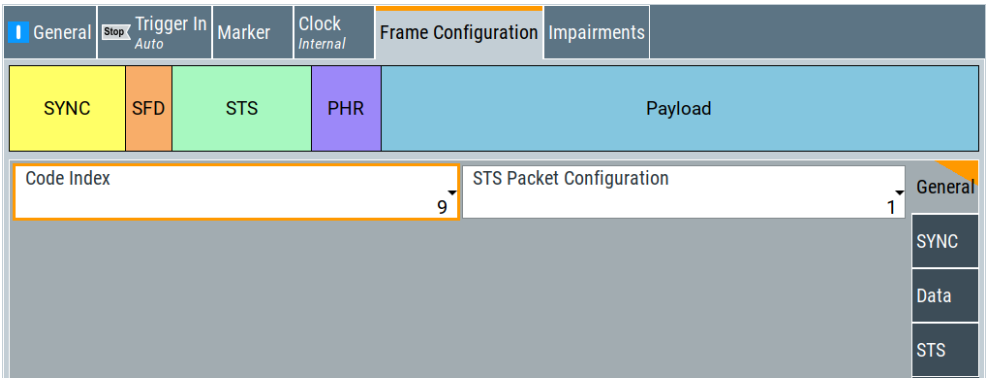
► Select "Baseband > HRP UWB 802.15.4 > Frame Configuration".

The dialog provides settings to configure HRP UWP frames.

3.2.1 General settings

Access:

► Select "Frame Configuration > General".



The tab provides settings to configure the code index and the scrambled timestamp sequence (STS) packets of HRP UWP frames.

Settings:

Code Index
Sets the code index that determines the code sequence.

Available code indexes depend on the channel number and mode, see "Channel Number" on page 15.

Remote command:
`[:SOURce<hw>]:BB:HUWB:FCONfig:CINDex` on page 57

STS Packet Configuration
Requires "Mode > 802.15.4z-BPRF" or "Mode > 802.15.4z-HPRF".

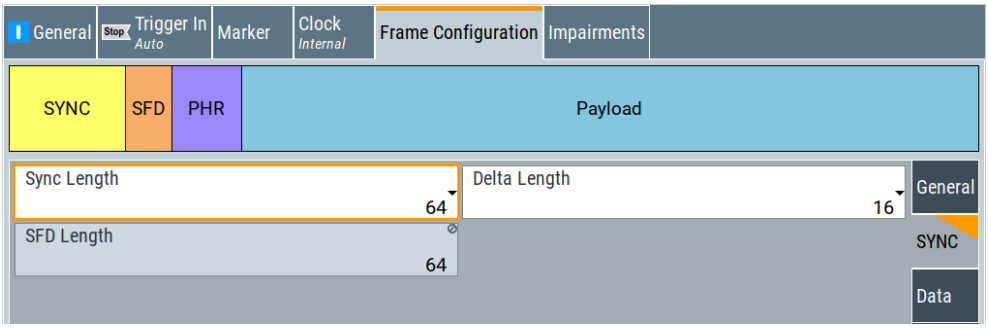
Sets the scrambled timestamp sequence (STS) packet configuration. If "STS Packet Configuration > 1/2/3", you can configure additional STS settings, see Chapter 3.2.5, "STS settings", on page 28.

Remote command:
`[:SOURce<hw>]:BB:HUWB:STS:PC` on page 66

3.2.2 SYNC settings

Access:

► Select "Frame Configuration > SYNC".



The tab provides settings to configure SYNC settings.

Settings:

Sync Length
Sets the length of the SYNC field.

Remote command:
`[:SOURce<hw>]:BB:HUWB:FCONfig:SYNLength` on page 63

Delta Length
Sets the delta length. The length depends on the HRP UWB mode and bandwidth.

HRP UWB mode	Bandwidth / MHz	Delta length
802.15.4	499.2 1081.6 1331.2 1354.97	4, 16, 64 4, 16 4, 16 4, 16
802.15.4z-BPRF	499.2 1081.6 1331.2 1354.97	4
802.15.4z-HPRF	499.2 1081.6 1331.2 1354.97	4, 16, 64 4, 16 4, 16 4, 16

Remote command:
[:SOURce<hw>]:BB:HUWB:FCONfig:DLENgth on page 60

SFD Length
Displays the symbol length of the start-of-frame delimiter (SFD). The length depends on the HRP UWB mode, see Table 3-1.

Remote command:
[:SOURce<hw>]:BB:HUWB:FCONfig:SFDLength on page 62

SFD
Sets the start-of-frame delimiter (SFD) symbol sequence.

Availability of the SFD sequence and the corresponding SFD length depends on the HRP UWB mode, see Table 3-1.

Table 3-1: SFD, SFD length and HRP UWB mode

SFD	SFD length	802.15.4	802.15.4z-BPRF	802.15.4z-HPRF
0	8	-	Supported	Supported
1	4	-	Supported	Supported
2	8	-	Supported	Supported
3	16	-	Supported	Supported
4	32	-	Supported	Supported
Legacy	8	Supported	-	-

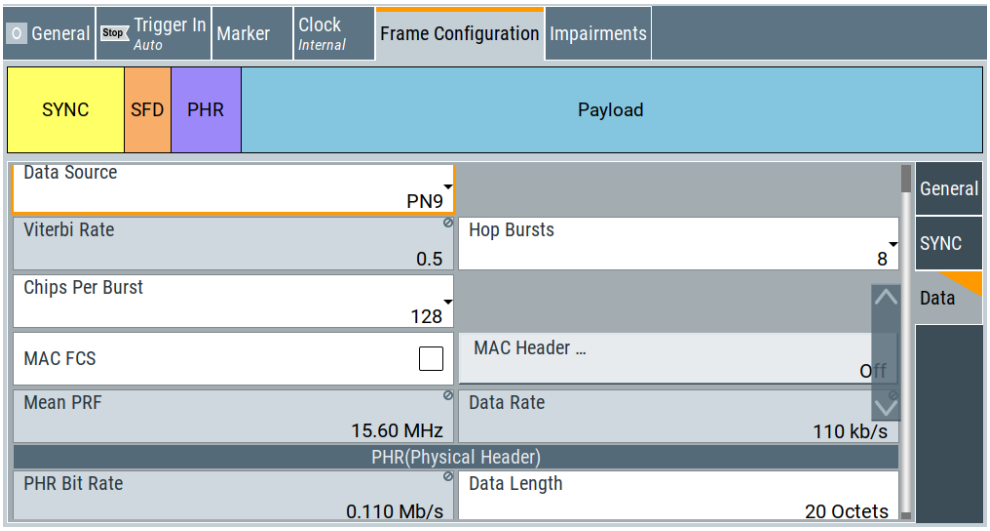
Additional to standard-compliant SFD sequences, "802.15.4" mode also supports a legacy sequence.

Remote command:
[:SOURce<hw>]:BB:HUWB:SFD on page 63

3.2.3 Data settings

Access:

► Select "Frame Configuration > Data".



The tab provides settings to configure physical data and physical header settings. For "STS Packet Configuration" = 3, you cannot configure the "Data" settings.

PHY header and PHY payload coding

The data for the physical header and physical payload is segmented into code blocks for coding via the Reed-Solomon coder. For a data length of 127 bytes (octets), there are four code blocks segmented from four frames. Table 3-2 gives an overview.

Table 3-2: PHY data length and code block segmentation

Frame			Code block b				
Number	**Length [byte]**	**Length [bit]**	**Number**	**b1 [bit]**	**b2 [bit]**	**b3 [bit]**	**b4 [bit]**
1	1 to 41	8 to 328	1	8 to 328	0	0	0
2	42 to 82	336 to 656	2	330	6 to 326	0	0
3	83 to 123	664 to 984	3	330	330	4 to 324	0
4	124 to 127	992 to 1016	4	330	330	330	2 to 26

Settings:

Physical Data
Provides settings to configure physical data.

Data Source ← Physical Data
Selects the data source.

Note: The bit order of the output data bits is least significant bit (LSB) first and most significant bit (MSB) last.

The following standard data sources are available:

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

See also:

- Section "Modulation Data" in the R&S SMBV100B user manual.
- Section "File and Data Management" in the R&S SMBV100B user manual.
- Section "Data List Editor" in the R&S SMBV100B user manual

Remote command:
[:SOURce<hw>]:BB:HUWB:FCONfig:DATA on page 58
[:SOURce<hw>]:BB:HUWB:FCONfig:DATA:DSELection on page 58
[:SOURce<hw>]:BB:HUWB:FCONfig:DATA:PATTern on page 59

Viterbi Rate ← Physical Data
Displays the Viterbi rate for convolutional coding.

The rate is fixed to 0.5, except for "Chips Per Burst > 1" it is 1.0.

Remote command:
[:SOURce<hw>]:BB:HUWB:FCONfig:VRATe? on page 63

Convolutional Code Constraint Length ← Physical Data
Requires "Mode > 802.15.4z-HPRF".

Sets the constraint length of the convolutional code.

Remote command:
[:SOURce<hw>]:BB:HUWB:CCCL on page 57

Hop Bursts ← Physical Data
Requires "Mode > 802.15.4" or "Mode > 802.15.4z-BPRF".

Sets the number of hop bursts.

Remote command:
[:SOURce<hw>]:BB:HUWB:FCONfig:HOPBurst on page 60

Chips Per Burst ← Physical Data
Sets the number of chips per burst.

Remote command:
[:SOURce<hw>]:BB:HUWB:FCONfig:CPBurst on page 58

MAC FCS ← Physical Data
Activates the MAC frame check sequence (FCS) field.

Remote command:
[:SOURce<hw>]:BB:HUWB:FCONfig:MCS:STATe on page 61

MAC FCS Length ← Physical Data
Requires "MAC FCS > On".

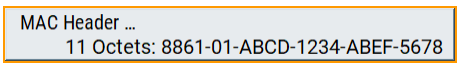
Sets the length of the MAC frame check sequence (FCS) field.

Remote command:
[:SOURce<hw>]:BB:HUWB:FCONfig:MFL on page 61

MAC Header ← Physical Data
Accesses the "MAC Header Configuration" dialog to configure MAC header parameters.

See Chapter 3.2.4, "MAC header configuration settings", on page 24.

If the MAC header is active, the button displays the length of the MAC header and the MAC address.



Remote command:
[:SOURce<hw>]:BB:HUWB:MACHeader:STRing? on page 76

Mean PRF ← Physical Data
Displays the mean pulse repetition frequency (PRF). The value depends on the hop bursts.

Remote command:
[:SOURce<hw>]:BB:HUWB:FCONfig:MPRF? on page 62

Data Rate ← Physical Data
Displays the data rate.

Remote command:
[:SOURce<hw>]:BB:HUWB:FCONfig:DR? on page 59

PHR Data Rate Mode ← Physical Data
Requires "Mode > 802.15.4z-BPRF" or "Mode > 802.15.4z-HPRF".

Sets the data rate mode of the physical header.

"DRBM_LP/DRBM_HP"
Requires "Mode > 802.15.4z-BPRF".

"DRHM_LR/DRHM_HR"
Requires "Mode > 802.15.4z-HPRF".

Remote command:
[:SOURce<hw>]:BB:HUWB:PHR:DRM on page 63

PHR (Physical Header)
Provides settings to configure the PHY header and PHY payload.

PHR Bit Rate ← PHR (Physical Header)
Displays the bit rate of the physical header. The value depends on the chips per burst.

Remote command:
[:SOURce<hw>]:BB:HUWB:FCONfig:PHRBrate? on page 62

Data Length ← PHR (Physical Header)
Sets the data length of the PHY header and PHY payload in octets.

PHY header and PHY payload data are segmented into code blocks for Reed-Solomon encoding, see Table 3-2.

The specified maximum data length is 127 octets. For "Mode > 802.15.4z-HPRF", you can set a maximum data length of up to 4095 octets.

Mode	Maximum data length
"802.15.4z"	127 octets
"802.15.4z-BPRF"	127 octets
"802.15.4z-HPRF"	4095 octets

Remote command:
[:SOURce<hw>]:BB:HUWB:FCONfig:DALEngth on page 59

Maximum Data Length ← PHR (Physical Header)
Requires "Mode > 802.15.4z-HPRF".

Sets the maximum data length of the physical header.

Remote command:
[:SOURce<hw>]:BB:HUWB:FCONfig:MDL on page 61

Frame
Provides information on the frame length.

Frame Length ← Frame
Displays the frame length.

The frame length is the sum of the MAC header length, the MAC frame check sequence (FCS) field length and the data length of the physical header.

Example: Frame lengths with enabled and disabled MAC parameters

By default, the frame length is 20 octets that are the data length of the physical header.

If you activate the MAC frame check sequence (FCS) field, the frame length increases. Using the default "MAC FCS Length > 2 Octets", the frame length is 22 octets.

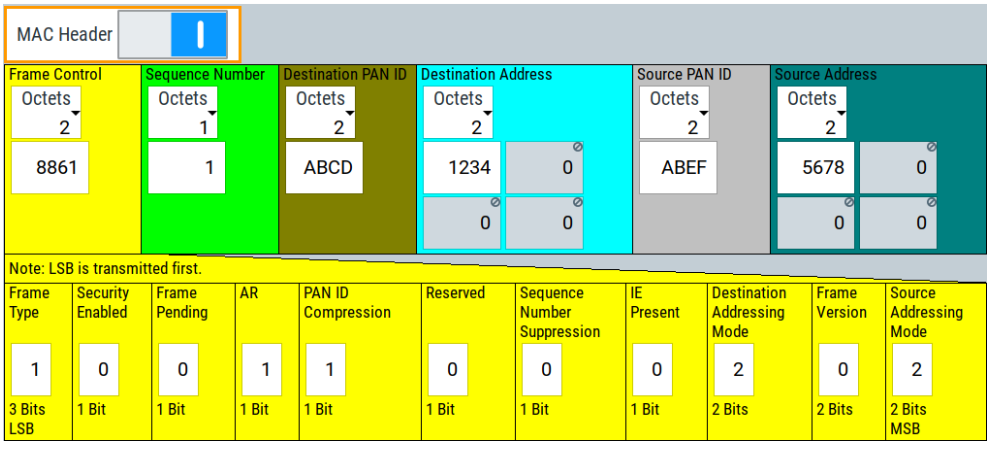
If you further activate the MAC header, the frame length increases. Using the default "MAC Header > 11 Octets", the frame length is 33 octets.

Remote command:
n.a.

3.2.4 MAC header configuration settings

Access:

► Select "Frame Configuration > Data > MAC Header".



The tab provides settings to configure the MAC header bits as defined in IEEE Std 802.15.4-2015.

MAC Header
Activates MAC header information.

Remote command:
`[:SOURce<hw>]:BB:HUWB:MACHeader:STATe` on page 76

Frame Control
Sets the length and the input value of the frame control field.

You can set lengths of 1 octet or 2 octets. The single bit field below ranges from least significant bit (LSB) to most significant bit (MSB):

- 1 octet (8-bit): Set bits for fields "Frame Type" to "Reserved".
- 2 octets (16-bit): Set bits for fields "Frame Type" to "Source Addressing Mode".

Remote command:
`[:SOURce<hw>]:BB:HUWB:MACHeader:LFRControl` on page 72
`[:SOURce<hw>]:BB:HUWB:MACHeader:CTRL` on page 68

Frame Type ← Frame Control
Sets the bits in the frame type field. The value is a 3-bit value, the field is the LSB part of the frame control field.

Table 3-3: Frame type settings (IEEE Std 802.15.4-2015, table 7.2.1.1-7)

Decimal value	Binary values b2, b1, b0	Description
0	000	Beacon
1	001	Data
2	010	Acknowledgment
3	011	MAC command

Decimal value	Binary values b2, b1, b0	Description
4	100	Reserved
5	101	Multipurpose
6	110	Fragment or Frak
7	111	Extended

Remote command:
[:SOURce<hw>]:BB:HUWB:MACHeader:FTYPe on page 70

Security Enabled ← Frame Control
Sets the bit in the security enabled field.

Remote command:
[:SOURce<hw>]:BB:HUWB:MACHeader:SEENabled on page 75

Frame Pending ← Frame Control
Sets the bit in the frame pending field.

Remote command:
[:SOURce<hw>]:BB:HUWB:MACHeader:FPENding on page 70

AR ← Frame Control
Sets the bit in the AR field. It specifies if an acknowledgment is required from the recipient device on receipt of a data frame or MAC command.

Remote command:
[:SOURce<hw>]:BB:HUWB:MACHeader:AR on page 68

PAN ID Compression ← Frame Control
Sets the bit in the PAN ID compression field as defined in IEEE Std 802.15.4-2015, table 7.2.1.5-2.

Remote command:
[:SOURce<hw>]:BB:HUWB:MACHeader:PIDComp on page 73

Reserved ← Frame Control
Sets a reserved bit for future use.

Remote command:
[:SOURce<hw>]:BB:HUWB:MACHeader:REServed on page 74

Sequence Number Suppression ← Frame Control
Requires frame control length of two octets.

Sets the bit in the sequence number suppression field.

Remote command:
[:SOURce<hw>]:BB:HUWB:MACHeader:SENSupp on page 75

IE Present ← Frame Control
Requires frame control length of two octets.

Sets the bit in the information element (IE) present field.

The value is one, if the frame contains IEs and it is zero otherwise.

Remote command:
[:SOURce<hw>]:BB:HUWB:MACHeader:IEPResent on page 71

Destination Addressing Mode ← Frame Control
Requires frame control length of two octets.

Sets the bits in the destination addressing mode. The value is a 2-bit value.

Table 3-4: Destination/Source Addressing Mode field (IEEE Std 802.15.4-2015, Table 7-3)

Decimal value	Binary values b1, b0	Description
0	00	PAN ID and address fields are not present
1	01	Reserved
2	10	Address field contains a short address (16 bit).
3	11	Address field contains an extended address (64 bit).

Remote command:
[:SOURce<hw>]:BB:HUWB:MACHeader:DADMode on page 69

Frame Version ← Frame Control
Requires frame control length of two octets.

Sets the bits in the frame version field. The value is a 2-bit value.

Remote command:
[:SOURce<hw>]:BB:HUWB:MACHeader:FVERsion on page 70

Source Addressing Mode ← Frame Control
Requires frame control length of two octets.

Sets the bits in the source addressing mode field. The value is a 2-bit value.

For valid values to enter, see "Destination Addressing Mode" on page 27.

Remote command:
[:SOURce<hw>]:BB:HUWB:MACHeader:SADMode on page 74

Sequence Number
Sets the length and the input value of the sequence number field. The value is in hexadecimal representation.

Remote command:
[:SOURce<hw>]:BB:HUWB:MACHeader:LSEQnumber on page 73
[:SOURce<hw>]:BB:HUWB:MACHeader:SEQNumber on page 75

Destination PAN ID
Sets the length and the input value of the destination PAN ID field. The value is in hexadecimal representation.

Remote command:
[:SOURce<hw>]:BB:HUWB:MACHeader:LDEPanid on page 71
[:SOURce<hw>]:BB:HUWB:MACHeader:DPANid on page 69

Destination Address
Sets the length and the input values of the destination address field. The value is in hexadecimal representation.

Remote command:
[:SOURce<hw>]:BB:HUWB:MACHeader:LDADdress on page 71
[:SOURce<hw>]:BB:HUWB:MACHeader:DADD on page 69
[:SOURce<hw>]:BB:HUWB:MACHeader:DAD2 on page 69
[:SOURce<hw>]:BB:HUWB:MACHeader:DAD3 on page 69
[:SOURce<hw>]:BB:HUWB:MACHeader:DAD4 on page 69

Source PAN ID
Sets the length and the input value of the source PAN ID field. The value is in hexadecimal representation.

Remote command:
[:SOURce<hw>]:BB:HUWB:MACHeader:LSOPanid on page 73
[:SOURce<hw>]:BB:HUWB:MACHeader:SPANid on page 75

Source Address
Sets the length and the input values of the source address field. The value is in hexadecimal representation.

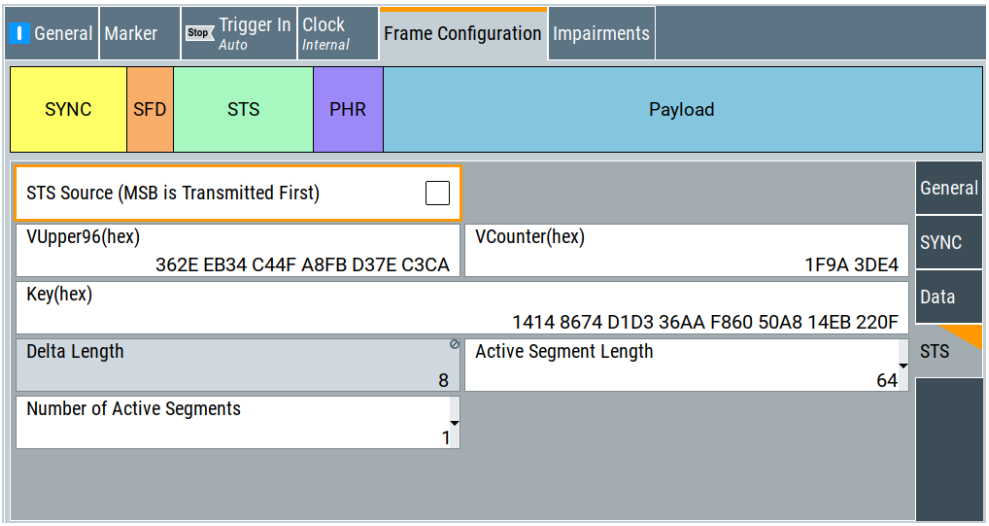
Remote command:
[:SOURce<hw>]:BB:HUWB:MACHeader:LSADdress on page 72
[:SOURce<hw>]:BB:HUWB:MACHeader:SADD on page 74
[:SOURce<hw>]:BB:HUWB:MACHeader:SAD2 on page 74
[:SOURce<hw>]:BB:HUWB:MACHeader:SAD3 on page 74
[:SOURce<hw>]:BB:HUWB:MACHeader:SAD4 on page 74

3.2.5 STS settings

Access:

1. Select the HRP UWB mode:
   - "General > Mode > 802.15.4z-BPRF"
   - "General > Mode > 802.15.4z-HPRF"
2. Select "Frame Configuration > General > STS Packet Configuration > 1/2/3".

3. Select "Frame Configuration > STS".



The tab provides settings to configure the scrambled timestamp sequence (STS).

To select and import an STS data list

To import a binary data from an STS data list, internally or externally generated:

1. Activate "STS Source (MSB is Transmitted First)".

   "Select STS Data List" is displayed.

2. Click "Select STS Data List" to access the standard "User Files" dialog.
   a) Navigate to the list file (*.dm_iqd) and click "Select" to select an existing data list.
   b) Use the "New" and "Edit" functions to create internally new data list or to edit an existing one.
   c) Use the standard "File Manager" function to transfer external data lists to the instrument.

Settings:

STS Source (MSB is Transmitted First)
Activates the scrambled timestamp sequence (STS) source. If activated, you can select an STS data list from a designated folder to import a user-defined STS sequence.

The bit order of the imported data is most significant bit (MSB) first.

How to: "To select and import an STS data list" on page 29

Remote command:
[:SOURce<hw>]:BB:HUWB:STS:DLS on page 64
[:SOURce<hw>]:BB:HUWB:STS:DATA:DSELection on page 64

VUpper96(hex)
Sets the upper part of the V value. The value is a 96-bit value in hexadecimal representation.

Remote command:
[:SOURce<hw>]:BB:HUWB:STS:UPARt on page 66

VCounter(hex)
Sets the counter part of the V valued. The value is a 32-bit value in hexadecimal representation.

Remote command:
[:SOURce<hw>]:BB:HUWB:STS:CPARt on page 65

Key(hex)
Sets the key value. The value is a 128-bit value in hexadecimal representation.

Remote command:
[:SOURce<hw>]:BB:HUWB:STS:KEY on page 65

Delta Length
Displays the delta length of the scrambled timestamp sequence (STS). The delta length depends on the HRP UWB mode.

HRP UWB mode	Delta length
802.15.4z-BPRF	8
802.15.4z-HPRF	4

Remote command:
[:SOURce<hw>]:BB:HUWB:STS:DLEN on page 65

Active Segment Length
Sets the active segment length in units of 512 chips (1 µs).

For both HRP UWB modes "802.15.4z-BPRF" and "802.15.4z-HPRF", you can set active segment lengths as follows: 16, 32, 64, 128, 256, 512, 1024, 2048.

Remote command:
[:SOURce<hw>]:BB:HUWB:ASL on page 56

Number of Active Segments
Sets the number of active segments.

For both HRP UWB modes "802.15.4z-BPRF" and "802.15.4z-HPRF", you can set the following number of active segments: 1, 2, 3, 4

Remote command:
[:SOURce<hw>]:BB:HUWB:ASN on page 56

Additional Gap between Payload and STS
Requires "Mode > 802.15.4z-HPRF" and "STS Packet Configuration > 2".

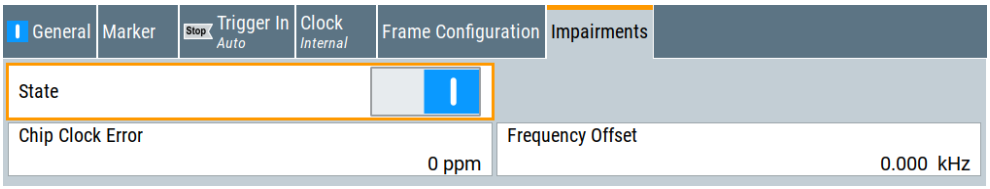
Sets an additional gap between payload and STS.

Remote command:
[:SOURce<hw>]:BB:HUWB:FCONfig:ADDGap on page 57

3.3 Impairments settings

Access:

► Select "Baseband > HRP UWB 802.15.4 > Impairments".



The tab provides settings to configure impairing of the signal.

Settings:

State
Activates adding impairments to the signal.

Impairments change the signal to simulate a non-ideal transmitter.

Remote command:
[:SOURce<hw>]:BB:HUWB:IMPairments:STATe on page 76

Chip Clock Error
Sets the chip clock error.

The set error corresponds to applying a deviation to the transmitter chip clock.

Remote command:
[:SOURce<hw>]:BB:HUWB:IMPairments:CCERror on page 76

Frequency Offset
Sets the carrier frequency offset.

Remote command:
[:SOURce<hw>]:BB:HUWB:IMPairments:FOFFset on page 76

4 Signal generation control

4.1 Filter/Clipping/ARB settings

Access:

► Select "General > Filter/Clipping/ARB".

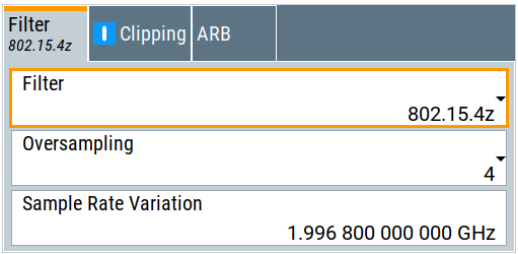
The dialog provides settings to configure the baseband filter, to enable clipping and adjust the sequence length of the arbitrary waveform component.

Settings:

4.1.1 Filter settings

Access:

► Select "General > Filter/Clipping/ARB > Filter".



The tab provides settings to configure the baseband filter.

Settings:

Filter
Selects the baseband filter.

Additional to the built-in filters for custom digital modulation, you can select the default filter type "802.15.4z". This filter is a root-raised cosine filter, that is optimized for 802.15.4z-BPRF and 802.15.4z-HPRF mode.

Remote command:
`[:SOURce<hw>]:BB:HUWB:FILTer:TYPE` on page 78

Optimization
Selects one of the provided EUTRA/LTE filters.

Each filter is designed for different application field and optimized for a particular performance. Depending on the filter implementation, these filters require different calculation time. The applied upsampling factor also influences the size of the calculated output waveform file.

Waveforms can be calculated in the following ways:
- With the "Generate Waveform File" function
- With the signal generation software R&S WinIQSIM2

The following table outlines the difference between the provided EUTRA/LTE filters by comparing their major specifications.

Table 4-1: Overview of the EUTRA/LTE filters

Characteristic	**"Best EVM"**	**"Best ACP"** **"Best ACP (Narrow)"**	**"Best EVM (no upsampling)"**
Design goal	An excellent EVM performance while ignoring the effects on ACP	A combination of an excellent ACP performance and a good EVM performance "Best ACP (Narrow)" features also a smoother shape in frequency domain	A combination of an excellent ACP performance and a good EVM performance Small output waveform file size
Calculation time (in real-time processing)	By real-time processing, short calculation time	Long calculation time: the filtered signal is precalculated because of the filter complexity	Long calculation time: the filtered signal is precalculated because of the filter complexity
Upsampling	Upsampling with factor 2 The sample rate of the output waveform is twice the LTE sample rate	Upsampling with factor 2 The sample rate of the output waveform is twice the LTE sample rate The signal processing requires twice as much internal memory. The available memory on the instrument is sufficient for the simulation of half as many frames compared to filter "Best EVM"	Upsampling is not applied The sample rate of the output waveform is not changed
Output waveform file size	Increased file size	Increased file size	File size is maintained The resulting file size is smaller than in the other cases
Recommended application field	Receiver and performance tests with internal real-time generation, where BLER is analyzed	Transmitter and components tests where excellent ACP is required	Receiver and performance tests with pre-generated waveform files, where BLER is analyzed

In specific configurations, an internal ("Auto") filter is applied automatically. This filter is designed for best possible optimization in configurations, like the carrier aggregation with carriers that span different bandwidths.

Remote command:
[:SOURce<hw>]:BB:HUWB:FILTer:PARameter:LTE:OPTimization
on page 80

Load User Filter
If Filter > "User" is selected, it opens the standard dialog "Select List File" for loading a user-defined filter file.

User filters are used as offline filters. The following types are supported:

- Files with predefined file format and extensions `*.vaf`
  For information, refer to the description "Introduction to "filtwiz" Filter Editor" on the Rohde & Schwarz web page.
- ASCII files with simple format and file extension `*.dat`
  These files describe filters as a sequence of normalized filter coefficients. Each coefficient is defined as a pair of I and Q samples. The I and Q components alternate at each file line. The I and Q values vary between - 1 and + 1.
  A user filter can contain up to 2560 coefficients.
  The user filter must be real-valued. For both I and Q components of the coefficients, only real coefficients different than 0 are allowed.
  You can create user filter files for example with MATLAB, see Example"Script that generates user filter file" on page 34.

Example: Script that generates user filter file

This MATLAB script creates a user filter file that fits the LTE default settings: "Channel Bandwidth = 10 MHz", "Number of Resource Blocks = 50", "FFT Size = 1024".

```
n_fft = 1048; %10MHz
n_scs = 50*12; %50RBs*12 subcarriers per RB

trans_region = 0.02 * n_fft/2; %in %, controls steepness of filter slopes,
relative to nyquist frequency

%cutoff frequencies
f = [n_scs/2 n_scs/2+trans_region];

%ripples in dB
rp = 0.01; %passband
rs = 80; %stopband
dev = [(10^(rp/20)-1)/(10^(rp/20)+1) 10^(-rs/20)];

%estimate filter order
[n,fo,ao,w] = firpmord(f,[1 0],dev,n_fft);

%generate filter coefficients
b = firpm(n,fo,ao,w);

fvtool(b); %displays filter response

%write filter out into .dat filter coefficient file
coeffs_out = zeros(2*length(b),1);
```

```
coeffs_out(1:2:end) = real(b);
coeffs_out(2:2:end) = imag(b);

dlmwrite(['smw_user_filter_' num2str(n) 'coeffs_' num2str(n_scs)
'scs_' num2str(n_fft) 'fft.dat'],coeffs_out);
```

Remote command:
[:SOURce<hw>]:BB:HUWB:FILTer:PARameter:USER on page 80

Roll Off Factor or BxT
Sets the filter parameter.

The filter parameter ("Roll off Factor" or "BxT") depends on the currently selected filter type. This parameter is preset to the default for each of the predefined filters.

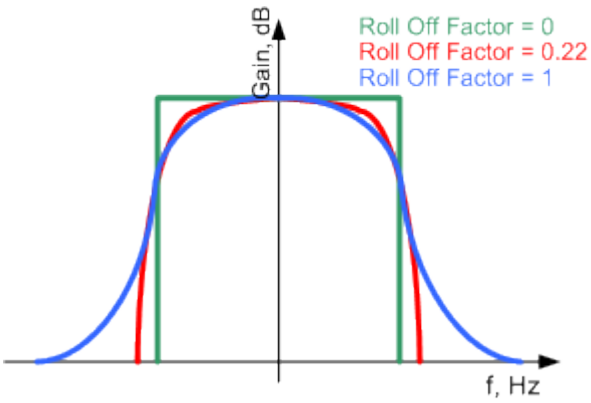


Figure 4-1: Example of the frequency response of a filter with different rolloff factors

For the default cosine filter, a rolloff factor of 0.10 is used.

Remote command:
[:SOURce<hw>]:BB:HUWB:FILTer:PARameter:APCo25 on page 79
[:SOURce<hw>]:BB:HUWB:FILTer:PARameter:COSine on page 79
[:SOURce<hw>]:BB:HUWB:FILTer:PARameter:GAUSs on page 79
[:SOURce<hw>]:BB:HUWB:FILTer:PARameter:PGAuss on page 79
[:SOURce<hw>]:BB:HUWB:FILTer:PARameter:RCOSine on page 79
[:SOURce<hw>]:BB:HUWB:FILTer:PARameter:SPHase on page 79
[:SOURce<hw>]:BB:HUWB:FILTer:PARameter:LTE:ROFactor on page 80

Cut Off Frequency Shift
Requires "Filter > Cosine" or "Filter > EUTRA/LTE" and "Optimization > Best EVM".

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

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

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

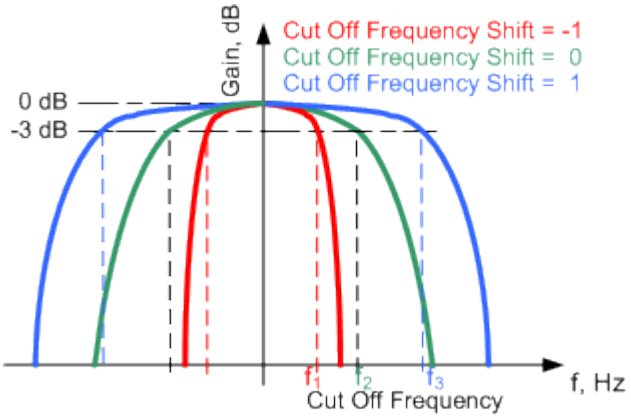


Figure 4-2: Example of the frequency response of a filter with different cutoff frequency shift

Remote command:
`[:SOURce<hw>]:BB:HUWB:FILTer:PARameter:COSine:COFS` on page 80
`[:SOURce<hw>]:BB:HUWB:FILTer:PARameter:LTE:COFS` on page 80

Cut Off Frequency Factor
Requires "Filter > Lowpass" or "Filter > EUTRA/LTE" and "Optimization > Best ACP/ Best ACP (Narrow)".

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

Remote command:
`[:SOURce<hw>]:BB:HUWB:FILTer:PARameter:LPASs` on page 79
`[:SOURce<hw>]:BB:HUWB:FILTer:PARameter:LPASsevm` on page 79
`[:SOURce<hw>]:BB:HUWB:FILTer:PARameter:LTE:COFFactor` on page 79

Oversampling
Sets the oversampling factor of the generated waveform. The ARB generator of the R&S SMBV100B requires low oversampling factors and still provides excellent signal quality in terms of EVM and ACP.

A reduced sample rate saves significantly the amount of memory or allows an increased signal cycle time, and vice versa.

Remote command:
`[:SOURce<hw>]:BB:HUWB:FILTer:OSAMpling` on page 78

Sample Rate Variation
Sets the sample rate of the signal.

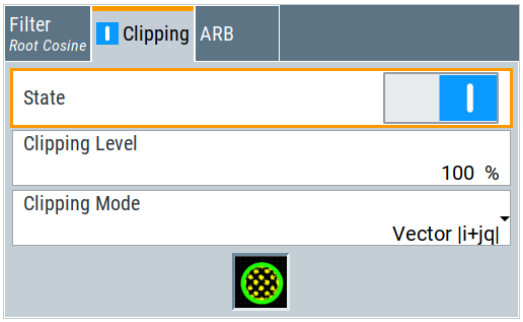
A variation of this parameter only affects the ARB clock rate; all other signal parameters remain unchanged. If the sampling rate in the frame configuration menu is changed, this parameter is reset to the chosen sampling rate.

Remote command:
`[:SOURce<hw>]:BB:HUWB:SRATe:VARiation` on page 81

4.1.2 Clipping settings

Access:

► Select "General > Filter/Clipping/ARB > Clipping".



The tab provides settings to configure clipping.

Settings:

Clipping State
Switches baseband clipping on and off.

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

Remote command:
`[:SOURce<hw>]:BB:HUWB:CLIPping:STATe` on page 82

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:HUWB:CLIPping:LEVel` on page 81

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

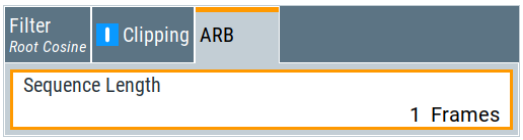
- "Vector | i + jq |"
  The limit is related to the amplitude | i + q |. The I and Q components are mapped together, the angle is retained.
- "Scalar | i | , | q |"
  The limit is related to the absolute maximum of all the I and Q values | i | + | q |. The I and Q components are mapped separately, the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

Remote command:
[:SOURce<hw>]:BB:HUWB:CLIPping:MODE on page 81

4.1.3 ARB settings

Access:

► Select "General > Filter/Clipping/ARB > ARB".



The tab provides settings to configure the arbitrary waveform.

Settings:

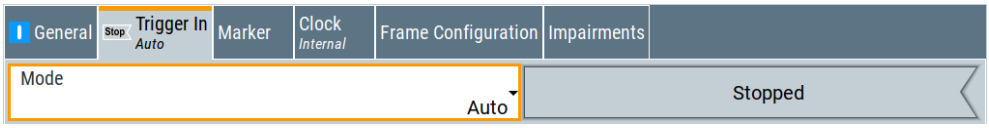
Sequence Length
Changes the sequence length of the arbitrary waveform component of the signal. This component is calculated in advance and output in the arbitrary waveform generator. It is added to the real-time signal components.

Remote command:
[:SOURce<hw>]:BB:HUWB:SLENgth on page 50

4.2 Trigger settings

Access:

► Select "Baseband > HRP UWB > Trigger In".



The dialog provides settings to select and configure the trigger, like trigger source, trigger delay, and to arm or trigger an internal trigger manually. The current signal generation status is displayed in the header of the tab together with information on the enabled trigger mode.

As in the "Marker" and "Clock" tabs, the tab provides also access to the settings of the related connectors.

This section focuses on the available settings.

For information on how these settings affect the signal, refer to section "Basics on ..." in the R&S SMBV100B user manual.

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

The provided trigger signals are not dedicated to a particular connector. Trigger signals can be mapped to one or two User x connectors.

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

To route and enable a trigger signal, proceed as follows:

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

Settings:

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 or external) causes a restart.
- "Armed Retrigger"

The signal is generated only when a trigger event occurs. Then the signal is generated continuously. Every subsequent trigger event causes a restart.
An "Arm" stops signal generation. A subsequent trigger event (internal or external) causes a restart.

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

Remote command:
`[:SOURce<hw>]:BB:HUWB[:TRIGger]:SEQuence` on page 89

Time Based Trigger
Requires trigger "Mode" > "Armed Auto"/"Single".

Activates time-based triggering with a fixed time reference.

The R&S SMBV100B triggers signal generation when its operating system time ("Current Time") matches a specified time trigger ("Trigger Time"). As trigger source, you can use an internal trigger or an external global trigger.

How to: Chapter "Time-based triggering" in the R&S SMBV100B user manual.

Remote command:
`[:SOURce<hw>]:BB:HUWB:TRIGger:TIME[:STATe]` on page 84

Trigger Time
Requires trigger "Mode" > "Armed Auto"/"Single".

Sets date and time for a time-based trigger signal.

Set a trigger time that is later than the "Current Time". The current time is the operating system time of the R&S SMBV100B. If you set an earlier trigger time than the current time, time-based triggering is not possible.

How to: Chapter "Time-based triggering" in the R&S SMBV100B user manual.

Remote command:
`[:SOURce<hw>]:BB:HUWB:TRIGger:TIME:DATE` on page 84
`[:SOURce<hw>]:BB:HUWB:TRIGger:TIME:TIME` on page 85

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:HUWB:TRIGger:SLUNit` on page 88

Signal Duration
Requires trigger "Mode" > "Single".

Enters the length of the trigger signal sequence.

Use this parameter, for example, for the following applications:

- To output the trigger signal partly.
- To output a predefined sequence of the trigger signal.

Remote command:
[:SOURce<hw>]:BB:HUWB:TRIGger:SLENgth on page 87

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

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

Remote command:
[:SOURce<hw>]:BB:HUWB:TRIGger:RMODe? on page 87

Arm
Stops the signal generation until subsequent trigger event occurs.

Remote command:
[:SOURce<hw>]:BB:HUWB:TRIGger:ARM:EXECute on page 84

Execute Trigger
For internal trigger source, executes trigger manually.

Remote command:
[:SOURce<hw>]:BB:HUWB:TRIGger:EXECute on page 85

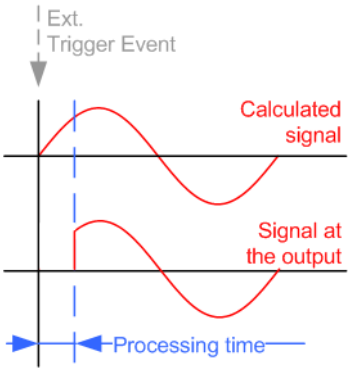
Trigger Source
The following sources of the trigger signal are available:

- "Internal"
  The trigger event is executed manually by the "Execute Trigger".
- "External Global Trigger"
  The trigger event is the active edge of an external trigger signal provided and configured at the User x connectors.
- "Baseband Sync In"
  In primary-secondary instrument mode, secondary instruments are triggered by the active edge of the synchronization signal.

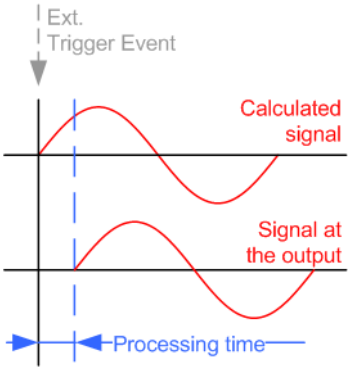
Remote command:
[:SOURce<hw>]:BB:HUWB:TRIGger:SOURce on page 88

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

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



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



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

Remote command:
`[:SOURce<hw>]:BB:HUWB:TRIGger[:EXTernal]:SYNC:OUTPut` on page 89

External / Trigger Inhibit
Applies for external trigger signal.

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

For more information, see chapter "Basics" in the R&S SMBV100B user manual.

Remote command:
`[:SOURce<hw>]:BB:HUWB:TRIGger[:EXTernal]:INHibit` on page 89

(External) Delay Unit
Determine whether the trigger delay is expressed in samples or directly defined as a time period (seconds).

To specify the delay, use the parameter "(External) Trigger Delay/Specified Trigger Delay".

The parameter Actual Trigger Delay/Actual External Delay displays the delay converted in time.

Remote command:
[:SOURce<hw>]:BB:HUWB:TRIGger:DELay:UNIT on page 84

(Specified) External Delay/(Specified) Trigger Delay
The name of the parameter and the units the delay is expressed in, changes depending on the parameter "External Delay Unit".

Delays the trigger event of the signal from:
- The external trigger source

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

For more information, see chapter "Basics on ..." in the R&S SMBV100B user manual.

The parameter "Actual Trigger Delay" displays the delay converted in time.

Remote command:
[:SOURce<hw>]:BB:HUWB:TRIGger[:EXTernal]:DELay on page 88
[:SOURce<hw>]:BB:HUWB:TRIGger:EXTernal:TDELay on page 86

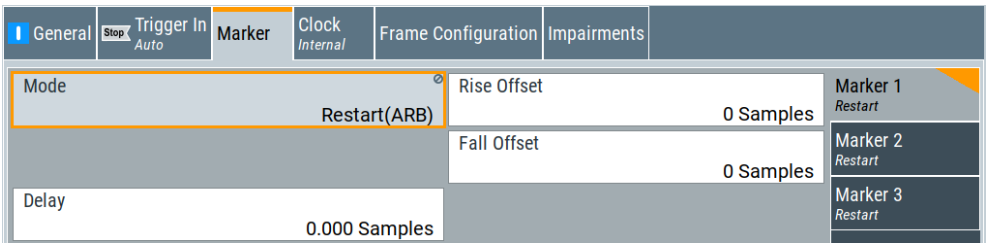
Actual Trigger Delay/Actual External Delay
Displays the time (in seconds) an external trigger event or a trigger event form the other path is delayed with.

Remote command:
[:SOURce<hw>]:BB:HUWB:TRIGger:EXTernal:RDELay? on page 86

4.3 Marker settings

Access:

► Select "Baseband > HRP UWB > Marker".



The dialog provides settings to select and configure the marker output signal, like marker mode and the marker delay.

This section focuses on the available settings.

For information on how these settings affect the signal, refer to section "Basics on ..." in the R&S SMBV100B user manual.

Routing and enabling a marker

The provided marker signals are not dedicated to a particular connector. They can be mapped to one or more User x connectors.

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

- Define the shape of the generated marker, i.e. select the "Marker > Mode".
- Define the connector where the selected signal is provided.
  Use the Global connectors settings.

Settings:

Marker Mode

Marker configuration for up to 3 markers. The settings are used to select the marker mode defining the shape and periodicity of the markers. The contents of the dialog change with the selected marker mode.

"Restart(ARB)" A marker signal is generated at the start of each ARB sequence.

Remote command:

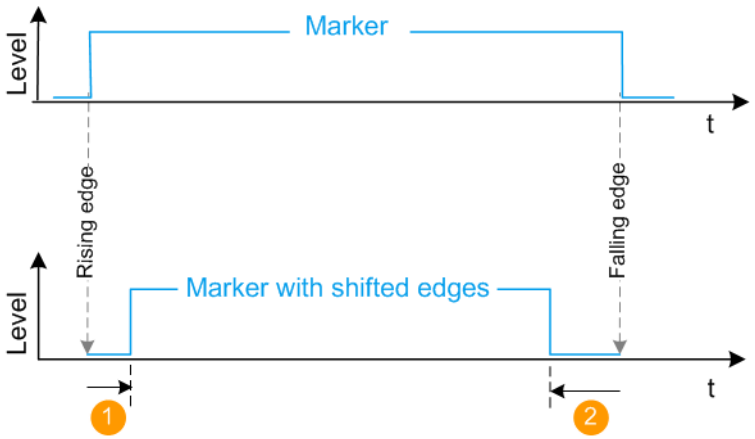
`[:SOURce<hw>]:BB:HUWB:TRIGger:OUTPut<ch>:MODE` on page 90

Rise/Fall Offset

Requires "Marker Mode > Restart(ARB)".

Sets the value for the rise/fall offset.

The ramps of the marker signal are shifted by the specified number of samples. Positive values delay the rising ramp; negative values - shift it back.



1 = Positive rise offset
2 = Positive fall offset

Remote command:
[:SOURce<hw>]:BB:HUWB:TRIGger:OUTPut<ch>:ROFFset on page 91
[:SOURce<hw>]:BB:HUWB:TRIGger:OUTPut<ch>:FOFFset on page 91

Marker x Delay
Delays the marker signal at the marker output relative to the signal generation start.

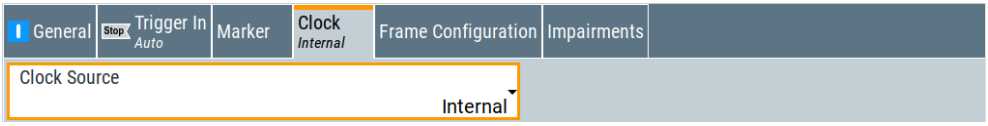
Variation of the parameter "Marker x" > "Delay" causes signal recalculation.

Remote command:
[:SOURce<hw>]:BB:HUWB:TRIGger:OUTPut<ch>:DELay on page 90

4.4 Clock settings

Access:

► Select "Baseband > HRP UWB > Clock".



The tab provides settings necessary to select and configure the clock signal, like the clock source and clock mode.

This section focuses on the available settings.

For information on how these settings affect the signal, refer to section "Basics on ..." in the R&S SMBV100B user manual.

Defining the clock

The provided clock signals are not dedicated to a particular connector. They can be mapped to one or more User x connectors.

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

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

- Define the signal source, that is select the "Clock > Source".
- Define the connector where the selected signal is provided.
  Use the Global connectors settings.

Settings:

Clock Source
Selects the clock source.

- "Internal"
  The instrument uses its internal clock reference.

Remote command:
`[:SOURce<hw>]:BB:HUWB:CLOCk:SOURce` on page 91

Clock Mode
Sets the type of externally supplied clock.

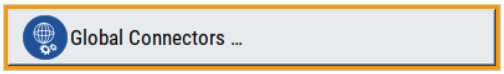
Remote command:
`[:SOURce<hw>]:BB:HUWB:CLOCk:MODE` on page 91

4.5 Global connectors settings

Accesses a dialog to configure global connectors.

The button is available in the following dialogs or tabs:

- "Trigger / Marker / Clock" dialog that is accessible via the "TMC" block in the block diagram.
- "Trigger In", "Marker" and "Clock" tabs that are accessible via the "Baseband" block in the block diagram.



See also chapter "Global connectors settings" in the user manual.

5 Remote control commands

The following commands are required to generate signals with the HRP UWB option in a remote environment. We assume that the R&S SMBV100B has already been set up for remote operation in a network as described in the R&S SMBV100B documentation. A knowledge about the remote control operation and the SCPI command syntax is assumed.

Conventions used in SCPI command descriptions

For a description of the conventions used in the remote command descriptions, see section "Remote-Control Commands" in the R&S SMBV100B user manual.

Common suffixes

The following common suffixes are used in the remote commands:

Suffix	Value range	Description
SOURce<hw>	1	Available baseband signals
OUTPut<ch>	1 to 3	Available markers

Programming examples

This description provides simple programming examples. The purpose of the examples is to present **all** commands for a given task. In real applications, one would rather reduce the examples to an appropriate subset of commands.

The programming examples have been tested with a software tool which provides an environment for the development and execution of remote tests. To keep the example as simple as possible, only the "clean" SCPI syntax elements are reported. Non-executable command lines (e.g. comments) start with two // characters.

At the beginning of the most remote control program, an instrument preset/reset is recommended to set the instrument to a definite state. The commands `*RST` and `SYSTem:PRESet` are equivalent for this purpose. `*CLS` also resets the status registers and clears the output buffer.

The following commands specific to the HRP UWB are described here:

5.1 General commands

Example: To save the current configuration

```
SOURce1:BB:HUWB:SETTing:STORe "/var/user/my_settings"
*RST
SOURce1:BB:HUWB:SETTing:CATalog?
// Response: my_HUWB, HUWB
SOURce1:BB:HUWB:SETTing:LOAD "/var/user/HUWB"
SOURce1:BB:HUWB:STATe 1
SOURce1:BB:HUWB:SETTing:DEL "my_HUWB"
SOURce1:BB:HUWB:WAVeform:CREate "/var/user/my_HUWB_wv"
```

Example: To generate an HRP UWB signal

```
SOURce1:BB:HUWB:PRESet

SOURce1:BB:HUWB:STD HPRF
SOURce1:BB:HUWB:CNUMber 3
SOURce1:BB:HUWB:BWIDth?
// Response in MHz: 499.2
SOURce1:BB:HUWB:IINTerval 50
SOURce1:BB:HUWB:SLENgth 1
SOURce1:BB:HUWB:OSAMpling 4
SOURce1:BB:HUWB:SRATe:VARiation 500000
SOURce1:BB:HUWB:STATe 1
SOURce1:FREQuency:CW 4492800000
SOURce1:POWer:POWer -30
OUTPut1:STATe 1
```

Example: To generate a waveform

```
SOURce1:BB:HUWB:PRESet

SOURce1:BB:HUWB:STD HPRF
SOURce1:BB:HUWB:CNUMber 3
SOURce1:BB:HUWB:BWIDth?
// Response in MHz: 499.2
// To generate a waveform with fixed frame length of 2 ms.
SOURce:BB:HUWB:F2MS 1
// Sets the frame length to 2 ms
// Idle interval = 0µs is the default value if frame length 2 ms is activated
SOURce1:BB:HUWB:IINTerval?
// Response is 0
SOURce1:BB:HUWB:SLENgth 1
SOURce1:BB:HUWB:FILTer:OSAMpling OS_4
SOURce1:BB:HUWB:SRATe:VARiation 500000
SOURce1:BB:HUWB:STATe 1
SOURce1:FREQuency:CW 4492800000
```

```
SOURce1:POWer:POWer -30
OUTPut1:STATe 1
```


[:SOURce<hw>]:BB:HUWB: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:HUWB:STATe`.

Example: See Example"To generate an HRP UWB signal" on page 48.

Usage: Event

Manual operation: See "Set to Default" on page 14

[:SOURce<hw>]:BB:HUWB:STATe <HrpUwbState>

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

Parameters:

<HrpUwbState> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"To generate an HRP UWB signal" on page 48.

Manual operation: See "State" on page 14

[:SOURce<hw>]:BB:HUWB:SETTing:CATalog

Queries the files with settings in the default directory. Listed are files with the file extension *.hrpuwb.

Example: See Example"To save the current configuration" on page 48.

Manual operation: See "Save/Recall" on page 14

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

Deletes the selected file from the default or the specified directory. Deleted are files with extension `*.hrpuwb`.

Parameters:
<Filename> string

Example: See Example"To save the current configuration" on page 48.

Manual operation: See "Save/Recall" on page 14

[:SOURce<hw>]:BB:HUWB:SETTing:LOAD <Filename>

Loads the selected file from the default or the specified directory. Loaded are files with extension `*.hrpuwb`.

Parameters:
<Filename> string

Example: See Example"To save the current configuration" on page 48.

Manual operation: See "Save/Recall" on page 14

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

Saves the current settings into the selected file; the file extension (`*.hrpuwb`) is assigned automatically.

Parameters:
<Filename> string

Example: See Example"To save the current configuration" on page 48.

Manual operation: See "Save/Recall" on page 14

[:SOURce<hw>]:BB:HUWB:SLENgth <SLength>

Sets the sequence length of the signal in number of frames. The signal is calculated in advance and output in the arbitrary waveform generator. The maximum number of frames is calculated as follows:

Max. No. of Frames = Arbitrary waveform memory size/(sampling rate x 10 ms).

Parameters:
<SLength> integer

Range: 1 to 1024
*RST: 1

Example: `SOURce1:BB:HUWB:SLENgth 4`
Selects the generation of 4 frames.

Manual operation: See "Sequence Length" on page 38

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

Saves the current settings as an ARB signal in a waveform file (`*.wv`).

Parameters:
<Filename> string

Example: See Example"To save the current configuration" on page 48.

Manual operation: See "Generate Waveform File" on page 15

[:SOURce<hw>]:BB:HUWB:BWIDth?

Queries the channel bandwidth.

Example: See Example"To generate an HRP UWB signal" on page 48.

Usage: Query only

Manual operation: See "Bandwidth" on page 15

[:SOURce<hw>]:BB:HUWB:CNUMber <ChannelNumber>

Sets the channel number.

Parameters:
<ChannelNumber> integer

Range: 0 to 15
*RST: 0

Example: See Example"To configure non-HRP UWB frames" on page 52.

Example: See Example"To configure HRP UWB 802.15.4z-BPRF frames" on page 53.

Example: See Example"To configure HRP UWB 802.15.4z-HPRF frames" on page 54.

Manual operation: See "Channel Number" on page 15

[:SOURce<hw>]:BB:HUWB:F2MS <Fixed2msFrame>

Sets the frame length of a generated waveform shorter than 2 ms to a fixed value of 2 ms.

If activated, the idle interval is set to 0.0 µs by default.

Parameters:
<Fixed2msFrame> 1 | ON | 0 | OFF

*RST: 0

Example: Example"To generate a waveform" on page 48

Manual operation: See "Fixed 2 ms Frame Length" on page 16

[:SOURce<hw>]:BB:HUWB:IINTerval <IInterval>

Sets the time of the interval separating two frames.

Parameters:

<IInterval> float

Range: 0 to 1000000
Increment: 0.1
*RST: 50
Default unit: µs

Example: See Example"To generate an HRP UWB signal" on page 48.

Manual operation: See "Idle Interval" on page 16

[:SOURce<hw>]:BB:HUWB:STD <Mode>

Sets the HRP UWB mode.

Parameters:

<Mode> NONHRP | HPRF | BPRF

NONHRP
Enables HRP non-ERDEV mode.

BPRF
Enables HRP-ERDEV base pulse repetition frequency (BPRF) mode.

HPRF
Enables HRP-ERDEV higher pulse repetition frequency (HPRF) mode.

*RST: NONHRP

Example: See Example"To generate an HRP UWB signal" on page 48.

Manual operation: See "Mode" on page 15

5.2 Frame configuration commands

Example: To configure non-HRP UWB frames

```
SOURce1:BB:HUWB:PRESet
SOURce1:BB:HUWB:STD NONHRP
SOURce1:BB:HUWB:CNUMber 4
SOURce1:BB:HUWB:BWIDth?
// Response in MHz: 1331.2
SOURce1:BB:HUWB:FCONfig:CINDex CI_7

// Configure SYNC parameters.
SOURce1:BB:HUWB:FCONfig:SYNLength SL_16
SOURce1:BB:HUWB:FCONfig:DLENgth DL_16
```

```
SOURce1:BB:HUWB:FCONfig:SFDLength?
// Response: SFDL_8

// Configure physical data and physical header parameters.
SOURce1:BB:HUWB:FCONfig:DATA PN9
SOURce1:BB:HUWB:FCONfig:HOPBurst HB_8
SOURce1:BB:HUWB:FCONfig:CPBurst CPB_2
SOURce1:BB:HUWB:FCONfig:VRATe?
// Response: 0.5
SOURce1:BB:HUWB:FCONfig:CPBurst CPB_1
SOURce1:BB:HUWB:FCONfig:VRATe?
// Response: 1.0
SOURce1:BB:HUWB:FCONfig:MCS:STATe 1
SOURce1:BB:HUWB:FCONfig:MFL MFL_2
// Sets a MAC FCS length of two octets.
SOURce1:BB:HUWB:FCONfig:MPRF?
// Response in MHz: 15.6
SOURce1:BB:HUWB:FCONfig:DR?
// Response in Mb/s: 27.24
SOURce1:BB:HUWB:FCONfig:PHRBrate?
// Response in Mb/s: 0.85
SOURce1:BB:HUWB:FCONfig:DLENgth 127
```

Example: To configure HRP UWB 802.15.4z-BPRF frames

```
SOURce1:BB:HUWB:PRESet
SOURce1:BB:HUWB:STD BPRF
SOURce1:BB:HUWB:CNUMber 3
SOURce1:BB:HUWB:BWIDth?
// Response in MHz: 499.2
SOURce1:BB:HUWB:FCONfig:CINDex CI_7

// Configure SYNC parameters.
SOURce1:BB:HUWB:FCONfig:SYNLength SL_64
SOURce1:BB:HUWB:FCONfig:DLENgth DL_4
SOURce1:BB:HUWB:SFD SFD_2
SOURce1:BB:HUWB:FCONfig:SFDLength?
// Response: SFDL_8

// Configure physical data and physical header parameters.
SOURce1:BB:HUWB:FCONfig:DATA PN9
SOURce1:BB:HUWB:FCONfig:HOPBurst HB_2
SOURce1:BB:HUWB:FCONfig:CPBurst CPB_8
SOURce1:BB:HUWB:FCONfig:VRATe?
// Response: 0.5
SOURce1:BB:HUWB:FCONfig:MCS:STATe 1
SOURce1:BB:HUWB:FCONfig:MFL MFL_2
// Sets a MAC FCS length of two octets.
SOURce1:BB:HUWB:FCONfig:MPRF?
// Response in MHz: 62.4
SOURce1:BB:HUWB:FCONfig:DR?
// Response in Mb/s: 6.81
```

```
SOURce1:BB:HUWB:FCONfig:PHRBrate?
// Response in Mb/s: 7.8
SOURce1:BB:HUWB:FCONfig:DLENgth 1

// Configure scrambled timestamp sequence (STS) parameters.
SOURce1:BB:HUWB:STS:PC SPC_3
SOURce1:BB:HUWB:STS:UPARt #H362EEB34C44FA8FBD37EC3CA,96
SOURce1:BB:HUWB:STS:CPARt #H1F9A3DE4,32
SOURce1:BB:HUWB:STS:KEY #H14148674D1D336AAF86050A814EB220F,128
SOURce1:BB:HUWB:STS:DLEN
// Response: DL_8
SOURce1:BB:HUWB:ASL ASL_64
SOURce1:BB:HUWB:ASN ASN_1
```

Example: To configure HRP UWB 802.15.4z-HPRF frames

```
SOURce1:BB:HUWB:PRESet
SOURce1:BB:HUWB:STD HPRF
SOURce1:BB:HUWB:CNUMber 7
SOURce1:BB:HUWB:BWIDth?
// Response in MHz: 1081.6
SOURce1:BB:HUWB:FCONfig:CINDex CI_8

// Configure SYNC parameters.
SOURce1:BB:HUWB:FCONfig:SYNLength SL_16
SOURce1:BB:HUWB:FCONfig:DLENgth DL_16
SOURce1:BB:HUWB:SFD SFD_4
SOURce1:BB:HUWB:FCONfig:SFDLength?
// Response: SFDL_32

// Configure physical data and physical header parameters.
SOURce1:BB:HUWB:FCONfig:DATA PN9
SOURce1:BB:HUWB:FCONfig:VRATe?
// Response: 0.5
SOURce1:BB:HUWB:CCCL CL7
SOURce1:BB:HUWB:FCONfig:MCS:STATe 1
SOURce1:BB:HUWB:FCONfig:MFL MFL_2
// Sets a MAC FCS length of two octets.
SOURce1:BB:HUWB:FCONfig:MPRF?
// Response in MHz: 15.6
SOURce1:BB:HUWB:FCONfig:DR?
// Response in Mb/s: 31.2
SOURce1:BB:HUWB:FCONfig:PHRBrate?
// Response in Mb/s: 31.2
SOURce1:BB:HUWB:FCONfig:DALength 20

// Configure scrambled timestamp sequence (STS) parameters.
SOURce1:BB:HUWB:STS:PC SPC_3
SOURce1:BB:HUWB:STS:UPARt #H362EEB34C44FA8FBD37EC3CA,96
SOURce1:BB:HUWB:STS:CPARt #H1F9A3DE4,32
SOURce1:BB:HUWB:STS:KEY #H14148674D1D336AAF86050A814EB220F,128
SOURce1:BB:HUWB:STS:DLEN
```

```
// Response: DL_4
SOURce1:BB:HUWB:ASL ASL_256
SOURce1:BB:HUWB:ASN ASN_4

SOURce1:BB:HUWB:FCONfig:DALength?
// Response: 1023
// The data length is 1023 octets.
SOURce1:BB:HUWB:STS:PC SPC_2
SOURce1:BB:HUWB:FCONfig:ADDGap?
// Response: 0
// Set an additional gap of one octet.
SOURce1:BB:HUWB:FCONfig:ADDGap 1
// The maximum data length decreases to 1023 octets.
SOURce1:BB:HUWB:FCONfig:DALEngth?
// Response: 1022
```

Example: To modify and monitor frame lengths

```
SOURce1:BB:HUWB:STD NONHRP
SOURce1:BB:HUWB:FCONfig:DALength?
// Response in octets: "20"
SOURce1:BB:HUWB:FCONfig:FLENgth?
// Response in octets: "20"
// The frame length equals the data length of the physical header.

// Activate MAC frame check sequence field and set a length of four octets.
SOURce1:BB:HUWB:FCONfig:MCS:STATe 1
SOURce1:BB:HUWB:FCONfig:MFL MFL_4
SOURce1:BB:HUWB:FCONfig:FLENgth?
// Response in octets: "24"
Activate MAC header and use the default length of 11 octets.
SOURce1:BB:HUWB:MACHeader:STATe 1
SOURce1:BB:HUWB:FCONfig:FLENgth?
// Response in octets: "35"

// You can further increase the frame length in mode 802.15.4z-HPRF.
SOURce1:BB:HUWB:STD HPRF
// Set the maximum data length to 1023 octets.
SOURce1:BB:HUWB:FCONfig:MDL MDL_1023
SOURce1:BB:HUWB:FCONfig:DALength 1023
SOURce1:BB:HUWB:FCONfig:FLENgth?
// Response in octets: "1038"
// Comprising 1023 octets data length, four octets FCS length and
// 11 octets MAC header length.
```

[:SOURce<hw>]:BB:HUWB:ASL <ActSegLength>

Sets the active segment length.

Parameters:

<ActSegLength> ASL_16 | ASL_32 | ASL_64 | ASL_128 | ASL_256 | ASL_512 | ASL_1024 | ASL_2048

*RST: ASL_32

Example: See Example"To configure HRP UWB 802.15.4z-BPRF frames" on page 53.

Example: See Example"To configure HRP UWB 802.15.4z-HPRF frames" on page 54.

Manual operation: See "Active Segment Length" on page 30

[:SOURce<hw>]:BB:HUWB:ASN <AcgSegNumber>

Sets the number of active segments.

Parameters:

<AcgSegNumber> ASN_1 | ASN_2 | ASN_3 | ASN_4

*RST: ASN_1

Example: See Example"To configure HRP UWB 802.15.4z-BPRF frames" on page 53.

Example: See Example"To configure HRP UWB 802.15.4z-HPRF frames" on page 54.

Manual operation: See "Number of Active Segments" on page 30

[:SOURce<hw>]:BB:HUWB:CCCL <CCCL>

Sets the constraint length of the convolutional code.

Parameters:

<CCCL> CL3 | CL7

*RST: CL3

Example: See Example"To configure HRP UWB 802.15.4z-HPRF frames" on page 54.

Manual operation: See "Convolutional Code Constraint Length" on page 22

[:SOURce<hw>]:BB:HUWB:FCONfig:ADDGap <AdditionalGap>

Sets additional gap between payload and STS.

Parameters:

<AdditionalGap> integer

Range: 0 to 127
*RST: 0

Example: See Example"To configure non-HRP UWB frames" on page 52.

Manual operation: See "Additional Gap between Payload and STS" on page 31

[:SOURce<hw>]:BB:HUWB:FCONfig:CINDex <CodeIndex>

Sets the code index.

Parameters:

<CodeIndex> CI_1 | CI_2 | CI_3 | CI_4 | CI_5 | CI_6 | CI_7 | CI_8 | CI_9 | CI_10 | CI_11 | CI_12 | CI_13 | CI_14 | CI_15 | CI_16 | CI_17 | CI_18 | CI_19 | CI_20 | CI_21 | CI_22 | CI_23 | CI_24 | CI_25 | CI_26 | CI_27 | CI_28 | CI_29 | CI_30 | CI_31 | CI_32

*RST: CI_1

Example: See Example"To configure non-HRP UWB frames" on page 52.

Example: See Example"To configure HRP UWB 802.15.4z-BPRF frames" on page 53.

Example: See Example"To configure HRP UWB 802.15.4z-HPRF frames" on page 54.

Manual operation: See "Code Index" on page 17

[:SOURce<hw>]:BB:HUWB:FCONfig:CPBurst <ChipsPerBurst>

Sets the chips per burst.

Parameters:

<ChipsPerBurst> CPB_1 | CPB_2 | CPB_4 | CPB_16 | CPB_8 | CPB_32 | CPB_64 | CPB_128 | CPB_512

*RST: CPB_8

Example: See Example"To configure non-HRP UWB frames" on page 52.

Example: See Example"To configure HRP UWB 802.15.4z-BPRF frames" on page 53.

Manual operation: See "Chips Per Burst" on page 22

[:SOURce<hw>]:BB:HUWB:FCONfig:DATA <DataSource>

Sets the data source for the payload data in a frame.

Parameters:

<DataSource> PN9 | PN11 | PN15 | PN20 | PN16 | PN21 | PN23 | ONE | ZERO | DLISt | PATT

PNxx
The pseudo-random sequence generator is used as the data source. There is a choice of different lengths of random sequence.

DLISt
A data list is used. The data list is selected with the aid of command `SOURce1:BB:HUWB:DATA DLISt`.

ALL0 | ALL1
Internal 0 or 1 data is used.

PATT
Internal data is used. The bit pattern for the data is defined with the aid of command `SOURce1:BB:HUWB:DATA:PATTern`.

*RST: PN9

Example: See Example"To configure non-HRP UWB frames" on page 52.

Example: See Example"To configure HRP UWB 802.15.4z-BPRF frames" on page 53.

Example: See Example"To configure HRP UWB 802.15.4z-HPRF frames" on page 54.

Manual operation: See "Data Source" on page 21

[:SOURce<hw>]:BB:HUWB:FCONfig:DATA:DSELection <DSelection>

Selects an existing data list file from the default directory or from the specific directory.

The data list is only used, if the `DLIS` is selected.

Parameters:
<DSelection> string

Example: Load a data list saved in a file from the default directory.
```
SOURce1:BB:HUWB:FCONfig:DATA DLIS
SOURce1:BB:HUWB:FCONfig:DATA:DSELect
"/var/user/myUWB"
```

Manual operation: See "Data Source" on page 21

[:SOURce<hw>]:BB:HUWB:FCONfig:DATA:PATTern <DPattern>, <BitCount>

Sets the data pattern, if pattern is selected as the data source.

See `[:SOURce<hw>]:BB:HUWB:FCONfig:DATA` on page 58.

Parameters:
<DPattern> numeric
*RST: #H0

<BitCount> integer
Range: 1 to 64
*RST: 1

Example:
```
SOURce1:BB:HUWB:FCONfig:DATA PATT
SOURce1:BB:HUWB:FCONfig:DATA:PATTern #H0,1
```

Manual operation: See "Data Source" on page 21

[:SOURce<hw>]:BB:HUWB:FCONfig:DR?

Queries the data rate.

Example: See Example"To configure non-HRP UWB frames" on page 52.

Example: See Example"To configure HRP UWB 802.15.4z-BPRF frames" on page 53.

Example: See Example"To configure HRP UWB 802.15.4z-HPRF frames" on page 54.

Usage: Query only

Manual operation: See "Data Rate" on page 23

[:SOURce<hw>]:BB:HUWB:FCONfig:DALEngth <DLength>

Sets the data length of the physical header data in octets.

Parameters:
<DLength> integer
Range: 1 to 4096
*RST: 20

Example: See Example"To configure non-HRP UWB frames" on page 52.

Example: See Example"To configure HRP UWB 802.15.4z-BPRF frames" on page 53.

Example: See Example"To configure HRP UWB 802.15.4z-HPRF frames" on page 54.

Manual operation: See "Data Length" on page 23

[:SOURce<hw>]:BB:HUWB:FCONfig:DLENgth <DeltaLength>

Sets the delta length.

Parameters:

<DeltaLength> DL_4 | DL_16 | DL_64

*RST: DL_16

Example: See Example"To configure non-HRP UWB frames" on page 52.

Example: See Example"To configure HRP UWB 802.15.4z-BPRF frames" on page 53.

Example: See Example"To configure HRP UWB 802.15.4z-HPRF frames" on page 54.

Manual operation: See "Delta Length" on page 18

[:SOURce<hw>]:BB:HUWB:FCONfig:FLENgth?

Queries the frame length.

The frame length is the sum of the MAC header length, the MAC frame check sequence (FCS) field length and the data length of the physical header.

Return values:

<FrameLength> integer

Example: See Example"To modify and monitor frame lengths" on page 55.

Usage: Query only

[:SOURce<hw>]:BB:HUWB:FCONfig:HOPBurst <HopBurst>

Sets the number of hop bursts.

Parameters:

<HopBurst> HB_2 | HB_8 | HB_32

*RST: HB_2

Example: See Example"To configure non-HRP UWB frames" on page 52.

Example: See Example"To configure HRP UWB 802.15.4z-BPRF frames" on page 53.

Manual operation: See "Hop Bursts" on page 22

[:SOURce<hw>]:BB:HUWB:FCONfig:MCS:STATe <McsState>

Activates MAC frame check sequence field.

Parameters:

<McsState> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"To configure non-HRP UWB frames" on page 52.

Example: See Example"To configure HRP UWB 802.15.4z-BPRF frames" on page 53.

Example: See Example"To configure HRP UWB 802.15.4z-HPRF frames" on page 54.

Manual operation: See "MAC FCS" on page 22

[:SOURce<hw>]:BB:HUWB:FCONfig:MDL <MaxDataLen>

Sets the maximum data length for HPRF mode.

Parameters:

<MaxDataLen> MDL_1023 | MDL_2047 | MDL_4095

MDL_1023
1023 octets

MDL_2047
2047 octets

MDL_4095
4095 octets

*RST: MDL_1023

Example: See Example"To modify and monitor frame lengths" on page 55.

Manual operation: See "Maximum Data Length" on page 24

[:SOURce<hw>]:BB:HUWB:FCONfig:MFL <MacFCSLen>

Sets the length of the frame check sequence field.

Parameters:

<MacFCSLen> MFL_2 | MFL_4

MFL_2
Two octets

MFL_4
Four octets

*RST: MFL_2

Example: See Example"To modify and monitor frame lengths" on page 55.

Manual operation: See "MAC FCS Length" on page 22

[:SOURce<hw>]:BB:HUWB:FCONfig:MPRF?

Queries the mean pulse repetition frequency (PRF).

Return values:
<MeanPRF> float

Example: See Example"To configure non-HRP UWB frames" on page 52.

Example: See Example"To configure HRP UWB 802.15.4z-BPRF frames" on page 53.

Example: See Example"To configure HRP UWB 802.15.4z-HPRF frames" on page 54.

Usage: Query only

Manual operation: See "Mean PRF" on page 23

[:SOURce<hw>]:BB:HUWB:FCONfig:PHRBrate?

Queries the physical header bit rate.

Example: See Example"To configure non-HRP UWB frames" on page 52.

Example: See Example"To configure HRP UWB 802.15.4z-BPRF frames" on page 53.

Example: See Example"To configure HRP UWB 802.15.4z-HPRF frames" on page 54.

Usage: Query only

Manual operation: See "PHR Bit Rate" on page 23

[:SOURce<hw>]:BB:HUWB:FCONfig:SFDLength <SFDLength>

Queries the symbol length of the start-of-frame delimiter (SFD).

The SFD length depends on the set SFD symbol sequence, see Table 5-1.

Parameters:
<SFDLength> SFDL_4 | SFDL_8 | SFDL_16 | SFDL_32 | SFDL_64
*RST: SFDL_8

Example: See Example"To configure non-HRP UWB frames" on page 52.

Example: See Example"To configure HRP UWB 802.15.4z-BPRF frames" on page 53.

Example: See Example"To configure HRP UWB 802.15.4z-HPRF frames" on page 54.

Manual operation: See "SFD Length" on page 19

[:SOURce<hw>]:BB:HUWB:FCONfig:SYNLength <SyncLength>

Sets the sync length.

Parameters:

<SyncLength> SL_16 | SL_24 | SL_32 | SL_48 | SL_64 | SL_96 | SL_128 | SL_256 | SL_1024 | SL_4096

*RST: SL_64

Example: See Example"To configure non-HRP UWB frames" on page 52.

Example: See Example"To configure HRP UWB 802.15.4z-BPRF frames" on page 53.

Example: See Example"To configure HRP UWB 802.15.4z-HPRF frames" on page 54.

Manual operation: See "Sync Length" on page 18

[:SOURce<hw>]:BB:HUWB:FCONfig:VRATe?

Queries the viterbi rate for convolutional coding.

Example: See Example"To configure non-HRP UWB frames" on page 52.

Example: See Example"To configure HRP UWB 802.15.4z-BPRF frames" on page 53.

Example: See Example"To configure HRP UWB 802.15.4z-HPRF frames" on page 54.

Usage: Query only

Manual operation: See "Viterbi Rate" on page 22

[:SOURce<hw>]:BB:HUWB:PHR:DRM <DataRateMode>

Sets the data rate mode of the physical header.

Parameters:

<DataRateMode> BMLP | BMHP | HMLR | HMHR

*RST: BMLP

Example: See Example"To configure HRP UWB 802.15.4z-BPRF frames" on page 53.

Example: See Example"To configure HRP UWB 802.15.4z-HPRF frames" on page 54.

Manual operation: See "PHR Data Rate Mode" on page 23

[:SOURce<hw>]:BB:HUWB:SFD <SFDIndex>

Sets the start-of-frame delimiter (SFD) symbol sequence.

The indices represent SFD symbol sequences with SFD lengths as listed in Table 5-1.

Table 5-1: SFD: indices and lengths

Index	SFD_0	SFD_1	SFD_2	SFD_3	SFD_4	SFD_5	SFD_6	SFD_7	SFD_8
SFD	0	1	2	3	4	User1	User2	User3	Legacy
SFD length	8	4	8	16	32	8	16	64	8

Using indices SFD_5, SFD_6 and SFD_7 requires
`[:SOURce<hw>]:BB:HUWB:SFD:USRState 1`.

Parameters:
<SFDIndex> SFD_0 | SFD_1 | SFD_2 | SFD_3 | SFD_4 | SFD_5 | SFD_6 | SFD_7 | SFD_8
*RST: SFD_5

Example: See Example"To configure HRP UWB 802.15.4z-BPRF frames" on page 53.

Example: See Example"To configure HRP UWB 802.15.4z-HPRF frames" on page 54.

Manual operation: See "SFD" on page 19

[:SOURce<hw>]:BB:HUWB:SFD:USRState <Userstate>

Enables using SFD indices SFD_5, SFD_6 and SFD_7.

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

[:SOURce<hw>]:BB:HUWB:STS:DLS <StsDatalist>

Activates the STS source.

If activated, you can select an STS data list from a designated folder to import a user defined STS sequence.

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

Example: Activate the STS source:
`SOURce1:BB:HUWB:STS:DLS 1`

Manual operation: See "STS Source (MSB is Transmitted First)" on page 29

[:SOURce<hw>]:BB:HUWB:STS:DATA:DSELection <StsDlist>

Selects an existing data list file from the default directory or from a specific directory. The data list is only used, if `DLS` is activated.

Parameters:
<StsDlist> string

Example: Load a data list saved in a file from the default directory.
```
SOURce1:BB:HUWB:STS:DLS 1
SOURce1:BB:HUWB:STS:DATA:DSELection
"/var/user/myUWB"
```

Manual operation: See "STS Source (MSB is Transmitted First)" on page 29

[:SOURce<hw>]:BB:HUWB:STS:CPARt <CounterPart>

Sets the counter part of the V valued. The value is a 32-bit value in hexadecimal representation.

Parameters:
<CounterPart> integer

Example: See Example"To configure HRP UWB 802.15.4z-BPRF frames" on page 53.

Example: See Example"To configure HRP UWB 802.15.4z-HPRF frames" on page 54.

Manual operation: See "VCounter(hex)" on page 30

[:SOURce<hw>]:BB:HUWB:STS:DLEN <DeltaLength>

Queries the delta length of the scrambled timestamp sequence (STS).

Parameters:
<DeltaLength> DL_4 | DL_8
*RST: DL_4

Example: See Example"To configure HRP UWB 802.15.4z-BPRF frames" on page 53.

Example: See Example"To configure HRP UWB 802.15.4z-HPRF frames" on page 54.

Manual operation: See "Delta Length" on page 30

[:SOURce<hw>]:BB:HUWB:STS:KEY <Key>

Sets the key value of the scrambled timestamp sequence (STS). The value is a 128-bit value in hexadecimal representation.

Parameters:
<Key> integer

Example: See Example"To configure HRP UWB 802.15.4z-BPRF frames" on page 53.

Example: See Example"To configure HRP UWB 802.15.4z-HPRF frames" on page 54.

Manual operation: See "Key(hex)" on page 30

[:SOURce<hw>]:BB:HUWB:STS:PC <SPC>

Sets the scrambled timestamp sequence (STS) packet configuration.

Parameters:

<SPC> SPC_0 | SPC_1 | SPC_2 | SPC_3

*RST: SPC_0

Example: See Example"To configure HRP UWB 802.15.4z-BPRF frames" on page 53.

Example: See Example"To configure HRP UWB 802.15.4z-HPRF frames" on page 54.

Manual operation: See "STS Packet Configuration" on page 17

[:SOURce<hw>]:BB:HUWB:STS:UPARt <UpperPart>

Sets the upper part of the V value. The value is a 96-bit value in hexadecimal representation.

Parameters:

<UpperPart> integer

Example: See Example"To configure HRP UWB 802.15.4z-BPRF frames" on page 53.

Example: See Example"To configure HRP UWB 802.15.4z-HPRF frames" on page 54.

Manual operation: See "VUpper96(hex)" on page 30

5.3 MAC header commands

Example: To configure MAC header information

```
SOURce1:BB:HUWB:MACHeader:STATe 0
// Configure frame control field parameters.
SOURce1:BB:HUWB:MACHeader:LFRControl L2
SOURce1:BB:HUWB:MACHeader:CTRL 34913
SOURce1:BB:HUWB:MACHeader:FTYPe 1
SOURce1:BB:HUWB:MACHeader:SEENabled 0
SOURce1:BB:HUWB:MACHeader:FPENding 0
SOURce1:BB:HUWB:MACHeader:AR 1
SOURce1:BB:HUWB:MACHeader:PIDComp 1
SOURce1:BB:HUWB:MACHeader:REServed 0
SOURce1:BB:HUWB:MACHeader:SENSupp 0
SOURce1:BB:HUWB:MACHeader:IEPResent 0
SOURce1:BB:HUWB:MACHeader:DADMode 2
SOURce1:BB:HUWB:MACHeader:FVERsion 0
SOURce1:BB:HUWB:MACHeader:SADMode 2

// Configure sequence number field parameters.
SOURce1:BB:HUWB:MACHeader:LSEQnumber L1
SOURce1:BB:HUWB:MACHeader:SEQNumber 1

// Configure destination PAN ID field parameters.
SOURce1:BB:HUWB:MACHeader:LDEPanid L2
SOURce1:BB:HUWB:MACHeader:DPANid 43981

// Configure destination address field parameters.
SOURce1:BB:HUWB:MACHeader:LDADdress L2
SOURce1:BB:HUWB:MACHeader:DADD 4660

// Configure source PAN ID field parameters.
SOURce1:BB:HUWB:MACHeader:LSOPanid L2
SOURce1:BB:HUWB:MACHeader:SPANid 44015

// Configure source address field parameters.
SOURce1:BB:HUWB:MACHeader:LSADdress L2
SOURce1:BB:HUWB:MACHeader:SADD 22136

// Activate MAC header information.
SOURce1:BB:HUWB:MACHeader:STATe 1

// Query MAC header information.
SOURce1:BB:HUWB:MACHeader:STRing?
// Response: "11 Octets: 8861-01-ABCD-1234-ABEF-5678"
```

[:SOURce<hw>]:BB:HUWB:MACHeader:AR <AR>

Sets the bit in the AR field.

Parameters:

<AR> integer

Range: 0 to 1
*RST: 0

Example: See Example"To configure MAC header information" on page 67.

Manual operation: See "AR" on page 26

[:SOURce<hw>]:BB:HUWB:MACHeader:CTRL <FrameControl>

Sets the input value of the frame control field. The value is an 8-bit or 16-bit value in hexadecimal representation.

Parameters:

<FrameControl> integer

Range: 0 to 65535
*RST: 0

Example: See Example"To configure MAC header information" on page 67.

Manual operation: See "Frame Control" on page 25

[:SOURce<hw>]:BB:HUWB:MACHeader:DAD2 <DestAddr2>
[:SOURce<hw>]:BB:HUWB:MACHeader:DAD3 <DestAddr3>
[:SOURce<hw>]:BB:HUWB:MACHeader:DAD4 <DestAddr4>
[:SOURce<hw>]:BB:HUWB:MACHeader:DADD <DestinationAddr>

DADD requires destination address length of two or eight octets.

DAD2, DAD3 and DAD4 require destination address length of eight octets. See `[:SOURce<hw>]:BB:HUWB:MACHeader:LDADdress` on page 71.

Sets the first, second, third and fourth input value of the destination address field.

Parameters:

<DestinationAddr> integer

Range: 0 to 65535
*RST: 0

Example: See Example"To configure MAC header information" on page 67.

Manual operation: See "Destination Address" on page 28

[:SOURce<hw>]:BB:HUWB:MACHeader:DADMode <DestAddrMode>

Requires frame control length of two octets. See `[:SOURce<hw>]:BB:HUWB:MACHeader:LFRControl` on page 72.

Sets bits of the destination addressing mode.

Parameters:

<DestAddrMode> integer

Range: 0 to 3
*RST: 0

Example: See Example"To configure MAC header information" on page 67.

Manual operation: See "Destination Addressing Mode" on page 27

[:SOURce<hw>]:BB:HUWB:MACHeader:DPANid <DestinationPanI>

Sets the length and the input value of the destination PAN ID field.

Parameters:
<DestinationPanI> integer
Range: 0 to 65535
*RST: 0

Manual operation: See "Destination PAN ID" on page 27

[:SOURce<hw>]:BB:HUWB:MACHeader:FPENding <FramePending>

Sets the bit in the frame pending field.

Parameters:
<FramePending> integer
Range: 0 to 1
*RST: 0

Example: See Example"To configure MAC header information" on page 67.

Manual operation: See "Frame Pending" on page 26

[:SOURce<hw>]:BB:HUWB:MACHeader:FTYPe <FrameType>

Sets the bits in the frame type field. The value is a 3-bit value.

Parameters:
<FrameType> integer
Range: 0 to 7
*RST: 0

Example: See Example"To configure MAC header information" on page 67.

Manual operation: See "Frame Type" on page 25

[:SOURce<hw>]:BB:HUWB:MACHeader:FVERsion <FrameVersion>

Requires frame control length of two octets. See `[:SOURce<hw>]:BB:HUWB:MACHeader:LFRControl` on page 72.

Sets the bits in the frame version field. The value is a 2-bit value.

Parameters:
<FrameVersion> integer
Range: 0 to 3
*RST: 0

Example: See Example"To configure MAC header information" on page 67.

Manual operation: See "Frame Version" on page 27

[:SOURce<hw>]:BB:HUWB:MACHeader:IEPResent <IePresent>

Requires frame control length of two octets. See `[:SOURce<hw>]:BB:HUWB:MACHeader:LFRControl` on page 72.

Sets the bit in the information element (IE) present field.

Parameters:

<IePresent> integer

Range: 0 to 1
*RST: 0

Example: See Example"To configure MAC header information" on page 67.

Manual operation: See "IE Present" on page 26

[:SOURce<hw>]:BB:HUWB:MACHeader:LDADdress <LenDestAddr>

Sets the length of the destination address field. You can set lengths of zero octets, two octets or eight octets.

Parameters:

<LenDestAddr> L0 | L2 | L8

L0
Sets destination address length to zero octets.

L2
Sets destination address length to two octets.

L8
Sets destination address length to eight octets.

*RST: L0

Example: See Example"To configure MAC header information" on page 67.

Manual operation: See "Destination Address" on page 28

[:SOURce<hw>]:BB:HUWB:MACHeader:LDEPanid <LenDestPanId>

Sets the length of the destination PAN ID field. You can set lengths of zero octets or two octets.

Parameters:

<LenDestPanId> L0 | L2

L0
Sets destination PAN ID length to zero octets.

L2
Sets destination PAN ID length to two octets.

*RST: 0

Example: See Example"To configure MAC header information" on page 67.

Manual operation: See "Destination PAN ID" on page 27

[:SOURce<hw>]:BB:HUWB:MACHeader:LFRControl <LenFrameControl>

Sets the length of the frame control field. You can set lengths of one octet or two octets.

Parameters:

<LenFrameControl> L1 | L2

L1
Sets frame control length to one octet.

L2
Sets frame control length to two octets.

*RST: 0

Example: See Example"To configure MAC header information" on page 67.

Manual operation: See "Frame Control" on page 25

[:SOURce<hw>]:BB:HUWB:MACHeader:LSADdress <LenSrcAddress>

Sets the length of the source address field. You can set lengths of zero octets, two octets or eight octets.

Parameters:

<LenSrcAddress> L0 | L2 | L8

L0
Sets source address length to zero octets.

L2
Sets source address length to two octets.

L8
Sets source address length to eight octets.

*RST: L0

Example: See Example"To configure MAC header information" on page 67.

Manual operation: See "Source Address" on page 28

[:SOURce<hw>]:BB:HUWB:MACHeader:LSEPanid <LenSourcePanId>

Activates or deactivates the source PAN ID information.

Parameters:

<LenSourcePanId> 0 | 1 | OFF | ON

*RST: 0

[:SOURce<hw>]:BB:HUWB:MACHeader:LSEQnumber <LenSeqNumber>

Sets the length of the sequence number field. You can set zero octets or one octet.

Parameters:

<LenSeqNumber> L0 | L1

L0
Sets the sequence number length to zero octets.

L1
Sets the sequence number length to one octet.

*RST: 0

Example: See Example"To configure MAC header information" on page 67.

Manual operation: See "Sequence Number" on page 27

[:SOURce<hw>]:BB:HUWB:MACHeader:LSOPanid <LenSourcePanId>

Sets the length of the source PAN ID field. You can set lengths of zero octets or two octets.

Parameters:

<LenSourcePanId> L0 | L2

L0
Sets source PAN ID length to zero octets.

L2
Sets source PAN ID length to two octets.

*RST: 0

Example: See Example"To configure MAC header information" on page 67.

Manual operation: See "Source PAN ID" on page 28

[:SOURce<hw>]:BB:HUWB:MACHeader:PIDComp <PanIdCompress>

Sets the bit in the PAN ID compression field.

Parameters:

<PanIdCompress> integer

Range: 0 to 1
*RST: 0

Example: See Example"To configure MAC header information" on page 67.

Manual operation: See "PAN ID Compression" on page 26

[:SOURce<hw>]:BB:HUWB:MACHeader:REServed <Reserved>

Sets a reserved bit for future use.

Parameters:

<Reserved> integer

Range: 0 to 1
*RST: 0

Example: See Example"To configure MAC header information" on page 67.

Manual operation: See "Reserved" on page 26

[:SOURce<hw>]:BB:HUWB:MACHeader:SAD2 <SourceAddress2>
[:SOURce<hw>]:BB:HUWB:MACHeader:SAD3 <SourceAddress3>
[:SOURce<hw>]:BB:HUWB:MACHeader:SAD4 <SourceAddress4>
[:SOURce<hw>]:BB:HUWB:MACHeader:SADD <SourceAddress>

SADD requires source address length of two or eight octets.

SAD2, SAD3 and SAD4 require source address lengths of eight octets.

See `[:SOURce<hw>]:BB:HUWB:MACHeader:LSADdress` on page 72.

Sets the first, second, third and fourth input value of the source address field.

Parameters:

<SourceAddress> integer

Range: 0 to 65535
*RST: 0

Example: See Example"To configure MAC header information" on page 67.

Manual operation: See "Source Address" on page 28

[:SOURce<hw>]:BB:HUWB:MACHeader:SADMode <SrcAddrMode>

Requires frame control length of two octets. See `[:SOURce<hw>]:BB:HUWB:MACHeader:LFRControl` on page 72.

Sets the bits in the source addressing mode field. The value is a 2-bit value.

Parameters:

<SrcAddrMode> integer

Range: 0 to 3
*RST: 0

Example: See Example"To configure MAC header information" on page 67.

Manual operation: See "Source Addressing Mode" on page 27

[:SOURce<hw>]:BB:HUWB:MACHeader:SEENabled <SecurityEnabled>

Sets the bit in the security enabled field.

Parameters:

<SecurityEnabled> integer

Range: 0 to 1
*RST: 0

Example: See Example"To configure MAC header information" on page 67.

Manual operation: See "Security Enabled" on page 26

[:SOURce<hw>]:BB:HUWB:MACHeader:SENSupp <SeqNumbSuppr>

Requires frame control length of two octets. See `[:SOURce<hw>]:BB:HUWB:MACHeader:LFRControl` on page 72.

Sets the bit in the sequence number suppression field.

Parameters:

<SeqNumbSuppr> integer

Range: 0 to 1
*RST: 0

Example: See Example"To configure MAC header information" on page 67.

Manual operation: See "Sequence Number Suppression" on page 26

[:SOURce<hw>]:BB:HUWB:MACHeader:SEQNumber <SequenceNumber>

Parameters:

<SequenceNumber> integer

Range: 0 to 65535
*RST: 0

Manual operation: See "Sequence Number" on page 27

[:SOURce<hw>]:BB:HUWB:MACHeader:SPANid <SourcePanId>

Sets the input value of the source PAN ID field. The value is a 16-bit value in hexadecimal representation.

Parameters:

<SourcePanId> integer

Range: 0 to 65535
*RST: 0

Example: See Example"To configure MAC header information" on page 67.

Manual operation: See "Source PAN ID" on page 28

[:SOURce<hw>]:BB:HUWB:MACHeader:STATe <State>

Activates or deactivates MAC header information.

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

Example: See Example"To configure MAC header information" on page 67.

Manual operation: See "MAC Header" on page 25

[:SOURce<hw>]:BB:HUWB:MACHeader:STRing?

Queries the length of the MAC header and the MAC address in hexadecimal format.

Return values:
<String> string

Example: See Example"To configure MAC header information" on page 67.

Usage: Query only

Manual operation: See "MAC Header" on page 22

5.4 Impairments commands

Example: To impair an HRP UWB signal

```
// Configure symbol timing error in ppm.
SOURce1:BB:HUWB:IMPairments:STERror 10
// Configure frequency offset in Hz.
SOURce1:BB:HUWB:IMPairments:FOFFset 25000
// Activate impairing the signal.
SOURce1:BB:HUWB:IMPairments:STATe 1
```

[:SOURce<hw>]:BB:HUWB:IMPairments:FOFFset <FOffset>
[:SOURce<hw>]:BB:HUWB:IMPairments:STATe <State>
[:SOURce<hw>]:BB:HUWB:IMPairments:CCERror <STError>

Sets the chip clock error of the impairment symbols.

Parameters:

<STError> integer

Range: -300 to 300
*RST: 0

Example: See Example"To impair an HRP UWB signal" on page 76.

Manual operation: See "Chip Clock Error" on page 31

5.5 Filter commands

Example: To configure filter settings

```
// ****************************************************************
// Configure filter type, roll-off factor, oversampling and output
// sample rate.
// ****************************************************************
SOURce1:BB:HUWB:FILTer:TYPE RCOS
SOURce1:BB:HUWB:FILTer:ROFactor 0.5
// Set an oversampling factor of 1.
SOURce1:BB:HUWB:FILTer:OSAMP OS_1
SOURce1:BB:HUWB:FILTer:SRATe:VARiation?
// Response in Hz: 499200000
SOURce1:BB:HUWB:FILTer:OSAMP OS_2
SOURce1:BB:HUWB:FILTer:SRATe:VARiation?
// Response in Hz: 998400000

// ****************************************************************
// Configure an LTE filter.
// ****************************************************************
SOURce1:BB:HUWB:FILTer:TYPE LTEF
SOURce1:BB:HUWB:FILTer:PARameter:LTE:OPTimization EVM
// LTE filter is optimized for EVM performance.
SOURce1:BB:HUWB:FILTer:PARameter:LTE:COFFactor 0.1
SOURce1:BB:HUWB:FILTer:PARameter:LTE:ROFactor -0.2
// Change LTE filter optimization for ACP performance.
SOURce1:BB:HUWB:FILTer:PARameter:LTE:OPTimization ACP
SOURce1:BB:HUWB:FILTer:PARameter:LTE:COFS 0.34
// Check, if the internal filter is active.
SOURce1:BB:HUWB:FILTer:AUTO?
// Response: 0
// The internal filter is not active.

// ****************************************************************
// Configure a user-defined filter.
// ****************************************************************
SOURce1:BB:HUWB:FILTer:TYPE USER
// Load the file, that specifies the filter. You can load files with
// extension *.dat or *.vaf.
```

```
SOURce1:BB:HUWB:FILTer:PARameter:USER "/var/user/my_filter"
// Loads a user-defined filter as defined in file "my_filter.dat".
```


[:SOURce<hw>]:BB:HUWB:FILTer:TYPE <Type>

Selects the baseband filter type.

Parameters:

<Type> RCOSine | COSine | GAUSs | LGAuss | CONE | COF705 | COEQualizer | COFequalizer | C2K3x | APCO25 | SPHase | RECTangle | USER | PGAuss | LPASs | DIRac | ENPShape | EWPShape | LTEFilter | LPASSEVM | APCO25Hcpm | APCO25Lsm | HRP | SOQPSK

*RST: HRP

Example: See Example"To configure filter settings" on page 77.

Manual operation: See "Filter" on page 32

[:SOURce<hw>]:BB:HUWB:FILTer:OSAMpling <OverSampling>

Sets the oversampling factor of the generated waveform.

A reduced sample rate saves significantly the amount of memory or allows an increased signal cycle time, and vice versa.

Parameters:

<OverSampling> OS_1 | OS_2 | OS_3 | OS_4 | OS_5 | OS_6 | OS_7 | OS_8

*RST: OS_1

Example: See Example"To configure filter settings" on page 77.

Manual operation: See "Oversampling" on page 36

[:SOURce<hw>]:BB:HUWB:FILTer:PARameter:APCo25 <Apco25>
[:SOURce<hw>]:BB:HUWB:FILTer:PARameter:COSine <Cosine>
[:SOURce<hw>]:BB:HUWB:FILTer:PARameter:GAUSs <Gauss>
[:SOURce<hw>]:BB:HUWB:FILTer:PARameter:LPASs <LPass>
[:SOURce<hw>]:BB:HUWB:FILTer:PARameter:LPASsevm <CutoffFrequency>
[:SOURce<hw>]:BB:HUWB:FILTer:PARameter:PGAuss <PGauss>
[:SOURce<hw>]:BB:HUWB:FILTer:PARameter:RCOSine <RCosine>
[:SOURce<hw>]:BB:HUWB:FILTer:PARameter:SPHase <SPhase>

Sets the filter parameter.

Filter type	Parameter	Parameter name	Min	Max	Incre-ment	Default
APCO25	Rolloff factor	<Apco25>	0.05	0.99	0.01	0.2
COSine	Rolloff factor	<Cosine>	0	1	0.01	0.1
GAUSs	BxT	<Gauss>	0.15	2.5	0.01	0.5
LPASs	Cutoff frequency	<LPass>	0.02	2	0.01	0.34
LPASSEVM	Cutoff frequency	<CutoffFrequency>	0.05	2	0.01	0.29
PGAuss	BxT	<PGauss>	0.15	2.5	0.01	0.5
RCOSine	Rolloff factor	<RCosine>	0	1	0.01	0.22
SPHase	BxT	<SPhase>	0.15	2.5	0.01	2

Parameters:
<SPhase> float
Range: 0.15 to 2.5
Increment: 0.01
*RST: 2

Example: See Example"To configure filter settings" on page 77.

Manual operation: See "Roll Off Factor or BxT" on page 35

[:SOURce<hw>]:BB:HUWB:FILTer:PARameter:LTE:COFFactor <CutoffFactor>

Sets the cut-off frequency factor for the LTE filter type.

Parameters:
<CutoffFactor> float
Range: 0.02 to 2
Increment: 0.001
*RST: 0.34

Example: See Example"To configure filter settings" on page 77.

Manual operation: See "Cut Off Frequency Factor" on page 36

[:SOURce<hw>]:BB:HUWB:FILTer:PARameter:COSine:COFS <Cofs>
[:SOURce<hw>]:BB:HUWB:FILTer:PARameter:LTE:COFS <CutOffFreqShift>

Sets the cut-off frequency shift of the applied filter.

Parameters:
<CutOffFreqShift> float
Range: -1 to 1
Increment: 0.01
*RST: -0.2

Example: See Example"To configure filter settings" on page 77.

Manual operation: See "Cut Off Frequency Shift" on page 35

[:SOURce<hw>]:BB:HUWB:FILTer:PARameter:LTE:OPTimization <Optimization>

Defines the applied LTE filter.

Parameters:
<Optimization> EVM | STD | ACP | ACPN | BENU
*RST: EVM

Example: See Example"To configure filter settings" on page 77.

Manual operation: See "Optimization" on page 33

[:SOURce<hw>]:BB:HUWB:FILTer:PARameter:LTE:ROFactor <RollOffFactor>

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

Parameters:
<RollOffFactor> float
Range: 0 to 1
Increment: 0.01
*RST: 0.1

Example: See Example"To configure filter settings" on page 77.

Manual operation: See "Roll Off Factor or BxT" on page 35

[:SOURce<hw>]:BB:HUWB:FILTer:PARameter:USER <Filename>

Loads the file from the default or the specified directory.

Loaded are files with extension `*.vaf` or `*.dat`.

Parameters:
<Filename> string

Example: See Example"To configure filter settings" on page 77.

Manual operation: See "Load User Filter" on page 34

[:SOURce<hw>]:BB:HUWB:SRATe:VARiation <SymRateVar>

Sets the sample rate of the signal.

A variation of this parameter affects the ARB clock rate; all other signal parameters remain unchanged. When changing values of the affecting parameters, the sample rate is reset.

Parameters:

<SymRateVar> float

Range: 400 to 3.19488E10
Increment: 1E-3
*RST: 9.984E8

Example: See Example"To configure filter settings" on page 77.

Manual operation: See "Sample Rate Variation" on page 36

5.6 Clipping commands

Example: To configure clipping settings

```
// Selects the absolute maximum of all the I and Q values as the
// reference level.
SOURce1:BB:HUWB:CLIPping:MODE SCAL
// Set the limit for level clipping to 80% of this maximum level.
SOURce1:BB:HUWB:CLIPping:LEVel 80PCT
// Activate level clipping.
SOURce1:BB:HUWB:CLIPping:STATe 1
```


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

Sets the limit for level clipping.

Parameters:

<Level> integer

Range: 1 to 100
*RST: 100

Example: See Example"To configure clipping settings" on page 81.

Manual operation: See "Clipping Level" on page 37

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

Sets the method for level clipping.

Parameters:

<Mode> VECTor | SCALar

*RST: VECTor

Example: See Example"To configure clipping settings" on page 81.

Manual operation: See "Clipping Mode" on page 37

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

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

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See Example"To configure clipping settings" on page 81.

Manual operation: See "Clipping State" on page 37

5.7 Trigger commands

Example: To configure an external trigger

```
SOURce1:BB:HUWB:TRIGger:SEQuence AAUT
SOURce1:BB:HUWB:TRIGger:SOURce EGT
SOURce1:BB:HUWB:TRIGger:EXTernal:SYNChronize:OUTPut 1
SOURce1:BB:HUWB:TRIGger:EXTernal:INHibit 100
SOURce1:BB:HUWB:TRIGger:DELay:UNIT SAMP
SOURce1:BB:HUWB:TRIGger:EXTernal:DELay 10
SOURce1:BB:HUWB:TRIGger:EXTernal:RDELay?
// Response: 0.00000065
SOURce1:BB:HUWB:TRIGger:DELay:UNIT TIME
SOURce1:BB:HUWB:TRIGger:EXTernal:TDELay 0.00001
SOURce1:BB:HUWB:TRIGger:EXTernal:RDELay?
// Response: 0.00001
```

Example: To configure an internal trigger

```
// ****************************************************************
// Configure trigger in single mode. Set trigger source to internal,
// signal duration unit and duration.
// ****************************************************************
SOURce1:BB:HUWB:TRIGger:SEQuence SING
SOURce1:BB:HUWB:TRIGger:SOURce INT
SOURce1:BB:HUWB:TRIGger:SLUNit SEQ
SOURce1:BB:HUWB:TRIGger:SLUNit FRAMe
SOURce1:BB:HUWB:TRIGger:SLENgth 2
// ****************************************************************
// Alternatively, configure trigger in armed retrigger mode. Set
// trigger source to internal.
// Enable Bluetooth, start the trigger - signal generation starts.
// Stop signal generation and wait for a trigger event to restart
// signal generation.
// Query the current trigger signal generation status.
// ****************************************************************
SOURce1:BB:HUWB:TRIGger:SEQuence ARETrigger
SOURce1:BB:HUWB:TRIGger:SOURce INT
SOURce1:BB:HUWB:STATe 1
SOURce1:BB:HUWB:TRIGger:EXEcute
SOURce1:BB:HUWB:TRIGger:ARM:EXECute
// Trigger event restarts signal generation.
SOURce1:BB:HUWB:TRIGger:RMODe?
// Response: 1
// Trigger is running.
```

Commands:

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

Stops signal generation; a subsequent trigger event restarts signal generation.

Example: See Example"To configure an internal trigger" on page 83.

Usage: Event

Manual operation: See "Arm" on page 41

[:SOURce<hw>]:BB:HUWB:TRIGger:DELay:UNIT <TrigDelUnit>

Sets the units in that the trigger delay is expressed.

Parameters:

<TrigDelUnit> SAMPle | TIME

*RST: SAMPle

Example: See Example"To configure an external trigger" on page 82.

Manual operation: See "(External) Delay Unit" on page 42

[:SOURce<hw>]:BB:HUWB:TRIGger:TIME[:STATe] <State>

Activates time-based triggering with a fixed time reference. If activated, the R&S SMBV100B triggers signal generation when its operating system time matches a specified time.

Specify the trigger date and trigger time with the following commands:

`SOURce<hw>:BB:<DigStd>:TRIGger:TIME:DATE`

`SOURce<hw>:BB:<DigStd>:TRIGger:TIME:TIME`

`<DigStd>` is the mnemonic for the digital standard, for example, `ARB`. Time-based triggering behaves analogously for all digital standards that support this feature.

Parameters:

<State> 1 | ON | 0 | OFF

*RST: 0

Example: See example "Configure a time-based trigger signal" in the subchapter "Trigger Commands" of the chapter "SOURce:BB:ARB subsystem" in the R&S SMBV100B user manual.

Manual operation: See "Time Based Trigger" on page 40

[:SOURce<hw>]:BB:HUWB:TRIGger:TIME:DATE <Year>, <Month>, <Day>

Sets the date for a time-based trigger signal. For trigger modes single or armed auto, you can activate triggering at this date via the following command:

`SOURce<hw>:BB:<DigStd>:TRIGger:TIME:STATe`

<DigStd> is the mnemonic for the digital standard, for example, ARB. Time-based triggering behaves analogously for all digital standards that support this feature.

Parameters:

<Year> integer
Range: 1980 to 9999

<Month> integer
Range: 1 to 12

<Day> integer
Range: 1 to 31

Example: See example "Configure a time-based trigger signal" in the subchapter "Trigger Commands" of the chapter "SOURce:BB:ARB subsystem" in the R&S SMBV100B user manual.

Manual operation: See "Trigger Time" on page 40

[:SOURce<hw>]:BB:HUWB:TRIGger:TIME:TIME <Hour>, <Minute>, <Second>

Sets the time for a time-based trigger signal. For trigger modes single or armed auto, you can activate triggering at this time via the following command:

SOURce<hw>:BB:<DigStd>:TRIGger:TIME:STATe

<DigStd> is the mnemonic for the digital standard, for example, ARB. Time-based triggering behaves analogously for all digital standards that support this feature.

Parameters:

<Hour> integer
Range: 0 to 23

<Minute> integer
Range: 0 to 59

<Second> integer
Range: 0 to 59

Example: See example "Configure a time-based trigger signal" in the subchapter "Trigger Commands" of the chapter "SOURce:BB:ARB subsystem" in the R&S SMBV100B user manual.

Manual operation: See "Trigger Time" on page 40

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

Executes a trigger.

Example: See Example"To configure an internal trigger" on page 83.

Usage: Event

Manual operation: See "Execute Trigger" on page 41

[:SOURce<hw>]:BB:HUWB:TRIGger:EXTernal:RDELay?

Queries the time (in seconds) of an external trigger event is delayed for.

Return values:

<ResExtDelaySec> float

Range: 0 to 688
Increment: 250E-12
*RST: 0

Example: See Example"To configure an external trigger" on page 82.

Usage: Query only

Manual operation: See "Actual Trigger Delay/Actual External Delay" on page 43

[:SOURce<hw>]:BB:HUWB:TRIGger:EXTernal:TDELay <TrigExtTimeDel>

Specifies the trigger delay for external triggering. The value affects all external trigger signals.

Parameters:

<TrigExtTimeDel> float

Range: 0 to 688
Increment: 250E-12
*RST: 0

Example: See Example"To configure an external trigger" on page 82.

Manual operation: See "(Specified) External Delay/(Specified) Trigger Delay" on page 43

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

Specifies the trigger delay (expressed as number of samples) for triggering by the trigger signal from the other path (two-path instruments only).

Parameters:

<Delay> float

Range: 0 to 2147483647
Increment: 0.01
*RST: 0

Example: See Example"To configure an internal trigger" on page 83.

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

For triggering via the other path, specifies the number of samples by which a restart is inhibited.

Parameters:

<Inhibit> integer

Range: 0 to 67108863
*RST: 0

Example: See Example"To configure an internal trigger" on page 83.

[:SOURce<hw>]:BB:HUWB:TRIGger:OBASeband:RDELay?

Queries the actual trigger delay (expressed in time units) of the trigger signal from the second path.

Return values:

<IntOthRDelaySec> float

Range: 0 to 688
Increment: 250E-12
*RST: 0

Example: See Example"To configure an external trigger" on page 82.

Usage: Query only

[:SOURce<hw>]:BB:HUWB:TRIGger:OBASeband:TDELay <IntOthDelaySec>

Specifies the trigger delay (expressed in time units) for triggering by the trigger signal from the other path.

Parameters:

<IntOthDelaySec> float

Range: 0 to 688
Increment: 250E-12
*RST: 0

Example: See Example"To configure an internal trigger" on page 83.

[:SOURce<hw>]:BB:HUWB:TRIGger:RMODe?

Queries the signal generation status.

Return values:

<RMode> STOP | RUN

*RST: STOP

Example: See Example"To configure an internal trigger" on page 83.

Usage: Query only

Manual operation: See "Running/Stopped" on page 41

[:SOURce<hw>]:BB:HUWB:TRIGger:SLENgth <SLength>

Defines the length of the signal sequence that is output in the `SINGle` trigger mode.

Parameters:

<SLength> integer

Range: 1 to dynamic
*RST: 1

Example: See Example"To configure an internal trigger" on page 83.

Manual operation: See "Signal Duration" on page 40

[:SOURce<hw>]:BB:HUWB:TRIGger:SLUNit <SLUnit>

Defines the unit for the entry of the signal sequence length.

Parameters:

<SLUnit> SEQuence | SAMPle

*RST: SEQ

Example: See Example"To configure an external trigger" on page 82.

Example: See Example"To configure an internal trigger" on page 83.

Manual operation: See "Signal Duration Unit" on page 40

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

Selects the trigger signal source and determines the way the triggering is executed. Provided are:

- Internal triggering by a command (`INTernal`)
- External trigger signal via one of the User x connectors
  `EGT1`: External global trigger
- In primary-secondary instrument mode, the external baseband synchronization signal (`BBSY`)
- `EXTernal`: Setting only
  Provided only for backward compatibility with other Rohde & Schwarz signal generators.
  The R&S SMBV100B accepts this value and maps it automatically as follows:
  `EXTernal = EGT1`

Parameters:

<Source> INTernal|EGT1|EXTernal|BBSY

*RST: INTernal

Example: See Example"To configure an external trigger" on page 82.

Example: See Example"To configure an internal trigger" on page 83.

Manual operation: See "Trigger Source" on page 41

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

Sets the trigger delay.

Parameters:

<Delay> float

Range: 0 to 2147483647
Increment: 0.01
*RST: 0

Example: See Example"To configure an external trigger" on page 82.

Manual operation: See "(Specified) External Delay/(Specified) Trigger Delay" on page 43

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

Specifies the number of symbols by which a restart is inhibited.

Parameters:

<Inhibit> integer

Range: 0 to 21.47*symbRate
*RST: 0

Example: See Example"To configure an external trigger" on page 82.

Manual operation: See "External / Trigger Inhibit" on page 42

[:SOURce<hw>]:BB:HUWB:TRIGger[:EXTernal]:SYNC:OUTPut <Output>

Enables signal output synchronous to the trigger event.

Parameters:

<Output> 1 | ON | 0 | OFF

*RST: 1

Example: See Example"To configure an external trigger" on page 82.

Manual operation: See "Sync. Output to External Trigger/Sync. Output to Trigger" on page 41

[:SOURce<hw>]:BB:HUWB[:TRIGger]:SEQuence <Sequence>

Selects the trigger mode:

- `AUTO` = auto
- `RETRigger` = retrigger
- `AAUTo` = armed auto
- `ARETrigger` = armed retrigger
- `SINGle` = single

Parameters:

<Sequence> AUTO | RETRigger | AAUTo | ARETrigger | SINGle

*RST: AUTO

Example: See Example"To configure an external trigger" on page 82.

Example: See Example"To configure an internal trigger" on page 83.

Manual operation: See "Trigger Mode" on page 39

5.8 Marker commands

Example: To configure and enable standard marker signals

```
// Configure marker 1 settings.
SOURce1:BB:HUWB:TRIGger:OUTPut1:MODE REST
SOURce1:BB:HUWB:TRIGger:OUTPut1:ROFFset 1
SOURce1:BB:HUWB:TRIGger:OUTPut1:FOFFset 1
SOURce1:BB:HUWB:TRIGger:OUTPut1:DELay 10
SOURce1:BB:HUWB:STATe 1
```

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

Defines the signal for the selected marker output.

Parameters:

<Mode> RESTart

*RST: RESTart

Example: See Example"To configure and enable standard marker signals" on page 90.

Manual operation: See "Marker Mode" on page 44

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

Defines the delay between the signal on the marker outputs and the start of the signals.

Parameters:

<Delay> float

Range: 0 to 16777215
Increment: 1E-3
*RST: 0

Example: See Example"To configure and enable standard marker signals" on page 90.

Manual operation: See "Marker x Delay" on page 45

[:SOURce<hw>]:BB:HUWB:TRIGger:OUTPut<ch>:ROFFset <MarkRiseOffs>
[:SOURce<hw>]:BB:HUWB:TRIGger:OUTPut<ch>:FOFFset <MarkFallOffs>

Sets the rise/fall offset.

Parameters:
<MarkFallOffs> integer
Range: -640000 to 640000
*RST: 0

Example: See Example"To configure and enable standard marker signals" on page 90.

Manual operation: See "Rise/Fall Offset" on page 44

5.9 Clock commands

Example: To configure clock settings

```
SOURce1:BB:HUWB:CLOCk:SOURce?
// Response: INT
```


[:SOURce<hw>]:BB:HUWB:CLOCk:MODE <Mode>

Sets the type of externally supplied clock.

Parameters:
<Mode> SAMPle | MSAMple | CSAMple
*RST: SAMPle

Example: See Example"To configure clock settings" on page 91.

Manual operation: See "Clock Mode" on page 46

[:SOURce<hw>]:BB:HUWB:CLOCk:SOURce <Source>

Selects the clock source:

- `INTernal`: Internal clock reference

Parameters:
<Source> INTernal
*RST: INTernal

Example: See Example"To configure clock settings" on page 91.

Manual operation: See "Clock Source" on page 46

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