

# R&S<sup>®</sup>SMM-K149

## HRP UWB 802.15.4

### User Manual



1179208302  
Version 08

**ROHDE & SCHWARZ**  
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This document describes the following software options:

- R&S®SMM-K149 HRP UWB (1441.1099.xx)

This manual describes firmware version FW 5.30.047.xx and later of the R&S®SMM100A.

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The following abbreviations are used throughout this manual: R&S®SMM100A is abbreviated as R&S SMM, R&S®WinIQSIM2 is abbreviated as R&S WinIQSIM2; the license types 02/03/07/11/13/16/12 are abbreviated as xx.

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# 1 Welcome to the HRP UWB option

The R&S SMM-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 SMM100A user manual. The latest version is available at:

[www.rohde-schwarz.com/manual/SMM100A](http://www.rohde-schwarz.com/manual/SMM100A)

## Installation

You can find detailed installation instructions in the delivery of the option or in the R&S SMM100A service manual.

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• <a href="#">Accessing the HRP UWB dialog</a> .....	5
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## 1.1 Key features

The option R&S SMM-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 SMM100A, 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®SMM100A.

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 SMM100A user documentation. Unless specified otherwise, you find the documents at:

[www.rohde-schwarz.com/manual/smm100a](http://www.rohde-schwarz.com/manual/smm100a)

### 1.4.1 Getting started manual

Introduces the R&S SMM100A 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 SMM100A is not included.

The contents of the user manuals are available as help in the R&S SMM100A. 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 SMM100A 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 SMM100A. 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/smm100a](http://www.rohde-schwarz.com/brochure-datasheet/smm100a)

#### 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/smm100a](http://www.rohde-schwarz.com/firmware/smm100a)

#### 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/smm100a](http://www.rohde-schwarz.com/application/smm100a)

#### 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 SMM100A 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:

- Baseband Generator (R&S SMM-B9)
- Baseband real-time extension (R&S SMM-K520)
- Option HRP UWB (R&S SMM-K149)
- Option baseband extension to 240 MHz RF bandwidth (R&S SMM-K523)
- Option baseband extension to 500 MHz RF bandwidth (R&S SMM-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 SMM-K255 for playing LTE waveforms
- If supported, install the real-time option of the digital standard, e.g. R&S SMM-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.

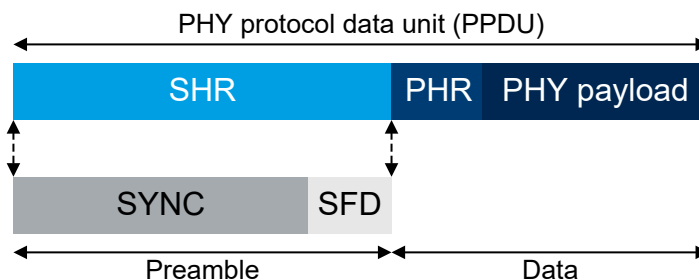


Figure 2-1: HRP UWB PHY frame structure

## 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.

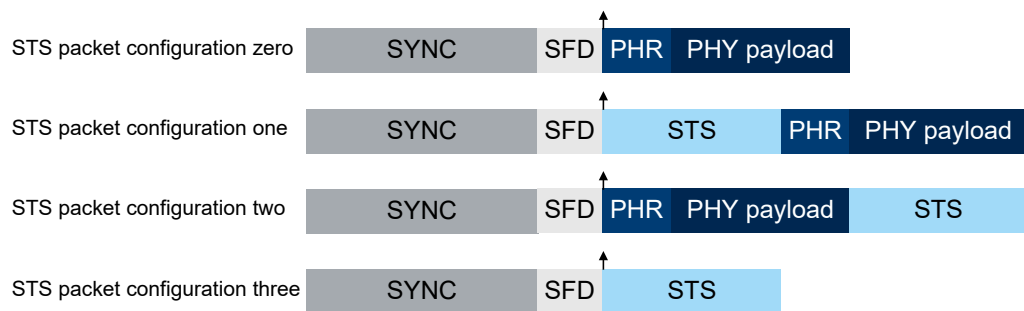


Figure 2-2: HRP-ERDEV frame structures with RMARKER position

### 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".

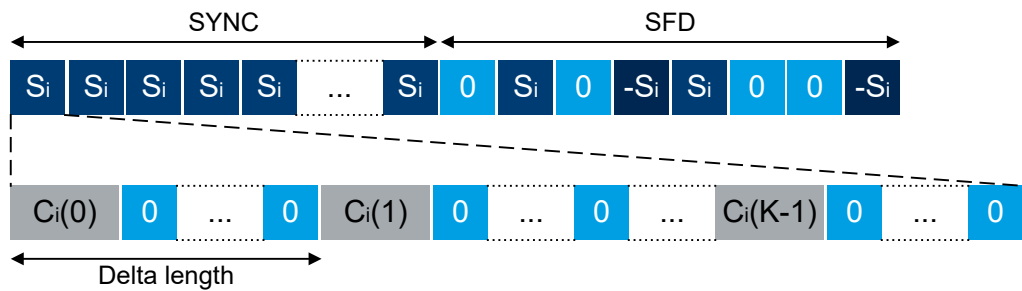


Figure 2-3: Construction of preamble symbols from a code sequence

### 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 SMM100A.

**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:

- [General settings](#)..... 13
- [Frame configuration settings](#)..... 16
- [Impairments settings](#)..... 31

### 3.1 General settings

Access:

- ▶ Select "Baseband > HRP UWB 802.15.4".

General	Marker	Stop Trigger In Auto	Clock Internal	Frame Configuration	Impairments
<div style="display: flex; justify-content: space-between;"> <span>Set To Default</span> <span>Recall ...</span> <span>Save ...</span> <span>Generate Waveform ...</span> </div>					
Mode			802.15.4		
Channel Number		9		Bandwidth	
				499.20 MHz	
Fixed 2 ms Frame Length			<input type="checkbox"/>		
			Idle Interval		
			50.0 us		
Filter/Clipping/ARB ... 802.15.4z / Clip Off / 1 Frames					

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](#)..... 14
- [Set to Default](#)..... 14
- [Save/Recall](#)..... 14
- [Generate Waveform File](#)..... 15
- [Mode](#)..... 15
- [Channel Number](#)..... 15
- [Bandwidth](#)..... 15
- [Fixed 2 ms Frame Length](#)..... 16
- [Idle Interval](#)..... 16
- [Filter/Clipping/ARB](#)..... 16

**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 SMM100A 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 <sup>1)</sup>
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

<sup>1)</sup> 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  $\mu$ s 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.

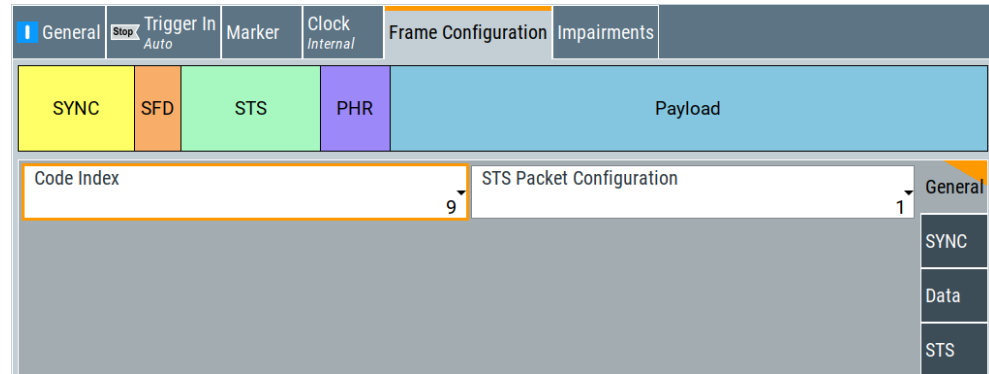
• <a href="#">General settings</a> .....	17
• <a href="#">SYNC settings</a> .....	18
• <a href="#">Data settings</a> .....	20
• <a href="#">MAC header configuration settings</a> .....	24
• <a href="#">STS settings</a> .....	28



### 3.2.1 General settings

Access:

- ▶ Select "Frame Configuration > General".



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

#### Settings:

<a href="#">Code Index</a> .....	17
<a href="#">STS Packet Configuration</a> .....	17

#### 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.

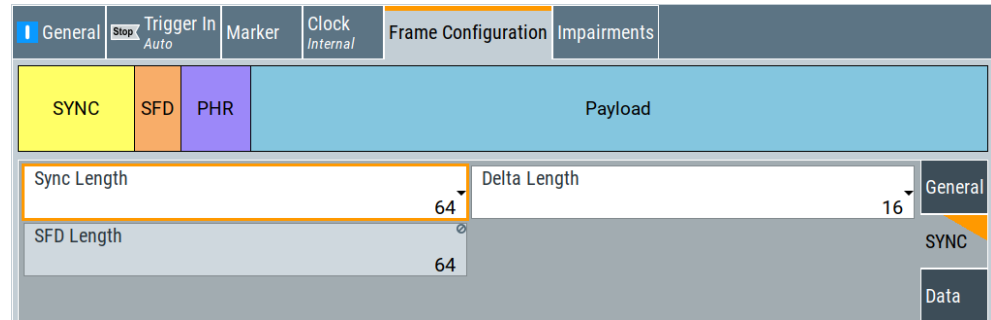
Remote command:

`[ :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.....	18
Delta Length.....	18
SFD Length.....	19
SFD.....	19

#### 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	4, 16, 64
	1081.6	4, 16
	1331.2	4, 16
	1354.97	4, 16
802.15.4z-BPRF	499.2	4
	1081.6	
	1331.2	
	1354.97	
802.15.4z-HPRF	499.2	4, 16, 64
	1081.6	4, 16
	1331.2	4, 16
	1354.97	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 screenshot shows the 'Frame Configuration' tab with the 'Data' sub-tab selected. The interface is divided into sections for SYNC, SFD, PHR, and Payload. The 'Data' section includes the following settings:

Parameter	Value
Data Source	PN9
Viterbi Rate	0.5
Chips Per Burst	128
MAC FCS	<input type="checkbox"/>
Mean PRF	15.60 MHz
PHR Bit Rate	0.110 Mb/s
Hop Bursts	8
MAC Header ...	Off
Data Rate	110 kb/s
Data Length	20 Octets

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.....	21
L Data Source.....	21
L Viterbi Rate.....	22
L Convolutional Code Constraint Length.....	22
L Hop Bursts.....	22
L Chips Per Burst.....	22
L MAC FCS.....	22
L MAC FCS Length.....	22
L MAC Header.....	22
L Mean PRF.....	23
L Data Rate.....	23
L PHR Data Rate Mode.....	23
PHR (Physical Header).....	23
L PHR Bit Rate.....	23
L Data Length.....	23
L Maximum Data Length.....	24
Frame.....	24
L Frame Length.....	24

**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 SMM100A user manual.
- Section "File and Data Management" in the R&S SMM100A user manual.
- Section "Data List Editor" in the R&S SMM100A 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.

```
MAC Header ...
11 Octets: 8861-01-ABCD-1234-ABEF-5678
```

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".

MAC Header										
Frame Control Octets 2 8861	Sequence Number Octets 1 1	Destination PAN ID Octets 2 ABCD	Destination Address Octets 2 1234 0 0 0	Source PAN ID Octets 2 ABEF	Source Address Octets 2 5678 0 0 0					
Note: LSB is transmitted first.										
Frame Type 1 3 Bits LSB	Security Enabled 0 1 Bit	Frame Pending 0 1 Bit	AR 1 1 Bit	PAN ID Compression 1 1 Bit	Reserved 0 1 Bit	Sequence Number Suppression 0 1 Bit	IE Present 0 1 Bit	Destination Addressing Mode 2 2 Bits	Frame Version 0 2 Bits	Source Addressing Mode 2 2 Bits MSB



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

MAC Header.....	25
Frame Control.....	25
L Frame Type.....	25
L Security Enabled.....	26
L Frame Pending.....	26
L AR.....	26
L PAN ID Compression.....	26
L Reserved.....	26
L Sequence Number Suppression.....	26
L IE Present.....	26
L Destination Addressing Mode.....	27
L Frame Version.....	27
L Source Addressing Mode.....	27
Sequence Number.....	27
Destination PAN ID.....	27
Destination Address.....	28
Source PAN ID.....	28
Source Address.....	28

### 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".

General	Marker	Stop Trigger In Auto	Clock Internal	Frame Configuration	Impairments	
SYNC	SFD	STS	PHR	Payload		
STS Source (MSB is Transmitted First) <input type="checkbox"/>						General
VUpper96(hex) 362E EB34 C44F A8FB D37E C3CA				VCounter(hex) 1F9A 3DE4		SYNC
Key(hex) 1414 8674 D1D3 36AA F860 50A8 14EB 220F						Data
Delta Length 8				Active Segment Length 64		STS
Number of Active Segments 1						

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).....	29
VUpper96(hex).....	30
VCounter(hex).....	30
Key(hex).....	30
Delta Length.....	30
Active Segment Length.....	30
Number of Active Segments.....	30
Additional Gap between Payload and STS.....	31

#### 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 value. 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  $\mu$ s).

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.

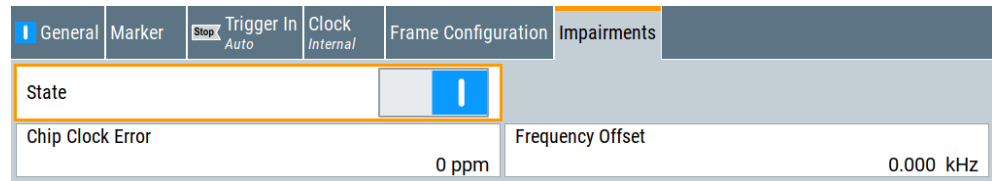
Remote command:

[ :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.....	31
Chip Clock Error.....	31
Frequency Offset.....	31

#### 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.

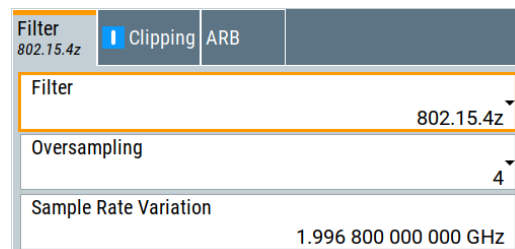
**Settings:**

- [Filter settings](#).....32
- [Clipping settings](#).....37
- [ARB settings](#).....38

#### 4.1.1 Filter settings

Access:

- ▶ Select "General > Filter/Clipping/ARB > Filter".



The tab provides settings to configure the baseband filter.

**Settings:**

- [Filter](#).....32
- [Optimization](#).....33
- [Load User Filter](#).....34
- [Roll Off Factor or BxT](#).....35
- [Cut Off Frequency Shift](#).....35
- [Cut Off Frequency Factor](#).....36
- [Oversampling](#).....36
- [Sample Rate Variation](#).....36

**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)"
<b>Design goal</b>	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
<b>Calculation time</b> (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
<b>Upsampling</b>	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
<b>Output waveform file size</b>	Increased file size	Increased file size	File size is maintained  The resulting file size is smaller than in the other cases
<b>Recommended application field</b>	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.

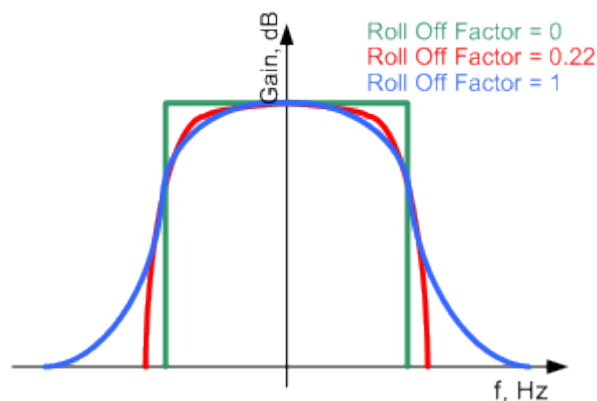


Figure 4-1: Example of the frequency response of a filter with different rolloff factors

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:COSSine` on page 79  
`[ :SOURce<hw> ] :BB:HUWB:FILTer:PARAmeter:GAUSSs` on page 79  
`[ :SOURce<hw> ] :BB:HUWB:FILTer:PARAmeter:PGAuss` on page 79  
`[ :SOURce<hw> ] :BB:HUWB:FILTer:PARAmeter:RCOSSine` on page 79  
`[ :SOURce<hw> ] :BB:HUWB:FILTer:PARAmeter:SPHase` on page 79  
`[ :SOURce<hw> ] :BB:HUWB:FILTer:PARAmeter:LTE:ROFactor` on page 80

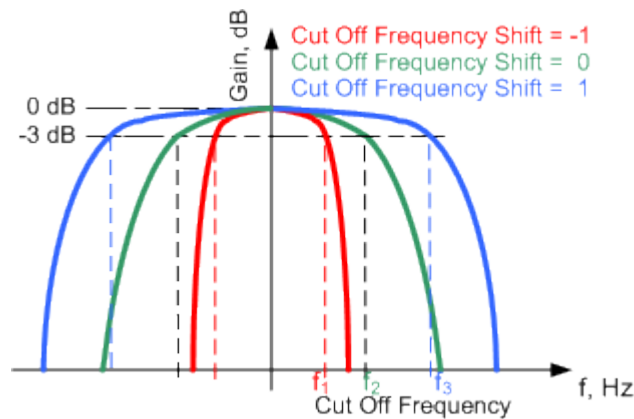
### Cut Off Frequency Shift

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:COSSine: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 SMM100A 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.

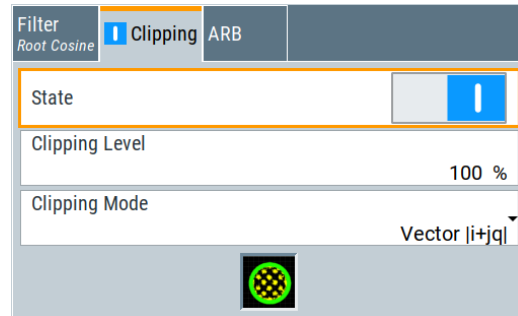
Remote command:

[\[:SOURce<hw>\]: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.....	37
Clipping Level.....	37
Clipping Mode.....	37

### 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.

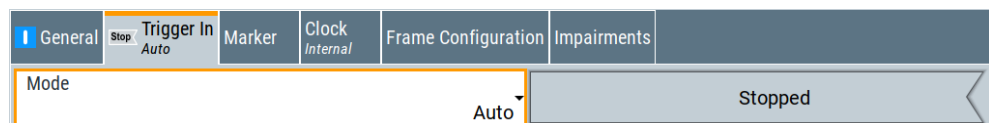
Remote command:

[ :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 SMM100A user manual.



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

Use the [Local and global 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:

<a href="#">Trigger Mode</a> .....	39
<a href="#">Time Based Trigger</a> .....	40
<a href="#">Trigger Time</a> .....	40
<a href="#">Signal Duration Unit</a> .....	40
<a href="#">Signal Duration</a> .....	40
<a href="#">Running/Stopped</a> .....	41
<a href="#">Arm</a> .....	41
<a href="#">Execute Trigger</a> .....	41
<a href="#">Trigger Source</a> .....	41
<a href="#">Sync. Output to External Trigger/Sync. Output to Trigger</a> .....	41
<a href="#">External / Trigger Inhibit</a> .....	42
<a href="#">(External) Delay Unit</a> .....	42
<a href="#">(Specified) External Delay/(Specified) Trigger Delay</a> .....	43
<a href="#">Actual Trigger Delay/Actual External Delay</a> .....	43

### 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 SMM100A 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 SMM100A 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 SMM100A. 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 SMM100A 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.

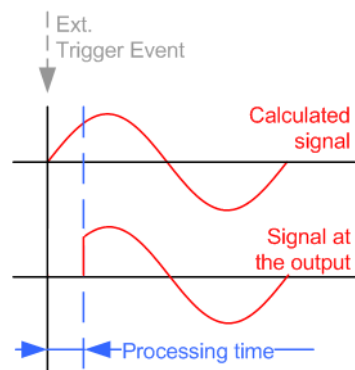
Remote command:

[\[:SOURce<hw>\]:BB:HUWB:TRIGger:SOURce](#) on page 88

**Sync. Output to External Trigger/Sync. Output to Trigger**

Enables signal output synchronous to the trigger event.

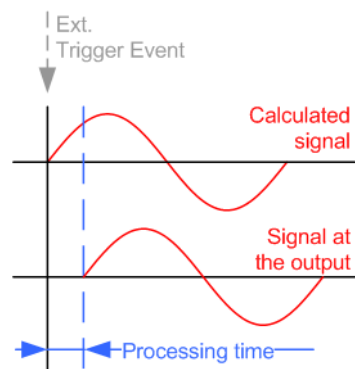
- "On"  
Corresponds to the default state of this parameter.  
The signal calculation starts simultaneously with the trigger event. Because of the processing time of the instrument, the first samples are cut off and no signal is output. After elapsing of the internal processing time, the output signal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



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 SMM100A 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

For more information, see chapter "Basics on ..." in the R&S SMM100A user manual.

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

Remote command:

[\[:SOURCE<hw>\]:BB:HUWB:TRIGGER\[:EXTERNAL\]:DELAY](#) on page 89

[\[:SOURCE<hw>\]: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 from the other path is delayed with.

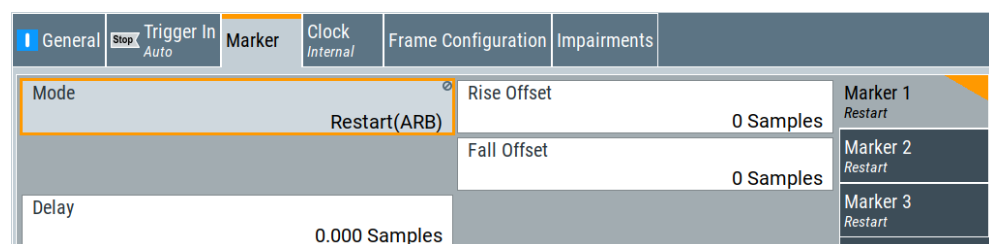
Remote command:

[\[:SOURCE<hw>\]: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 SMM100A user manual.



### Routing and enabling a marker

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

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

- Define the shape of the generated marker, i.e. select the "Marker > Mode".
- Define the connector where the selected signal is provided.  
Use the [Local and global connectors settings](#).

### Settings:

<a href="#">Marker Mode</a> .....	44
<a href="#">Rise/Fall Offset</a> .....	44
<a href="#">Marker x Delay</a> .....	45

### 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:

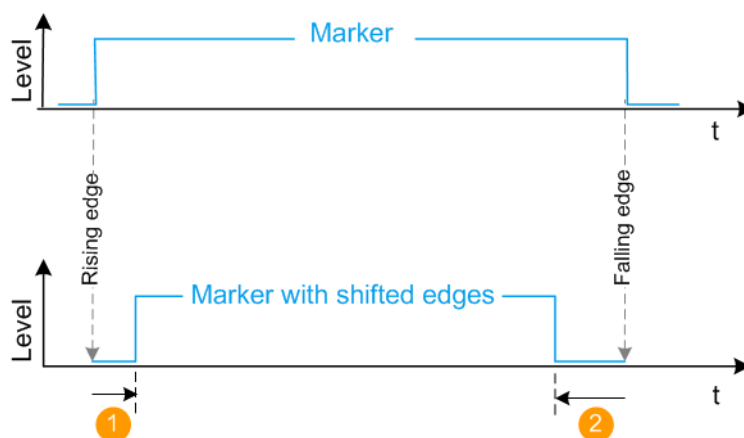
`[ :SOURce<hw> ] :BB:HUWB:TRIGger:OUTPut<ch>:MODE` on page 90

### 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.

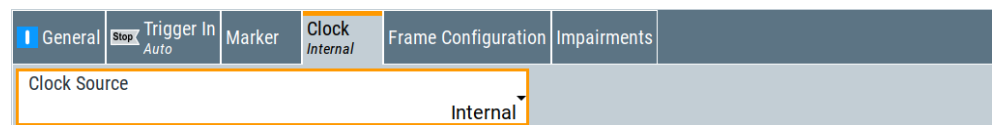
Remote command:

[ :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 SMM100A user manual.

**Defining the clock**

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

Use the [Local and global 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 [Local and global connectors settings](#).

**Settings:**

<a href="#">Clock Source</a> .....	45
<a href="#">Clock Mode</a> .....	46

**Clock Source**

Selects the clock source.

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

Remote command:

[ :SOURce<hw> ] :BB:HUWB:CLOCK:SOURce on page 92

### **Clock Mode**

Sets the type of externally supplied clock.

Remote command:

[ :SOURce<hw> ] :BB:HUWB:CLOCK:MODE on page 91

## **4.5 Local and global connectors settings**

Accesses a dialog to configure local connectors or 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 "Local and 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 SMM100A has already been set up for remote operation in a network as described in the R&S SMM100A 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 SMM100A 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:

• <a href="#">General commands</a> .....	48
• <a href="#">Frame configuration commands</a> .....	52
• <a href="#">MAC header commands</a> .....	67
• <a href="#">Impairments commands</a> .....	76
• <a href="#">Filter commands</a> .....	77
• <a href="#">Clipping commands</a> .....	81
• <a href="#">Trigger commands</a> .....	82
• <a href="#">Marker commands</a> .....	90
• <a href="#">Clock commands</a> .....	91

## 5.1 General commands

### Example: To save the current configuration

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

### Example: To generate an HRP UWB signal

```
SOURcel:BB:HUWB:PRESet

SOURcel:BB:HUWB:STD HPRF
SOURcel:BB:HUWB:CNUMber 3
SOURcel:BB:HUWB:BWIDth?
// Response in MHz: 499.2
SOURcel:BB:HUWB:IINTerval 50
SOURcel:BB:HUWB:SLENgth 1
SOURcel:BB:HUWB:OSAMpling 4
SOURcel:BB:HUWB:SRATE:VARIation 500000
SOURcel:BB:HUWB:STATe 1
SOURcel:FREQuency:CW 4492800000
SOURcel:POWER:POWER -30
OUTPut1:STATe 1
```

### Example: To generate a waveform

```
SOURcel:BB:HUWB:PRESet

SOURcel:BB:HUWB:STD HPRF
SOURcel:BB:HUWB:CNUMber 3
SOURcel:BB:HUWB:BWIDth?
// Response in MHz: 499.2
// To generate a waveform with fixed frame length of 2 ms.
SOURcel: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
SOURcel:BB:HUWB:IINTerval?
// Response is 0
SOURcel:BB:HUWB:SLENgth 1
SOURcel:BB:HUWB:FILTer:OSAMpling OS_4
SOURcel:BB:HUWB:SRATE:VARIation 500000
SOURcel:BB:HUWB:STATe 1
SOURcel:FREQuency:CW 4492800000
```



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

<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:PRESet</a> .....	49
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:STATe</a> .....	49
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:SETTing:CATalog</a> .....	49
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:SETTing:DELete</a> .....	50
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:SETTing:LOAD</a> .....	50
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:SETTing:STORE</a> .....	50
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:SLENgth</a> .....	50
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:WAVeform:CREate</a> .....	51
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:BWIDth?</a> .....	51
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:CNUMber</a> .....	51
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:F2MS</a> .....	51
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:IINTerval</a> .....	52
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:STD</a> .....	52

---

### **[: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 <Interval>**

Sets the time of the interval separating two frames.

**Parameters:**

<Interval> float  
 Range: 0 to 1000000  
 Increment: 0.1  
 \*RST: 50  
 Default unit:  $\mu$ s

**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:HUIB:FCONfig:SFDLength?
// Response: SFDL_8

// Configure physical data and physical header parameters.
SOURCE1:BB:HUIB:FCONfig:DATA PN9
SOURCE1:BB:HUIB:FCONfig:HOPBurst HB_8
SOURCE1:BB:HUIB:FCONfig:CPBurst CPB_2
SOURCE1:BB:HUIB:FCONfig:VRATE?
// Response: 0.5
SOURCE1:BB:HUIB:FCONfig:CPBurst CPB_1
SOURCE1:BB:HUIB:FCONfig:VRATE?
// Response: 1.0
SOURCE1:BB:HUIB:FCONfig:MCS:STATE 1
SOURCE1:BB:HUIB:FCONfig:MFL MFL_2
// Sets a MAC FCS length of two octets.
SOURCE1:BB:HUIB:FCONfig:MPRF?
// Response in MHz: 15.6
SOURCE1:BB:HUIB:FCONfig:DR?
// Response in Mb/s: 27.24
SOURCE1:BB:HUIB:FCONfig:PHRBrate?
// Response in Mb/s: 0.85
SOURCE1:BB:HUIB:FCONfig:DLEnGth 127

```

#### Example: To configure HRP UWB 802.15.4z-BPRF frames

```

SOURCE1:BB:HUIB:PRESet
SOURCE1:BB:HUIB:STD BPRF
SOURCE1:BB:HUIB:CNUMber 3
SOURCE1:BB:HUIB:BWIDth?
// Response in MHz: 499.2
SOURCE1:BB:HUIB:FCONfig:CINdex CI_7

// Configure SYNC parameters.
SOURCE1:BB:HUIB:FCONfig:SYNLength SL_64
SOURCE1:BB:HUIB:FCONfig:DLEnGth DL_4
SOURCE1:BB:HUIB:SFD SFD_2
SOURCE1:BB:HUIB:FCONfig:SFDLength?
// Response: SFDL_8

// Configure physical data and physical header parameters.
SOURCE1:BB:HUIB:FCONfig:DATA PN9
SOURCE1:BB:HUIB:FCONfig:HOPBurst HB_2
SOURCE1:BB:HUIB:FCONfig:CPBurst CPB_8
SOURCE1:BB:HUIB:FCONfig:VRATE?
// Response: 0.5
SOURCE1:BB:HUIB:FCONfig:MCS:STATE 1
SOURCE1:BB:HUIB:FCONfig:MFL MFL_2
// Sets a MAC FCS length of two octets.
SOURCE1:BB:HUIB:FCONfig:MPRF?
// Response in MHz: 62.4
SOURCE1:BB:HUIB: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.
```

<a href="#">[:SOURCE&lt;hw&gt;]:BB:HUWB:ASL.....</a>	56
<a href="#">[:SOURCE&lt;hw&gt;]:BB:HUWB:ASN.....</a>	56
<a href="#">[:SOURCE&lt;hw&gt;]:BB:HUWB:CCCL.....</a>	57
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<a href="#">[:SOURCE&lt;hw&gt;]:BB:HUWB:FCONfig:DATA.....</a>	58

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<code>[SOURce&lt;hw&gt;]:BB:HUWB:FCONfig:DR?</code> .....	59
<code>[SOURce&lt;hw&gt;]:BB:HUWB:FCONfig:DALEngth</code> .....	59
<code>[SOURce&lt;hw&gt;]:BB:HUWB:FCONfig:DLEngth</code> .....	60
<code>[SOURce&lt;hw&gt;]:BB:HUWB:FCONfig:FLEngth?</code> .....	60
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<code>[SOURce&lt;hw&gt;]:BB:HUWB:STS:DLEN</code> .....	65
<code>[SOURce&lt;hw&gt;]:BB:HUWB:STS:KEY</code> .....	65
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---

#### `[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 | DLIS | PATT

**PNxx**

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

**DLIS**

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

**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

```

SOURCEl:BB:HUIWB:MACHeader:STATe 0
// Configure frame control field parameters.
SOURCEl:BB:HUIWB:MACHeader:LFRControl L2
SOURCEl:BB:HUIWB:MACHeader:CTRL 34913
SOURCEl:BB:HUIWB:MACHeader:FTYPE 1
SOURCEl:BB:HUIWB:MACHeader:SEENabled 0
SOURCEl:BB:HUIWB:MACHeader:FPENding 0
SOURCEl:BB:HUIWB:MACHeader:AR 1
SOURCEl:BB:HUIWB:MACHeader:PIDComp 1
SOURCEl:BB:HUIWB:MACHeader:REServed 0
SOURCEl:BB:HUIWB:MACHeader:SENSupp 0
SOURCEl:BB:HUIWB:MACHeader:IEPresent 0
SOURCEl:BB:HUIWB:MACHeader:DADMode 2
SOURCEl:BB:HUIWB:MACHeader:FVERsion 0
SOURCEl:BB:HUIWB:MACHeader:SADMode 2

// Configure sequence number field parameters.
SOURCEl:BB:HUIWB:MACHeader:LSEQnumber L1
SOURCEl:BB:HUIWB:MACHeader:SEQNumber 1

// Configure destination PAN ID field parameters.
SOURCEl:BB:HUIWB:MACHeader:LDEPanid L2
SOURCEl:BB:HUIWB:MACHeader:DPANid 43981

// Configure destination address field parameters.
SOURCEl:BB:HUIWB:MACHeader:LDADdress L2
SOURCEl:BB:HUIWB:MACHeader:DADD 4660

// Configure source PAN ID field parameters.
SOURCEl:BB:HUIWB:MACHeader:LSOPanid L2
SOURCEl:BB:HUIWB:MACHeader:SPANid 44015

// Configure source address field parameters.
SOURCEl:BB:HUIWB:MACHeader:LSADdress L2
SOURCEl:BB:HUIWB:MACHeader:SADD 22136

// Activate MAC header information.
SOURCEl:BB:HUIWB:MACHeader:STATe 1

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

[:SOURCEl<hw>]:BB:HUIWB:MACHeader:AR.....68
[:SOURCEl<hw>]:BB:HUIWB:MACHeader:CTRL.....68
[:SOURCEl<hw>]:BB:HUIWB:MACHeader:DAD2.....69

```

<code>[SOURce&lt;hw&gt;]:BB:HUWB:MACHeader:DAD3</code> .....	69
<code>[SOURce&lt;hw&gt;]:BB:HUWB:MACHeader:DAD4</code> .....	69
<code>[SOURce&lt;hw&gt;]:BB:HUWB:MACHeader:DADD</code> .....	69
<code>[SOURce&lt;hw&gt;]:BB:HUWB:MACHeader:DADMode</code> .....	69
<code>[SOURce&lt;hw&gt;]:BB:HUWB:MACHeader:DPANid</code> .....	69
<code>[SOURce&lt;hw&gt;]:BB:HUWB:MACHeader:FPENding</code> .....	70
<code>[SOURce&lt;hw&gt;]:BB:HUWB:MACHeader:FTYPE</code> .....	70
<code>[SOURce&lt;hw&gt;]:BB:HUWB:MACHeader:FVERsion</code> .....	70
<code>[SOURce&lt;hw&gt;]:BB:HUWB:MACHeader:IEPResent</code> .....	71
<code>[SOURce&lt;hw&gt;]:BB:HUWB:MACHeader:LDADdress</code> .....	71
<code>[SOURce&lt;hw&gt;]:BB:HUWB:MACHeader:LDEPANid</code> .....	71
<code>[SOURce&lt;hw&gt;]:BB:HUWB:MACHeader:LFRControl</code> .....	72
<code>[SOURce&lt;hw&gt;]:BB:HUWB:MACHeader:LSADdress</code> .....	72
<code>[SOURce&lt;hw&gt;]:BB:HUWB:MACHeader:LSEPANid</code> .....	72
<code>[SOURce&lt;hw&gt;]:BB:HUWB:MACHeader:LSEQnumber</code> .....	73
<code>[SOURce&lt;hw&gt;]:BB:HUWB:MACHeader:LSOPANid</code> .....	73
<code>[SOURce&lt;hw&gt;]:BB:HUWB:MACHeader:PIDComp</code> .....	73
<code>[SOURce&lt;hw&gt;]:BB:HUWB:MACHeader:REServed</code> .....	74
<code>[SOURce&lt;hw&gt;]:BB:HUWB:MACHeader:SAD2</code> .....	74
<code>[SOURce&lt;hw&gt;]:BB:HUWB:MACHeader:SAD3</code> .....	74
<code>[SOURce&lt;hw&gt;]:BB:HUWB:MACHeader:SAD4</code> .....	74
<code>[SOURce&lt;hw&gt;]:BB:HUWB:MACHeader:SADD</code> .....	74
<code>[SOURce&lt;hw&gt;]:BB:HUWB:MACHeader:SADMode</code> .....	74
<code>[SOURce&lt;hw&gt;]:BB:HUWB:MACHeader:SEENabled</code> .....	75
<code>[SOURce&lt;hw&gt;]:BB:HUWB:MACHeader:SENSupp</code> .....	75
<code>[SOURce&lt;hw&gt;]:BB:HUWB:MACHeader:SEQNumber</code> .....	75
<code>[SOURce&lt;hw&gt;]:BB:HUWB:MACHeader:SPANid</code> .....	75
<code>[SOURce&lt;hw&gt;]:BB:HUWB:MACHeader:STATe</code> .....	76
<code>[SOURce&lt;hw&gt;]:BB:HUWB:MACHeader:STRing?</code> .....	76

---

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

Sets the bit in the AR field.

#### Parameters:

<code>&lt;AR&gt;</code>	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 <DestinationPanId>**

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

**Parameters:**

<DestinationPanId> 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 <lePresent>**

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:**

<lePresent>            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.
SOURcel:BB:HUWB:IMPairments:STERror 10
// Configure frequency offset in Hz.
SOURcel:BB:HUWB:IMPairments:FOFFset 25000
// Activate impairing the signal.
SOURcel:BB:HUWB:IMPairments:STATe 1
```

[\[:SOURce<hw>\]:BB:HUWB:IMPairments:FOFFset](#)..... 76  
[\[:SOURce<hw>\]:BB:HUWB:IMPairments:STATe](#)..... 76  
[\[:SOURce<hw>\]:BB:HUWB:IMPairments:CCERror](#)..... 76

---

**[: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:HUSB:FILTer:TYPE RCOS
SOURCE1:BB:HUSB:FILTer:ROFactor 0.5
// Set an oversampling factor of 1.
SOURCE1:BB:HUSB:FILTer:OSAMP OS_1
SOURCE1:BB:HUSB:FILTer:SRATE:VARIation?
// Response in Hz: 499200000
SOURCE1:BB:HUSB:FILTer:OSAMP OS_2
SOURCE1:BB:HUSB:FILTer:SRATE:VARIation?
// Response in Hz: 998400000

// *****
// Configure an LTE filter.
// *****
SOURCE1:BB:HUSB:FILTer:TYPE LTEF
SOURCE1:BB:HUSB:FILTer:PARAMeter:LTE:OPTimization EVM
// LTE filter is optimized for EVM performance.
SOURCE1:BB:HUSB:FILTer:PARAMeter:LTE:COFFactor 0.1
SOURCE1:BB:HUSB:FILTer:PARAMeter:LTE:ROFactor -0.2
// Change LTE filter optimization for ACP performance.
SOURCE1:BB:HUSB:FILTer:PARAMeter:LTE:OPTimization ACP
SOURCE1:BB:HUSB:FILTer:PARAMeter:LTE:COFS 0.34
// Check, if the internal filter is active.
SOURCE1:BB:HUSB:FILTer:AUTO?
// Response: 0
// The internal filter is not active.

// *****
// Configure a user-defined filter.
// *****
SOURCE1:BB:HUSB: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".
```

<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:FILTer:TYPE</a> .....	78
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:FILTer:OSAMpling</a> .....	78
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:FILTer:PARAmeter:APCo25</a> .....	79
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:FILTer:PARAmeter:COSSine</a> .....	79
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:FILTer:PARAmeter:GAUSSs</a> .....	79
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:FILTer:PARAmeter:LPASs</a> .....	79
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:FILTer:PARAmeter:LPASsevm</a> .....	79
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:FILTer:PARAmeter:PGAuss</a> .....	79
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:FILTer:PARAmeter:RCOSSine</a> .....	79
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:FILTer:PARAmeter:SPHase</a> .....	79
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:FILTer:PARAmeter:LTE:COFFactor</a> .....	79
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:FILTer:PARAmeter:COSSine:COFS</a> .....	80
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:FILTer:PARAmeter:LTE:COFS</a> .....	80
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:FILTer:PARAmeter:LTE:OPTimization</a> .....	80
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:FILTer:PARAmeter:LTE:ROFactor</a> .....	80
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:FILTer:PARAmeter:USER</a> .....	80
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:SRATe:VARiation</a> .....	81

---

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

Selects the baseband filter type.

#### **Parameters:**

<Type> RCOSine | COSine | GAUSSs | LGAuss | CONE | COF705 |  
 COEQualizer | COFequalizer | C2K3x | APCO25 | SPHase |  
 RECTangle | USER | PGAuss | LPASs | DIRac | ENPShape |  
 EWPSshape | 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:GAUSSs <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	Increment	Default
APCO25	Rolloff factor	<Apco25>	0.05	0.99	0.01	0.2
COSine	Rolloff factor	<Cosine>	0	1	0.01	0.1
GAUSSs	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
```

<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:CLIPping:LEVel</a> .....	81
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:CLIPping:MODE</a> .....	81
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:CLIPping:STATe</a> .....	82

---

**[: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.
// *****
SOURCEl:BB:HUIWB:TRIGger:SEQuence SING
SOURCEl:BB:HUIWB:TRIGger:SOURce INT
SOURCEl:BB:HUIWB:TRIGger:SLUNit SEQ
SOURCEl:BB:HUIWB:TRIGger:SLUNit FRAME
SOURCEl:BB:HUIWB: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.
// *****
SOURCEl:BB:HUIWB:TRIGger:SEQuence ARETrigger
SOURCEl:BB:HUIWB:TRIGger:SOURce INT
SOURCEl:BB:HUIWB:STATe 1
SOURCEl:BB:HUIWB:TRIGger:EXECute
SOURCEl:BB:HUIWB:TRIGger:ARM:EXECute
// Trigger event restarts signal generation.
SOURCEl:BB:HUIWB:TRIGger:RMODe?
// Response: 1
// Trigger is running.
```

**Commands:**

[SOURCE<hw>]:BB:HUIWB:TRIGger:ARM:EXECute.....	84
[SOURCE<hw>]:BB:HUIWB:TRIGger:DELAy:UNIT.....	84
[SOURCE<hw>]:BB:HUIWB:TRIGger:TIME[:STATe].....	84
[SOURCE<hw>]:BB:HUIWB:TRIGger:TIME:DATE.....	84
[SOURCE<hw>]:BB:HUIWB:TRIGger:TIME:TIME.....	85
[SOURCE<hw>]:BB:HUIWB:TRIGger:EXECute.....	85
[SOURCE<hw>]:BB:HUIWB:TRIGger:EXTErnal:RDELAy?.....	86
[SOURCE<hw>]:BB:HUIWB:TRIGger:EXTErnal:TDELAy.....	86
[SOURCE<hw>]:BB:HUIWB:TRIGger:OBASeband:DELAy.....	86
[SOURCE<hw>]:BB:HUIWB:TRIGger:OBASeband:INHibit.....	86
[SOURCE<hw>]:BB:HUIWB:TRIGger:OBASeband:RDELAy?.....	87
[SOURCE<hw>]:BB:HUIWB:TRIGger:OBASeband:TDELAy.....	87
[SOURCE<hw>]:BB:HUIWB:TRIGger:RMODe?.....	87
[SOURCE<hw>]:BB:HUIWB:TRIGger:SLENgth.....	87
[SOURCE<hw>]:BB:HUIWB:TRIGger:SLUNit.....	88
[SOURCE<hw>]:BB:HUIWB:TRIGger:SOURce.....	88
[SOURCE<hw>]:BB:HUIWB:TRIGger[:EXTErnal]:DELAy.....	89
[SOURCE<hw>]:BB:HUIWB:TRIGger[:EXTErnal]:INHibit.....	89
[SOURCE<hw>]:BB:HUIWB:TRIGger[:EXTErnal]:SYNC:OUTPut.....	89
[SOURCE<hw>]:BB:HUIWB[:TRIGger]:SEQuence.....	89

---

**[ :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 SMM100A 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 sub-chapter "Trigger Commands" of the chapter "SOURce:BB:ARB subsystem" in the R&S SMM100A 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 sub-chapter "Trigger Commands" of the chapter "SOURCE:BB:ARB subsystem" in the R&S SMM100A 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 sub-chapter "Trigger Commands" of the chapter "SOURCE:BB:ARB subsystem" in the R&S SMM100A 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 local or global connectors
  - EGT1 | EGT2: External global trigger
  - EGC1 | EGC2: External global clock
- In primary-secondary instrument mode, the external baseband synchronization signal (BBSY)
- OBASeband | BEXTernal | EXTernal: **Setting only**  
 Provided only for backward compatibility with other Rohde & Schwarz signal generators.  
 The R&S SMM100A accepts these values and maps them automatically as follows:  
 EXTernal = EGT1, BEXTernal = EGT2, OBASeband = INTA

**Parameters:**

<Source> INTernal|EGT1|EGT2|EGC1|EGC2|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
```

<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:TRIGger:OUTPut&lt;ch&gt;:MODE.....</a>	90
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:TRIGger:OUTPut&lt;ch&gt;:DELay.....</a>	90
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:TRIGger:OUTPut&lt;ch&gt;:ROFFset.....</a>	91
<a href="#">[:SOURce&lt;hw&gt;]:BB:HUWB:TRIGger:OUTPut&lt;ch&gt;:FOFFset.....</a>	91

---

**[: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
```

```
SOURce1:BB:HUWB:CLOCK:SOURce EXT
SOURce1:BB:HUWB:CLOCK:MODE SAMP
CLOCK:INPUt:FREQuency?
// Response in Hz: 1000000
```

```
[ :SOURce<hw>]:BB:HUWB:CLOCK:MODE.....91
[:SOURce<hw>]:BB:HUWB:CLOCK:SOURce.....92
```

---

```
[ :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
- **ELCLock**: External local clock
- **EXTernal = ELCLock**: Setting only  
Provided for backward compatibility with other Rohde & Schwarz signal generators

**Parameters:**

<Source>            INTernal  
                      \*RST:        INTernal

**Example:**            See [Example "To configure clock settings"](#) on page 91.

**Manual operation:** See ["Clock Source"](#) on page 45

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