Bluetooth® Enhanced Data Rate Digital Standard for R&S®SMW200A

User Manual

1175.6803.02 ─ 02

Test & Measurement

User Manual

ROHDE&SCHWARZ

This document describes the following software options:

- R&S®SMW-K60
  1413.4239.02

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The following abbreviations are used throughout this manual: R&S®SMW200A is abbreviated as R&S SMW, R&S®WinIQSIM2 is abbreviated as R&S WinIQSIM2

Contents

1 Preface

1.1 Documentation Overview

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

- Getting Started printed manual
- Online Help system on the instrument
- Documentation CD-ROM with:
  - Getting Started
  - Online help system (`*.chm`) as a standalone help
  - User Manuals for base unit and options
  - Service manual
  - Data sheet and product brochure
  - Links to useful sites on the R&S internet

Online Help

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

Getting Started

This manual is delivered with the instrument in printed form and in PDF format on the documentation CD. It provides the information needed to set up and start working with the instrument. Basic operations and typical measurement examples are described. Safety information is also included.

User Manual

User manuals are provided for the base unit and each additional (software) option.

The user manual for the base unit is a supplement to the Getting Started manual and provides basic information on operating the R&S SMW in general. In this manual, all instrument functions are described in detail. Furthermore, it provides a complete description of the remote control commands with programming examples. An introduction to remote control is provided, as well as information on maintenance, instrument interfaces and troubleshooting.

In the user manuals for the individual software options, the specific instrument functions of this option are described in detail. For additional information on default settings and parameters, refer to the data sheets. Basic information on operating the R&S SMW is not included in these user manuals.

The user manuals are available in PDF format - in printable form - on the Documentation CD-ROM delivered with the instrument.

All user manuals are also available for download from the R&S website, on the R&S SMW product page at http://www.rohde-schwarz.com/product/SMW.html.

Service Manual

This manual is available in PDF format on the CD delivered with the instrument. It describes how to check compliance with rated specifications, instrument function, repair, troubleshooting and fault elimination. It contains all information required for repairing the R&S SMW by replacing modules.

Release Notes

The release notes describe the installation of the firmware, new and modified functions, eliminated problems, and last minute changes to the documentation. The corresponding firmware version is indicated on the title page of the release notes. The most recent release notes are available for download from the R&S website, on the R&S SMW product page at http://www.rohde-schwarz.com/product/SMW.html > Downloads > Firmware.

Web Helps

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

The web help is an additional file format that offers quick online access. The web helps are not intended for download but rather to access the required information directly form the R&S website.

Web helps are available at the R&S website, on the R&S SMW product page at http://www.rohde-schwarz.com/product/SMW.html > Download > Web Help.

1.2 Conventions Used in the Documentation

1.2.1 Typographical Conventions

The following text markers are used throughout this documentation:

Convention	Description
"Graphical user interface elements"	All names of graphical user interface elements on the screen, such as dialog boxes, menus, options, buttons, and softkeys are enclosed by quotation marks.
KEYS	Key names are written in capital letters.
`File names, commands, program code`	File names, commands, coding samples and screen output are distinguished by their font.
Input	Input to be entered by the user is displayed in italics.

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

1.2.2 Conventions for Procedure Descriptions

When describing how to operate the instrument, several alternative methods may be available to perform the same task. In this case, the procedure using the touchscreen is described. Any elements that can be activated by touching can also be clicked using an additionally connected mouse. The alternative procedure using the keys on the instrument or the on-screen keyboard is only described if it deviates from the standard operating procedures.

The term "select" may refer to any of the described methods, i.e. using a finger on the touchscreen, a mouse pointer in the display, or a key on the instrument or on a keyboard.

2 About this Digital Standard and Basics

2.1 Introduction

The R&S Signal Generator provides you with ability to generate signals in accordance with Bluetooth Specification 2.1+EDR. The basic documents for this specification are regulations for Europe, Japan and North America. The frequency band defined for Bluetooth devices is the unlicensed 2.4 GHz ISM (Industrial Scientific medical) frequency band.

Two modulation modes are used for Bluetooth: a mandatory mode, called the Basic Rate and an optional one, called the Enhanced Data Rate. The Basic Rate mode uses binary FM modulation and has data rate of 1 MBps. The Enhanced Data Rate uses two types of PSK modulation, the π/4-DQPSK or 8DPSK, and achives data rates of 2 Mbps and 3 Mbps, respectively. All modulations schemes have the symbol rate equal to 1Ms/s.

A Time Division Duplex (TDD) scheme for full duplex transmission is defined for both modes.

The latest Bluetooth Low Energy specification is supported as well. See chapter 3.6.3, "Bluetooth Low Energy", on page 34 for a detailed description on Bluetooth Low Energy support.

The following list gives an overview of the options provided by the R&S Signal Generator for generating of signals according to the Bluetooth specification:

- Support for three transport modes, the ACL+EDR, SCO, eSCO+EDR transport modes
- Support of all packet types for both the Basic Rate and the Enhanced Data Rate modes
- Generation of signals with up to 5238 frames sequence length
- Configuration of the packet contents with a convenient packet editor or all data packets, both with optional data whitening
- Generation of signals in accordance to the Dirty Transmitter Test specification for both the basic and Enhanced Data Rates and with possibilities to change the start phase, the frequency drift rate and the frequency drift deviation
- Power Ramp Control with possibilities to choose ramp time, rise and fall offset
- Configuration of the clipping, filter and modulation settings

2.1.1 Bluetooth Transport Modes

There are three different transport modes defined in the Bluetooth specification, each of them with special applications:

- Synchronous Connection-Oriented (SCO)
  The SCO transport mode is used for a symmetric point-to-point link establishment between a master and a specific slave in the piconet.
- Extended Synchronous Connection-Oriented (eSCO)

The eSCO transport mode is used for a symmetric or asymmetric, point-to-point link establishment between the master and a specific slave.

- Asynchronous Connection-Less (ACL)
  The ACL transport mode is used for a point-to-multipoint link establishment between the master and all slaves participating on the piconet.

There are some common transmitted packets used by all transport modes and some specific packets defined for each transport mode.

2.1.2 Bluetooth Packet Types

2.1.2.1 ACL packets

The ACL packets are used for asymmetric links and they contain user data or control data. The table and the figures below give an overview of the ACL packets and their structure.

Table 2-1: ACL packet - Bascic Rate

Type	Payload Header (bytes)	User Payload (bytes)	FEC	CRC	Slot Num ber
DM1	1	0-17	2/3	Yes, 16-bit	1
DH1		0-27	no		
DM3	2	0-121	2/3		3
DH3		0-183	no		
DM5		0-224	2/3		5
DH5		0-339	no		
AUX1	1	0-29		no	

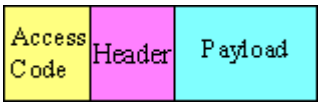


Fig. 2-1: Packet Structure of ACL packets - Basic Rate

Table 2-2: ACL packets - Enhanced Rate

Type	Payload Header (bytes)	User Payload (bytes)	FEC	CRC	Slot Num ber
2-DH1	2	0-54	no	Yes, 16-bit	1
2-DH3		0-367			3
2-DH5		0-679			5
3-DH1		0-83			1

Type	Payload Header (bytes)	User Payload (bytes)	FEC	CRC	Slot Num ber
3-DH3		0-552			3
2-DH5		0-1021			5

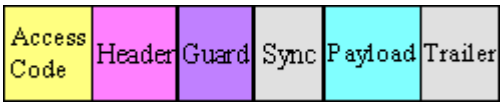


Fig. 2-2: Packet Structure of ACL packets - Enhanced Rate

2.1.2.2 SCO and eSCO packets

The SCO and eSCO packets are used for symmetric links. The SCO packets are used for 64 kb/s speech transmission and for transparent synchronous data. The eSCO packets are also used for 64kb/s speech transmission and transparent data at 64 kb/s but also at other rates.

The tables and the figures below give an overview of the SCO and eSCO packets and their structure.

Table 2-3: SCO packets

Type	Payload Header (bytes)	User Payload (bytes)	FEC	CRC	Slot Num ber
HV1	n.a.	10	1/3	no	n.a.
HV2		20	2/3		
HV3		30			
DV	1 (Data only)	10+(0-9)	2/3 (Data only)	Yes, 16-bit (Data only)	

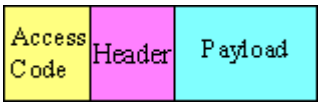


Fig. 2-3: Packet Structure SCO packets

Fig. 2-4: Packet Structure SCO packets (data only)

Table 2-4: eSCO packets - Basic Rate

Type	Payload Header (bytes)	User Payload (bytes)	FEC	CRC	Slot Num ber
EV3	n.a.	1-30	no	Yes, 16-bit (Data only)	1
EV4		1-120	2/3		3
EV5		1-180	no		3

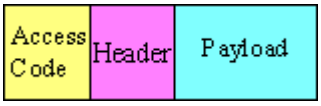


Fig. 2-5: Packet Structure eSCO packets - Basic Rate

Table 2-5: eSCO packets - Basic Rate

Type	Payload Header (bytes)	User Payload (bytes)	FEC	CRC	Slot Num ber
2-EV3	n.a.	1-60	no	Yes, 16-bit	1
2-EV5		1-360			3
3-EV3		1-90			1
3-EV5		1-540			3

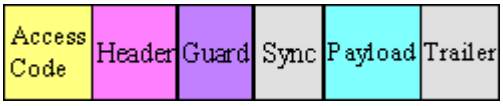


Fig. 2-6: Packet Structure eSCO packets - Enhanced Rate

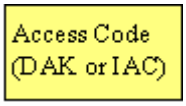
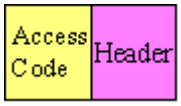
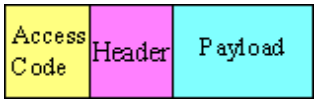
2.1.2.3 Link control packets for ACL, SCO, eSCO transport modes

There are some common kinds of packet types. An overview of these packet types is given in the table below.

Table 2-6: Common link control packets

Transport modes	Type	Payload Header (bytes)	FEC	CRC	Application
SCO,eSCO,ACL	ID				Paging, inquiry, response
SCO,eSCO,ACL	NULL	n.a.	n.a.	n.a.	Carries Link information to the source, e.g. about successfully received signal (ARQN) or the state of the receiving buffer (FLOW)
SCO,eSCO,ACL	POLL				Similar to NULL packet, used by master to poll the slaves, must be confirmed
SCO,ACL	FHS	18	2/3	Yes	Page master response, inquiry response, in roll switch

Table 2-7: Common link control packets: packet structure

Packet Type ID	Packet Types NULL and PULL	Packet Types FHS
		

2.1.3 Packet Structure and Fields

Allmost all Bluetooth transmitted packets have standard format and consist of the access code, the header and the payload with useful information. The exceptions are the ID packet which consists of the access code only and NULL and POLL packets which carry only the access code and the header.

2.1.3.1 Access code

The access code is used for synchronisation, DC offset compensation and identification. The fields of the access code are shown in the figure below and their meaning is explained in the table below.

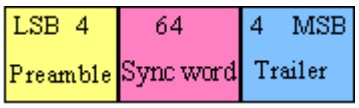


Table 2-8: The access code fields

Field	Description	Packets
Preamble	A fixed zero-one pattern of 4 symbols, used to facilitate DC compensation	All packets
Sync Word	A 64-bit code word derived from a 24 bit address, improves timing acquisition	All packets
Trailer	A fixed zero-one pattern of four symbols, extended DC compensation	All packets, except ID

2.1.3.2 Header

The Header contains link control information. The fields of the header are shown in the figure and their meaning is explained in the table below.

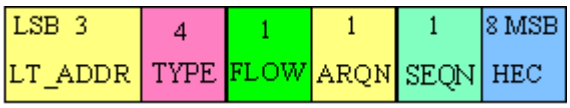


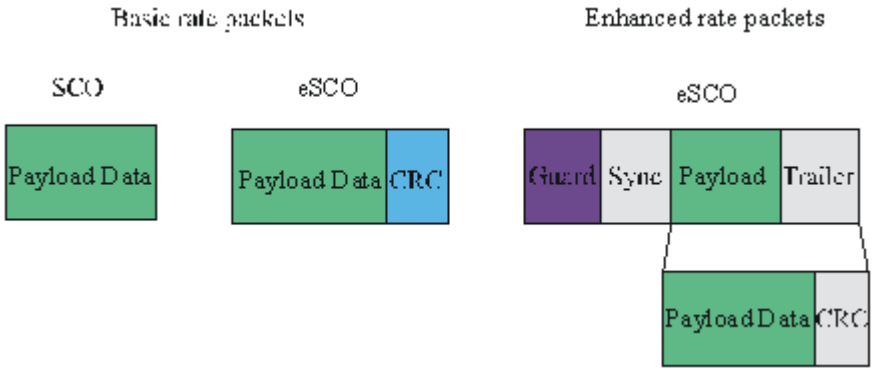
Table 2-9: The header fields

Field	Description	Packets
LT_ADDR	Logical transport address, indicates the destination slave for a packet in a master-to-slave transmission slot and the source slave for a slave-to-master transmission slot	
TYPE	Type code, specifies which packet type is used	
FLOW	Flow control, used for flow control of packets over the ACL logical transport. When the RX buffer in the recipient is full, a STOP indication shall be returned. When the RX buffer can accept data, a Go indication shall be returned.	All packets, except ID
ARQN	Automatic Repeat Request Number, acknowledgement indication, used to inform the source of a successful transfer of payload data with CRC can be positive acknowledged ACK or negative acknowledged NAK,	
SEQN	Sequential numbering scheme to order the data packet stream	
HEC	Header-error-check to check the header integrity	

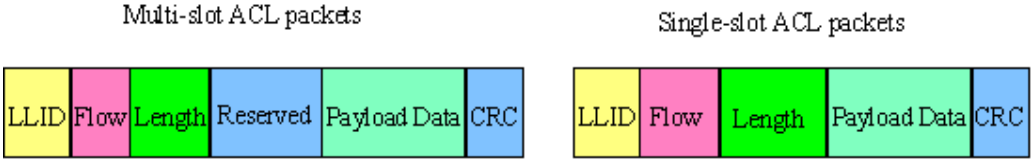
2.1.3.3 Payload format

The payload structure depends on the type of the data field and the data rate. Two fields are defined in the payload: the synchronous data field and the asynchronous data field. The ACL packets only have the asynchronous data field and the SCO and eSCO packets only have the synchronous data field. The exception is DV of SCO transport mode which has both data fields, synchronous and asynchronous.

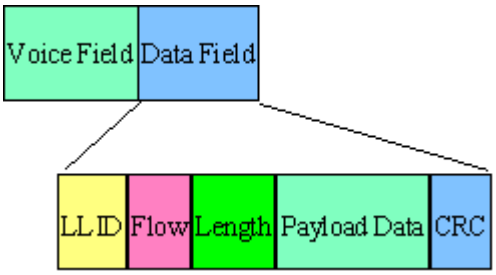
Synchronous data fields



Asynchronous data fields



Synchronous and Asynchronous data fields



The meaning of some payload fields is given in the table below.

Table 2-10: The payload fields

Field	Description
CRC	The cyclic redundancy error check
Guard, Sync	The guard time and synchronization sequence, used for physical layer change of modulation scheme
LLID	The logical link identifier, specifies the logical link
Flow	Field which controls the flow on the logical channels

The payload format and content of the FHS packet are different from other packets. The fields of the FHS packet are shown in the figure below and their meaning is explained in the table below.

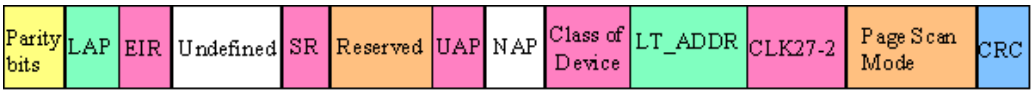


Table 2-11: The payload fields for the FHS packet

Field	Description
Parity bits	Form the first part of the sync word of the access code of the device that sends the FHS packet
LAP	Contains the lower address part of the device that sends the FHS packet
EIR	An extended inquiry response, provides miscellaneous information during the inquiry response procedure
Undefined	Reserved for future use and shall be set to zero
SR	The scan repetition field, indicates the interval between two consecutive page scan windows
Reserved	Shall be set to 10
UAP	Contains the upper address part of the device that sends the FHS packet
NAP	Contains the non–significant address part of the device that sends the FHS packet
Class of device	Contains the class of device of the device that sends the FHS packet. This field is defined in Bluetooth Assigned Numbers.
LT_ADDR	Contains the logical transport address

Field	Description
CLK27-2	Contains the value of the native clock of the device that sends the FHS packet, sampled at the beginning of the transmission of the access code of this FHS packet
Page scan mode	Indicates which scan mode is used by default by the sender of the FHS packet

2.1.4 Bluetooth Modulation Schemes

The modulation used for the basic data rate packets is GFSK (Gaussian Frequency Shift Keying) with a bandwidth bit period product BT=0.5. The modulation index is between 0.28 and 0.35.

The modulation scheme used for enhanced data rate packets changes within the packet. The access code and packet header has GFSK modulation scheme and are transmitted with the Basic Rate 1Mbps, while the subsequent synchronisation sequence, payload and trailer sequence have a PSK type of modulation and are transmitted with a data rate of 2 Mbps or optionally 3 Mbps.

The PSK modulation, namely π/4 rotated differential encoded quaternary phase shift keying (π/4–DQPSK) is defined for for the 2 Mbps transmission.

The PSK modulation, namely differential encoded 8-ary phase shift keying (8DPSK), is defined for the 3Mbps transmission.

The modulation types and corresponding packet types are given in the table below.

Table 2-12: The modulation types and corresponding packet types

Modulation type	Packet types
GFSK	ID, NULL, POLL, FHS, DM1, DH1, DM3, DH3, DM5, DH5, AUX1, HV1, HV2, HV3, DV, EV3, EV4, EV5
GFSK + π/4-DQPSK	2-DH1, 2-DH3, 2-DH5, 2-EV3, 2-EV5
GFSK + 8DPSK	3-DH1, 3-DH3, 3-DH5, 3-EV3, 3-EV5

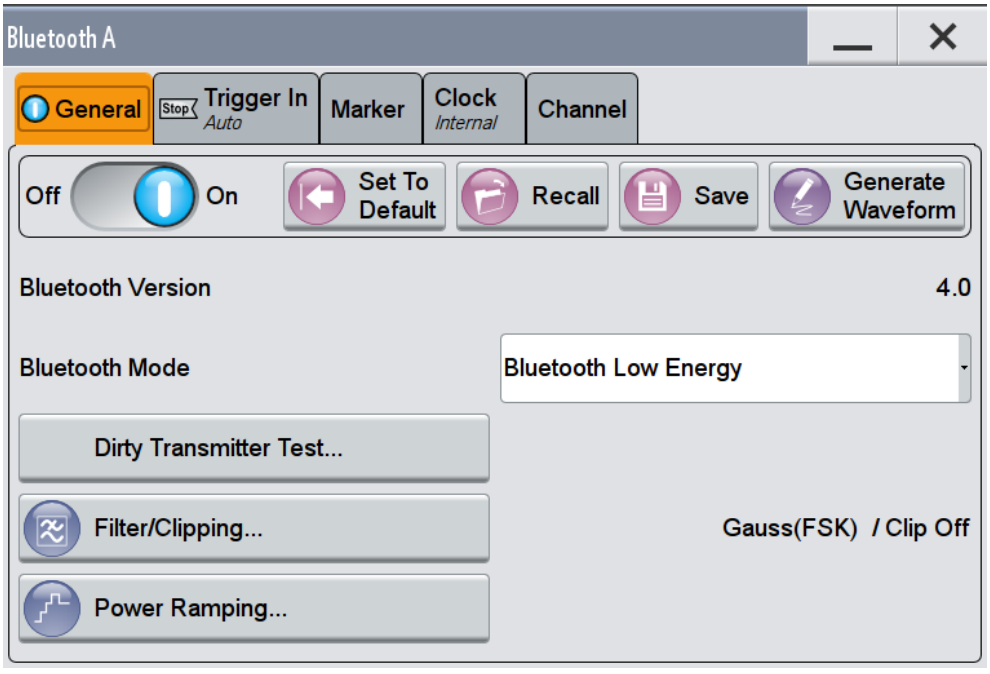
3 Bluetooth Configuration and Settings

► To access the Bluetooth settings, select "Baseband > Bluetooth".

The remote commands required to define these settings are described in chapter 4, "Remote-Control Commands", on page 65.

3.1 General Settings

► To access the Bluetooth settings, select "Baseband > Bluetooth > General".



This dialog provides access to the default and the "Save/Recall" settings. The choice of the bluetooth mode and transport mode determines which parameters are available.

State
Enables/disables the Bluetooth standard.

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

Remote command:
[:SOURce<hw>]:BB:BTOoth:STATe on page 69

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 Set to default
Bluetooth Version	2.1 + EDR (2.1 = current version number)
Bluetooth Mode	Basic Rate + EDR
Transport mode	ACL (Asynchronous) + EDR
Packet type	DH1
Sequence length	1 Frames
Packet configuration	Packet Editor/ Whitening off
Dirty Transmitter Test	Not in Use
Filter	Gauss (FSK)
Clipping	Clipping off
Power Ramping	Cosine / 1 Symbols
Trigger	Auto
Marker	Restart
Clock	Internal

Remote command:
[:SOURce<hw>]:BB:BTOoth:PRESet on page 67

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

The file name and the directory it is stored in are user-definable; the file extension is however predefined.

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

Remote command:
[:SOURce<hw>]:BB:BTOoth:SETTing:CATalog on page 68
[:SOURce<hw>]:BB:BTOoth:SETTing:LOAD on page 68
[:SOURce<hw>]:BB:BTOoth:SETTing:STORe on page 69
[:SOURce<hw>]:BB:BTOoth:SETTing:DELete on page 68

Generate Waveform File
With enabled signal generation, triggers the instrument to store the current settings as an ARB signal in a waveform file. Waveform files can be further processed by the ARB and/or as a multi carrier or a multi segment signal.

The file name and the directory it is stored in are user-definable; the predefined file extension for waveform files is `*.wv`.

Remote command:
[:SOURce<hw>]:BB:BTOoth:WAVeform:CREate on page 70

Bluetooth Version
Displays the current version of the standard.

The default settings and parameters provided are oriented towards the specifications of the version displayed.

Remote command:
[:SOURce<hw>]:BB:BTOoth:VERSion on page 70

Bluetooth Mode
Determines the digital Bluetooth standard. Basic Rate + EDR or Bluetooth Low Energy are available.

"Basic Rate +EDR"
Selects the Bluetooth mode Basic Rate + EDR.
Specific settings of the basic mode are described in chapter 3.6.1, "Bluetooth Basic Rate + EDR", on page 28.

"Bluetooth Low Energy"
Selects the Bluetooth mode Low Energy. The settings concerning Bluetooth Low Energy mode are described in chapter 3.6.3, "Bluetooth Low Energy", on page 34.

Remote command:
[:SOURce<hw>]:BB:BTOoth:BMODe on page 105

Transport Mode
Only available for "Bluetooth Mode " set to "Basic Rate + EDR"

Selects the transport mode.

"ACL+EDR" The transport mode selected is used for a point-to-multipoint link establishment between the master and all the slaves participating on the piconet.

"SCO" The transport mode selected is used for a point-to-point link establishment between a master and a single slave in the piconet.

"eSCO+EDR" The transport mode selected is used for a symmetric or asymmetric point-to-point link establishment between a master and a specific slave.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:TMODe` on page 69

Dirty Transmitter Test
Access to the "Dirty Transmitter Test" dialog, see chapter 3.7, "Dirty Transmitter Test", on page 56.

Filter / Clipping
Access to the dialog for setting baseband filtering, the modulation settings and clipping, see chapter 3.8, "Filter/Clipping Settings", on page 59.

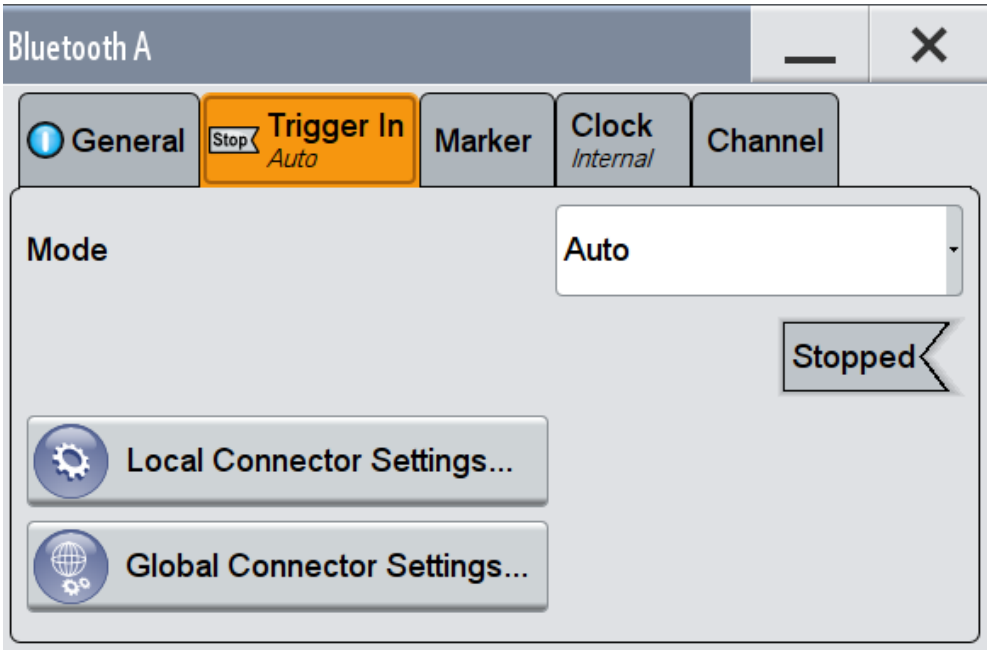
Power Ramping
Access to the "Power Ramp Control" dialog, see chapter 3.9, "Power Ramping Settings", on page 63.

3.2 Trigger Settings

This tab provides an access to the settings necessary to select and configure the trigger, like trigger source, mode, trigger delay, trigger suppression, as well as to arm or trigger an internal trigger manually. The current signal generation status is displayed in the header of the tab together with information on the enabled trigger mode. As in the "Marker" and "Clock" tabs, this tab provides also an 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 chapter "Basics" in the R&S SMW user manual.

► To access this dialog, select "Baseband > Bluetooth > Trigger In".



This dialog comprises the settings required for configuring the trigger.

Routing and Enabling a Trigger

The provided trigger signals are not dedicated to a particular connector but can be mapped to one or more globally shared USER or local T/M/(C) connectors.

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

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

- Define the signal source and the effect of a trigger event, i.e. select the "Trigger In > Mode" and "Trigger In > Source"
- Define the connector, USER or T/M/(C), the selected signal is provided at, i.e. configure the Local and Global Connector Settings.

Provided are the following settings:

Trigger Mode

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

Note: To enable simultaneous signal generation in all basebands, the trigger settings in the available basebands are coupled in any instrument's configuration involving signal routing with signal addition (e.g. MIMO configuration, routing and summing of basebands and/or streams).

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

- "Auto"
  The signal is generated continuously.
- "Retrigger"

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

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

Remote command:
`[:SOURce<hw>]:BB:BTOoth[:TRIGger]:SEQuence` on page 82

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

"Sequence Length"	The selected unit for the entry of the length of the signal sequence at the output in the Single trigger mode is sequence length .
"Frames"	The selected unit for the entry of the length of the signal sequence at the output in the Single trigger mode is frame.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:TRIGger:SLUNit` on page 80

Trigger Signal Duration
Enters the length of the signal sequence to be output in the "Single" trigger mode. The input is expressed in the signal units.

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

Remote command:
`[:SOURce<hw>]:BB:BTOoth:TRIGger:SLENgth` on page 80

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

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

Remote command:
`[:SOURce<hw>]:BB:BTOoth:TRIGger:RMODe` on page 79

Arm
Stops the signal generation until subsequent trigger event occurs.

Remote command:
[:SOURce<hw>]:BB:BTOoth:TRIGger:ARM:EXECute on page 77

Execute Trigger
For internal trigger source, executes trigger manually.

Remote command:
[:SOURce<hw>]:BB:BTOoth:TRIGger:EXECute on page 78

Trigger Source
Note: To enable simultaneous signal generation in all basebands, the trigger settings in the available basebands are coupled in any instrument's configuration involving signal routing with signal addition (e.g. MIMO configuration, routing and summing of basebands and/or streams).

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

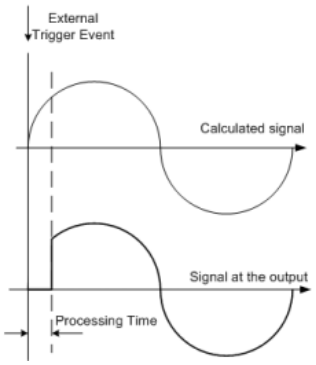
The following sources of the trigger signal are available:

- "Internal"
  The trigger event is executed manually by the "Execute Trigger".
- "Internal (Baseband A/B)"
  The trigger event is provided by the trigger signal from the other basebands.
- "External Global Trigger 1 / 2"
  The trigger event is the active edge of an external trigger signal provided and configured at the global USER connectors.
- "External Global Clock 1 / 2"
  The trigger event is the active edge of an external global clock signal provided and configured at the global USER connectors.
- "External Local Trigger"
  The trigger event is the active edge of an external trigger signal provided and configured at the local T/M/(C) connector.
  With coupled trigger settings, the signal has to be provided at the T/M/C 1/2/3 connectors.
- "External Local Clock"
  The trigger event is the active edge of an external local clock signal provided and configured at the local T/M/C connector.
  With coupled trigger settings, the signal has to be provided at the T/M/C 1 connector.

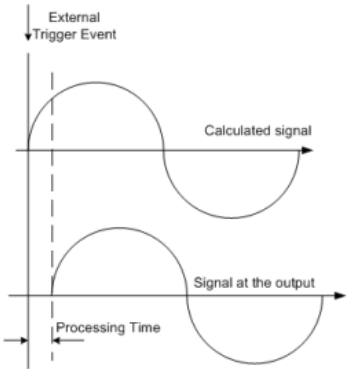
Remote command:
[:SOURce<hw>]:BB:BTOoth:TRIGger:SOURce on page 81

Sync. Output to External Trigger
For an external trigger signal, enables/disables the output of a signal synchronous to the external trigger event.

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



Remote command:
`[:SOURce<hw>]:BB:BTOoth:TRIGger[:EXTernal]:SYNChronize:OUTPut` on page 78

External Trigger Delay
For external trigger signal or trigger signal from the other path, sets the trigger signal delay.

One possible application field of this feature is the synchronization of the instrument with the device under test (DUT) or other external devices.

For more information, see chapter "Basics" in the R&S SMW User Manual.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:TRIGger[:EXTernal]:DELay` on page 81
`[:SOURce<hw>]:BB:BTOoth:TRIGger:OBASeband:DELay` on page 78

External Trigger Inhibit
For external trigger signal or trigger signal from the other path, sets the duration a new trigger event subsequent to triggering is suppressed. In "Retrigger" mode for example, a new trigger event will not cause a restart of the signal generation until the specified inhibit duration does not expire.

For more information, see chapter "Basics" in the R&S SMW User Manual.

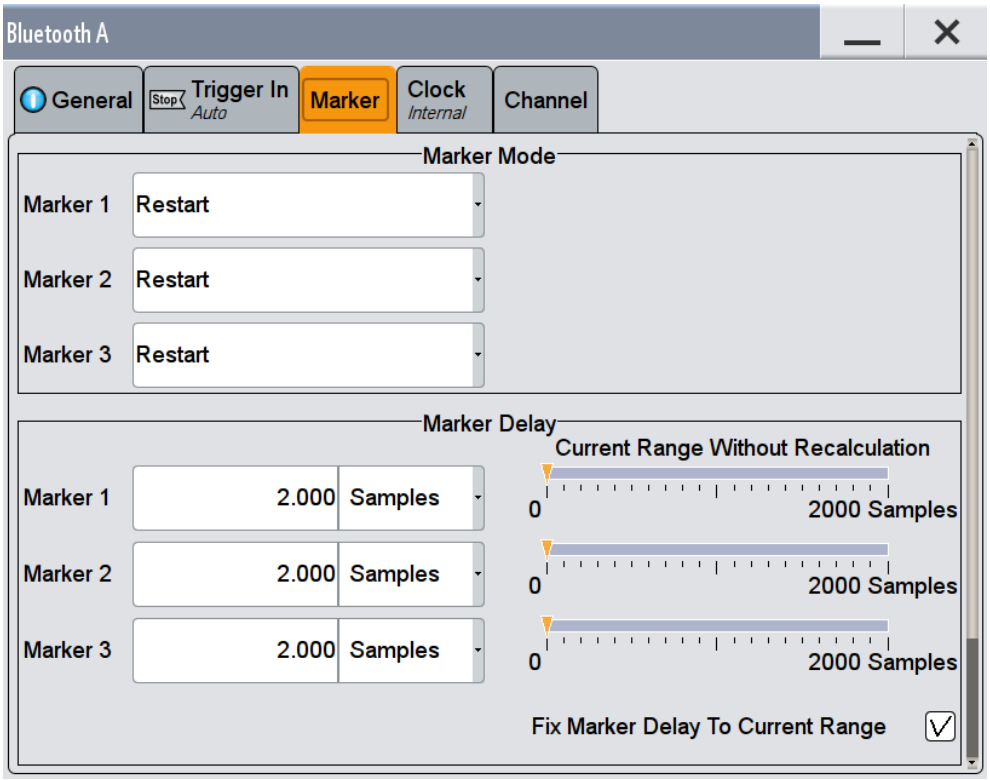
Remote command:
`[:SOURce<hw>]:BB:BTOoth:TRIGger[:EXTernal]:INHibit` on page 82
`[:SOURce<hw>]:BB:BTOoth:TRIGger:OBASeband:INHibit` on page 79

3.3 Marker Settings

This tab provides an access to the settings necessary to select and configure the marker output signal, like the marker mode or marker delay settings.

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

► To access this dialog, select "Baseband > Bluetooth > Marker".



This dialog comprises the settings required for configuring the marker.

Routing and Enabling a Marker

The provided marker signals are not dedicated to a particular connector but can be mapped to one or more globally shared USER or local T/M/(C) 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, USER or T/M/(C), the selected signal is output at, i.e. configure the Local and Global Connector Settings.

Provided are the following settings:

Marker Mode

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

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

"Frame Start" A marker signal is generated at the start of each frame.

"Frame Active Part" The marker masks the active part of the frame. At the start of each burst, the marker signal changes to high. It changes back to low after the end of each burst.

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

Remote command:

`[:SOURce<hw>]:BB:BTOoth:TRIGger:OUTPut<ch>:PULSe:DIVider` on page 86

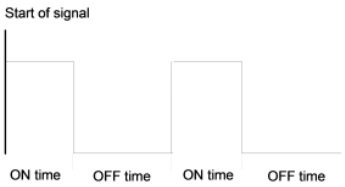
`[:SOURce<hw>]:BB:BTOoth:TRIGger:OUTPut<ch>:PULSe:FREQuency?` on page 87

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

Remote command:

`[:SOURce<hw>]:BB:BTOoth:TRIGger:OUTPut<ch>:PATTern` on page 86

"ON/OFF Ratio" A regular marker signal that is defined by an ON/OFF ratio is generated. A period lasts one ON and OFF cycle.
The "ON Time" and "OFF Time" are each expressed as a number of samples and are set in an input field which opens when ON/OFF ratio is selected.



Remote command:
[:SOURce<hw>]:BB:BTOoth:TRIGger:OUTPut<ch>:ONTime on page 86
[:SOURce<hw>]:BB:BTOoth:TRIGger:OUTPut<ch>:OFFTime on page 86

Remote command:
[:SOURce<hw>]:BB:BTOoth:TRIGger:OUTPut<ch>:MODE on page 85

Marker x Delay
Defines the delay between the marker signal at the marker outputs relative to the signal generation start.

"Marker x" For the corresponding marker, sets the delay as a number of symbols.

Remote command:
[:SOURce<hw>]:BB:BTOoth:TRIGger:OUTPut<ch>:DELay on page 84

"Current Range without Recalculation"
Displays the dynamic range within which the delay of the marker signals can be set without restarting the marker and the signal.
Move the setting mark to define the delay.

Remote command:
[:SOURce<hw>]:BB:BTOoth:TRIGger:OUTPut<ch>:DELay:MINimum? on page 84
[:SOURce<hw>]:BB:BTOoth:TRIGger:OUTPut<ch>:DELay:MAXimum? on page 84

"Fix marker delay to current range"
Restricts the marker delay setting range to the dynamic range.

Remote command:
[:SOURce<hw>]:BB:BTOoth:TRIGger:OUTPut:DELay:FIXed on page 83

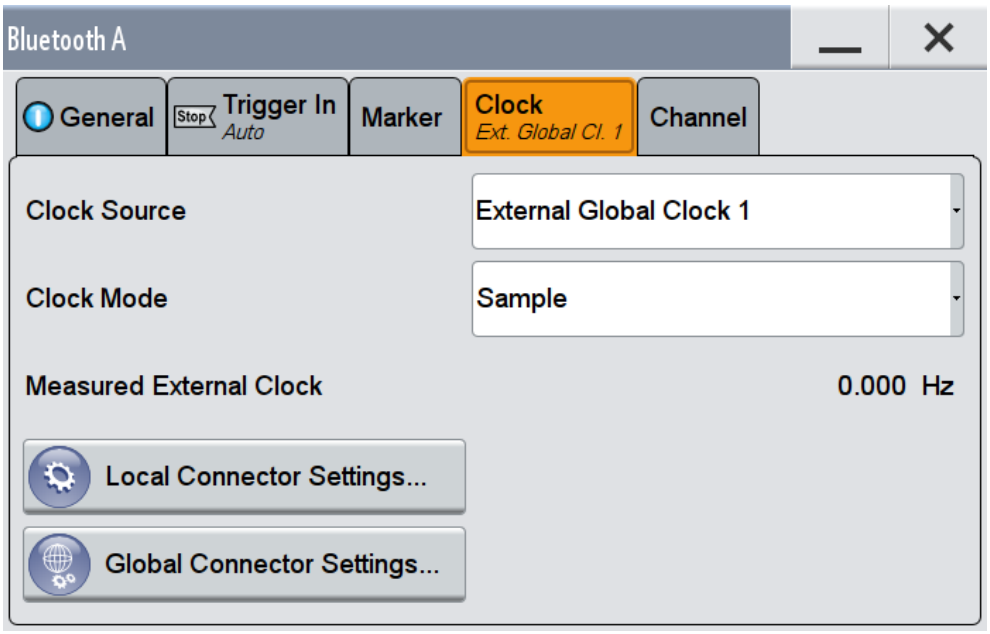
3.4 Clock Settings

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

This section focuses on the available settings.

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

► To access this dialog, select "Baseband > Bluetooth > Clock".



This dialog comprises the settings required for configuring the clock.

Defining the Clock

The provided clock signals are not dedicated to a particular connector but can be mapped to one or more globally shared USER and the two local T/M/C connectors.

Use the Local and Global Connector Settings to configure the signal mapping as well as 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, i.e. select the "Clock > Source"
- Define the connector, USER or T/M/C, the selected signal is provided at, i.e. configure the Local and Global Connector Settings.

Provided are the following settings.

Clock Source

Selects the clock source.

- "Internal"
  The instrument uses its internal clock reference.
- "External Global Clock 1/2"
  The instrument expects an external clock reference at the global USER connector, as configured in the "Global Connector Settings" dialog.
- "External Local Clock"

The instrument expects an external clock reference at the local T/M/C connector.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CLOCk:SOURce` on page 88

Clock Mode
Enters the type of externally supplied clock.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CLOCk:MODE` on page 87

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

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CLOCk:MULTiplier` on page 87

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

Remote command:
`CLOCk:INPut:FREQuency?`

3.5 Local and Global Connector Settings

Each of the "Trigger In", "Marker" and "Clock" dialogs as well as the "Trigger Marker Clock" dialog provides a quick access to the related local and global connector settings.

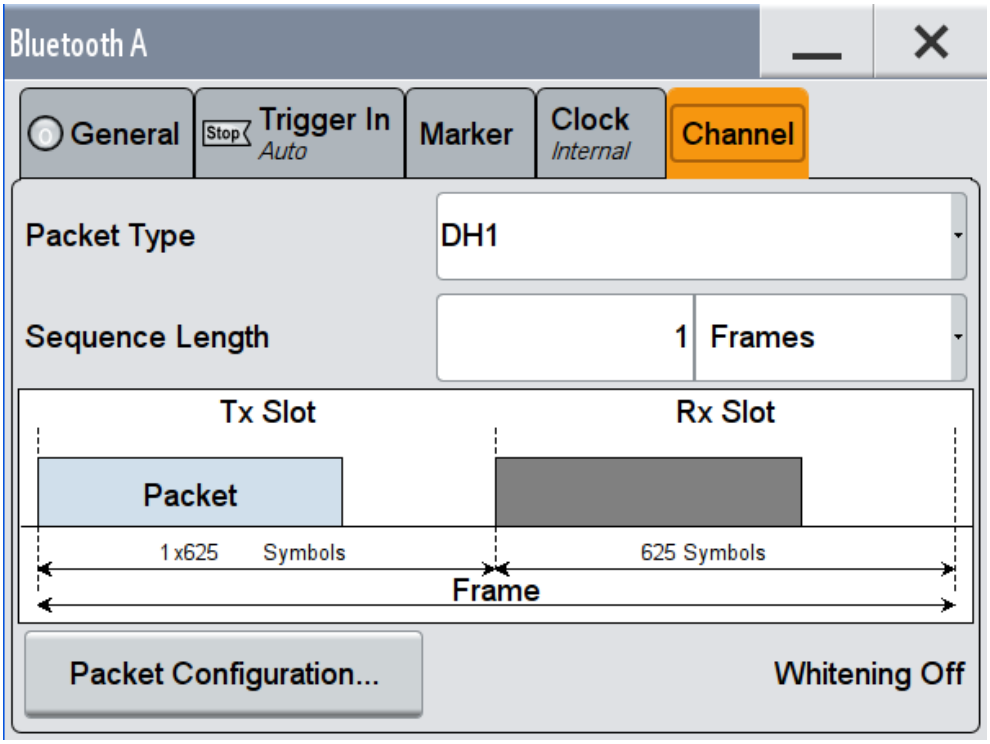
For more information, refer to the description R&S SMW User Manual, section "Local and Global Connectors".

3.6 Bluetooth Channel Settings

This dialog provides access to the "Bluetooth Basic Rate + EDR" or the "Bluetooth Low Energy" settings, depending on the selected bluetooth mode, see "Bluetooth Mode" on page 18.

3.6.1 Bluetooth Basic Rate + EDR

1. To access this dialog, select "Bluetooth > General > Bluetooth Mode > Basic Rate + EDR".
2. Select "Channel".



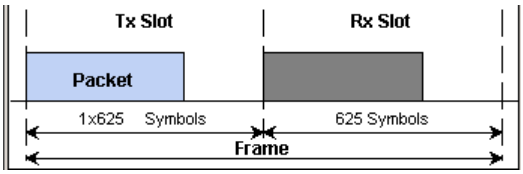
The dialog comprises the parameters to define the packet type and access the packet type configuration dialog. The graphic shows the frame structure of the selected packet type.

Packet Type
Selects the packet type.

The available packets depend on the selected Transport Mode.

All packet types as defined in the Bluetooth specification are supported. For an overview, see chapter 2.1.2, "Bluetooth Packet Types", on page 9.

The graphic shows the frame structure of the selected packet type.



The transmitted packet has a duration of N × 625 µs where N is an odd integer larger than 0. N depends on the type of the transmitted packet.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:PTYPe` on page 67

Sequence Length
Selects the sequence length in frames of the generated signal. The signal repeats after the specified number of frames.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:SLENgth` on page 69

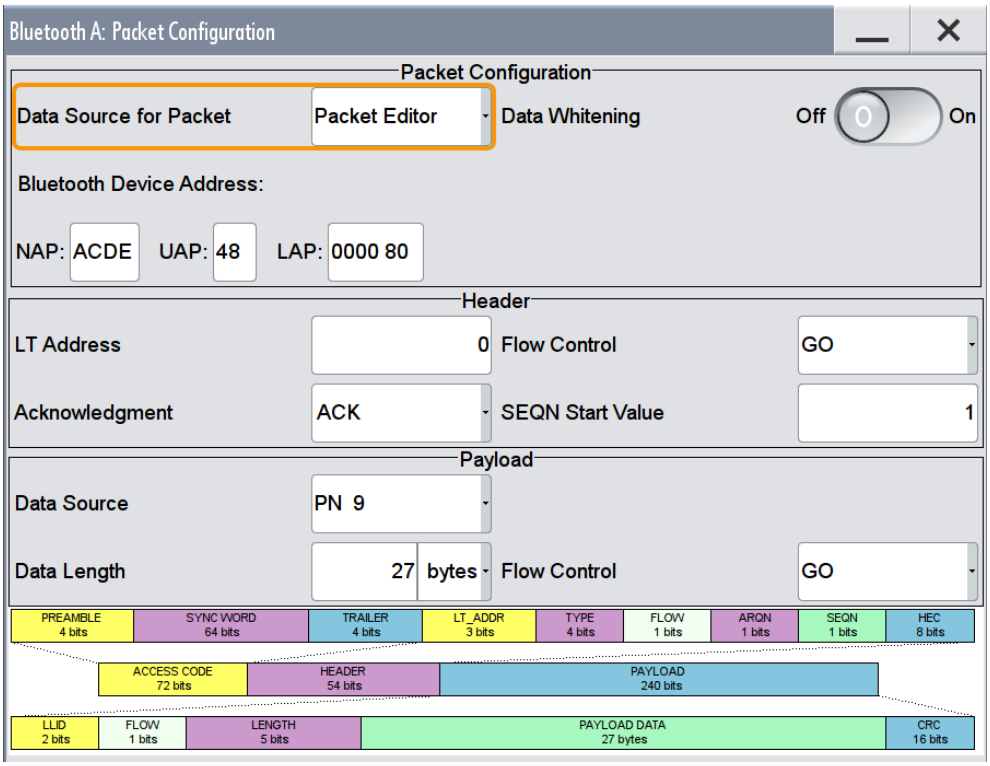
Packet Configuration
Access the "Packet Configuration" dialog, see chapter 3.6.2, "Packet Configuration - Bluetooth Basic Rate + EDR", on page 30.

The current data source for packet and the data whitening state are displayed next to the button.

Remote command:
n.a.

3.6.2 Packet Configuration - Bluetooth Basic Rate + EDR

1. To access this dialog, select "Bluetooth > General > Bluetooth Mode > Basic Rate + EDR".
2. To access the packet configuration dialog, select "Channel > Packet Configuration".



The dialog comprises the settings, necessary to configure the selected packet type.

Provided are the following settings:

Data Source for Packet
The data sent for each packet can be comfortably edited with the Packet Editor, or filled with a predefined ALL Data sequence.

"Packet Editor" Enables the edit mode to configure the packet fields individually.

"All Data" Fills the generated packets with the selected data source. This mode is useful if you need to load predefined data contents from a data list file or the data contents of the packet are not of interest.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DSFPacket` on page 94

Data Whitening
Activates or deactivates the Data Whitening.

Evenly distributed white noise is ideal for the transmission and real data can be forced to look similar to white noise with different methods called Data Whitening.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DWHitening` on page 94

Bluetooth Device Address (BD_ADDR)
Enters Bluetooth Device Address. Each Bluetooth device shall be allocated a unique 48-bit Bluetooth device address (BD_ADDR).

The BD_ADDR may take any values except the 64 reserved LAP values: 0x9E8B00 – 0x9E8B3F.

"NAP" Selects non-significant address part.
The length of NAP is 16 bits or 4 hexadecimal figures.

"UAP" Selects upper address part.
The length of UAP is 8 bits or 2 hexadecimal figures.

"LAP" Selects lower address part.
The length of LAP is 24 bits or 6 hexadecimal figures.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:PCONfiguration:BDANap` on page 91
`[:SOURce<hw>]:BB:BTOoth:PCONfiguration:BDAUap` on page 91
`[:SOURce<hw>]:BB:BTOoth:PCONfiguration:BDALap` on page 91

Logical Transport Address
(Available for all packet types except ID)

Enters the logical transport address for the header.

Each slave active in a piconet is assigned a primary logical transport address (LT_ADDR). The all-zero LT_ADDR is reserved for broadcast messages.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:PCONfiguration:LTADdress` on page 95

Flow Control (Header)
(Available for all packet types except ID)

Sets the FLOW bit in the header. This bit indicates start or stop of transmission of packets over the ACL logical transport.

"Go" Allows the other devices to transmit new data.

"Stop" Stops the other devices from transmitting data temporarily.

Remote command:
[:SOURce<hw>]:BB:BTOoth:PCONfiguration:HFControl on page 95

Acknowledgment
(Available for all packet types except ID)

Sets the ARQN bit of the packet header.

"NAK" Request to retransmit the previous payload.

"ACK" Previous payload has been received successfully.

Remote command:
[:SOURce<hw>]:BB:BTOoth:PCONfiguration:ACKNowledgement on page 90

SEQN Start Value
(Available for all packet types except ID)

Sets the start value of the header SEQN bit.

The SEQN bit is present in the header to filter out retransmissions in the destination. The signal generator is altering this bit automatically on consecutive frames, if a sequence length of at least 2 frames is set.

"0" The SEQN bit starts with 0.

"1" The SEQN bit starts with 1.

Remote command:
[:SOURce<hw>]:BB:BTOoth:PCONfiguration:SNSValue on page 97

Data Source
(Available for all packet types except ID, POLL, NULL and FHS packets)

Selects the data source used for the payload.

"All 0 / All 1" 0 data and 1 data is generated internally.

"Pattern" Pattern is user definable.
The bit pattern is defined in the "Pattern" entry field.

"PN xx" Pseudo-random noise sequence. XX can be equal to 9, 11, 15, 16, 20, 21, 23.

"Data List" Internal data from a programmable data list is used. The data list can be generated by the Data List Editor or generated externally.
Data lists are selected in the "Select Data List" field.

Remote command:
[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DATA on page 92
[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DATA:DPATtern on page 92
[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DATA:DSELection on page 93

Data Length
(Available all packet types except ID, POLL, NULL and FHS packets)

Enters the payload data length in bytes.

Remote command:
[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DLENgth on page 93

Flow Control (Payload)
(Available for all packets types except ID, POLL, NULL, FHS, HV1, HV2, HV3, EV3, EV4, EV5, 2-EV3, 2-EV5, 3-EV3, 3-EV5 packets.)

Sets the FLOW bit in the payload (flow control per logical link)

"Go" Indicates start of transmission of ACL packets after a new connection has been established.

"Stop" Indicates stop of transmission of ACL packets before an additional amount of payload data is sent.

Remote command:
[:SOURce<hw>]:BB:BTOoth:PCONfiguration:PFControl on page 96

Packet Length
(Available in All Data mode only and for all packet types except ID packet)

Enters the packet length in symbols.

Remote command:
[:SOURce<hw>]:BB:BTOoth:PCONfiguration:PLENgth on page 96

EIR packet follows
(Available for FHS packets)

Indicates that an extended inquiry response packet may follow.

"Yes" Indicates that an EIR packet follows.

"No" Indicates that EIR does not follow.

Remote command:
[:SOURce<hw>]:BB:BTOoth:PCONfiguration:EIRPacketfollows
on page 94

Scan Repetition Mode
(Available for FHS packets)

The 2-bit scan repetition field indicates the interval between two consecutive page scan windows, determines the behavior of the paging device.

"R0" The scan interval is equal to the scan window Tw page scan (continuous scan) and maximal 1.28s.

"R1" The scan interval is maximal 1.28s.

"R2" The scan interval is maximal 2.56s.

Remote command:
[:SOURce<hw>]:BB:BTOoth:PCONfiguration:SRMode on page 97

Class of Device
(Available for FHS packets)

A parameter received during the device discovery procedure, indicates the type of device and which types of service that are supported.

Remote command:
[:SOURce<hw>]:BB:BTOoth:PCONfiguration:CODevice on page 92

Data Source (Voice Field)
(Available for DV packets)

Selects the Data Source for the voice field.

"All 0 / All 1" 0 data and 1 data is generated internally

"Pattern" Pattern is user definable.
The bit pattern is defined in the "Pattern" entry field.

"PN xx" Pseudo-random noise sequence. XX can be equal to 9, 11, 15, 16, 20, 21, 23.

"Data List" Internal data from a programmable data list is used. The data list can be generated by the Data List Editor or generated externally.
Data lists are selected in the "Select Data List" field.

Remote command:
[:SOURce<hw>]:BB:BTOoth:PCONfiguration:VDATa on page 97
[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DATA:VDPAttern on page 93
[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DATA:VDSElection on page 93

3.6.3 Bluetooth Low Energy

The R&S SMW provides you with ability to generate signals in accordance with Bluetooth Low Energy Specification (LE). Bluetooth Low Energy makes it possible to transfer data from low power devices running on the smallest of batteries to a larger device, such as a PC, a mobile phone, or a PDA. For the first time, a Bluetooth connection to a wristwatch, or a heart rate sensor, or a data transfer from a digital camera, is possible. The Bluetooth low energy chips will offer capabilities that do not replace or supersede the existing Bluetooth 2.x standards. Data rates are comparable to Bluetooth 1.1, and are data-only (no audio content).

Bluetooth LE mode only uses the Basic Rate. The Basic Rate mode uses binary FM modulation and has a data rate of 1 MBps. The modulation scheme has the symbol rate equal to 1Ms/s.

For full duplex transmission, a Time Division Duplex (TDD) scheme is used.

The following list gives an overview of the options provided by the R&S Signal Generator for Bluetooth LE compliant signal generation:

- Support for two channel types, the Advertising and Data channel types.
- Support of all Bluetooth LE packet types.
- Sequence Length unit can be set to Event or Frame.
- Convenient packet editor for all supported packet types including optional data whitening.

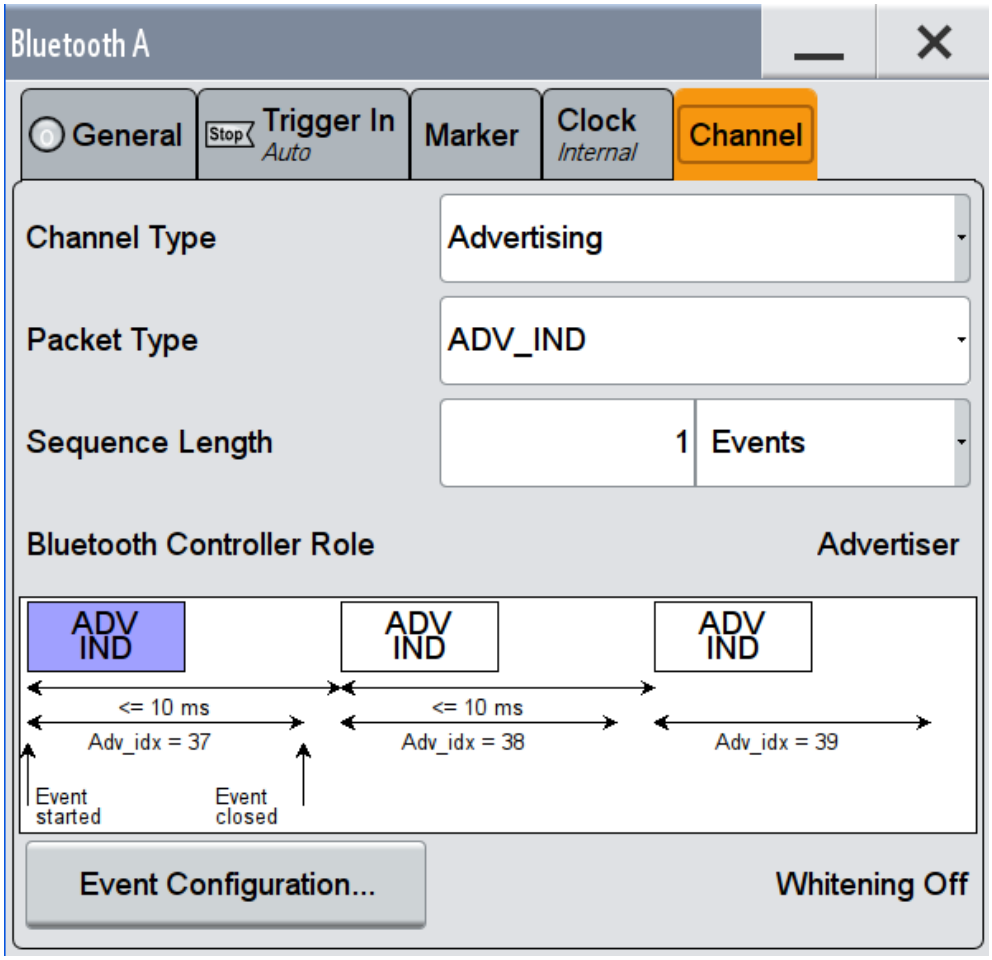
- Dirty Transmitter Test compliant to RF test specification, with options to change start phase, frequency drift rate and frequency drift deviation.
- Power Ramp Control with configurable ramp time, rise and fall offsets.
- Clipping, filter and modulation settings supported.

In the following description Bluetooth Low Energy is abbreviated as Bluetooth LE.

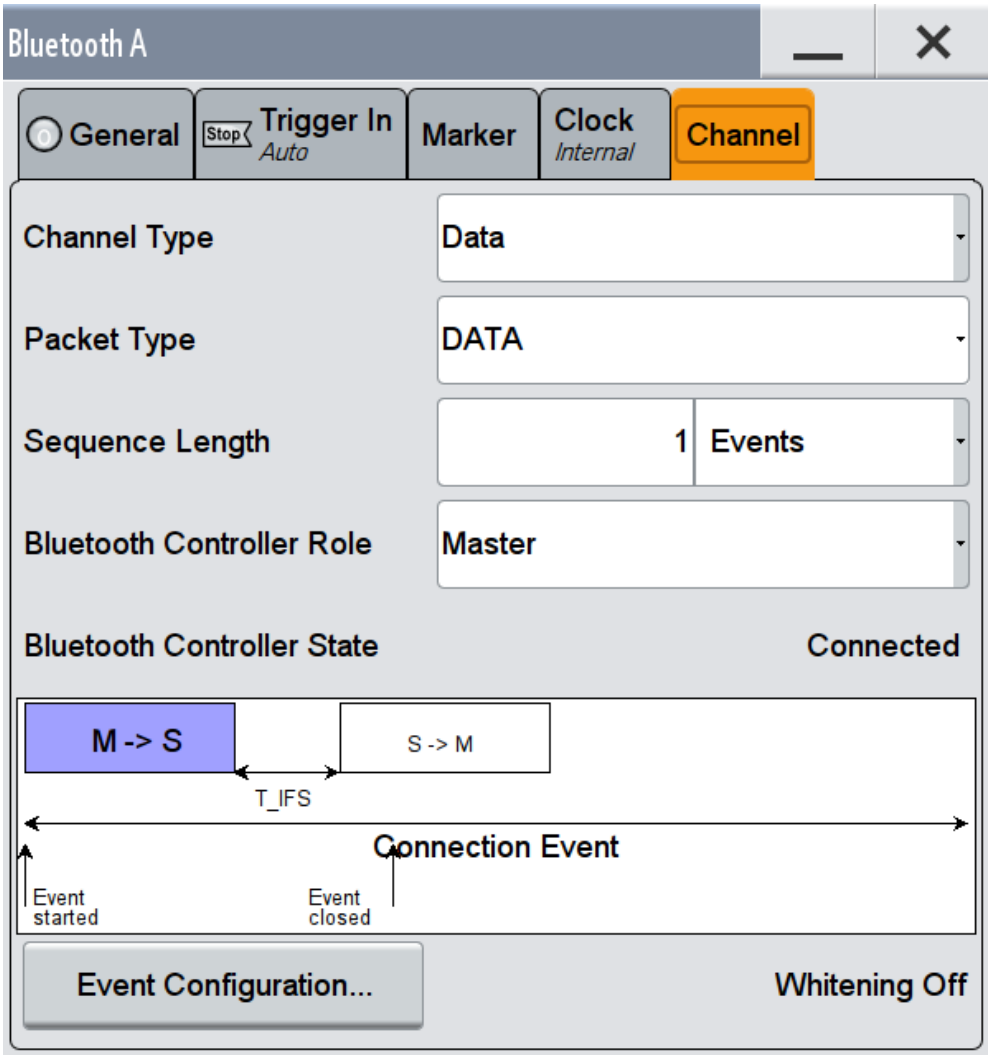
1. To access the dialog for configuration of the *Bluetooth LE* standard, select "Bluetooth > General > Bluetooth Mode > Bluetooth Low Energy"
2. Select "Channel"

   The "Channel" dialog varies depending on the selected "Channel Type":

   - "Advertising"



   - "Data"



The dialog comprises the parameters to define the packet type and access the packet type configuration dialog. The graphic shows the frame stucture of the selected packet type.

Channel Type
Determines the channel type. Advertising and data are available. Refer to chapter 3.6.4, "Event / Frame Configuration - Bluetooth LE", on page 39 for setting the respective parameters.

"Advertising" Selects channel type Advertising.

"Data" Selects channel type Data.
Devices in a connected state transmit data channel packets in connection events with a start point and an interval.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:CTYPe` on page 66

Packet Type
Selects the packet type.

The available packet types depend on the selected channel type, as shown in the table below (table 3-1).

Table 3-1: Packet types of the respective channel types:

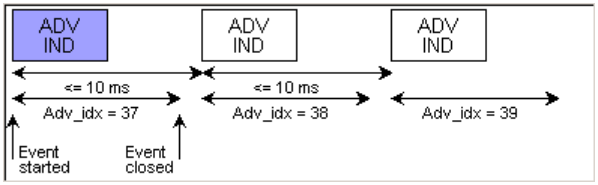
Packet Type	Advertising	Data
ADV_IND/	x	-
ADV_DIRECT_IND	x	-
ADV_NONCONN_IND	x	-
ADV_DISCOVER_IND	x	-
SCAN_REQ	x	-
SCAN_RSP	x	-
CONNECT_REQ	x	-
DATA	-	x
CONTROL_DATA ...	-	x
TEST PACKET	x	x

Depending on the Bluetooth Controller Role (master or slave), you can determine in detail the information of the "CONTROL_DATA", as shown in the following table table 3-2.

Table 3-2: Control information, available for master or slave.

CONTROL_DATA	Master	Slave
LL_CONNECTION_UPDATE_REQ	x	-
LL_CHANNEL_MAP_REQ	x	-
LL_TERMINATE_IND	x	-
LL_ENC_REQ	x	-
LL_RNC_RESP	-	x
LL_START_ENC_REQ	x	x
LL_START_ENC_RESP	x	x
LL_UNKNOWN_RESP	-	x
LL_FEATURE_REQ	x	-
LL_FEATURE_RESP	-	x
LL_PAUSE_ENC_REQ	x	-
LL_PAUSE_ENC_RESP	-	x
LL_VERSION_IND	x	x
LL_REJECT_IND	x	x

The graphic shows the frame structure of the selected packet type.



Remote command:
[:SOURce<hw>]:BB:BTOoth:UPTYpe on page 123

Sequence Length
Selects the number of frames or events depending on the packet type. The signal repeats after the specified number of frames/events.

For SCAN_REQ and CONNECT_REQ packet, the sequence length is expressed in "Frames".

For TERMINATE_IND packets, a default value according to the specification is given:
- Master: 'SlaveLatency + 6'
- Slave: '6'

For all other packet types the sequence length is expressed in "Events".

Remote command:
[:SOURce<hw>]:BB:BTOoth:USLength on page 124

Bluetooth Controller Role
Determines the controller role.

Note: The available packet types for the selected channel types and the controller roles are described in "Bluetooth Controller Role" on page 38.

Depending on the channel type, the field either displays the appropriate role or you can select one:
- "Advertiser"
  Displays the controller role corresponding to the packet type:
  – "Advertiser" for all ADV-xxx packet types and SCAN_RSP
  – "Scanner" for SCAN_REQ packet type
  – "Initiator" for CONNECT_REQ packet type
- "Data"
  Assigns a role to the controller:
  – "Master"
  – "Slave"

Remote command:
[:SOURce<hw>]:BB:BTOoth:BCRole on page 105

Bluetooth Controller State
Shows the state of the bluetooth controller for channel type "Data".

Remote command:
[:SOURce<hw>]:BB:BTOoth:BCText? on page 66

Event / Frame Configuration
Access the "Event Configuration" dialog, if the sequence length of the packet type is expressed in events, and accordingly, the "Frame Configuration" dialog, if it is expressed in frames, see chapter 3.6.4, "Event / Frame Configuration - Bluetooth LE", on page 39.

The data whitening state is displayed next to the button.

Remote command:
n.a.

Test Packet Configuration
Access the "Test Packet Configuration" dialog for packet type "TEST PACKET", see chapter 3.6.5.2, "Test Packet Configuration Settings", on page 54.

3.6.4 Event / Frame Configuration - Bluetooth LE

1. To access the dialog for configuration of the *Bluetooth LE* standard, select "Bluetooth > General > Bluetooth Mode > Bluetooth Low Energy"
2. Select "Channel > Event / Frame Configuration"

   The corresponding "Event" or "Frame" configuration dialog opens, with varying parameters, depending on the used channel type:

   - "Advertising Event"

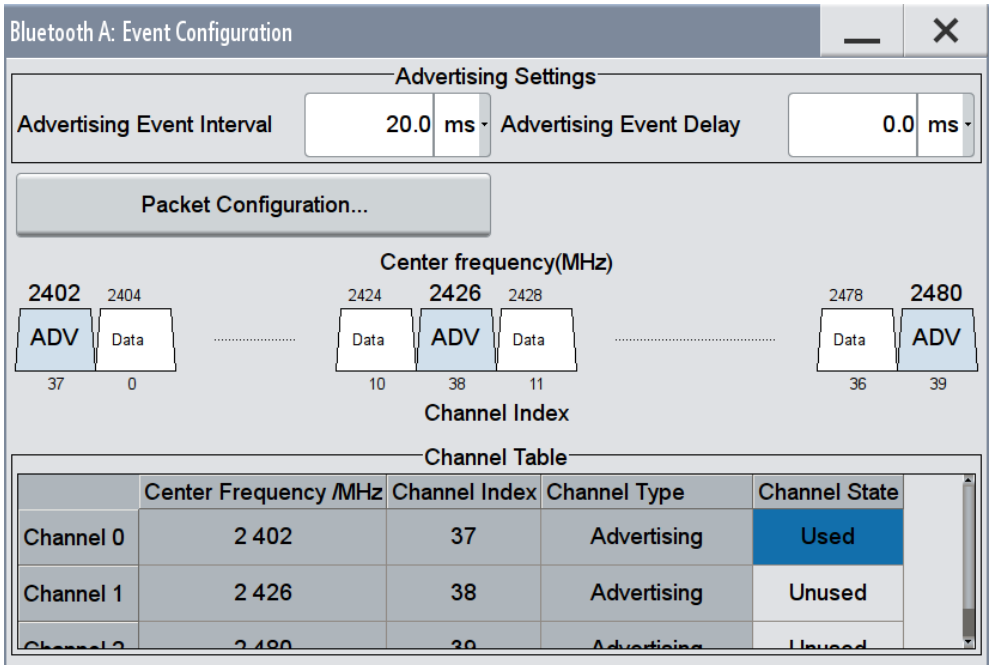


Fig. 3-1: Event Configuration Dialog of channel type Advertising

   - "Advertising Frame"

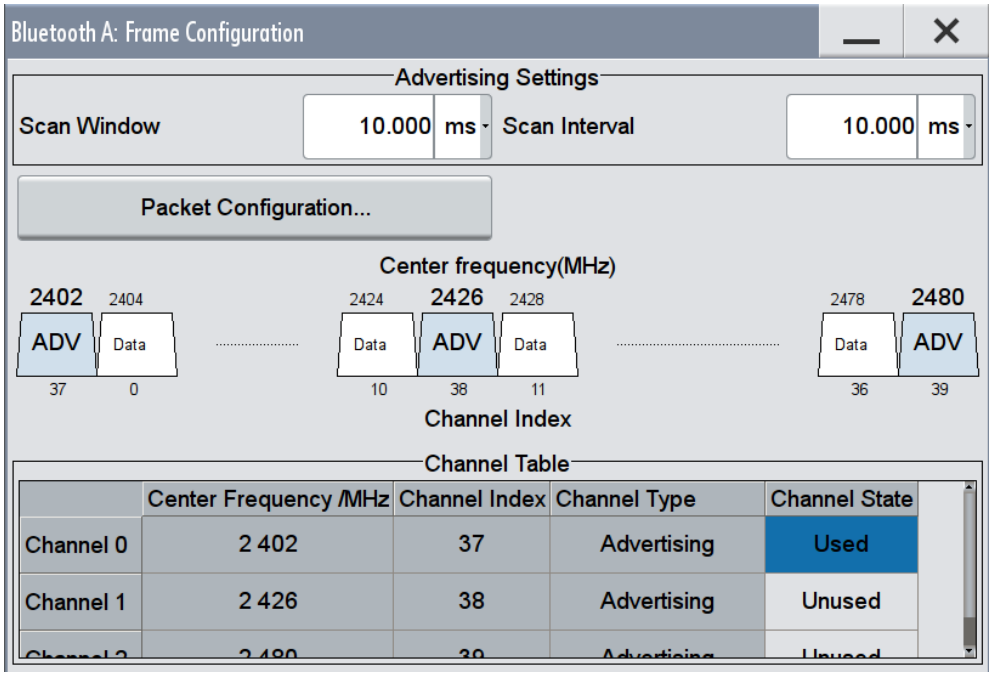


Fig. 3-2: Frame Configuration Dialog of channel type Advertising

- "Data Event"

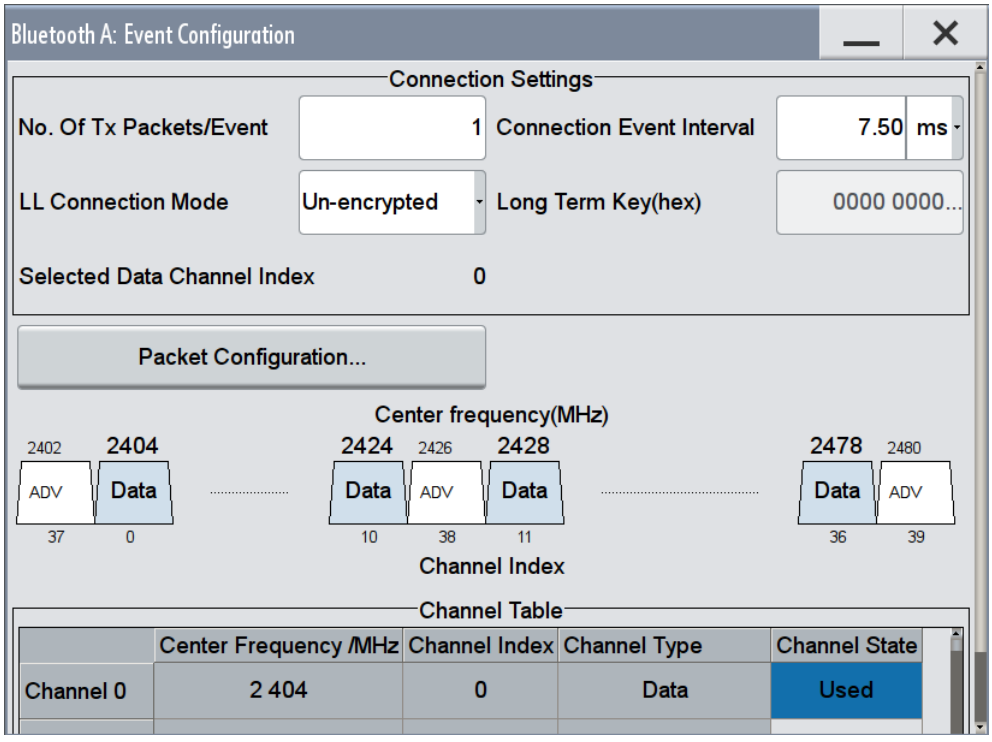


Fig. 3-3: Event Configuration Dialog of channel type Data

The upper section provides "Connection Settings"

The dialog contains the settings, necessary to configure the selected packet type, graphically shows the distribution of the packets and an overview of the channels and their assignments.

3.6.4.1 Advertising Event / Frame Configuration Settings

Advertising Event Interval
Sets the time interval between two consecutive advertising events, with regard to the starting points.

Note: This parameter is relevant for advertising event configuration and for the packet types ADV-IND, ADV_DIRECT_IND, ADV_NONCONN_IND and ADV_DISCOVER_IND.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:AEINterval` on page 108
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:ADINterval` on page 108

Advertising Event Delay
Sets a time delay between the start times of two consecutive advertising events. The value is added to the advertising event interval.

Note: This parameter is relevant for advertising event configuration and for the packet types ADV-IND, ADV_NONCONN_IND and ADV_DISCOVER_IND.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:AEDelay` on page 107

Scan Window
Sets the length of the window during which the scanner is operating in the advertising channel.

Note that the scan window is less or equal to the value of the scan interval.

Note: This parameter is relevant for advertising frame configuration and for the packet type SCAN_REQ.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:SWINdow` on page 122

Scan Interval
Sets the time interval between the starting points of two consecutive windows during which the scanner is operating in an advertising channel.

Note: This parameter is relevant for advertising frame configuration and for the packet type SCAN_REQ.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:SINTerval` on page 122

Advertising Packet Interval
Sets the time interval between packets starting points of two consecutive packets in the advertising channel.

Note: This parameter is relevant for advertising frame configuration and for the packet type SCAN_RSP.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:APINterval` on page 108

Transmit Window Offset
Displays the start point of the transmit window.

Note: This parameter is relevant for advertising frame configuration and for the packet type CONNECT_REQ.
This parameter is set in the Packet Configuration, see "Transmit Window Offset" on page 52.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:WOINfo?` on page 122

Transmit Window Size
Indicates the size of the transmit window, regarding to the start point.

Note that the scan window size is less or equal to the value of the connection interval.

Note: This parameter is relevant for advertising frame configuration and for the packet type CONNECT_REQ.
The parameter is set in the "Packet Configuration" dialog, see "Transmit Window Size" on page 52.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:WSINfo?` on page 123

Packet Configuration
Opens the dialog for setting the corresponding packet configuration.

This dialog is described in chapter 3.6.5.1, "Packet Configuration Settings", on page 46.

Remote command:
n.a.

3.6.4.2 Data Event Connection Settings

No. of Tx Packets per Event
Sets the number of Tx packets per event. Each connection contains at least one data channel packet. The maximum number of packets per event is determined by the duration of the connection event interval.

Note: This parameter is relevant for data event connection settings.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PNUMber` on page 121

Connection Event Interval
Set the time interval between the start points of two consecutive connection events. Subsequent transmissions within an event are separated by this parameter in order to separate connecting event starting points in time.

Note: This parameter is relevant for data event connection settings and advertising frame configuration with the packet types CONNECTION_UPDATE_REQ and CONNECT_REQ.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CINTerval`
on page 111
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:NCINterval`
on page 116
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CINTerval`
on page 111

LL Connection Mode

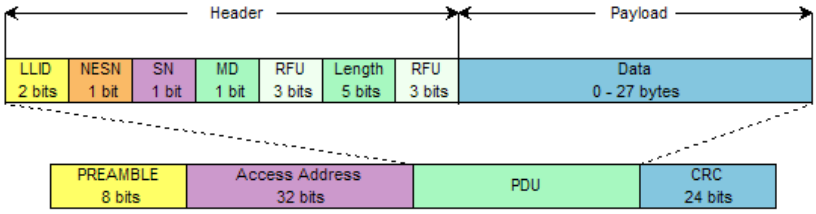
Select the link layer connection mode. In order to provide safe transmission of payload data, the data in the packet can be encrypted. If activated, the payload data follows MIC (Message authentication Code).

Note: This parameter is relevant for data event connection settings.

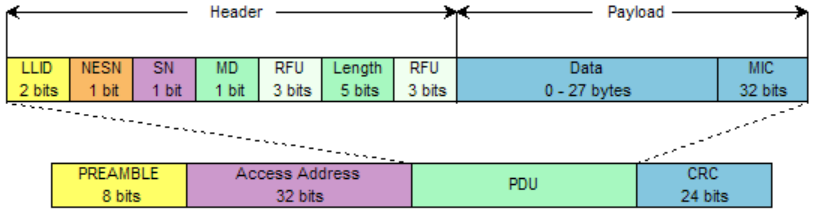
The following table shows which types of packets can be encrypted and / or unencrypted.

Packet Type	encrypted	unencrypted
DATA	X	X
CONNECTION_UPDATE_REQ	X	X
CHANNEL_MAP_REQ	X	X
LL_TERMINATE_IND	X	X
LL_ENC_REQ	-	X
LL_ENC_RSP	-	X
LL_START_ENC_REQ	-	X
LL_START_ENC_RSP	X	-
LL_FEATURE_REQ	X	X
LL_FEATURE_RSP	X	X
LL_PAUSE_ENC_REQ	-	X
LL_PAUSE_ENC_RSP	X	X
LL_VERSION_IND	X	X
LL_REJECT_IND	X	X
UNKNOWN_RSP	X	X

"Unencrypted" Payload data is transmitted without encoding.



"Encrypted" The link layer connection runs in encrypted mode.



Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:LCMode` on page 109

Long Term key (hex)
Indicates the time the controller needs to receive the long term key from the host. After this time, the controller is ready to enter into the last phase of encryption mode setup.

Note: This parameter is relevant for data event connection settings. In encrypted mode, the code can be edited.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:LTKey` on page 109

Selected Data Channel Index
Indicates the number of the first active data channel.

The data channel is selected for each connection event. The master and slave determine the used data channel by selecting from the list of used channels (see "Channel Table" on page 44).

Note: This parameter is relevant for data event connection settings.

Displays the data channel index currently selected.

Remote command:
n.a.

3.6.4.3 Channel Table Settings

The channel table displays all parameters characterizing the channel and the current state.

Channel Table
The channel table displays all parameters characterizing the channel and the current state.

Every channel is represented with bit positioned as per the data channel index. LSB represents data channel index 0 and the bit in position 36 represents data channel index 36.

If the channel is used channel its bit is to be set to '1'. Bit value '0' indicates that the channel is unused.

The bits in positions 37, 38 and 39 shall be set to zero upon transmission and ignored upon receipt.

"Center Frequency"
Indicates the center frequency of a channel.

"Channel Index"
Indicates the channel index.

"Channel Type"
Indicates the channel type.

"Channel State"
Indicates used and unused data channels.

Remote command:
Advertising Channel Table: `[:SOURce<hw>]:BB:BTOoth:ECONfiguration:ACTable:SET<ch>:STATe` on page 107
Data Channel Table: `[:SOURce<hw>]:BB:BTOoth:ECONfiguration:DCTable:SET<ch>:STATe` on page 107
Data Channel Mapping Table: `[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DCMTable:SET<ch>:STATe` on page 107

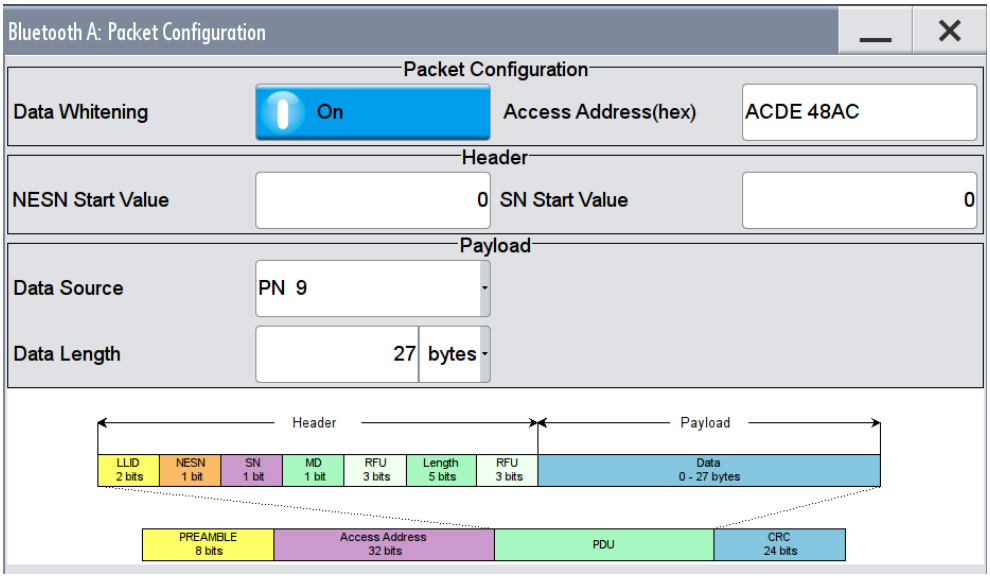
Remote command:
Entire data set for Advertising Channel Table: `[:SOURce<hw>]:BB:BTOoth:ECONfiguration:ACTable` on page 106
Entire data set for Data Channel Table: `[:SOURce<hw>]:BB:BTOoth:ECONfiguration:DCTable` on page 106
Entire data set for Channel Map Table: `[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DCMTable` on page 106

3.6.5 Packet Configuration - Bluetooth LE

To access the packet configuration dialog of the *Bluetooth LE* standard, first select this mode in the "General" tab.

1. Select "Channel > Event/Frame Configuration", according to the selected packet type.
   The corresponding "Event" or "Frame" configuration dialog opens.

2. Select "Packet configuration".



The dialog contains the settings required to configure the selected packet type. The contents differ depending on the channel and packet types.

3.6.5.1 Packet Configuration Settings

Data Whitening
Activates or deactivates the Data Whitening.

Evenly distributed white noise is ideal for the transmission and real data can be forced to look similar to white noise with different methods called Data Whitening. Applied to the PDU and CRC fields of all packet types, whitening is used to avoid long equal sequences in the data bit stream.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DWHitening`
on page 113

Access Address
Sets the access address of the link layer connection.

Bluetooth LE transmissions are based on an interface packet format, that consists of a preamble (8 bits), the access address (32 bits), the PDU and CRC (24 bits).

The access address´ structure depends on the packet type:

- Data channel packets
  The access address is a pseudo-random LL connection address, generated by the initiator of the LL connection. The address has to follow some specific rules, which are described in the "Bluetooth Low Energy Technology Specification".
- Advertising channel packets
  The address is fixed to 01101011011111011001000101110001 with the left most bit sent first and being the LSB.

Note: This parameter is relevant for all available package types specified in events in the data channel, and frames in the advertiser channel, i.e. DATA, CONNECTION_UPDATE_REQ, CHANNEL_MAP_REQ, TERMINATE_IND, LLENC_REQ, LL_FEATURE_REQ, LL_PAUSE_ENC_REQ, LL_START_ENC_:RSP, FEATURE_REQ, and CONNECT_REQ.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:AADDress`
on page 109

NESN Start Value
Sets the start value of the next expected packet from the same device in the LL connection (**N**ext**E**xpected **S**equence**N**umber). This parameter can be set in the first event. From the second event this field is not indicated.

Note: This parameter is relevant for data event configuration and all data channel packet types except TEST_PACKET.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:NSValue`
on page 117

SN Start Value
Sets the sequence number of the packet. This parameter can be set in the first event. From the second event this field is not indicated.

Note: This parameter is relevant for data event configuration and all data channel packet types except TEST_PACKET.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SSValue`
on page 119

Device´s Addr Type
Selects the address type of the controller device. Depending on the Bluetooth controller role either the Tx ot Rx or both address types are assigned.

Subdivided into private and random, a Bluetooth LE device address consists of 48 bits. The format of the device address differs depending on the selected address type.

Note: This parameter is relevant for advertising event or frame configuration.

The bluetooth "Controller Role" and the packet type determine the available entries:
- **Tx** in conjunction with the packet types ADV_IND, ADV_DIRECT_IND, ADV_NONCONN_IND, ADV_DISCOVER_IND, SCAN_REQ, SCAN_RSP and CONNECT_REQ
- **Rx** for the packet types ADV_DIRECT_IND, SCAN_REQ and CONNECT_REQ

"Public" Allocates a unique 48 bit address to each bluetooth LE device. The public address is given from the registration authority IEEE.

"Random" Allocates a 48 bit address to each bluetooth LE device. A random address is optional.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:TATYpe`
on page 118

Data Source
Selects the data source used for the payload.

Note: This parameter is relevant for event configuration and packet types DATA, ADV_IND, ADV_NONCONN_IND and ADV_DISCOVER_IND.

"All 0 / All 1" 0 data and 1 data is generated internally.

"Pattern" Pattern is user definable.
The bit pattern is defined in the "Pattern" entry field.

"PN xx" Pseudo-random noise sequence. XX can be equal to 9, 11, 15, 16, 20, 21, 23.

"Data List" Internal data from a programmable data list is used. The data list can be generated by the Data List Editor or generated externally.
Data lists are selected in the "Select Data List" field.
From this dialog, the "File Select" windows for selecting Bluetooth data files and the "File Manager" are called. For description of data list handling refer to the operating manual of your R&S instrument.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DATA` on page 112
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DATA:DPATtern` on page 112
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DATA:DSELection` on page 112

Data Length
Enters the payload data length in bytes.

Note: This parameter is relevant for event configuration with packet types ADV_IND, ADV_NONCONN_IND and ADV_DISCOVER_IND.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DLENgth` on page 113

Connection Event Interval
Set the time interval between the start points of two consecutive connection events. Subsequent transmissions within an event are separated by this parameter in order to separate connecting event starting points in time.

Note: This parameter is relevant for data event connection settings and advertising frame configuration with the packet types CONNECTION_UPDATE_REQ and CONNECT_REQ.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CINTerval` on page 111
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:NCINterval` on page 116
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CINTerval` on page 111

Slave Latency
Sets a number of consecutive connection events the slave can ignore for asymmetric link layer connections.

Note: This parameter is relevant for data event and advertising frame configuration with the packet types CONNECTION_UPDATE_REQ and CONNECT_REQ.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SLATency`
on page 119
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:NSLatency`
on page 117

LL Connection Timeout
Defines the maximum time between two correctly received Bluetooth LE packets in the LL connection before the connection is considered lost.

Note: This parameter is relevant for data event and advertising frame configuration with the packet types CONNECTION_UPDATE_REQ and CONNECT_REQ.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:LCTimeout`
on page 115
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:NLCTimeout`
on page 116

Connection Instant
Sets a connection instant for indicating the connection event at which the new connection parameters are taken in use.

Both the master and the slave have a 32-bit connection event counter per LL connection. It is reset to zero on the first connection event of the LL connection and incremented by one on every elapsed connection event interval of the LL connection.

Note: This parameter is relevant for data event configuration with the packet types CONNECTION_UPDATE_REQ and CHANNEL_MAP_REQ.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CINStant`
on page 111

Show / Hide Data Channel (Mapping) Table
In data event and advertising frame configuration with the packet types CHANNEL_MAP_REQ and CONNECT_REQ, calls / hides the channel map table that displays the used channels and their parameters.

The channel table is described in chapter 3.6.4.3, "Channel Table Settings", on page 44.

Remote command:
n.a.

Hop Length
Sets the difference from the current channel to the next channel. The master and slave devices determine the data channel in use for every connection event from the channel map. Hop_length is set for the LL connection and communicated in the CONNECT_REQ packets.

Note: This parameter is relevant for data event and advertising frame configuration with the packet type CONNECT_REQ.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:HLENgth` on page 114

Random Vector (hex)
Sets the random vector of the master for device identification.

The parameter is an initialization vector provided by the Host in the HCI_ULP_Start_Encryption command.

Note: This parameter is relevant for data event configuration with the packet type LLENC_REQ.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:RVECtor` on page 118

Encrypted DIVersifier (hex)
Sets the encrypted diversifier of the master for device identification. The parameter is an initialization vector provided by the Host in the HCI_ULP_Start_Encryption command.

Note: This parameter is relevant for data event configuration with the packet type LLENC_REQ.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:EDIVersifier` on page 114

Session Key iD (hex)
Sets the master's or the slave's portion of the session key diversifier (SKDm/SKDs).

Note: This parameter is relevant for data event configuration with the packet types LLENC_REQ (Master) and LL_ENC_RSP (Slave).

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MSKD` on page 115

Initialization Vector (hex)
Sets the master's or the slave's portion of the initialization vector(IVm/IVs).

Note: This parameter is relevant for data event configuration with the packet types LLENC_REQ (Master) and LL_ENC_RSP (Slave).

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MIVector` on page 115

Feature Set Length
Enables that the feature set length is indicated.

FeatureSet indicates whether the Controller features are used or not. All the data in FeatureSet is RFU(zero).

Note: This parameter is relevant for data event configuration with the packet types FEATURE_REQ (Master) and FEATURE_RSP (Slave).

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:FSLength`
on page 114

Unknown Type (hex)
Enables that an invalid control packet is indicated.

The CtrType field indicates the value of the LL control packet that caused the transmission of this packet.

This parameter is relevant for data event configuration with the packet type UNKNOWN_RSP (Slave).

Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:UTYPe`
on page 120

Controller´s Device Addr
Sets the advertiser´s device address.

In Bluetooth LE systems all the transmissions start with an 8 bit preamble followed by an access address. The access address is composed of a the parts "Company_Id" (LSB) and the "Company_assigned" (MSB). Beside the address fields the notation is given.

For advertising channel packets the format of the device address differs, depending on the selected address type.

Note: This parameter is relevant for advertising event or frame configuration. Refer to Tx/Rx Addres Type - Bluetooth LEDevice´s Addr Type for information about the available package types for the respective "Controller Roles".

- "Public Address Types"
  The public address is given from the registration authority IEEE and is composed of:
  – LSB: 24 bits = company_assigned
  – MSB: 24 bits = company_id
- "Private Address Type"
  A private address is optional and composed of:
  – LSB: 24 bits = hash

– MSB: 24 bits = random

Remote command:
Company_Assigned and Company_Id in Advertiser´s Device Address
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ACID
on page 109
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ACASsigned
on page 109
Company_Assigned and Company_Id in Scanner's Device Address
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SCASsigned
on page 110
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SCID
on page 110
Company_Assigned and Company_Id in Initiator's Device Address
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ICASsigned
on page 110
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ICID
on page 110

CRC Initial
Sets the initialization value for the CRC (Cyclic Redundary Check, 24 bits) calculation. A packet has been received correctly, when it has passed the CRC check.

Note: This parameter is relevant for advertising frame configuration and the packet type CONNECT_REQ.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CIValue
on page 111

Transmit Window Size
Sets the size of the transmit window, regarding to the start point.

Note that the scan window size is less or equal to the value of the connection interval, see "Connection Event Interval" on page 42.

Note: This parameter is relevant for advertising frame configuration and for the packet types CONNECT_REQ and CONNECTION_UPDATE_REQ.
This parameter is also indicated in the Frame Configuration Dialog.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:WSIZe
on page 121
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:NWSize
on page 118

Transmit Window Offset
Sets the start point of the transmit window.

Note: This parameter is relevant for advertising frame configuration and for the packet types CONNECT_REQ and CONNECTION_UPDATE_REQ.

This parameter is also indicated in the Frame Configuration Dialog.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:WOFFset
on page 121
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:NWOFfset
on page 117

Sleep Clock Accuracy
Defines the master´s clock accuracy with specified encoding. This parameter is used by the slave to determine required listening windows in the LL connection. It is a controller design parameter known by the Controller.

Note: This parameter is relevant for advertising frame configuration and the packet type CONNECT_REQ.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SCACcuracy
on page 119

Error Code
Sets the error code value to inform the remote device why the connection is about to be terminated in case of LL_TERMINATE_IND packet. On the other hand, this parameter for LL_REJECT_IND packet is used for the reason a request was rejected. A 8 bit value is set.

Note: This parameter is relevant for data frame configuration and the packet type LL_TERMINATE_IND and LL_REJECT_IND.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ECODe
on page 113

Company ID
Sets the company identifier of the manufacturer of the Bluetooth Controller. A 16 bit value is set.

Note: This parameter is relevant for data frame configuration and for the packet type LL_VERSION_IND.

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CID
on page 110

Version Number
Sets the version of the Bluetooth Controller specification (8 bits).

Note: This parameter is relevant for data frame configuration and the packet type LL_VERSION_IND

Remote command:
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:VNUMber
on page 120

Sub Version Number
Sets a unique value for each implementation or revision of an implementation of the Bluetooth Controller.

A 16 bit value is set.

Note: This parameter is relevant for data frame configuration and for the packet type LL_VERSION_IND.

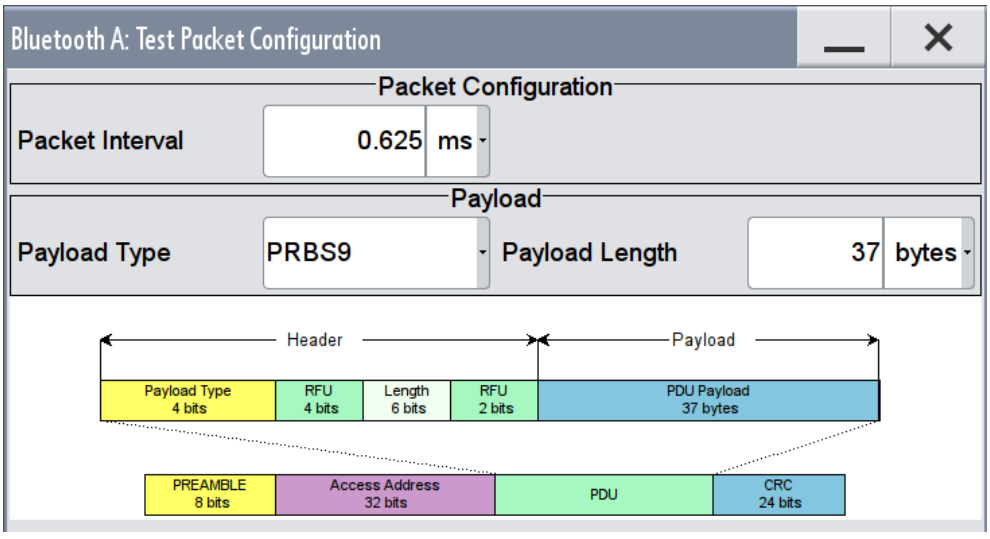
Remote command:
`[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SVNumber`
on page 120

Graph
The figure in the packet configuration dialog shows the packet structure of the currently selected packet type.

Remote command:
n.a.

3.6.5.2 Test Packet Configuration Settings

1. To access the dialog for configuration of the *Bluetooth LE* standard, select "Bluetooth > General > Bluetooth Mode > Bluetooth Low Energy"
2. Select "Channel > Packet Type > TEST PACKET"
3. Select "Test Packet Configuration"



The dialog contains the settings, necessary to configure the test packet and graphically shows the distribution of the packets.

When you configure a "Dirty Transmitter Test", you also have direct access to the test packet dialog.

Packet Interval
Sets the time interval between two consecutive test packets, with regard to the starting points.

Test Packet Interval

Note: This parameter is relevant for test packet types only.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:DTTest:TPConfiguration:TPINterval`
on page 105

Payload Type
Selects the data source used for the payload test packets.

Note: This parameter is relevant for test packet types only.

"PRBS 9, 15" Select a PRBS-modulated data sequence (PRBS = pseudo random binary sequence) for testing.

"Pattern 1, 2, 3, 4, 5, 6" Pattern is predefined.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:DTTest:TPConfiguration:UPSource`
on page 106

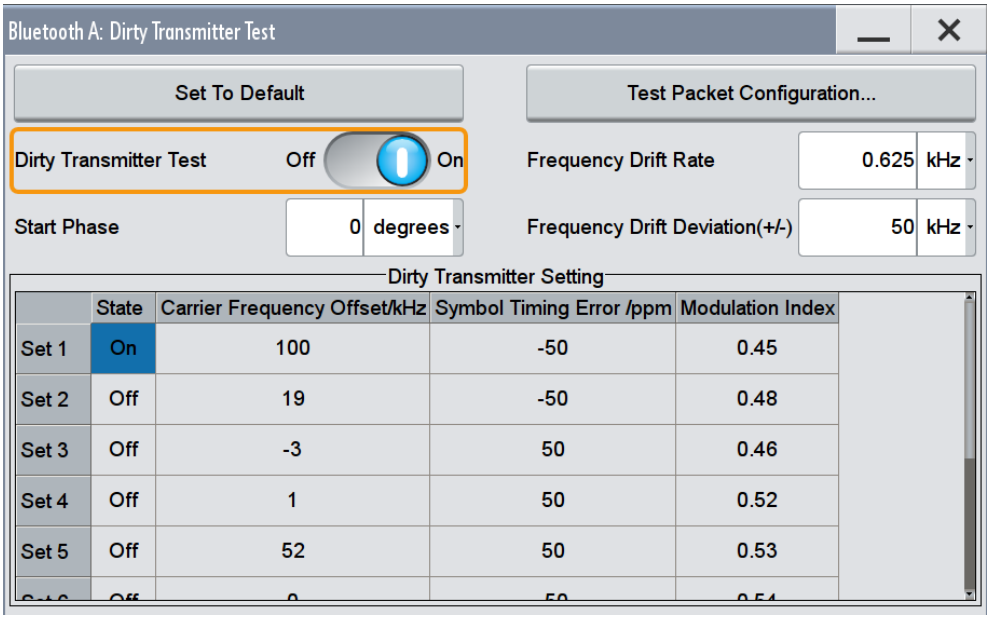
Payload Length
Sets the payload length.

Note: This parameter is relevant for test packet types only.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:DTTest:TPConfiguration:UPLength`
on page 106

3.7 Dirty Transmitter Test

► To access this dialog select "Bluetooth > General > Dirty Transmitter Test"



The dialog comprises the settings, necessary to configure the Dirty Transmitter.

The Dirty Transmitter settings contain parameters which can be changed for the master signal in order to test the connection under 'dirty transmitter' conditions and define the influence on the receiver quality (bit error rate tests).

Dirty transmitter parameters according to the Bluetooth test specification (Basic Rate) are given in the table below.

Table 3-3: Dirty transmitter parameters according to the Bluetooth test specification (Basic Rate)

Set	Carrier Frequency Offset	Symbol Timing Error	Modulation Index
1	75	-20	0.28
2	14	-20	0.30
3	-2	+20	0.29
4	1	+20	0.32
5	39	+20	0.33
6	0	-20	0.34
7	-42	-20	0.29
8	74	-20	0.31
9	-19	-20	0.28
10	-75	+20	0.35

Dirty transmitter parameters according to the Bluetooth test specification (EDR) are given in the table below.

Table 3-4: Dirty transmitter parameters according to the Bluetooth test specification (EDR)

Set	Carrier Frequency Offset	Symbol Timing Error
1	0	0
2	+65	-20
3	-65	+20

Provided are the following settings:

Set to Default
Calls the default settings for the Dirty Transmitter Test.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:DTTest:STDefault` on page 100

Test Packet Configuration
Access the "Test Packet Configuration" dialog for packet type "TEST PACKET", see chapter 3.6.5.2, "Test Packet Configuration Settings", on page 54.

Dirty Transmitter Test
(Available only for packet types DH1, DH3, DH5, 2-DH1, 2-DH3, 2 - DH5, 3-DH1, 3-DH3, 3-DH5, 2-EV3, 2-EV5, 3-EV3, 3-EV5.)

Activates or deactivates the Dirty Transmitter Test.

For Basic Rate packets, each set of parameters in the "Dirty Transmitter Setting" table below is used for a duration of 20 ms. After 20 ms, the following set is used, continuing with the first set after the sequence is completed.

For EDR packets, the parameter sets apply for 20 packets each.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:DTTest:DTTState` on page 98

Start Phase
Enters a start phase.

The start phase of the sine wave used to drift the modulated Bluetooth signal around center frequency + carrier frequency offset is set here.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:DTTest:SPHase` on page 99

Frequency Drift Rate
Enters a frequency drift rate.

A sine wave is used to drift the modulated Bluetooth siganal around center frequency + carrier frequency offset with the set frequency drift rate.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:DTTest:FDRate` on page 99

Frequency Drift Deviation (+/-)
Enters a frequency drift deviation.

A sine wave is used to drift the modulated Bluetooth signal around center frequency + carrier frequency offset. The maximum deviation reached during the drift equals the set frequency drift deviation.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:DTTest:FDDeviation` on page 98

Dirty Transmitter Setting
Indicates the dirty transmitter parameters according to the Bluetooth test specification (Basic Rate).

State ← Dirty Transmitter Setting
Activates or deactivates the corresponding parameter set.

If a set deactivated, its parameters are skipped in the sequence. Instead, the next active set is used.

For Basic Rate packets, each set applies to 20ms of signal. For EDR packets, each set applies to 20 packets.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:DTTest:TABLe:LONG:SET<ch>:STATe`
on page 101
`[:SOURce<hw>]:BB:BTOoth:DTTest:TABLe:SHORt:SET<ch>:STATe`
on page 102

Carrier Frequency Offset kHz ← Dirty Transmitter Setting
Enters a carrier frequency offset.

The center frequency of the modulated RF carrier is offset by the specified value.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:DTTest:TABLe:LONG:SET<ch>:CFOFfset`
on page 100
`[:SOURce<hw>]:BB:BTOoth:DTTest:TABLe:SHORt:SET<ch>:CFOFfset`
on page 102

Symbol Timing Error ← Dirty Transmitter Setting
Enters the symbol timing error in ppm.

The Symbol Timing Error modifies the symbol clock frequency by the set amount.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:DTTest:TABLe:LONG:SET<ch>:STERror`
on page 101
`[:SOURce<hw>]:BB:BTOoth:DTTest:TABLe:SHORt:SET<ch>:STERror`
on page 103

Modulation Index ← Dirty Transmitter Setting
(Only for Basic Rate Packets)

Enters the modulation index.

The modulation index specifies the frequency deviation.

The modulation index **h** is defined as:

$$h = \frac{2\Delta f}{f_{symbol}}$$

where f_{symbol} is the "symbol rate" and Δf is the "frequency deviation".

According to the Bluetooth standard, the modulation index is allowed to vary between 0.28 and 0.35.

Remote command:

`[:SOURce<hw>]:BB:BTOoth:DTTest:TABLe:LONG:SET<ch>:MINDex`
on page 100

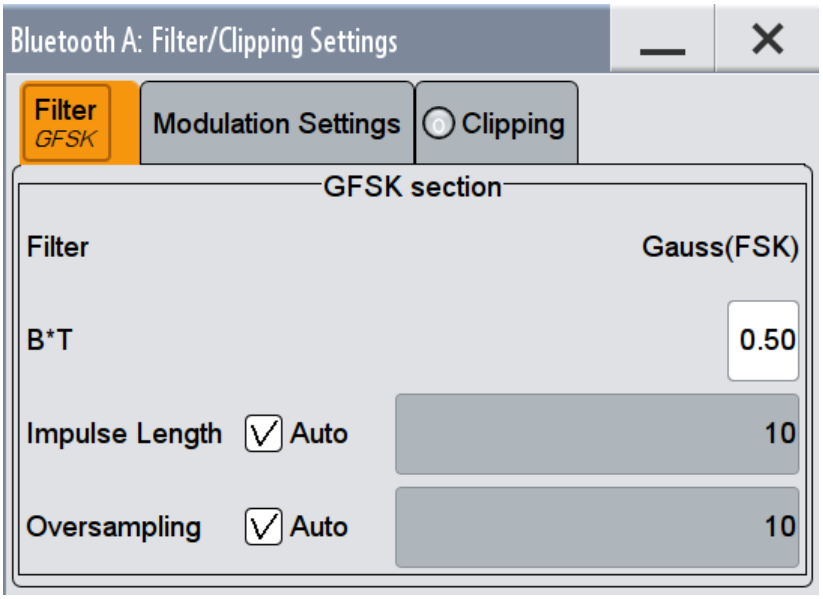
3.8 Filter/Clipping Settings

► To access this dialog select "Baseband > Bluetooth > General > Filter / Clipping".

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

3.8.1 Filter Settings

► To access this dialog select "Baseband > Bluetooth > General > Filter / Clipping > Filter".



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

Provided are the following settings for configuring the baseband filter:

Filter
Indicates the filter used for GFSK part.

With EDR Packets, you can set the filter used for DQPSK/8DPSK sections.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:FILTer:TYPE` on page 72

Roll Off Factor / B xT
Sets the filter parameter.

Sets the filter parameter.

The filter parameter offered ("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.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:APCO25` on page 74
`[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:COSine` on page 75
`[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:FGAuss` on page 75
`[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:GAUSs` on page 75
`[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:PGAuss` on page 76
`[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:RCOSine` on page 76
`[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:SPHase` on page 76

Cut Off Frequency Factor
(available for filter parameter Lowpass only)

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

Remote command:
`[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:LPASs` on page 75

Impulse Length
(For WinIQSIM2 only)

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

Remote command:
`[:SOURce<hw>]:BB:BTOoth:FILTer:ILENgth:AUTO[:STATe]` on page 73
`[:SOURce<hw>]:BB:BTOoth:FILTer:ILENgth` on page 72

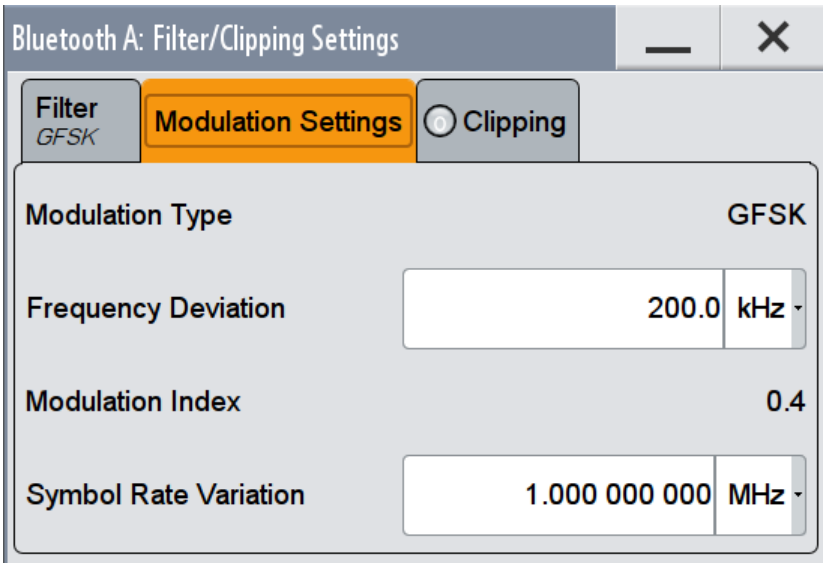
Oversampling
(For WinIQSIM2 only)

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

Remote command:
`[:SOURce<hw>]:BB:BTOoth:FILTer:OSAMpling:AUTO[:STATe]` on page 73
`[:SOURce<hw>]:BB:BTOoth:FILTer:OSAMpling` on page 73

3.8.2 Modulation Settings

► To access this dialog select "Baseband > Bluetooth > General > Filter / Clipping > Modulation Settings".



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

Provided are the following settings:

Modulation type
Displays the modulation type used for the current packet selection.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:FILTer:MTYPe` on page 74

Frequency deviation
Enter the frequency deviation of the frequency modulated part.

The frequency deviation can be varied in a range from 100.0 kHz to 200.0 kHz according to Bluetooth specification.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:MSETtings:FDEViation` on page 74

Modulation index
Displays the modulation index resulting from the entered frequency deviation value.

Modulation index is calculated from the given frequency deviation and symbol rate values.

The modulation index **h** is defined as:

$$h = \frac{2\Delta f}{f_{symbol}}$$

where f_{symbol} is the "symbol rate" and Δf is the "frequency deviation".

According to the Bluetooth standard, the modulation index is allowed to vary between 0.28 and 0.35.

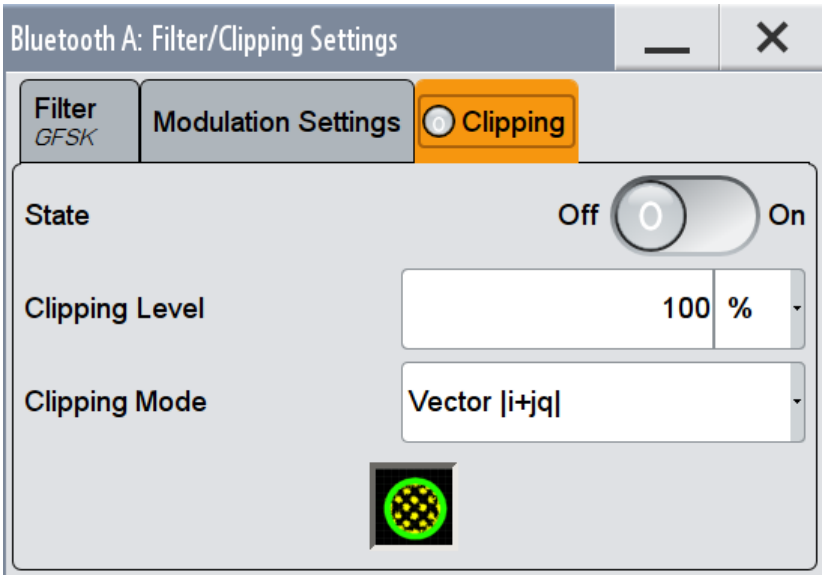
Remote command:
[:SOURce<hw>]:BB:BTOoth:FILTer:MINDex on page 74

Symbol Rate Variation
Enter the symbol rate.

Remote command:
[:SOURce<hw>]:BB:BTOoth:SRATe:VARiation on page 77

3.8.3 Clipping Settings

► To access this dialog select "Baseband > Bluetooth > General > Filter / Clipping > Clipping".



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

Provided are the following settings:

Clipping State
Switches baseband clipping on and off.

Switches baseband clipping on and off.

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

Remote command:
[:SOURce<hw>]:BB:BTOoth:CLIPping:STATe on page 72

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:BTOoth:CLIPping:LEVel` on page 71

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

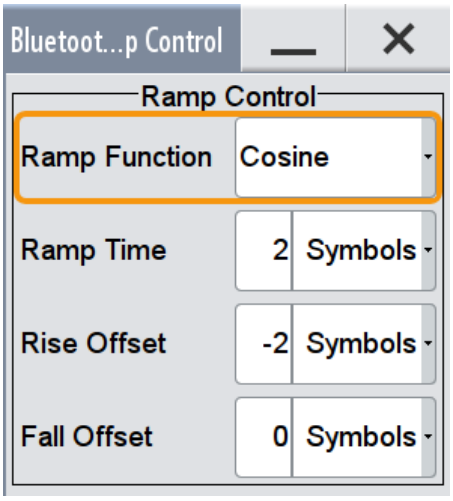
Selects the clipping method. A graphic illustration of the way in which these two methods work is given in the dialog.

- "Vector | i + q |"
  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:BTOoth:CLIPping:MODE` on page 71

3.9 Power Ramping Settings

► To access this dialog select "Bluetooth > General > Power Ramping"



The dialog comprises the settings, necessary to configure the power ramping.

Provided are the following settings:

Ramp Function
Selects the form of the transmitted power, i.e. the shape of the rising and falling edges during power ramp control.

"Linear" The transmitted power rises and falls with linear fashion.

"Cosine" The transmitted power rises and falls with a cosine-shaped edge. This gives rise to a more favorable spectrum than the Linear setting.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:PRAMping:RFUNction` on page 89

Ramp Time
Sets the power ramping rise time and fall time for a burst.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:PRAMping:RTIMe` on page 89

Rise Offset
Sets the offset in the rising edge of the envelope at the start of a burst. A positive value moves the ramp into the beginning of a transmitted packet and a negative value introduces an additional guard period before the start of the packet.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:PRAMping:ROFFset` on page 89

Fall Offset
Sets the offset of the falling edge of the envelope at the end of a burst. A positive value introduces a guard period after the end of the packet and a negative value moves the ramp into the end part of the transmitted packet.

Remote command:
`[:SOURce<hw>]:BB:BTOoth:PRAMping:FOFFset` on page 88

4 Remote-Control Commands

The following commands are required to perform signal generation with the Bluetooth options in a remote environment. We assume that the R&S SMW has already been set up for remote operation in a network as described in the R&S SMW documentation. A knowledge about the remote control operation and the SCPI command syntax are assumed.

The commands in the `SOURce:BB:BTOoth` subsystem are described in three sections, separated into general remote commands, commands for Packet Configuration settings and commands for Dirty Transmitter Test settings.

This subsystem contains commands for the primary and general settings of the Bluetooth standard. These settings concern activation and deactivation of the standard, setting filter, clock, trigger and clipping settings, defining the symbol rate variation and the sequence length, as well as the preset and power adjust setting.

Common Suffixes

The following common suffixes are used in remote commands:

Suffix	Value range	Description
`SOURce<hw>`	[1] .. 4	available baseband signals
`OUTPut<ch>`	[1] .. 3	available markers

Basic tasks that are also performed in the base unit in the same way are not described here.

For a description of such tasks, see the R&S SMW User Manual.

In particular, this includes:

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

The following commands specific to the Bluetooth are described here:

4.1 General Commands

[:SOURce<hw>]:BB:BTOoth:BCText?

Queries the state/roll of the controller.

Return values:

<BcText> string

Connected
(for data channel type)
Shows that the state is Connected.

Advertiser
(for advertising channel type)
the current bluetooth Controller Role is Advertiser
for all ADV-xxx packet types and SCAN_RSP.

Scanner
(for advertising channel type)
the current bluetooth Controller Role is Scanner
for SCAN_REQ packet type

Initiator
(for advertising channel type)
the current bluetooth Controller Role is Initiator
for CONNECT_REQ packet type

Example: `SOUR:BB:BTO:BCT?`
Queries the state/roll of the controller.

Usage: Query only

Manual operation: See "Bluetooth Controller State" on page 38

[:SOURce<hw>]:BB:BTOoth:CTYPe <CType>

Determines the channel type. Advertising and data are available.

Parameters:

<CType> ADVertising | DATA

ADVertising
Selects channel type Advertising.

DATA
Selects channel type Data. Devices in a connected state transmit data channel packets in connection events with a start point and an interval.

*RST: ADVertising

Example: `SOUR:BB:BTO:CTYP ADV`
channel type Advertising.
`SOUR:BB:BTO:CTYP DATA`
channel type Data.

Manual operation: See "Channel Type" on page 36

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

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

All Bluetooth settings are preset.

Example: `BB:BTO:PRES`
resets all the Bluetooth settings to default values.

Usage: Event

Manual operation: See "Set to Default" on page 17

[:SOURce<hw>]:BB:BTOoth:PTYPe <PType>

The available packets depend on the selected transport mode. All packet types as defined in the Bluetooth specifications are supported.

Parameters:

<PType> ID | NULL | POLL | FHS | DM1 | DH1 | DM3 | DH3 | DM5 | DH5 | AUX1 | ADH1 | ADH3 | ADH5 | AEDH1 | AEDH3 | AEDH5 | HV1 | HV2 | HV3 | DV | EV3 | EV4 | EV5 | EEV3 | EEV5 | EEEV3 | EEEV5

*RST: DH1

Example: `BB:BTO:PTYP NULL`
sets the packet type.

Manual operation: See "Packet Type" on page 29

[:SOURce<hw>]:BB:BTOoth:SETTing:CATalog <Catalog>

This command reads out the files with Bluetooth settings in the default directory. The default directory is set using command `MMEM:CDIRectory`. Only files with the file extension `*.bto` will be listed.

Parameters:

<Catalog> string

Example: `MMEM:CDIR '/var/user/temp/bluetooth'`
sets the default directory to /var/user/temp/bluetooth.
`BB:BTO:SETT:CAT?`
reads out all the files with Bluetooth settings in the default directory.
`Response: 'Bluetooth_EDR','Bluetooth_SCO'`
the files `Bluetooth_EDR` and `Bluetooth_SCO` are available.

Manual operation: See "Save/Recall" on page 17

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

This command deletes the selected file with Bluetooth settings. The directory is set using command `MMEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. The file extension may be omitted. Only files with the file extension `*.bto` will be deleted.

Parameters:

<Filename> string

Example: `BB:BTO:SETT:DEL '/var/user/temp/bluetooth'`
deletes the specified file with Bluetooth settings.

Manual operation: See "Save/Recall" on page 17

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

This command loads the selected file with Bluetooth settings. The directory is set using command `MMEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. The file extension may be omitted. Only files with the file extension `*.bto` will be loaded.

Parameters:

<Filename> string

Example: `BB:BTO:SETT:LOAD 'bluetooth_1'`
loads file `bluetooth_1`.

Manual operation: See "Save/Recall" on page 17

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

This command stores the current Bluetooth settings into the selected file. The directory is set using command `MMEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. Only the file name has to be entered. Bluetooth settings are stored as files with the specific file extensions `*.bto`.

Setting parameters:

<Filename> string

Example: `BB:BTO:SETT:STOR 'bluetooth_1'`
stores the current Bluetooth settings into file `bluetooth_1`.

Usage: Setting only

Manual operation: See "Save/Recall" on page 17

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

The command sets the sequence length of the Bluetooth signal in number of frames. This signal is calculated in advance and output in the arbitrary waveform generator.

Parameters:

<SLength> float

Range: 1 to 53687
*RST: 1

Example: `BB:BTO:SLEN 10`
sets the sequence length to 10 frames.

Manual operation: See "Sequence Length" on page 30

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

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

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

Parameters:

<State> 0 | 1 | OFF | ON

*RST: OFF

Example: `BB:BTO:STAT ON`
activates modulation in accordance with the Bluetooth standard.

Manual operation: See "State" on page 17

[:SOURce<hw>]:BB:BTOoth:TMODe <TMode>

The command selects the transport mode.

Parameters:

<TMode> ACL | SCO | ESCO

ACL
The selected transport mode is used for a point-to-point multipoint link establishment between the master and all the slaves participating on the piconet.

SCO
The selected transport mode is used for a point-to-point link establishment between a master and a single slave in the piconet.

ESCO
The selected transport mode is used for a symmetric or asymmetric point-to point link establishment between a master and a specific slave.

*RST: ACL

Example: `BB:BTO:TMOD ACL`
selects transport mode ACL.

Manual operation: See "Transport Mode" on page 18

[:SOURce<hw>]:BB:BTOoth:VERSion <Version>

The command queries the version of the Bluetooth standard underlying the definitions.

Parameters:

<Version> string

Example: `BB:BTO:VERS?`
queries the Bluetooth version.
`Response: Version 2.1+EDR`

Manual operation: See "Bluetooth Version" on page 18

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

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

Setting parameters:

<Filename> string

Example: `MMEM:CDIR '/var/user/temp/waveform'`
sets the default directory to /var/user/temp/waveform.
`BB:BTO:WAV:CRE 'blutooth_1'`
creates the waveform file `bluetooth.wv` in the default directory.

Usage: Setting only

Manual operation: See "Generate Waveform File" on page 18

4.2 Filter/Clipping Settings

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

The command sets the limit for level clipping (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.

Parameters:

<Level> float

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

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

Manual operation: See "Clipping Level" on page 63

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

The command sets the method for level clipping (Clipping).

Parameters:

<Mode> VECTor | SCALar

VECTor
The reference level is the amplitude | i+jq |.

SCALar
The reference level is the absolute maximum of the I and Q values.

*RST: VECTor

Example: `BB:BTO:CLIP:MODE VECT`
sets the amplitude as reference level.

Manual operation: See "Clipping Mode" on page 63

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

The command activates level clipping (Clipping). The value is defined with the command `BB:BTO:CLIPping:LEVel`, the mode of calculation with the command `BB:BTO:CLIPping:MODE`.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: OFF

Example: `BB:BTO:CLIP:STAT ON`
activates level clipping.

Manual operation: See "Clipping State" on page 62

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

The command selects the filters used for π/4 DQPSK and 8DPSK modulations. This opens a selection window containing all the filters available to the instrument.

Parameters:

<Type> RCOSine | COSine | GAUSs | LGAuss | CONE | COF705 | COEQualizer | COFequalizer | C2K3x | APCO25 | SPHase | RECTangle | PGAuss | LPASs | DIRac | ENPShape | EWPShape

*RST: RCOS

Example: `BB:BTO:FILT:TYPE RCOS`
sets the filter type RCOSine.

Manual operation: See "Filter" on page 60

[:SOURce<hw>]:BB:BTOoth:FILTer:ILENgth <ILength>

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

Parameters:

<ILength> float

Range: 1 to 128
Increment: 1
*RST: 10

Example: `BB:BTO:FILT:ILEN 10`
sets the number of filter tabs to 10.

Manual operation: See "Impulse Length" on page 60

[:SOURce<hw>]:BB:BTOoth:FILTer:ILENgth:AUTO[:STATe] <State>

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

Parameters:

<State> 0 | 1 | OFF | ON

*RST: ON

Example: `BB:BTO:FILT:ILEN:AUTO ON`
the most sensible parameters are selected automatically.

Manual operation: See "Impulse Length" on page 60

[:SOURce<hw>]:BB:BTOoth:FILTer:OSAMpling <OSampling>

The command sets the upsampling factor.

Parameters:

<OSampling> integer

Range: 1 to 32
*RST: 10

Example: `BB:BTO:FILT:OSAM 10`
sets the upsampling factor to 10.

Manual operation: See "Oversampling " on page 60

[:SOURce<hw>]:BB:BTOoth:FILTer:OSAMpling:AUTO[:STATe] <State>

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

Parameters:

<State> 0 | 1 | OFF | ON

*RST: ON

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

Manual operation: See "Oversampling " on page 60

[:SOURce<hw>]:BB:BTOoth:FILTer:MINDex <MIndex>

Queries the modulation index resulting from the entered frequency deviation value.

Parameters:
<MIndex> string

Example: `BB:BTO:FILT:MIND`
Queries the modulation index
`Response: 0.5`

Manual operation: See "Modulation index" on page 61

[:SOURce<hw>]:BB:BTOoth:FILTer:MTYPe <MType>

Queries the modulation type used for the current packet selection.

Parameters:
<MType> string

Example: `BB:BTO:FILT:MTYP?`
Queries the modulation type

Manual operation: See "Modulation type" on page 61

[:SOURce<hw>]:BB:BTOoth:MSETtings:FDEViation <FDeviation>

The frequency deviation can be varied in a range from 100.0 kHz to 200.0 kHz.

Parameters:
<FDeviation> float

Range: 100 kHz to 200 kHz
Increment: 0.1 kHz
*RST: 160 kHz

Example: `BB:BTO:MSET:FDEV 160`
sets a frequency deviation.

Manual operation: See "Frequency deviation" on page 61

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

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

Parameters:
<Apco25> float

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

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

Manual operation: See "Roll Off Factor / B xT" on page 60

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

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

Parameters:

<Cosine> float

Range: 0 to 1.0
Increment: 0.01
*RST: 0.1

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

Manual operation: See "Roll Off Factor / B xT" on page 60

[:SOURce<hw>]:BB:BTOoth:FILTer:PARameter:FGAuss <FGauss>

The command sets the B x T for the Gauss filter type.

Parameters:

<FGauss> float

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

Example: `BB:BTO:FILT:PAR:FGA 0.5`
sets B x T to 0.5 for the Gauss filter type for the GFSK section of the packet.

Manual operation: See "Roll Off Factor / B xT" on page 60

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

The command sets the B x T for the Gauss filter type.

Parameters:

<Gauss> float

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

Example: `BB:BTO:FILT:PAR:GAUS 0.5`
sets B x T to 0.5 for the Gauss filter type for π/4 DQPSK or 8DPSK sections.

Manual operation: See "Roll Off Factor / B xT" on page 60

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

The command sets the cut off frequency factor for a lowpass filter (ACP Opt.).

Parameters:

<LPass> float

Range: 0.05 to 2.00
Increment: 0.01
*RST: 0.50

Example: `BB:BTO:FILT:PAR:LPAS 1`
sets the cut off frequency factor for a lowpass filter

Manual operation: See "Cut Off Frequency Factor" on page 60

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

The command sets the B x T for the Pure Gauss filter type.

Parameters:

<PGauss> float

Range: 0.15 to 2.5
*RST: 0.5
Default unit: 0.01

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

Manual operation: See "Roll Off Factor / B xT" on page 60

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

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

Parameters:

<RCosine> float

Range: 0 to 1.0
Increment: 0.01
*RST: 0.4

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

Manual operation: See "Roll Off Factor / B xT" on page 60

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

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

Parameters:

<SPhase> float

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

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

Manual operation: See "Roll Off Factor / B xT" on page 60

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

The command enters the symbol rate.

Parameters:
<Variation> float
Range: 400 to 15E6
Increment: 1 Hz
*RST: 1E6
Default unit: Hz

Example: `BB:BTO:SRAT:VAR 1`
sets the symbol rate variation to 1 MHz.

Manual operation: See "Symbol Rate Variation" on page 62

4.3 Trigger Settings

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

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

The command stops signal generation for trigger modes "Armed Auto" and "Armed Retrigger". A subsequent internal or external trigger event restart signal generation.

Example: `BB:BTO:TRIG:ARM:EXEC`
stops signal generation for trigger modes "Armed Auto "and "Armed Retrigger".

Usage: Event

Manual operation: See "Arm" on page 22

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

The command executes a trigger. The internal trigger source must be selected using the command `SOUR:BB:BTO:TRIG:SOUR INT` and a trigger mode other than "AUTO" must be selected using the command `SOUR:BB:BTO:TRIG:SEQ`.

Example: `BB:BTO:TRIG:SOUR INT`
sets internal triggering.
`BB:BTO:SEQ RETR`
sets Retrigger mode, i.e. every trigger event causes signal generation to restart.
`BB:BTO:TRIG:EXEC`
executes a trigger.

Usage: Event

Manual operation: See "Execute Trigger" on page 22

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

(enabled for "Trigger Source" External)

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

Parameters:

<Output> 0 | 1 | OFF | ON

ON
The signal calculation starts simultaneously with the external trigger event but because of the instrument's processing time the first samples are cut off and no signal is outputted. After elapsing of the internal processing time, the output signal is synchronous to the trigger event.

OFF
The signal output begins after elapsing of the processing time and starts with sample 0, i.e. the complete signal is outputted.

*RST: ON

Example: `BB:BTO:TRIG:SOUR EXT`
sets external triggering.
`BB:BTO:TRIG:EXT:SYNC:OUTP ON`
enables synchrounous output to external trigger

Manual operation: See "Sync. Output to External Trigger" on page 22

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

The command specifies the trigger delay (expressed as a number of samples) for triggering by the trigger signal from the second path.

Parameters:

<Delay> float

Range: 0 samples to (1<<16)-1u samples
Increment: 0.01 samples
*RST: 0 samples

Example: `BB:BTO:TRIG:SOUR OBAS`
sets for path A the internal trigger executed by the trigger signal from the second path (path B).
`BB:BTO:TRIG:OBAS:DEL 50`
sets a delay of 50 symbols for the trigger.

Manual operation: See "External Trigger Delay" on page 23

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

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

Parameters:

<Inhibit> integer

Range: 0 samples to (1<<26)-1u samples
Increment: 1 sample
*RST: 0 samples

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

Manual operation: See "External Trigger Inhibit" on page 24

[:SOURce<hw>]:BB:BTOoth:TRIGger:RMODe <RMode>

The command queries the current status of signal generation for all trigger modes with Bluetooth modulation on.

Parameters:

<RMode> RUN | STOP

RUN
the signal is generated. A trigger event occurred in the triggered mode.

STOP
the signal is not generated. A trigger event did not occur in the triggered modes, or signal generation was stopped by the command `:BB:BTO:TRIG:ARM:EXECute` (armed trigger modes only).

Example: `BB:BTO:SEQ ARET`
selects the Armed_Retrigger mode.
`BB:BTO:TRIG:RMOD?`
queries the current status of signal generation.
`Response: RUN`
the signal is generated, an external trigger was executed.

Manual operation: See "Running/Stopped" on page 21

[:SOURce<hw>]:BB:BTOoth:TRIGger:SLENgth <SLength>

The command defines the length of the signal sequence to be output in the Single trigger mode (`SOUR:BB:BTO:SEQ SING`). The unit is defined with command `SOUR:BB:BTO:TRIG:SLUNit`.

Parameters:
<SLength> float
Range: 1 to 7000
*RST: 1 sequence length

Example: `BB:BTO:SEQ SING`
sets trigger mode Single.
`BB:BTO:TRIG:SLUN FRAM`
sets unit frames for the entry of sequence length.
`BB:BTO:TRIG:SLEN 200`
sets a sequence length of 200 frames.

Manual operation: See "Trigger Signal Duration" on page 21

[:SOURce<hw>]:BB:BTOoth:TRIGger:SLUNit <SlUnit>

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

Parameters:
<SlUnit> FRAMe | SEQuence | EVENt
*RST: SEQuence

Example: `BB:BTO:SEQ SING`
sets trigger mode Single.
`BB:BTO:TRIG:SLUN FRAM`
sets unit frames for the entry of sequence length.
`BB:BTO:TRIG:SLEN 2`
sets a sequence length of 2 frames. The current frame will be output twice after the next trigger event.

Manual operation: See "Signal Duration Unit" on page 21

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

Selects the trigger signal source and determines the way the triggering is executed. Provided are internal triggering by means of a command, external trigger singnal via one of the provided local or global connectors and and triggering by a signal from the other paths.

Parameters:

<Source> INTB | INTernal | OBASeband | EGT1 | EGT2 | EGC1 | EGC2 | ELTRigger | INTA | ELCLock | BEXTernal | EXTernal

INTernal
Internal

INTA | INTB
Internal trigger from the other baseband

EGT1 | EGT2
External global trigger

EGC1 | EGC2
External global clock

ELTRigger
External local trigger

ELCLock
External local clock

OBASeband|BEXTernal|EXTernal
Provided only for backward compatibility with other R&S signal generators.
The R&S SMW accepts these values und maps them automatically as follow:
EXTernal = EGT1, BEXTernal = EGT2, OBASeband = INTA or INTB (depending on the current baseband)

*RST: INT

Example: `BB:BTO:TRIG:SOUR INT`
selects an internal trigger source

Manual operation: See "Trigger Source" on page 22

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

Specifies the trigger delay (expressed as a number of samples) for external triggering. The value affects all external trigger signals.

Parameters:

<Delay> float

Range: 0.0 to 65535.0
*RST: 0.0

Example: `BB:BTO:TRIG:SOUR EXT`
sets an external trigger.
`BB:BTO:TRIG:EXT:DEL 50`
sets a delay of 50 symbols for the trigger.

Manual operation: See "External Trigger Delay" on page 23

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

Specifies the number of samples by which a restart is to be inhibited following an external trigger event.

Parameters:

<Inhibit> float

Range: 0 to 67108863
*RST: 0

Example: `BB:BTO:TRIG:SOUR EXT`
selects an external trigger.
`BB:BTO:TRIG:EXT:INH 200`
sets a restart inhibit for 200 samples following a trigger event.

Manual operation: See "External Trigger Inhibit" on page 24

[:SOURce<hw>]:BB:BTOoth[:TRIGger]:SEQuence <Sequence>

The command selects the trigger mode.

Parameters:

<Sequence> AUTO | RETRigger | AAUTo | ARETrigger | SINGle

AUTO
The modulation signal is generated continuously.

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

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

ARETrigger
The modulation signal is generated only when a trigger event occurs. The device automatically toggles to RETRIG mode. Every subsequent trigger event causes a restart.
Signal generation is stopped with command `SOUR:BB:BTO:TRIG:ARM:EXEC` and started again when a trigger event occurs.

SINGle
The modulation signal is generated only when a trigger) event occurs. After the trigger event, the signal is generated once to the set sequence length (`SOUR:BB:BTO:TRIG:SLEN`). Every subsequent trigger event causes a restart.

*RST: AUTO

Example: BB:BTO:SEQ AAUT
sets the "Armed_auto" trigger mode; the device waits for the first trigger (e.g. with *TRG) and then generates the signal continuously.

Manual operation: See "Trigger Mode" on page 20

4.4 Marker Settings

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

OUTPut<ch>

The numeric suffix to OUTPut distinguishes between the available markers.

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

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

The numeric suffix in OUTPut has no significance for this command, since the setting always affects every marker.

Parameters:

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

Example: BB:BTO:TRIG:OUTP:DEL:FIX ON
restricts the marker signal delay setting range to the current range.

Manual operation: See "Marker x Delay" on page 26

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

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

Parameters:

<Delay> float

Range: 0 samples to ((1<<24)-1u) samples
Increment: 0.001 samples
*RST: 0 samples

Example: `BB:BTO:TRIG:OUTP2:DEL 1600`
sets a delay of 1600 samples for the corresponding marker signal.

Manual operation: See "Marker x Delay" on page 26

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

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

Return values:

<Maximum> float

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

Usage: Query only

Manual operation: See "Marker x Delay" on page 26

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

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

Return values:

<Minimum> float

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

Usage: Query only

Manual operation: See "Marker x Delay" on page 26

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

The command defines the signal for the selected marker output.

Parameters:

<Mode> RESTart | STARt | ACTive | PULSe | PATTern | RATio

RESTart
A marker signal is generated at the start of each signal sequence.

STARt
A marker signal is generated at the start of each frame

ACTive
The marker masks the active part of the frame. At the start of each burst, the marker signal changes to high. It changes back to low after the end of each burst.

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

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

RATio
A regular marker signal corresponding to the Time Off / Time On specifications in the commands
`SOURce:BB:BTO:TRIGger:OUTPut:OFFTime` and
`SOURce:BB:BTO:TRIGger:OUTPut:ONTime` is generated.

*RST: RESTart

Example: `BB:BTO:TRIG:OUTP:MODE REST`
selects the marker generation at the start of each signal sequence

Manual operation: See "Marker Mode" on page 25

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

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

Parameters:

<OffTime> float

Range: 1 sample to (1<<24)-1u samples
Increment: 1 sample
*RST: 1 sample

Example: `BB:BTO:TRIG:OUTP:OFFT 2000`
sets an OFF time of 2000 samples for the corresponding marker signal.

Manual operation: See "Marker Mode" on page 25

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

The command selects the data for a pattern.

Parameters:

<Pattern> integer

Example: `BB:BTO:TRIG:OUTP:MODE PATT`
sets the marker mode for the corresponding marker signal
`BB:BTO:TRIG:OUTP:PATT #B010101,6`
sets the pattern

Manual operation: See "Marker Mode" on page 25

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

The clock frequency is defined by entering a divider. The frequency is derived by dividing the symbol rate by the divider. The input box for divider opens when Pulse is selected, and the resulting pulse frequency is displayed below it.

Parameters:

<Divider> float

Range: 2 to 1024
Increment: 1
*RST: 2

Example: `BB:BTO:TRIG:OUTP:MODE:PULS`
selects marker mode Pulse
`BB:BTO:TRIG:OUTP:PULS:DIV 2`
sets a divider for the clock frequency.

Manual operation: See "Marker Mode" on page 25

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

The clock frequency is defined by entering a divider. The frequency is derived by dividing the symbol rate by the divider. The input box for divider opens when Pulse is selected, and the resulting pulse frequency is displayed below it.

Return values:
<Frequency> float

Example: `BB:BTO:TRIG:OUTP:MODE:PULS`
selects marker mode Pulse
`BB:BTO:TRIG:OUTP:PULS:DIV 2`
sets a divider for the clock frequency
`BB:BTO:TRIG:OUTP:PULS:FREQ`
displays resulting pulse frequency

Usage: Query only

Manual operation: See "Marker Mode" on page 25

4.5 Clock Settings

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

[:SOURce<hw>]:BB:BTOoth:CLOCk:MODE <Mode>

The command enters the type of externally supplied clock. When `MSAMple` is used, a multiple of the clock is supplied and the clock is derived internally from this. The multiplier is entered with the command `[:SOURce<hw>]:BB:BTOoth:CLOCk:MULTiplier`.

Parameters:
<Mode> SAMPle | MSAMple
*RST: SAMP

Example: `BB:BTO:CLOC:MODE MSAM`
sets the type of externally supplied clock.

Manual operation: See "Clock Mode" on page 28

[:SOURce<hw>]:BB:BTOoth:CLOCk:MULTiplier <Multiplier>

The command specifies the multiplication factor for clock type "Multiple Sample" (`:BB:BTO:CLOCk:MODE MSAMple`) in the case of an external clock source.

Parameters:

<Multiplier> float

Range: 1 to 64
Increment: 1
*RST: 4

Example: `BB:BTO:CLOC:SOUR EGC1`
selects the external clock source. The clock is supplied via the first multipurpose (global) connector (USER1).
`BB:BTO:CLOC:MODE MSAM`
selects clock type "Multiple Sample", i.e. the supplied clock has a rate which is a multiple of samples.
`BB:BTO:CLOC:MULT 12`
the multiplier for the external clock rate is 12.

Manual operation: See "Clock Multiplier" on page 28

[:SOURce<hw>]:BB:BTOoth:CLOCk:SOURce <Source>

Selects the clock source.

Parameters:

<Source> INTernal | EGC1 | EGC2 | ELCLock | EXTernal

INTernal
The instrument uses its internal clock reference

EGC1|EGC2
External global clock

ELCLock
External local clock

*RST: INTernal

Example: `BB:BTO:CLOC:SOUR: INT`
selects an internal clock reference.

Manual operation: See "Clock Source" on page 27

4.6 Power Ramping

[:SOURce<hw>]:BB:BTOoth:PRAMping:FOFFset <FOffset>

The command sets the offset of the falling edge of the envelope at the end of a burst. A positive value introduces a guard period after the end of the packet and negative value moves the ramp into the end part of the transmitted packet.

Parameters:

<FOffset> integer

Range: -32 to 32
Increment: 1
*RST: 0
Default unit: symbols

Example: `BB:BTO:PRAM:FOFF 8.0`
sets the offset in the falling edge of the envelope to 8.0 symbols.

Manual operation: See "Fall Offset" on page 64

[:SOURce<hw>]:BB:BTOoth:PRAMping:RFUNction <RFunction>

The command selects the form of the transmitted power, i.e. the shape of the rising and falling edges during power ramp control.

Parameters:

<RFunction> LINear | COSine

*RST: COSine

Example: `BB:BTO:PRAM:RFUN LIN`
sets linear shape for the rising and falling edges during power ramp control.

Manual operation: See "Ramp Function" on page 64

[:SOURce<hw>]:BB:BTOoth:PRAMping:ROFFset <ROffset>

The command sets the offset in the rising edge of the envelope at the start of a burst. A positive value moves the ramp into beginning of a transmitted packet and a negative value introduce an additional guard period after the end of the packet.

Parameters:

<ROffset> integer

Range: -32 symbols to 32 symbols
Increment: 1 symbol
*RST: 0 symbols

Example: `BB:BTO:PRAM:ROFF 8.0`
sets the offset in the rising edge of the envelope to 8.0 symbols.

Manual operation: See "Rise Offset" on page 64

[:SOURce<hw>]:BB:BTOoth:PRAMping:RTIMe <RTime>

The command sets the power ramping rise time and fall time for a burst.

Parameters:

<RTime> integer

Range: 1 symbol to 32 symbols
Increment: 1 symbol
*RST: 1 symbol

Example: `BB:BTO:PRAM:TIME 2.0`
sets the power ramping rise time and fall time for a burst to 2 samples.

Manual operation: See "Ramp Time" on page 64

4.7 Packet Configuration Setting

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:ACKNowledgement
<Acknowledgement>

This command sets the ARQN bit of the packet header..

Parameters:

<Acknowledgement> NAK | ACK

NAK
Request to retransmit the previous payload.

ACK
Previous payload has been received successfully.

*RST: ACK

Example: `BB:BTO:PTYP DH1`
selects the packet type DH1.
`BB:BTO:PCON:DSFP PED`
enable packet editor under data source for packet
`BB:BTO:PCON:ACKN ACK`
sets positive acknowledgement

Manual operation: See "Acknowledgment" on page 32

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:BDALap <BdaLap>

Enters the lower address part of Bluetooth Device Address. The length of LAP is 24 bits or 6 hexadecimal figures.

Parameters:
<BdaLap> integer
Range: #H000000 to #HFFFFFF
*RST: 80

Example: `BB:BTO:PCON:BDAL #H000000, 24`
sets the lower address part

Manual operation: See "Bluetooth Device Address (BD_ADDR)" on page 31

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:BDANap <BdaNap>

Enters the non-significant address part of Bluetooth Device Address. The length of NAP is 16 bits or 4 hexadecimal figures.

Parameters:
<BdaNap> integer
Range: #H0000 to #HFFFF
*RST: ABCD

Example: `BB:BTO:PCON:BDAN #H0000, 16`
sets the non-significant address part

Manual operation: See "Bluetooth Device Address (BD_ADDR)" on page 31

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:BDAUap <BdaUap>

Enters the upper address part of Bluetooth Device Address. The length of UAP is 8 bits or 2 hexadecimal figures.

Parameters:
<BdaUap> integer
Range: #H00 to #HFF
Increment: 1
*RST: 48

Example: `BB:BTO:PCON:BDAN #H00, 8`
sets the non-significant address part

Manual operation: See "Bluetooth Device Address (BD_ADDR)" on page 31

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:CODevice <CoDevice>

A parameter received during the device discovery procedure, indicates the type of device and which types of service that are supported.

Parameters:

<CoDevice> integer

Range: #H000000 to #HFFFFFF

Example: `BB:BTO:PTYP FHS`
sets the packet type
`BB:BTO:PCON:DSFP PED`
enable packet editor under data source for packet
`BB:BTO:PCON:COD '020104'`
sets the class of device

Manual operation: See "Class of Device" on page 33

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DATA <Data>

Selects the data source used for the payload.

Parameters:

<Data> ALL0 | ALL1 | PATTern | PN09 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt

*RST: PN09

Example: `BB:BTO:PTYP FHS`
sets the packet type
`BB:BTO:PCON:DSFP PED`
enable packet editor under data source for packet
`BB:BTO:PCON:DATA ALL1`
sets the data type.

Manual operation: See "Data Source" on page 32

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DATA:DPATtern <DPattern>

The command selects the data for a pattern.

Parameters:

<DPattern> integer

Increment: 1
*RST: 0

Example: `BB:BTO:PCON:DATA PATT`
sets the data type.
`BB:BTO:PCON:DATA:DPAT #B010101, 6`
selects the data for a pattern

Manual operation: See "Data Source" on page 32

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DATA:DSELection <DSelection>

The command selects data list file.

Parameters:

<DSelection> string
Increment: 1

Example: `BB:BTO:PCON:DATA DLIS`
selects the data type.
`BB:BTO:PCON:DSEL bluetooth_1`
selects the file for the data.

Manual operation: See "Data Source" on page 32

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DATA:VDPAttern <VdPattern>

The command selects the bit pattern for the voice data.

Parameters:

<VdPattern> integer
Increment: 1
*RST: 0

Example: `BB:BTO:PCON:DATA:PATT`
selects the data type.
`BB:BTO:PCON:DATA:VDPA #B010101, 6`
selects the bit pattern for the voice data.

Manual operation: See "Data Source (Voice Field)" on page 34

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DATA:VDSElection <VdSelection>

The command selects the data list for voice data.

Parameters:

<VdSelection> string
Increment: 1

Example: `BB:BTO:PCON:VDAT DLIS`
selects the data type.
`BB:BTO:PCON:VDSE bluetooth_1`
selects the file for the data.

Manual operation: See "Data Source (Voice Field)" on page 34

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DLENgth <DLength>

The command enters the payload data length in bytes.

Parameters:

<DLength> float

Range: 0 to 1021
Increment: 1
*RST: 0

Example: `BB:BTO:PTYP DH1`
sets the packet type.
`BB:BTO:PCON:DSFP PED`
enable packet editor under data source for packet
`BB:BTO:PCON:DLEN 25`
sets the data length.

Manual operation: See "Data Length" on page 32

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DSFPacket <DsfPacket>

The command selects the data source for the selected packet type.

Parameters:

<DsfPacket> PEDit | ADATa

PED
Enables Packet Editor. All packet fields can be configured individually.

ADAT
Fills the generated packets with the selected data source. Useful if predefined data contents are loaded with a data list file or the data contents of the packet are not of interest.

*RST: PEDit

Example: `BB:BTO:PCON:DSFP PED`
enables packet editor under data source for packet.

Manual operation: See "Data Source for Packet" on page 31

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:DWHitening <DWhitening>

The command activates or deactivates the Data Whitening.

Parameters:

<DWhitening> 0 | 1 | OFF | ON

*RST: OFF

Example: `BB:BTO:PCON:DWH ON`
activates data whitening.

Manual operation: See "Data Whitening" on page 31

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:EIRPacketfollows <EirPacketFollow>

The command indicates that an extended inquiry response packet may follow.

Parameters:

<EirPacketFollow> YES | NO

YES
Indicates that EIR packet follows.

NO
Indicates that EIR packet does not follow.

*RST: NO

Example: `BB:BTO:PCON:PTYP FHS`
sets the packet type.
`BB:BTO:PCON:DSFP PED`
enable packet editor under data source for packet
`BB:BTO:PCON:EIRP YES`
the EIR packet follows.

Manual operation: See "EIR packet follows" on page 33

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:HFControl <HfControl>

The command sets the FLOW bit in the header. This bit indicates start or stop of transmission of packets over the ACL logical transport.

Parameters:

<HfControl> GO | STOP

GO
Allows the other devices to transmit new data.

STOP
Stops the other devices from transmitting data temporarily.

*RST: GO

Example: `BB:BTO:PCON:PTYP DH1`
sets the packet type.
`BB:BTO:PCON:DSFP PED`
enable packet editor under data source for packet.
`BB:BTO:PCON:HFC GO`
allows the other devices to transmit new data.

Manual operation: See "Flow Control (Header)" on page 31

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:LTADdress <LtAddress>

The command enters the logical transport address for the header. Each slave active in a piconet is assigned a primary logical transport address (LT_ADDR). The all-zero LT_ADDR is reserved for broadcast messages.

Parameters:

<LtAddress> integer

Range: 0 to 7
Increment: 1
*RST: 0

Example: `BB:BTO:PCON:PTYP DH1`
sets the packet type.
`BB:BTO:PCON:DSFP PED`
enable packet editor under data source for packet
`BB:BTO:PCON:LTAD 0`
sets the logical transport address equal zero.

Manual operation: See "Logical Transport Address" on page 31

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:PFControl <PfControl>

The command sets the FLOW bit in the payload (flow control per logical link).

Parameters:

<PfControl> GO | STOP

GO
Indicates the start of transmission of ACL packets after a new connection has been established.

STOP
Indicates the stop of transmission of ACL packets before an additional amount of payload data is sent.

*RST: GO

Example: `BB:BTO:PCON:PTYP DH1`
sets the packet type.
`BB:BTO:PCON:DSFP PED`
enable packet editor under data source for packet
`BB:BTO:PCON:PFC GO`
allows the flow per logical link.

Manual operation: See "Flow Control (Payload)" on page 33

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:PLENgth <PLength>

The command enters the packet length in symbols.

Parameters:

<PLength> float

Range: 1 to 2873
Increment: 1
*RST: 0

Example: `BB:BTO:PCON:DSFP ADAT`
fills the all data under data source for packet.
`BB:BTO:PCON:PLEN 1`
sets the packet length.

Manual operation: See "Packet Length" on page 33

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:SNSValue <SnSvalue>

The command sets the start value of the header SEQN bit. The SEQN bit is present in the header to filter out retransmissions in the destination. The signal generator is altering this bit automatically on consecutive frames, if a sequence length of at least 2 frames is set.

Parameters:

<SnSvalue> integer

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

Example: `BB:BTO:PCON:PTYP DH1`
sets the packet type.
`BB:BTO:PCON:DSFP PED`
enables packet editor under data source for packet.
`BB:BTO:PCON:SNSV ONE`
sets the SEQN bit of the first CRC data packet at the start of a connection.

Manual operation: See "SEQN Start Value" on page 32

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:SRMode <SrMode>

The command indicates the interval between two consecutive page scan windows, determines the behavior of the paging device.

Parameters:

<SrMode> R0 | R1 | R2

R0
The scan interval is equal to the scan window T w page scan (continuous nscan) and maximal 1.28s.

R1
The scan interval is maximal 1.28s.

R2
The scan interval is maximal 2.56s.

*RST: R0

Example: `BB:BTO:PCON:PTYP FHS`
sets the packet type.
`BB:BTO:PCON:DSFP PED`
enables packet editor under data source for packet.
`BB:BTO:PCON:SRM R0`
sets the scan repetition mode.

Manual operation: See "Scan Repetition Mode" on page 33

[:SOURce<hw>]:BB:BTOoth:PCONfiguration:VDATa <VData>

The command selects the data source for the voice field.

Parameters:

<VData> ALL0 | ALL1 | PATTern | PN09 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt

*RST: PN09

Example: `BB:BTO:PCON:VDAT ALL1`
sets the voice data type.

Manual operation: See "Data Source (Voice Field)" on page 34

4.8 Dirty Transmitter Test

[:SOURce<hw>]:BB:BTOoth:DTTest:DTTState <DttState>

The command activates/deactivates the Dirty Transmitter Test. For Basic Rate packets, each set of parameters in the Dirty Transmitter Setting table below is used for a duration of 20 ms. After 20 ms, the following set is used, continuing with the first set after the sequence is completed.

For EDR packets, the parameter sets apply for 20 packets each.

Parameters:

<DttState> 0 | 1 | OFF | ON

*RST: OFF

Example: `BB:BTO:DTT:DTTS ON`
activates the Dirty Transmitter Test.

Manual operation: See "Dirty Transmitter Test" on page 57

[:SOURce<hw>]:BB:BTOoth:DTTest:FDDeviation <FdDeviation>

The command enters a frequency drift rate.

A sine wave is used to drift the modulated Bluetooth signal around center frequency + carrier frequency offset. The maximum deviation reached during the drift equals the set frequency drift deviation.

Parameters:

<FdDeviation> float

Range: -100 kHz to 100 kHz
Increment: 1 KHz
*RST: 25 kHz

Example: `BB:BTO:DTT:FDD 25`
enters frequency drift deviation.

Manual operation: See "Frequency Drift Deviation (+/-)" on page 58

[:SOURce<hw>]:BB:BTOoth:DTTest:FDRate <FdRate>

The command enters a frequency drift rate.

A sine wave is used to drift the modulated Bluetooth signal around center frequency + carrier frequency offset with the set frequency drift rate.

Parameters:

<FdRate> 0.3 KHz | 0.5 KHz | 1.6 KHz | 10 KHz

Range: 0.3 kHz to 10 kHz
*RST: 1.6 kHz

Example: `BB:BTO:DTT:FDR 1.6`
enters frequency drift rate.

Manual operation: See "Frequency Drift Rate" on page 57

[:SOURce<hw>]:BB:BTOoth:DTTest:SPHase <SPhase>

The command enters a start phase.

The start phase of the sine wave used to drift the modulated Bluetooth signal around center frequency + carrier frequency offset is set here.

Parameters:

<SPhase> integer

Range: 0 to 359
Increment: 1
*RST: 0
Default unit: degree

Example: `BB:BTO:DTT:SPH 0`
enters a start phase.

Manual operation: See "Start Phase" on page 57

[:SOURce<hw>]:BB:BTOoth:DTTest:STDefault

The command calls the default settings for the Dirty Transmitter Test.

Example: `BB:BTO:DTT:STD`
calls the default settings.

Usage: Event

Manual operation: See "Set to Default" on page 57

[:SOURce<hw>]:BB:BTOoth:DTTest:TABLe <Table>

The command calls the table settings.

Parameters:
<Table> NOTable | SHORt | LONG

Example: `BB:BTO:PTYP DH1`
calls the default settings.
`BB:BTO:DTT:TABL LONG`
calls the default settings.

[:SOURce<hw>]:BB:BTOoth:DTTest:TABLe:LONG:SET<ch>:CFOFfset <CfOffset>

The command enters a carrier frequency offset.

The carrier frequency offset shows the deviation of the transmitted initial center frequency from carrier frequency.

Parameters:
<CfOffset> float

Range: -150 kHz to 150 kHz
Increment: 1 kHz

Example: `BB:BTO:PTYP DH1`
sets the packet type.
`BB:BTO:DTT:TABL LONG`
enters the table type
`BB:BTO:DTT:TABL:LONG:SET2:CFOF 14`
enters a carrier frequency offset.

Manual operation: See "Dirty Transmitter Setting" on page 58

[:SOURce<hw>]:BB:BTOoth:DTTest:TABLe:LONG:SET<ch>:MINDex <MIndex>

The command enters the modulation index.

The modulation index specifies the frequency deviation..

The modulation index h is defined as

$$h = \frac{2\Delta f}{f_{symbol}}$$

where

f_{symbol} = "symbol rate" , set with the command `[:SOURce<hw>]:BB:BTOoth:SRATe:VARiation`

Δf = "frequency deviation", set with the command `[:SOURce<hw>]:BB:BTOoth:MSETtings:FDEViation`

According to the Bluetooth standard, the modulation index is allowed to vary between 0.28 and 0.35.

Parameters:

<MIndex> float

Range: 0.28 to 0.35
Increment: 0.01

Example: `BB:BTO:PTYP DH1`
sets the packet type.
`BB:BTO:DTT:TABL LONG`
enters the table type
`BB:BTO:DTT:TABL:LONG:SET2:MIND 0.3`
enters a modulation index.

Manual operation: See "Dirty Transmitter Setting" on page 58

[:SOURce<hw>]:BB:BTOoth:DTTest:TABLe:LONG:SET<ch>:STATe <State>

The command activates or deactivates the corresponding parameter set for the long table. If a set deactivated, its parameters are skipped in the sequence. Instead, the next active set is used.

For Basic Rate packets, each set applies to 20ms of signal.

Parameters:

<State> 0 | 1 | OFF | ON

Example: `BB:BTO:PTYP DH1`
sets the packet type.
`BB:BTO:DTT:TABL LONG`
enters the table type
`BB:BTO:DTT:TABL:LONG:SET2:STAT ON`
activates the set 2 in the long table.

Manual operation: See "Dirty Transmitter Setting" on page 58

[:SOURce<hw>]:BB:BTOoth:DTTest:TABLe:LONG:SET<ch>:STERror <StError>

The command enters a symbol timing error in ppm.

The Symbol Timing Error modifies the symbol clock frequency by the set amount.

Parameters:

<StError> float

Range: -150 ppm to 150 ppm
Increment: 1 ppm

Example: `BB:BTO:PTYP DH1`
sets the packet type.
`BB:BTO:DTT:TABL LONG`
enters the table type
`BB:BTO:DTT:TABL:LONG:SET2:STER -20`
enters a symbol timing error.

Manual operation: See "Dirty Transmitter Setting" on page 58

[:SOURce<hw>]:BB:BTOoth:DTTest:TABLe:SHORt:SET<ch>:CFOFfset <CfOffset>

The command enters a carrier frequency offset.

The carrier frequency offset shows the deviation of the transmitted initial center frequency from carrier frequency.

Parameters:

<CfOffset> float

Range: -150 kHz to 150 kHz
Increment: 1 kHz

Example: `BB:BTO:PTYP DH1`
sets the packet type.
`BB:BTO:DTT:TABL SHOR`
enters the table type
`BB:BTO:DTT:TABL:SHOR:SET2:CFOF 65`
enters a carrier frequency offset.

Manual operation: See "Dirty Transmitter Setting" on page 58

[:SOURce<hw>]:BB:BTOoth:DTTest:TABLe:SHORt:SET<ch>:STATe <State>

The command activates or deactivates the corresponding parameter set in the short table. If a set deactivated, its parameters are skipped in the sequence. Instead, the next active set is used.

For EDR packets, each set applies to 20 packets.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: ON

Example: `BB:BTO:PTYP DH1`
sets the packet type.
`BB:BTO:DTT:TABL SHOR`
enters the table type
`BB:BTO:DTT:TABL:SHOR:SET2:STAT ON`
activates the set 2 in the short table.

Manual operation: See "Dirty Transmitter Setting" on page 58

[:SOURce<hw>]:BB:BTOoth:DTTest:TABLe:SHORt:SET<ch>:STERror <StError>

The command enters a symbol timing error in ppm.

The Symbol Timing Error modifies the symbol clock frequency by the set amount.

Parameters:

<StError> float
Range: -150 ppm to 150 ppm
Increment: 1 ppm

Example: `BB:BTO:PTYP DH1`
sets the packet type.
`BB:BTO:DTT:TABL SHOR`
enters the table type
`BB:BTO:DTT:TABL:SHOR:SET2:STER 20`
enters a symbol timing error.

Manual operation: See "Dirty Transmitter Setting" on page 58

4.9 LE Commands

[:SOURce<hw>]:BB:BTOoth:BCRole <BcRole>

Determines the controller role. Depending on the selected channel type different roles are assigned to the controller. For channel type "Data", master or slave can be assigned. If channel type "Advertising" is selected, the parameter is read only and displayed directly above the graph.

Parameters:

<BcRole> MASTer | SLAVe

MASTER
Assigns master role to the controller.

SLAVE
Selects slave as controller role.

*RST: MASTer

Example: `SOUR:BB:BTO:BCR MAST`
master as controller role.
`SOUR:BB:BTO:BCR SLAV`
slave as controller role.

Manual operation: See "Bluetooth Controller Role" on page 38

[:SOURce<hw>]:BB:BTOoth:BMODe <BMode>

Determines the digital Bluetooth standard. Basic Rate + EDR or Bluetooth Low Energy are available.

Parameters:

<BMode> BASic | BLENergy

BASic
Selects the Bluetooth mode Basic Rate + EDR.

BLENergy
Selects the Bluetooth mode Low Energy.

*RST: BASic

Example: `SOUR:BB:BTO:BMOD BLEN`
Bluetooth mode Low Energy.

Manual operation: See "Bluetooth Mode" on page 18

[:SOURce<hw>]:BB:BTOoth:DTTest:TPConfiguration:TPINterval <TpInterval>

Sets the time interval between two consecutive test packets, with regard to the starting points.

Parameters:

<TpInterval> float

Range: 0.625 to 12.5
Increment: 0.001
*RST: 0.625

Example: `SOUR:BB:BTO:DTT:TPC:TPIN 1.0`
sets a time interval of 1.0.

Manual operation: See "Packet Interval" on page 55

[:SOURce<hw>]:BB:BTOoth:DTTest:TPConfiguration:UPLength <UpLength>

Sets the payload length.

Parameters:
<UpLength> integer
Range: 1 to 37
*RST: 1

Example: `SOUR:BB:BTO:DTT:TPC:UPL 37`
sets a payload length of 37.

Manual operation: See "Payload Length" on page 55

[:SOURce<hw>]:BB:BTOoth:DTTest:TPConfiguration:UPSource <UpSource>

Selects the data source used for the payload test packets.

Parameters:
<UpSource> PN09 | PAT1 | PAT2 | PN15 | PAT3 | PAT4 | PAT5 | PAT6

PN9 / PN15
Select a PRBS-modulated data sequence
(PRBS = pseudo random binary sequence) for testing.

PAT1 … PAT6
Pattern is predefined.

*RST: PN09

Example: `SOUR:BB:BTO:DTT:TPC:UPS PN09`
PRBS-modulated data sequence for testing.

Manual operation: See "Payload Type" on page 55

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:ACTable <AcTable>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:DCTable <DcTable>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DCMTable <DcmTable>

The data channel map table indicates the entire data set of the channels in a table.

Every channel is represented with bit positioned as per the data channel index. LSB represents data channel index 0 and the bit in position 36 represents data channel index 36.

If the channel is used channel its bit is to be set to '1'. Bit value '0' indicates that the channel is unused.

The bits in positions 37, 38 and 39 shall be set to zero upon transmission and ignored upon receipt.

Note: This parameter is relevant for data event and advertising frame configuration with the packet types:

- CHANNEL_MAP_REQ
- CONNECT_REQ

Parameters:
<DcmTable> string

Example: `SOUR:BB:BTO:ECON:ACTable NOT`
Entire data set for Advertising Channel Table
`SOUR:BB:BTO:ECON:DCT NOT`
Entire data set for Data Channel Table
`SOUR:BB:BTO:ECON:PCON:DCMT NOT`
Entire data set for Channel Map Table

Manual operation: See "Channel Table" on page 44

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:ACTable:SET<ch>:STATe <State>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:DCTable:SET<ch>:STATe <State>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DCMTable:SET<ch>:STATe <State>

Indicates used and unused data channels.

Note: This parameter is relevant for data event and advertising frame configuration with the packet types:

- CHANNEL_MAP_REQ
- CONNECT_REQ

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

Example: `SOUR:BB:BTO:ECON:ACT:SET2:STAT ON`
State in Advertising Channel Table
`SOURce:BB:BTO:ECON:DCT:SET1:STAT ON`
State in Data Channel Table
`SOUR:BB:BTO:ECON:PCON:DCMT:SET1:STAT ON`
State in Data Channel Map Table

Manual operation: See "Channel Table" on page 44

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:AEDelay <AeDelay>

Sets a time delay between the start times of two consecutive advertising events. The value is added to the advertising event interval.

Parameters:
<AeDelay> float
Range: 0.0 to 10.0
*RST: 0.0

Example: `SOUR:BB:BTO:ECON:AED 10.0`
sets a time delay of 10.0 s.

Manual operation: See "Advertising Event Delay" on page 41

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:ADINterval <AdInterval>

Sets the time interval between two consecutive advertising events for packet type "ADV_DIRECT_IND".

Parameters:
<AdInterval> float
Range: 0.9 to 3.0
*RST: 3.0

Example: `SOUR:BB:BTO:ECON:ADIN 1.3`
sets a time interval of 1.3.

Manual operation: See "Advertising Event Interval" on page 41

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:AEINterval <AeInterval>

Sets the time interval between two consecutive advertising events, with regard to the starting points.

Parameters:
<AeInterval> float
Range: 20.0 to 10240.0
*RST: 20.0

Example: `SOUR:BB:BTO:ECON:AEIN 20.0`
sets a time interval of 20.0.

Manual operation: See "Advertising Event Interval" on page 41

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:APINterval <ApInterval>

Sets the time interval between packets starting points of two consecutive packets in the advertising channel.

Parameters:
<ApInterval> float
Range: 1.3 to 1.5
*RST: 1.3

Example: `SOUR:BB:BTO:ECON:APIN 1.3`
sets a time interval of 1.3.

Manual operation: See "Advertising Packet Interval" on page 41

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:LCMode <LcMode>

Select the link layer connection mode. In order to provide safe transmission of payload data, the data in the packet can be encrypted. If activated, the payload data follows MIC (Message authentication Code).

Parameters:

<LcMode> UENC | ENC

UENC
Payload data is transmitted without encoding.

ENC
The link layer connection runs in encrypted mode.

*RST: UENC

Example: `SOUR:BB:BTO:ECON:LCM UENC`
without encoding.
`SOUR:BB:BTO:ECON:LCM ENC`
in encrypted mode.

Manual operation: See "LL Connection Mode" on page 43

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:LTKey <LtKey>

Indicates the time the controller needs to receive the long term key from the host. After this time, the controller is ready to enter into the last phase of encryption mode setup.

Parameters:

<LtKey> integer

Example:
```
SOUR:BB:BTO:ECON:LCM ENC
SOUR:BB:BTO:ECON:LTK
#H00000000000000000000000000000000,128
```
In encrypted mode, the code can be edited.

Manual operation: See "Long Term key (hex)" on page 44

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:AADDress <AAddress>

Sets the access address of the link layer connection (32-bit string).

Parameters:

<AAddress> integer

Example: `SOUR:BB:BTO:ECON:PCON:AADD #H00000000,32`
sets an access address.

Manual operation: See "Access Address" on page 46

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ACID <Acid>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ACASsigned <AcAssigned>

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SCASsigned <ScAssigned>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SCID <Scid>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ICASsigned <IcAssigned>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ICID <Icid>

Sets the advertiser´s device address. In bluetooth low energy systems all the transmissions start with an 8 bit preamble followed by an access address. The access address is composed of a the parts "Company_Id" (LSB) and the "Company_assigned" (MSB). Beside the address fields the notation is given. For advertising channel packets the format of the device address differs, depending on the selected address type.

- "Public Address Types"
  The public address is given from the registration authority IEEE and is composed of:
  – LSB: 24 bits = company_assigned
  – MSB: 24 bits = company_id
- "Private Address Type"
  A private address is optional and composed of:
  – LSB: 24 bits = hash
  – MSB: 24 bits = random

Parameters:
<Icid> integer

Example:
```
SOUR:BB:BTO:ECON:PCON:ACID #H000000,24
SOUR:BB:BTO:ECON:PCON:ACAS #H000000,24
```
Company_Assigned and Company_Id in Advertiser´s Device Address)
```
SOUR:BB:BTO:ECON:PCON:SCAS #H000000,24
SOUR:BB:BTO:ECON:PCON:SCID #H000000,24
```
Company_Assigned and Company_Id in Scanners Device Address)
```
SOUR:BB:BTO:ECON:PCON:ICAS #H000000,24
SOUR:BB:BTO:ECON:PCON:ICID #H000000,24
```
Company_Assigned and Company_Id in Initiators Device Address)

Manual operation: See "Controller´s Device Addr" on page 51

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CID <Cid>

Sets the company identifier of the manufacturer of the Bluetooth Controller. A 16 bit value is set.

Note: This parameter is relevant for data frame configuration and for the packet type LL_VERSION_IND.

Parameters:
<Cid> integer
*RST: 0

Example: `SOUR:BB:BTO:ECON:PCON:CID #H0000,16`
sets the company ID.

Manual operation: See "Company ID" on page 53

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CINStant
<CInstant>

Sets a connection instant for indicating the connection event at which the new connection parameters are taken in use.

Parameters:
<CInstant> float
Range: 0 to 1000
*RST: 0

Example: `SOUR:BB:BTO:ECON:PCON:CINS 2`
sets a connection instant.

Manual operation: See "Connection Instant" on page 49

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CINTerval
<CInterval>

(for data event and advertising frame configuration with the packet type CONNECT_REQ)

Set the time interval between the start points of two consecutive connection events.

Parameters:
<CInterval> float
Range: 7.5 to 4000.0
*RST: 7.5

Example: `SOUR:BB:BTO:UPTY CREQ`
sets packet type CONNECT_REQ
`SOUR:BB:BTO:ECON:PCON:CINT 7.5`
sets a time interval.

Manual operation: See "Connection Event Interval" on page 42

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:CIValue <CiValue>

Sets the initialization value for the CRC (Cyclic Redundary Check, 24 bits) calculation. A packet has been received correctly, when it has passed the CRC check.

Parameters:
<CiValue> integer

Example: `SOUR:BB:BTO:ECON:PCON:CIV #H000000,24`
sets the initialization value for the CRC.

Manual operation: See "CRC Initial" on page 52

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DATA <Data>

Selects the data source used for the payload.

Parameters:

<Data> ALL0 | ALL1 | PATTern | PN09 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt

All 0 / All 1
0 data and 1 data is generated internally.

Pattern
Pattern is user definable.

PN xx
Pseudo-random noise sequence. XX can be equal to 9, 11, 15, 16, 20, 21, 23.

Data List
Internal data from a programmable data list is used. The data list can be generated by the Data List Editor or generated externally.

*RST: PN09

Example:

```
SOUR:BB:BTO:ECON:PCON:DATA ALL0 | ALL1
SOUR:BB:BTO:ECON:PCON:DATA PATT
SOUR:BB:BTO:ECON:PCON:DATA:DPAT #H3F,8
SOUR:BB:BTO:ECON:PCON:DATA PN09
SOUR:BB:BTO:ECON:PCON:DATA DLIS
SOUR:BB:BTO:ECON:PCON:DATA:DSEL 'bluetooth-le'
```

Manual operation: See "Data Source" on page 48

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DATA:DPATtern <DPattern>

The command selects the data for a pattern.

Parameters:

<DPattern> integer

*RST: 0

Example:

```
BB:BTO:ECON:PCON:DATA PATT
```
sets the data type.
```
BB:BTO:ECON:PCON:DATA:DPAT #B010101, 6
```
selects the data for a pattern

Manual operation: See "Data Source" on page 48

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DATA:DSELection <DSelection>

The command selects data list file.

Parameters:

<DSelection> string

Example: `BB:BTO:ECON:PCON:DATA DLIS`
selects the data type.
`BB:BTO:ECON:PCON:DSEL Bluetooth-le`
selects the file for the data.

Manual operation: See "Data Source" on page 48

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DLENgth
<DLength>

Enters the payload data length in bytes.

Parameters:
<DLength> float
Range: 0 to 31
*RST: 0

Example: `SOUR:BB:BTO:ECON:PCON:DLEN 31`
payload data length is 31 bytes.

Manual operation: See "Data Length" on page 48

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:DWHitening
<DWhitening>

Activates or deactivates the Data Whitening. Evenly distributed white noise is ideal for the transmission and real data can be forced to look similar to white noise with different methods called Data Whitening. Applied to the PDU and CRC fields of all packet types, whitening is used to avoid long equal seqeunces in the data bit stream.

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

Example: `BB:BTO:ECON:PCON:DWH ON`
activates data whitening.

Manual operation: See "Data Whitening" on page 46

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:ECODe <ECode>

Sets the error code value to inform the remote device why the connection is about to be terminated in case of LL_TERMINATE_IND packet. On the other hand, this parameter for LL_REJECT_IND packet is used for the reason a request was rejected. A 8 bit value is set.

Note: This parameter is relevant for data frame configuration and the packet type:

- LL_TERMINATE_IND
- LL_REJECT_IND

Parameters:
<ECode> integer
*RST: 0

Example: `SOUR:BB:BTO:ECON:PCON:ECOD #H00,8`
sets the error code

Manual operation: See "Error Code" on page 53

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:EDIVersifier
<EDiversifier>

Sets the encrypted diversifier of the master for device identification. The parameter is an initialization vector provided by the Host in the HCI_ULP_Start_Encryption command.

Parameters:
<EDiversifier> integer

Example: `SOUR:BB:BTO:ECON:PCON:EDIV #H0000, 16`
sets the encrypted diversifier of the master.

Manual operation: See "Encrypted DIVersifier (hex)" on page 50

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:FSLength
<FsLength>

Enables that the feature set length is indicated. FeatureSet indicates whether the Controller features are used or not. All the data in FeatureSet is RFU(zero).

Parameters:
<FsLength> float
Range: 1 to 26
*RST: 26

Example: `SOUR:BB:BTO:ECON:PCON:FSL 12`
feature set length is 12.

Manual operation: See "Feature Set Length" on page 51

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:HLENgth
<HLength>

(for data event and advertising frame configuration with the packet type CONNECT_REQ)

Sets the difference from the current channel to the next channel. The master and slave devices determine the data channel in use for every connection event from the channel map. Hop_length is set for the LL connection and communicated in the CONNECT_REQ and CHANNEL_MAP_REQ packets.

Parameters:

<HLength> integer

Range: 5 to 16
*RST: 5

Example: `SOUR:BB:BTO:UPTY CREQ`
sets packet type CONNECT_REQ
`SOUR:BB:BTO:ECON:PCON:HLEN 10`
hop length is 10.

Manual operation: See "Hop Length" on page 50

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:LCTimeout <LcTimeout>

(for data event and advertising frame configuration with the packet type:

CONNECT_REQ

Defines the maximum time between two correctly received Bluetooth Low Energy packets in the LL connection before the connection is considered lost.

Parameters:

<LcTimeout> float

Range: 100.0 to 32000.0
*RST: 100.0

Example: `SOUR:BB:BTO:UPTY CREQ`
sets packet type CONNECT_REQ
`SOUR:BB:BTO:ECON:PCON:LCT 150`
LL Connection Timeout is 150.

Manual operation: See "LL Connection Timeout" on page 49

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MIVector <MiVector>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SIVector <SiVector>

Sets the master's or the slave's portion of the initialization vector(IVm/IVs).

Parameters:

<SiVector> integer

Example: `SOUR:BB:BTO:ECON:PCON:MIV #H0000000000000000,32`
(Master).
`SOUR:BB:BTO:ECON:PCON:SIV #H0000000000000000,32`
(Slave).

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:MSKD <Mskd>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SSKD <Sskd>

Sets the master's or the slave's portion of the session key diversifier (SKDm/SKDs).

Parameters:
<Sskd> integer

Example: SOUR:BB:BTO:ECON:PCON:MSKD #H0000000000000000,64
(Master).
SOUR:BB:BTO:ECON:PCON:SSKD #H0000000000000000,64
(Slave).

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:NCINterval
<NcInterval>

(for data event and advertising frame configuration with the packet type CONNECTION_UPDATE_REQ)

Set the time interval between the start points of two consecutive connection events.

Parameters:
<NcInterval> float
Range: 7.5 to 4000.0
*RST: 7.5

Example: SOUR:BB:BTO:UPTY CUR
sets packet type CONNECTION_UPDATE_REQ
SOUR:BB:BTO:ECON:PCON:NCIN 7.5
sets a time interval.

Manual operation: See "Connection Event Interval" on page 42

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:NLCTimeout
<NlcTimeout>

(for data event and advertising frame configuration with the packet type CONNECTION_UPDATE_REQ)

Defines the maximum time between two correctly received Bluetooth Low Energy packets in the LL connection before the connection is considered lost.

Parameters:
<NlcTimeout> float
Range: 100.0 to 32000.0
*RST: 100.0

Example: SOUR:BB:BTO:UPTY CUR
sets packet type CONNECTION_UPDATE_REQ
SOUR:BB:BTO:ECON:PCON:NLCT 150
LL Connection Timeout is 150.

Manual operation: See "LL Connection Timeout" on page 49

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:NSLatency
<NsLatency>

(for data event and advertising frame configuration with the packet type CONNECTION_UPDATE_REQ)

Sets a number of consecutive connection events the slave can ignore for asymmetric link layer connections.

Parameters:

<NsLatency> integer

Range: 0 to 1000
*RST: 0

Example: `SOUR:BB:BTO:UPTY CUR`
sets packet type CONNECTION_UPDATE_REQ
`SOUR:BB:BTO:ECON:PCON:NSL 10`
sets the number of consecutive connection events.

Manual operation: See "Slave Latency" on page 49

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:NSValue <NsValue>

Sets the start value of the next expected packet from the same device in the LL connection ("N"ext"E"xpected "S"equence"N"umber). This parameter can be set in the first event. From the second event this field is not indicated.

Parameters:

<NsValue> integer

Range: 0 to 1
*RST: 1

Example: `SOUR:BB:BTO:ECON:PCON:NSV 1`
Start Value is 1.

Manual operation: See "NESN Start Value" on page 47

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:NWOFfset
<NwOffset>

(for data event and advertising frame configuration with the packet type CONNECTION_UPDATE_REQ)

Sets the start point of the transmit window.

Parameters:

<NwOffset> float

Range: 0.0 to 5000.0
*RST: 0.0

Example: SOUR:BB:BTO:UPTY CUR
sets packet type CONNECTION_UPDATE_REQ
SOUR:BB:BTO:ECON:PCON:NWOF 800.0
sets the start point of the transmit window.

Manual operation: See "Transmit Window Offset" on page 52

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:NWSize <NwSize>

(for data event and advertising frame configuration with the packet type CONNECTION_UPDATE_REQ)

Sets the size of the transmit window, regarding to the start point.

Parameters:
<NwSize> float
Range: 1.25 to 10.0
*RST: 1.25

Example: SOUR:BB:BTO:UPTY CUR
sets packet type CONNECTION_UPDATE_REQ
SOUR:BB:BTO:ECON:PCON:NWS 8.0
sets the size of the transmit window.

Manual operation: See "Transmit Window Size" on page 52

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:TATYpe <TaType>
[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:RATYpe <RaType>

Selects the address type of the controller device. Depending on the Bluetooth controller role either Tx or Rx or both address types are assigned. Subdivided into private and random, a Bluetooth LE device address consits of 48 bits. The format of the device address differs depending on the selected address type.

Parameters:
<RaType> PUBLic | RANDom

PUBlic
Allocates a unique 48 bit address to each bluetooth LE device. The public address is given from the registration authority IEEE.

RANDom
Allocates a 48 bit address to each bluetooth LE device. A random address is optional.

*RST: PUBLic

Example: SOUR:BB:BTO:ECON:PCON:TATY PUBL
SOUR:BB:BTO:ECON:PCON:RATY RAND

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:RVECtor <RVector>

Sets the random vector of the master for device identification.The parameter is an initialization vector provided by the Host in the HCI_ULP_Start_Encryption command.

Parameters:
<RVector> integer

Example: `SOUR:BB:BTO:ECON:PCON:RVEC #H0000000000000000,64`
sets the random vector of the master.

Manual operation: See "Random Vector (hex)" on page 50

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SCACcuracy <ScAccuracy>

Defines the master´s clock accuracy with specified encoding. This parameter is used by the slave to determine required listening windows in the LL connection. It is a controller design parameter known by the Controller.

Parameters:
<ScAccuracy> SCA0 | SCA1 | SCA2 | SCA3 | SCA4 | SCA5 | SCA6 | SCA7
*RST: SCA0

Example: `SOUR:BB:BTO:ECON:PCON:SCAC SCA1`
sets the encoding value

Manual operation: See "Sleep Clock Accuracy" on page 53

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SLATency <SLatency>

(for data event and advertising frame configuration with the packet type CONNECT_REQ)

Sets a number of consecutive connection events the slave can ignore for asymmetric link layer connections.

Parameters:
<SLatency> integer
Range: 0 to 1000
*RST: 0

Example: `SOUR:BB:BTO:UPTY CREQ`
sets packet type CONNECT_REQ
`SOUR:BB:BTO:ECON:PCON:SLAT 10`
sets the number of consecutive connection events.

Manual operation: See "Slave Latency" on page 49

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SSValue <SsValue>

Sets the sequence number of the packet. This parameter can be set in the first event. From the second event this field is not indicated.

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

Example: SOUR:BB:BTO:ECON:PCON:SSV 1
sets the sequence number of the packet.

Manual operation: See "SN Start Value" on page 47

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:SVNumber
<SvNumber>

Sets a unique value for each implementation or revision of an implementation of the Bluetooth Controller. A 16 bit value is set.

Note: This parameter is relevant for data frame configuration and for the packet type:

LL_VERSION_IND.

Parameters:
<SvNumber> integer
*RST: 0

Example: SOUR:BB:BTO:ECON:PCON:SVN #H0000,16
sets the sub version number

Manual operation: See "Sub Version Number" on page 54

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:UTYPe <UType>

Enables that an invalid control packet is indicated. The CtrType field indicates the value of the LL control packet that caused the transmission of this packet.

Parameters:
<UType> integer

Example: SOUR:BB:BTO:ECON:PCON:UTYP #H8, 00
enables that an invalid control packet is indicated.

Manual operation: See "Unknown Type (hex)" on page 51

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:VNUMber
<VNumber>

Sets the company identifier of the manufacturer of the Bluetooth Controller. A 8 bit value is set.

Note: This parameter is relevant for data frame configuration and for the packet type LL_VERSION_IND.

Parameters:
<VNumber> integer
*RST: 0

Example: `SOUR:BB:BTO:ECON:PCON:VNUM #H00,8`
sets the version number

Manual operation: See "Version Number" on page 53

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:WOFFset
<WOffset>

(for data event and advertising frame configuration with the packet type CONNECT_REQ)

Sets the start point of the transmit window.

Parameters:
<WOffset> float
Range: 0.0 to 5000.0
*RST: 0

Example: `SOUR:BB:BTO:UPTY CREQ`
sets packet type CONNECT_REQ
`SOUR:BB:BTO:ECON:PCON:WOFF 800.0`
sets the start point of the transmit window.

Manual operation: See "Transmit Window Offset" on page 52

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PCONfiguration:WSIZe <WSize>

(for data event and advertising frame configuration with the packet type CONNECT_REQ)

Sets the size of the transmit window, regarding to the start point.

Parameters:
<WSize> float
Range: 1.25 to 10.0
*RST: 1.25

Example: `SOUR:BB:BTO:UPTY CREQ`
sets packet type CONNECT_REQ
`SOUR:BB:BTO:ECON:PCON:WSIZ 8.0`
sets the size of the transmit window.

Manual operation: See "Transmit Window Size" on page 52

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:PNUMber <PNumber>

Sets the number of Tx packets per event. Each connection contains at least one data channel packet. The maximum number of packets per event is determined by the duration of the connection event interval.

Parameters:
<PNumber> float
Range: 1 to 2580
*RST: 1

Example: `SOUR:BB:BTO:ECON:PNUM 2580`
sets the number of Tx packets per event.

Manual operation: See "No. of Tx Packets per Event" on page 42

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:SINTerval <SInterval>

Sets the time interval between the starting points of two consecutive windows during which the scanner is operating in an advertising channel.

Parameters:
<SInterval> float
Range: 2.5 to 10240.0
*RST: 2.5

Example: `SOUR:BB:BTO:ECON:SINT 3.5`
sets the time interval.

Manual operation: See "Scan Interval" on page 41

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:SWINdow <SWindow>

Sets the length of the window during which the scanner is operating in the advertising channel. Note that the scan window is less or equal to the value of the scan interval.

Parameters:
<SWindow> float
Range: 2.5 to 10240.0
*RST: 2.5

Example: `SOUR:BB:BTO:ECON:SWIN 2.5`
sets the length of the window.

Manual operation: See "Scan Window" on page 41

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:WOINfo?

(for data event and advertising frame configuration with the packet type CONNECT_REQ)

Queries the start point of the transmit window.

Return values:
<WoInfo> string

Example: `SOUR:BB:BTO:UPTY CREQ`
sets packet type CONNECT_REQ
`SOUR:BB:BTO:ECON:PCON:WOIN?`
queries the start point of the transmit window.

Usage: Query only

Manual operation: See "Transmit Window Offset" on page 42

[:SOURce<hw>]:BB:BTOoth:ECONfiguration:WSINfo?

(for data event and advertising frame configuration with the packet type CONNECT_REQ)

Queries the size of the transmit window, regarding to the start point.

Return values:
<WsInfo> string

Example: `SOUR:BB:BTO:UPTY CREQ`
sets packet type CONNECT_REQ
`SOUR:BB:BTO:ECON:PCON:WSIN?`
queries the size of the transmit window.

Usage: Query only

Manual operation: See "Transmit Window Size" on page 42

[:SOURce<hw>]:BB:BTOoth:UPTYpe <UpType>

Selects the packet type. The available packets depend on the selected channel type.

Parameters:
<UpType> AIND | ADINd | ANINd | SREQ | SRSP | CREQ | ADCind | DATA | CUReq | CMReq | TIND | EREQ | ERSP | SEReq | SERSp | URSP | FREQ | FRSP | TPACket | PEReq | PERSp | VIND | RIND

*RST: AIND

Example:
```
SOUR:BB:BTO:UPTY AIND
SOUR:BB:BTO:UPTY ADIN
SOUR:BB:BTO:UPTY ANIN
SOUR:BB:BTO:UPTY ADC
SOUR:BB:BTO:UPTY SREQ
SOUR:BB:BTO:UPTY SRSP
SOUR:BB:BTO:UPTY CREQ
SOUR:BB:BTO:UPTY TPAC
```
Channel type "Advertising"
```
SOUR:BB:BTO:UPTY DATA
SOUR:BB:BTO:UPTY CUR
SOUR:BB:BTO:UPTY CMR
SOUR:BB:BTO:UPTY TIND
SOUR:BB:BTO:UPTY LER
SOUR:BB:BTO:UPTY SERS
SOUR:BB:BTO:UPTY FREQ
SOUR:BB:BTO:UPTY TPAC
```
Channel type "Data" and Controller role "Master".
```
SOUR:BB:BTO:UPTY DATA
SOUR:BB:BTO:UPTY TIND
SOUR:BB:BTO:UPTY LERS
SOUR:BB:BTO:UPTY SER
SOUR:BB:BTO:UPTY SERS
SOUR:BB:BTO:UPTY URSP
SOUR:BB:BTO:UPTY FRSP
SOUR:BB:BTO:UPTY TPAC
```
Channel type "Data" and Controller role "Slave".

Manual operation: See "Packet Type" on page 36

[:SOURce<hw>]:BB:BTOoth:USLength <UsLength>

Selects the number of frames or events depending on the packet type. The signal repeats after the specified number of frames/events.

For SCAN_REQ and CONNECT_REQ packet, the sequence length is expressed in "Frames".

For TERMINATE_IND packets, a default value according to the specification is given:

Master: 'SlaveLatency + 6'

Slave: '6'

For all other packet types the sequence length is expressed in "Events".

Parameters:

<UsLength> float

Range: 1 to 1000
*RST: 1

Example:
```
SOUR:BB:BTO:USL 1000
```
selects the number of frames or events.

Manual operation: See "Sequence Length" on page 38

List of Commands

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