R&S®SMBVB-K151/-K152/-K153 ILS/VOR/DME

User Manual

1178917802

Version 08

ROHDE & SCHWARZ

Make ideas real

This document describes the following software options:

- R&S®SMBVB-K151 ILS (1423.8120.xx)
- R&S®SMBVB-K152 VOR (1423.8137.xx)
- R&S®SMBVB-K153 DME (1423.8143.xx)

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

Throughout this manual, products from Rohde & Schwarz are indicated without the ® symbol, e.g. R&S®SMBV100B is indicated as R&S SMBVB.

Contents

1   Welcome to the avionics options

The avionics options are firmware applications that add functionality to generate signals in accordance with the related avionic standard.

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

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

www.rohde-schwarz.com/manual/SMBV100B

Installation

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

1.1   Key features

Common key features and features that are specific to the avionic option are as follows:

ILS key features

Option R&S SMBVB-K151 is a firmware application that adds functionality to generate signals in accordance with the ground-based instrument landing system (ILS). It provides lateral and vertical guidance to an aircraft approaching and landing on a runway.

R&S SMBVB-K151 key features are:

- Emulation of instrument landing system (ILS)
- Generating ILS signal components: glide slope, localizer and marker beacons
- ICAO standard carrier frequencies and user-defined carrier frequencies
- Adjustable COM/ID settings.

VOR key features

The R&S SMBVB-K152 is a firmware application that adds functionality to generate signals in accordance with the VHF Omnidirectional radio range radio navigation system. VOR determines the aircraft position by receiving radio signals from a network of ground beacons.

R&S SMBVB-K152 key features are:

- Emulation of VHF omnidirectional radio range (VOR)
- ICAO standard carrier frequencies and user-defined carrier frequencies
- User-defined position settings
- Adjustable COM/ID settings

DME key features

The R&S SMBVB-K153 is a firmware application that adds functionality to generate signals in accordance with the distance measuring equipment (DME) for aircraft. DME measures the slant range distance between the vessel and a fixed ground-based station.

The most important R&S SMBVB-K153 features at a glance:

- DME system emulation
- Generating DME interrogation signals and reply signals
- ICAO standard carrier frequencies and user-defined carrier frequencies
- Adjustable COM/ID settings
- Testing echo rejection, velocity tracking and simulating flights

Real-time simulation

Changing a parameter in the avionic standards causes an instant signal change in the R&S SMBV100B. There is no extra measurement cycle to calculate the RMS value of the baseband signal to set the correct RF level.

If the avionics standard is activated for the first time, or after every subsequent on/off sequence, the measurement cycle will take place to determine the correct RF level. Every subsequent parameter change in the avionic standard is performed without another measurement cycle to provide a continuous signal output.

1.2 Accessing the avionics dialog

To open the dialog with avionics settings

► In the block diagram of the R&S SMBV100B, select "Baseband" > "ILS"/"VOR"/"DME".

A dialog box opens that displays the provided general settings of the selected standard.

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

1.3 What's new

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

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

- DME flight simulation added, see "Flight Simulation" on page 68.
- Number of DME reply pulses added, see "Number of Replies for Efficiency Calculation" on page 59.
- DME input signal parameters updated for DME reply and DME interrogation modes, see "Trigger Level" on page 61 and "Search Trigger Level" on page 61.
- Time-based triggering, see "Time Based Trigger" on page 80 and "Trigger Time" on page 80.
- Editorial changes

1.4 Documentation overview

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

www.rohde-schwarz.com/manual/smbv100b

1.4.1 Getting started manual

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

1.4.2 User manuals and help

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

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

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

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

1.4.3　Service manual

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

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

https://gloris.rohde-schwarz.com

1.4.4　Instrument security procedures

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

1.4.5　Printed safety instructions

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

1.4.6　Data sheets and brochures

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

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

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

1.4.7　Release notes and open source acknowledgment (OSA)

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

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

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

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

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

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

1.4.9 Videos

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

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

Figure 1-1: Product search on YouTube

1.5 Scope

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

In particular, it includes:

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

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

1.6 Notes on screenshots

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

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

2 About avionics

This chapter summarizes information on avionics standards supported at the
R&S SMBV100B. Also, it links detailed information on the avionic standard supported
at the R&S SMBV100B.

Overview of avionics standards

- **Landing systems:** ILS (Instrument Landing System)
  Landing systems are ground-based approach systems that provide precision guid-
  ance to aircraft approaching and landing on a runway.
  For more information, see Chapter 3, "Generating ILS signals", on page 14.

- **Radio/Flight navigation systems:** VOR (VHF Omnidirectional Radio), DME (Dis-
  tance measuring equipment)
  The radio navigation systems are aircraft systems that support the pilots to deter-
  mine the aircraft positions and stay on course.
  For more information, see Chapter 4, "Generating VOR signals", on page 39 and
  Chapter 5, "Generating DME signals", on page 49.

3 Generating ILS signals

This chapter provides information on instrument landing system (ILS) signal generation with the R&S SMBV100B. This information includes required options, background information on ILS, generation of ILS signals, configuration and settings.

3.1 Required options

The basic equipment layout for generating ILS signals includes:
● Base unit
● Baseband real-time extension (R&S SMBVB-K520)
● Digital standard ILS (R&S SMBVB-K151)

3.2 About ILS

During the landing approach, the aircraft uses the instrument landing system (ILS) to monitor the correct approach path to the runway.
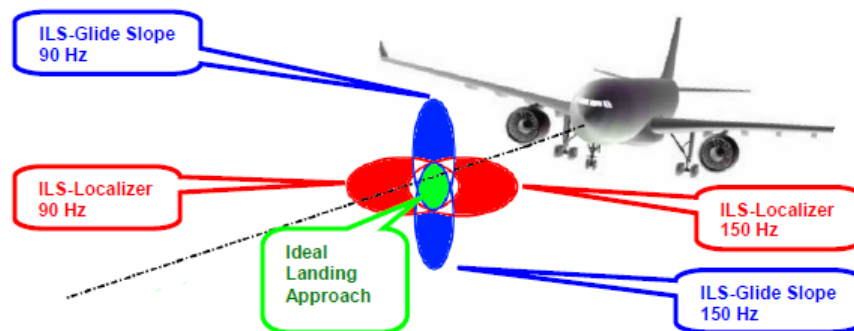

Figure 3-1: Approach navigation using instrument landing system (ILS) [1MA193]

An ILS consists of three independent subsystems:
● A glide slope for vertical guidance
● A localizer for horizontal guidance
● Optionally, marker beacons

Glide slope

The glide slope transmitter is located near the end of the runway (nearest to the start of the aircraft approach).

Typically, vertically aligned antennas transmit two intersecting main beams on top of one another at carrier frequencies between 329 MHz and 335 MHz (see Table 3-1). The top beam is usually modulated at 90 Hz and the beam below at 150 Hz [1MA193].

The information on position is provided after demodulation of the beam signals by evaluating the difference in depth of modulation (DDM). The following scenarios are possible:

- Predominance of the 90 Hz beam: the aircraft is too high and must descend
- Predominance of the 150 Hz beam: the aircraft is too low and needs to climb
- The signal strength from both beams is equal: the aircraft is in the center, on the right course.

If there is a predominance of the 90 Hz beam, then the aircraft is too high and must descend. A predominant 150 Hz means that the aircraft is too low and needs to climb.
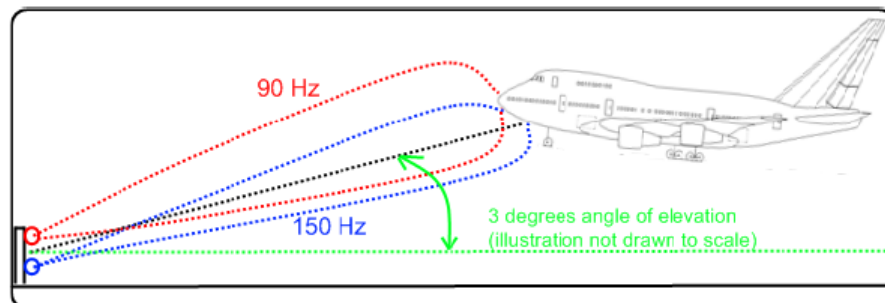
Localizer

The localizer transmitter is located near the end of the runway (nearest to the start of the aircraft approach). Typically, horizontally aligned antennas transmit two intersecting main beams beside one another at carrier frequencies between 108 MHz and 112 MHz (see Table 3-1). As seen from the approaching aircraft coming in for a landing, the left beam is usually modulated at 90 Hz and the right beam at 150 Hz [1MA193].

The information on position is provided after demodulation of the beam signals by evaluating the difference in depth of modulation (DDM). The following scenarios are possible:

- Predominance of the 90 Hz beam: the aircraft is too far to the left and must turn to the right
- Predominance of the 150 Hz beam: the aircraft is too far to the right and must turn to the left
- The signal strength from both beams is equal: the aircraft is in the center, on the right course.
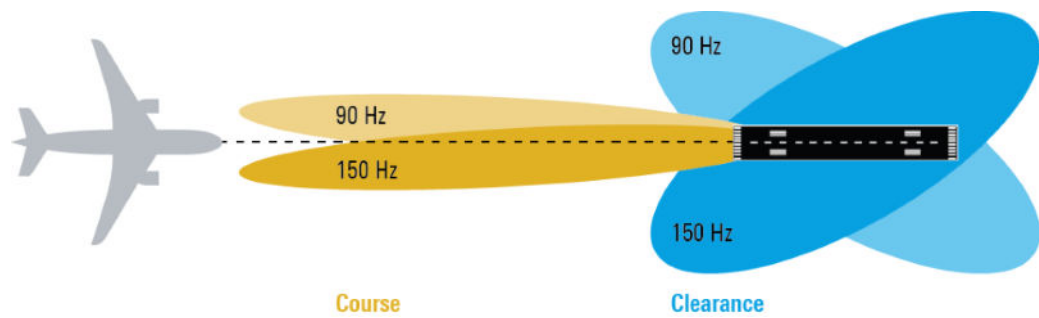
Marker beacons

Marker beacon receivers are used for a rough distance measurement. They are available only for some ILS installations [1MA193].
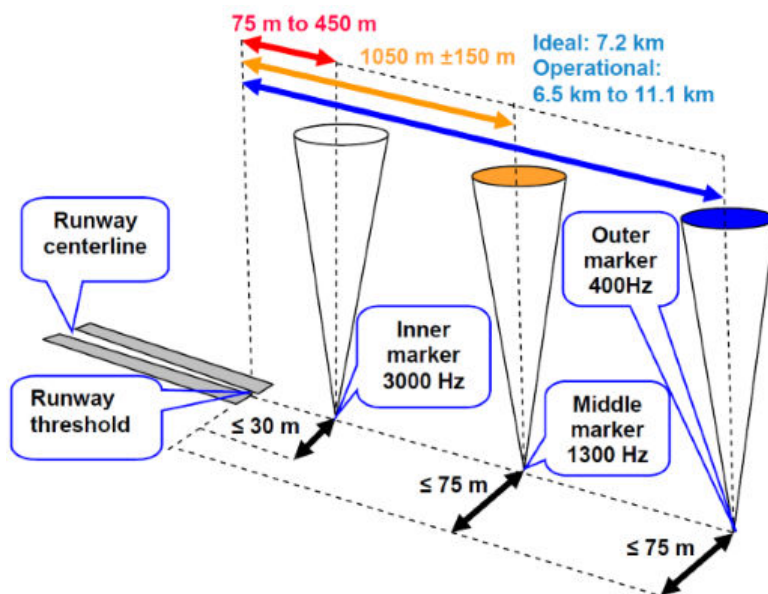
Figure 3-2: Marker beacon placement and distance to runway

Marker beacon receivers decode audio and provide signaling output to identify one of three marker beacons installed near the runway. They transmit a narrow beam width at 75 MHz carrier frequency in a vertical direction. Each of them has a different distinct modulation code to allow the receiver to identify which one it is flying over [1MA193].

Both visual (color of the marker beacon) and audio tone identification is supported for determining which marker has been flown over. The audio/visual pairing of marker beacons is as follows:

- Outer marker flashes BLUE in the cockpit at 400 Hz ("relaxed" tone).
- Middle marker flashes AMBER in the cockpit at 1300 Hz ("hurried" tone).
- Inner marker flashes WHITE in the cockpit at 3000 Hz ("urgent" tone).

Related Settings

For ILS settings at the R&S SMBV100B, see the following sections:

Channel frequencies

The column notations in the table below are as follows:

- **Chan.** = ICAO channel number
- **LOC freq.** = ILS localizer frequency (MHz)
- **GS freq.** = ILS glide slope frequency (MHz)

Table 3-1: ILS ICAO channels and frequencies (MHz)

Chan.	LOC freq.	GS freq.	Chan.	LOC freq.	GS freq.	Chan.	LOC freq.	GS freq.
18X	108.10	334.70	32X	109.50	332.60	46X	110.90	330.80
18Y	108.15	334.55	32Y	109.55	332.45	46Y	110.95	330.65
20X	108.30	334.10	34X	109.70	333.20	48X	111.10	331.70
20Y	108.35	333.95	34Y	109.75	333.05	48Y	111.15	331.55
22X	108.50	329.90	36X	109.90	333.80	50X	111.30	332.30
22Y	108.55	329.75	36Y	109.95	333.65	50Y	111.35	332.15
24X	108.70	330.50	38X	110.10	334.40	52X	111.50	332.90
24Y	108.75	330.35	38Y	110.15	334.25	52Y	111.55	332.75
26X	108.90	329.30	40X	110.30	335.00	54X	111.70	333.50
26Y	108.95	329.15	40Y	110.35	334.85	54Y	111.75	333.35
28X	109.10	331.40	42X	110.50	329.60	56X	111.90	331.10
28Y	109.15	331.25	42Y	110.55	329.45	56Y	111.95	330.95
30X	109.30	332.00	44X	110.70	330.20			
30Y	109.35	331.85	44Y	110.75	330.05			

3.3 ILS configuration and settings

Option: R&S SMBVB-K151

Access:

► Select "Baseband" > "ILS".

The remote commands required to define ILS settings are described in Chapter 7.3, "ILS commands", on page 100.

Settings:

3.3.1 General settings

This chapter provides settings to configure general ILS components.

Access:

► Select "ILS" > "General".
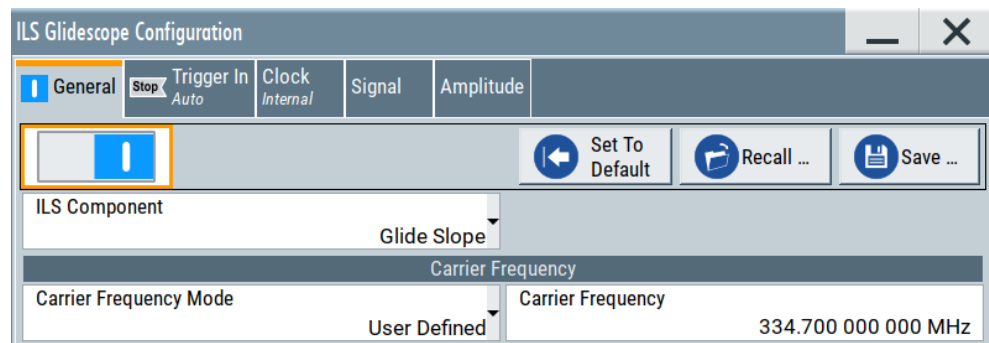
This dialog comprises general settings of the ILS standard, the default and the "Save/Recall" settings.
By default, an ILS glide slope modulation signal on an RF carrier with a frequency of 344.7 MHz or ICAO channel 18X. The dual-tone LF signal with frequencies 90 Hz and 150 Hz and a balanced modulation at SDM of 80 %.

Changing a parameter in the avionic standards causes an instant signal change in the R&S SMBV100B. There is no extra measurement cycle to calculate the RMS value of the baseband signal to set the correct RF level.

If the avionics standard is activated for the first time, or after every subsequent on/off sequence, the measurement cycle will take place to determine the correct RF level. Every subsequent parameter change in the avionic standard is performed without another measurement cycle to provide a continuous signal output.

Settings:

State
Activates the avionic standard.

Activation of the standard deactivates a previously active avionic standard. The "VOR/ILS/DME > Carrier Frequency" setting is applied automatically to the RF "Frequency" and displayed in the status bar.

Remote command:
`<subsystem>:STATe` on page 100

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

Standard	Parameter	Value
VOR/ILS/DME	State	Not affected by "Set to default"
VOR	Carrier Frequency Mode	User Defined
	Carrier Frequency	108.000000 MHz
ILS	ILS Component	Glide Slope (GS)
	ILS GS > Carrier Frequency Mode	User Defined
	ILS GS > Carrier Frequency	334.700000 MHz
DME	DME Mode	Interrogation
	Channel Mode	X Channel
	Carrier Frequency	1.025 GHz

Remote command:
`<subsystem>:PRESet` on page 98

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

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

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

Remote command:
`<subsystem>:SETTing:CATalog` on page 99
`<subsystem>:SETTing:DELete` on page 99
`<subsystem>:SETTing:LOAD` on page 99
`<subsystem>:SETTing:STORe` on page 99

ILS Component
Sets the ILS component.

"Glide slope"   Enables the glide slope.

"Localizer"   Enables the localizer.

"Marker Beacons"
　　　　　Enables the marker beacons.

Remote command:

`[:SOURce<hw>][:BB]:ILS:TYPE` on page 100

3.3.2 ILS glide slope settings

Access:

1. Select "ILS" > "General".

2. Select "ILS Component" > "Glide Slope".

Settings:

3.3.2.1 General settings

Access:

► Select "ILS" > "General".
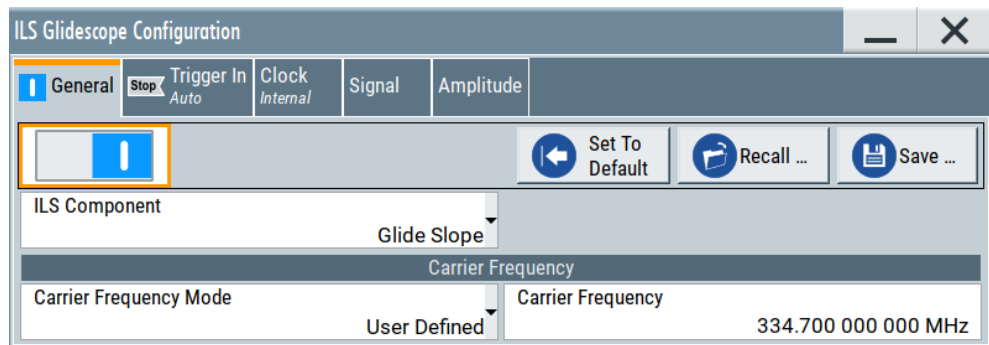
This dialog provides carrier frequency settings related to the ILS glide slope component of the ILS signal.

Settings:

Carrier Frequency Mode

Sets the mode for the carrier frequency of the signal.

Select "Carrier Frequency Mode > ICAO" to set a standard ILS frequency channel. If you want to couple carrier frequencies of ILS glide slope and localizer components, enable Sync with Glide Slope/ Sync with Localizer.

"User Defined"　　Activates user-defined variation of the carrier frequency.

"ICAO"　　　　　　Activates variation in predefined steps according to standard ILS transmitting frequencies (see Table 3-1).

Remote command:

[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:FREQuency:MODE on page 104

Carrier Frequency

Requires "Carrier Frequency Mode" > "User Defined".

Sets the carrier frequency of the signal.

Remote command:

[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:FREQuency on page 104

ICAO Channel

Requires "Carrier Frequency Mode" > "ICAO".

Sets the ICAO channel and the corresponding transmitting frequency.

If avionic standard modulation is activated and you change the "RF Frequency", the frequency value of the closest ICAO channel is applied automatically. The "ICAO Channel" is also updated.

For an overview of the ILS ICAO channel frequencies, see Table 3-1.

Remote command:

[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:ICAO:CHANnel on page 105

Sync with Glide Slope/ Sync with Localizer

Activates synchronization of the ILS glide slope with the ILS localizer carrier frequency or vice versa.

If "Carrier Frequency Mode" > "User", the ILS glide slope carrier frequency is applied to the ILS localizer carrier frequency or vice versa.

If "Carrier Frequency Mode" > "ICAO", the ILS glide slope ICAO channel is applied to the ILS localizer ICAO channel or vice versa. The ILS glide slope/localizer frequency of the ICAO channel (Table 3-1) is set automatically.

Remote command:

[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:FREQuency:SYNChronize[:STATe]
on page 104

[:SOURce<hw>][:BB]:ILS:LOCalizer:FREQuency:SYNChronize[:STATe]
on page 114

3.3.2.2　Signal settings

Access:

1. Select "ILS Component" > "Glide Slope". See Chapter 3.3.2, "ILS glide slope settings", on page 20.

2. Select "ILS" > "Signal".
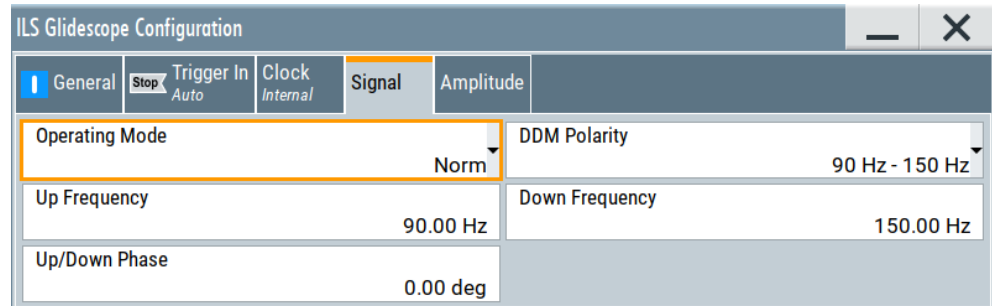
This dialog provides modulation signal settings related to the ILS glide slope component of the ILS signal.

Settings:

Operating Mode
Selects the operating mode for the ILS glide slope modulation signal.

"Norm"   ILS glide slope modulation is active.

"90 Hz"   Amplitude modulation of the output signal with the upper lobe signal component (90 Hz signal content) of the ILS glide slope signal.

The modulation depth of the 90 Hz signal results from the settings of the parameters Sum of Depth and DDM Depth according to:
- "Fly > Down"
  AM (90 Hz) = 0.5 × (SDM + DDM × 100 %)
- "Fly > Up"
  AM (90 Hz) = 0.5 × (SDM - DDM × 100 %)

"150 Hz"   Amplitude modulation of the output signal with the lower lobe signal component (150 Hz signal content) of the ILS glide slope signal.

The modulation depth of the 150 Hz signal results from the settings of parameters Sum of Depth and DDM Depth according to:
- "Fly > Down"
  AM (150 Hz) = 0.5 × (SDM + DDM × 100 %)
- "Fly > Up"
  AM (150 Hz) = 0.5 × (SDM - DDM × 100 %)

Remote command:
`[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:MODE` on page 106

DDM Polarity
Defines the polarity for DDM calculation, see "DDM Depth" on page 25.

Remote command:

`[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:DDM:POLarity` on page 103

Up Frequency

Sets the modulation frequency of the upper antenna lobe.

Remote command:

`[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:ULOBe[:FREQuency]` on page 107

Down Frequency

Sets the modulation frequency of the lower antenna lobe.

Remote command:

`[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:LLOBe[:FREQuency]` on page 105

Up/Down Phase

Sets the phase between the modulation signals of the upper and lower antenna lobe.

The zero crossing of the lower lobe (150Hz) signal serves as a reference. The angle refers to the period of the signal of the lower antenna lobe.

Remote command:

`[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:PHASe` on page 106

3.3.2.3   Amplitude settings

Access:

1. Select "ILS Component" > "Glide Slope". See Chapter 3.3.2, "ILS glide slope settings", on page 20.

2. Select "ILS" > "Amplitude".
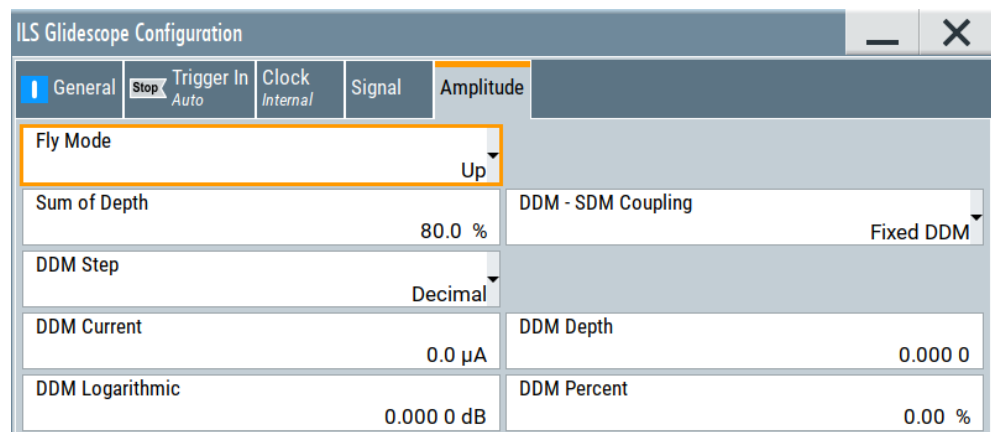
This dialog provides amplitude settings related to the ILS glide slope component of the ILS signal.

Settings:

Sum of Depth

Sets the arithmetic sum of the modulation depths of the upper lobe (90 Hz) and lower lobe (150 Hz) ILS glide slope signal contents.

The RMS modulation depth of the sum signal depends on the phase setting of both modulation tones.

Remote command:

[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:SDM on page 106

Fly Mode

Selects the simulation mode for the ILS glide slope modulation signal. A change of the setting automatically changes the sign of the DDM value.

This setting simulates the direction in which the pilot has to correct the course.

"Up"   The 150 Hz modulation signal is predominant, the DDM value is neg-
               ative (the airplane is too low, it must climb).

"Down"   The 90 Hz modulation signal is predominant, the DDM value is posi-
               tive (the airplane is too high, it must descend).

Remote command:

[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:DDM:DIRection on page 102

DDM Step

Selects the variation of the DDM values.

"Decimal"   Decimal variation according to the current cursor position.

"Predifined"   Variation in predefined steps according to the standardized DDM val-
               ues.

Remote command:

[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:DDM:STEP on page 103

DDM Current

Sets the current of the ILS indicating the instrument corresponding to the DDM value. The instrument current is calculated according to:

DDM Current μA = DDM Depth [%] × 857,125 μA

A variation of the instrument current automatically leads to a variation of the DDM value and the DDM value in dB.

Remote command:

[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:DDM:CURRent on page 101

DDM Depth

Sets the difference in depth of modulation between the upper lobe (90 Hz) and the lower lobe (150 Hz) tone of the ILS glide slope modulation signal.

The DDM value is calculated with the formula:
- "DDM Polarity" > "90 Hz - 150 Hz":
  DDM = [AM (90 Hz) - AM (150 Hz)] / 100%
- "DDM Polarity" > "150 Hz - 90 Hz":
  DDM = [AM (150 Hz) - AM (90 Hz)] / 100%

A variation of the DDM value automatically leads to a variation of the value of the instrument current and the DDM value in dB.

Remote command:
[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:DDM[:DEPTh] on page 103

DDM Logarithmic

Sets the DDM value in dB. The dB value is calculated according to:

DDM dB = 20 × LOG [(SDM+DDM×100%) / (SDM-DDM×100%)]

A variation of the value automatically leads to a variation of the DDM value and the instrument current.

Remote command:
[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:DDM:LOGarithmic on page 102

DDM Percent

Sets the difference in depth of modulation between the upper lobe (90 Hz) and the lower lobe (150 Hz) tone of the ILS glide slope modulation signal.

The DDM value in percent is calculated as follows:
- "DDM Polarity" > "90 Hz - 150 Hz":
  DDM = [AM (90 Hz) - AM (150 Hz)]
- "DDM Polarity" > "150 Hz - 90 Hz":
  DDM = [AM (150 Hz) - AM (90 Hz)]

A variation of the DDM value automatically leads to a variation of the value of the instrument current and the DDM value in dB.

Remote command:
[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:DDM:PCT on page 102

DDM - SDM Coupling

Selects if the DDM value is fixed or is changed with a change of sum of modulation depths (SDM, see below).

"Fixed DDM"   The absolute DDM value stays constant, if the SDM is changed.

"Coupled to SDM"

                 The absolute DDM value changes, if the SDM is changed. The DDM value expressed in dB stays constant.

Remote command:
[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:DDM:COUPling on page 101

3.3.3 ILS localizer settings

Access:

1. Select "ILS" > "General".

2. Select "ILS Component" > "Localizer".

Settings:

3.3.3.1 General settings

Access:

► Select "ILS > General".
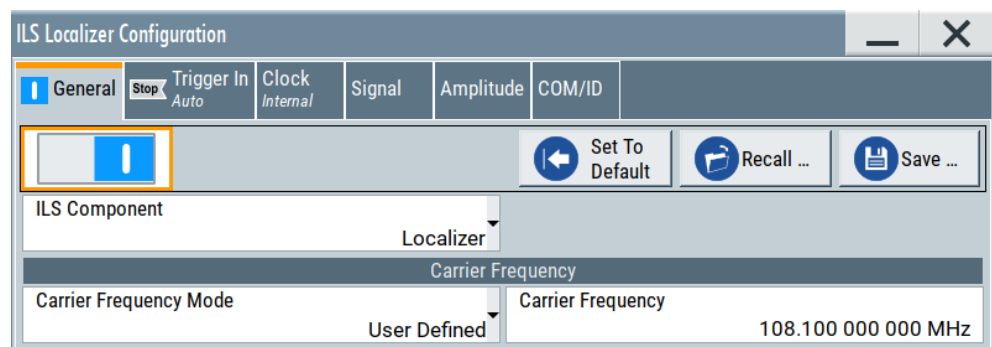
This dialog provides carrier frequency settings of the ILS localizer component of the ILS signal.

Settings:

Carrier Frequency Mode
Sets the mode for the carrier frequency of the signal.

"User Defined"   Activates user-defined variation of the carrier frequency.

"ICAO"   Activates variation in predefined steps according to standard ILS
                     transmitting frequencies (see Table 3-1).
                     Select the ICAO Channel to set a standard ILS frequency channel. If
                     you want to couple carrier frequencies of ILS glide slope and localizer
                     components, enable General settings.

Remote command:
[:SOURce<hw>][:BB]:ILS:LOCalizer:FREQuency:MODE on page 114

Carrier Frequency

Requires "Carrier Frequency Mode" > "User Defined".

Sets the carrier frequency of the signal.

Remote command:
[:SOURce<hw>][:BB]:ILS:LOCalizer:FREQuency on page 114

ICAO Channel

Requires "Carrier Frequency Mode > ICAO".

Sets the ICAO channel and the corresponding transmitting frequency.

If avionic standard modulation is activated and you change the "RF Frequency", the
frequency value of the closest ICAO channel is applied automatically. The "ICAO
Channel" is also updated.

For an overview of the ILS ICAO channel frequencies, see Table 3-1.

Remote command:
[:SOURce<hw>][:BB]:ILS:LOCalizer:ICAO:CHANnel on page 115

Sync with Glide Slope/ Sync with Localizer

Activates synchronization of the ILS glide slope with the ILS localizer carrier frequency
or vice versa.

If "Carrier Frequency Mode" > "User", the ILS glide slope carrier frequency is applied to
the ILS localizer carrier frequency or vice versa.

If "Carrier Frequency Mode" > "ICAO", the ILS glide slope ICAO channel is applied to
the ILS localizer ICAO channel or vice versa. The ILS glide slope/localizer frequency of
the ICAO channel (Table 3-1) is set automatically.

Remote command:
[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:FREQuency:SYNChronize[:STATe]
on page 104
[:SOURce<hw>][:BB]:ILS:LOCalizer:FREQuency:SYNChronize[:STATe]
on page 114

3.3.3.2   Signal settings

Access:

1. Select "ILS Component" > "Localizer". See Chapter 3.3.3, "ILS localizer settings",
    on page 26.

2. Select "ILS" > "Signal".
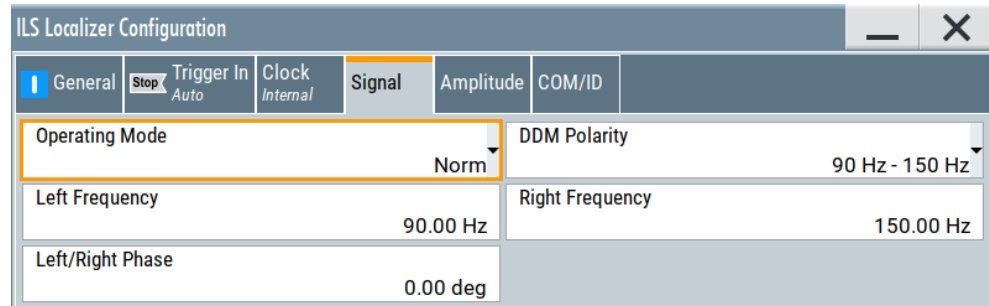
This dialog provides audio signal and modulation settings related to the ILS local-izer component of the ILS signal.

Settings:

Operating Mode

Selects the operating mode for the ILS localizer modulation signal.

"Norm"　　　　　　ILS localizer modulation is active.

"90 Hz"　　　　　　Amplitude modulation of the output signal with the left lobe (90 Hz) signal component of the ILS localizer signal.

　　　　　　　　　　The modulation depth of the 90 Hz signal results from the settings of parameters Sum of Depth and DDM Depth according to:
　　　　　　　　　　● "Fly > Right"
　　　　　　　　　　　AM (90 Hz) = 0.5 × (SDM + DDM × 100 %)
　　　　　　　　　　● "Fly > Left"
　　　　　　　　　　　AM (90 Hz) = 0.5 × (SDM - DDM × 100 %)

"150 Hz"　　　　　　Amplitude modulation of the output signal with the right lobe (150 Hz) signal component of the ILS localizer signal.

　　　　　　　　　　The modulation depth of the 150 Hz signal results from the settings of parameters Sum of Depth and DDM Depth according to:
　　　　　　　　　　● "Fly" = "Right"
　　　　　　　　　　　AM (150 Hz) = 0.5 × (SDM + DDM × 100 %)
　　　　　　　　　　● "Fly" = "Left"
　　　　　　　　　　　AM (150 Hz) = 0.5 × (SDM - DDM × 100 %)

Remote command:
[:SOURce<hw>][:BB]:ILS:LOCalizer:MODE on page 115

DDM polarity

Defines the polarity for DDM calculation, see "DDM Depth" on page 31.

Remote command:

`[:SOURce<hw>][:BB]:ILS:LOCalizer:DDM:POLarity` on page 113

Left Frequency

Sets the modulation frequency of the antenna lobe arranged at the left viewed from the air plane.

Remote command:

`[:SOURce<hw>][:BB]:ILS:LOCalizer:LLOBe[:FREQuency]` on page 115

Right Frequency

Sets the modulation frequency of the antenna lobe arranged at the right viewed from the air plane.

Remote command:

`[:SOURce<hw>][:BB]:ILS:LOCalizer:RLOBe[:FREQuency]` on page 116

Left/Right Phase

Sets the phase between the modulation signals of the left and right antenna lobe. The zero crossing of the right lobe (150 Hz) signal serves as a reference. The angle refers to the period of the signal of the right antenna lobe.

Remote command:

`[:SOURce<hw>][:BB]:ILS:LOCalizer:PHASe` on page 116

3.3.3.3 Amplitude settings

Access:

1. Select "ILS Component" > "Localizer". See Chapter 3.3.3, "ILS localizer settings", on page 26.

2. Select "ILS" > "Amplitude".
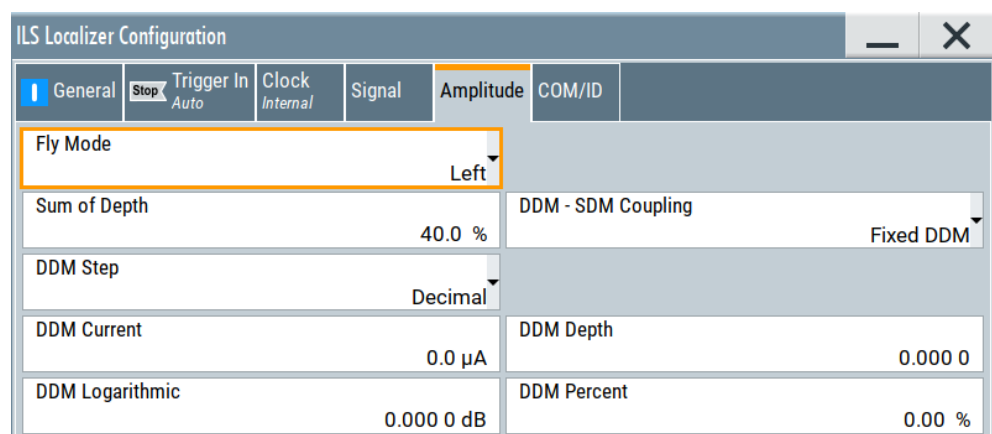
This dialog provides amplitude settings related to the ILS localizer component of the ILS signal.

Settings:

Fly Mode

Selects the simulation mode for the ILS localizer modulation signal. A change of the setting automatically changes the sign of the DDM value.

This setting simulates the direction in which the pilot has to correct the course.

"Left"　　　　　　The 150 Hz modulation signal is predominant, the DDM value is negative (the airplane is too far to the right, it must turn to the left).

"Right"　　　　　The 90 Hz modulation signal is predominant, the DDM value is positive (the airplane is too far to the left, it must turn to the right).

Remote command:

[:SOURce<hw>][:BB]:ILS:LOCalizer:DDM:DIRection on page 111

Sum of Depth

Sets the arithmetic sum of the modulation depths of the left lobe (90 Hz) and right lobe (150 Hz) ILS localizer signal contents.

The RMS modulation depth of the sum signal depends on the phase setting of both modulation tones.

The "Sum of Depth" and "COM/ID > Depth" must be smaller than 100 %.

Remote command:

[:SOURce<hw>][:BB]:ILS:LOCalizer:SDM on page 116

DDM - SDM Coupling

Selects if the DDM value is fixed or is changed with a change of sum of modulation depths (SDM, see below).

"Fixed DDM"　　　The absolute DDM value stays constant, if the SDM is changed.

"Coupled to SDM"　　The absolute DDM value changes, if the SDM is changed. The DDM value expressed in dB stays constant.

Remote command:

[:SOURce<hw>][:BB]:ILS:LOCalizer:DDM:COUPling on page 111

DDM Step

Selects the variation step of the DDM values.

"Decimal"　　　　Decimal variation according to the current cursor position.

"Predifined"　　　Variation in predefined steps according to the standardized DDM values.

Remote command:
[:SOURce<hw>][:BB]:ILS:LOCalizer:DDM:STEP on page 113

DDM Current

Sets the current of the ILS indicating instrument corresponding to the DDM value. The instrument current is calculated according to:

DDM µA = DDM × 967.75 µA

A variation of the instrument current automatically leads to a variation of the DDM value and the DDM value in dB.

Remote command:
[:SOURce<hw>][:BB]:ILS:LOCalizer:DDM:CURRent on page 111

DDM Depth

Sets the difference in depth of modulation (DDM) between the signal of the left lobe (90 Hz) and the right lobe (150 Hz) of the ILS localizer modulation signal.

The DDM value in percent is calculated as follows:
- "DDM Polarity > 90 Hz - 150 Hz" (default setting):
  DDM = [AM (90 Hz) - AM (150 Hz)] / 100 %
- "DDM Polarity > 150 Hz - 90 Hz":
  DDM = [AM (150 Hz) - AM (90 Hz)] / 100 %

A variation of the DDM value automatically leads to a variation of the DDM value in dB and the value of the instrument current.

Remote command:
[:SOURce<hw>][:BB]:ILS:LOCalizer:DDM[:DEPTh] on page 113

DDM Logarithmic

Sets the DDM value in dB. The dB value is calculated according to:

DDM dB = 20 × LOG [(SDM + DDM × 100 %) / (SDM - DDM × 100 %)]

A variation of the value automatically leads to a variation of the DDM value and the instrument current.

Remote command:
[:SOURce<hw>][:BB]:ILS:LOCalizer:DDM:LOGarithmic on page 112

DDM Percent

Sets the difference in depth of modulation between the signal of the left lobe (90 Hz) and the right lobe (150 Hz).

The DDM value in percent is calculated by the following formulas:
- "DDM Polarity > 90 Hz - 150 Hz" (default setting):
  DDM = [AM (90 Hz) - AM (150 Hz)]
- "DDM Polarity > 150 Hz - 90 Hz":
  DDM = [AM(150 Hz) - AM (90 Hz)]

A variation of the DDM value automatically leads to a variation of the DDM value in dB and the value of the instrument current.

Remote command:
[:SOURce<hw>][:BB]:ILS:LOCalizer:DDM:PCT on page 112

3.3.3.4 COM/ID settings

Access:

1. Select "ILS Component" > "Localizer". See Chapter 3.3.3, "ILS localizer settings", on page 26.

2. Select "ILS" > "COM/ID".
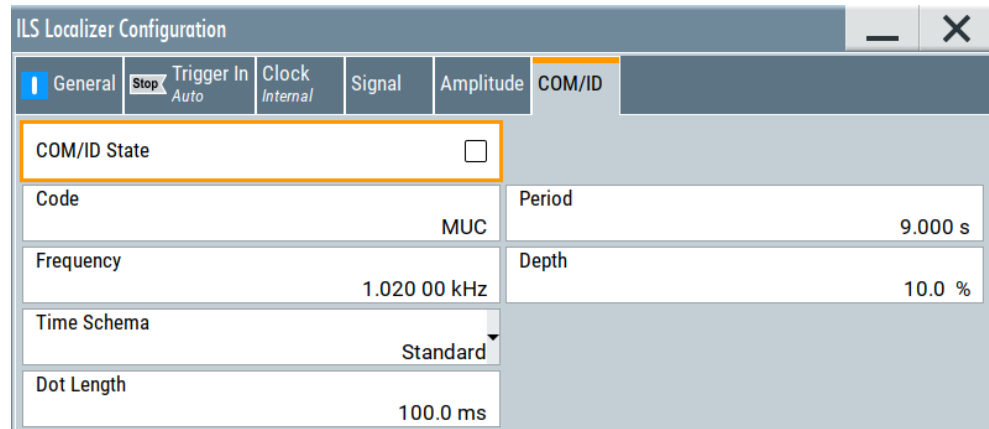
This dialog provides COM/ID settings related to the ILS localizer component of the ILS signal.

Settings:

COM/ID State

Enables/disables the COM/ID signal.

See also Chapter A, "Morse code settings", on page 164.

Remote command:

`[:SOURce<hw>][:BB]:ILS:LOCalizer:COMid[:STATe]` on page 110

Code

Sets the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport).

The COM/ID tone is sent according to the selected code, see Chapter A, "Morse code settings", on page 164.

If no coding is set, the COM/ID tone is sent uncoded (key down).

Remote command:
[:SOURce<hw>][:BB:ILS]:LOCalizer:COMid:CODE on page 108

Frequency
Sets the frequency of the COM/ID signal.

Remote command:
[:SOURce<hw>][:BB]:ILS:LOCalizer:COMid:FREQuency on page 109

Period
Sets the period of the COM/ID signal.

Remote command:
[:SOURce<hw>][:BB]:ILS:LOCalizer:COMid:PERiod on page 109

Depth
Sets the AM modulation depth of the COM/ID signal.

Note: The sum of Sum of Depth and COM/ID > Depth must be smaller than 100 %.

Remote command:
[:SOURce<hw>][:BB]:ILS:LOCalizer:COMid:DEPTh on page 108

Time Schema
Sets the time schema of the Morse code for the COM/ID signal.

"Standard"   The set dot length determines the length of the dash, the symbol
               space and letter space of the Morse code.

"User"   You can set each length value separately.

Remote command:
[:SOURce<hw>][:BB]:ILS:LOCalizer:COMid:TSCHema on page 110

Dot Length
Sets the length of a Morse code dot.

If "Time Schema" > "Standard", the dot length value determines also the length of the
dash (= 3 times the dot length), symbol space (= dot length) and letter space (= 3 times
the dot length).

Remote command:
[:SOURce<hw>][:BB]:ILS:LOCalizer:COMid:DOT on page 109

Dash Length
Requires "Time Schema" > "User".

Sets the length of a Morse code dash.

Remote command:
[:SOURce<hw>][:BB]:ILS:LOCalizer:COMid:DASH on page 108

Symbol Space
Requires "Time Schema" > "User".

Sets the length of the Morse code symbol space.

Remote command:

`[:SOURce<hw>][:BB]:ILS:LOCalizer:COMid:SYMBol` on page 110

Letter Space

Requires "Time Schema" > "User".

Sets the length of a Morse code letter space.

Remote command:

`[:SOURce<hw>][:BB]:ILS:LOCalizer:COMid:LETTer` on page 109

3.3.4 ILS marker beacons settings

Access:

1. Select "ILS > General".

2. Select "ILS Component > Marker Beacons".

Settings:

3.3.4.1 General settings

Access:

1. Select "ILS Component > Marker Beacons".
   See Chapter 3.3.4, "ILS marker beacons settings", on page 34.

2. Select "ILS > General".
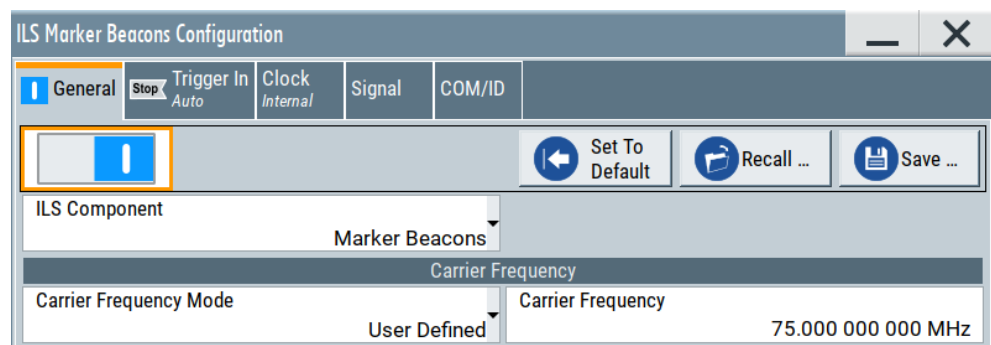
This dialog provides carrier frequency settings related to the ILS marker beacons component of the ILS signal.

Settings:

Carrier Frequency Mode

Sets the mode for the carrier frequency of the signal.

"User Defined"   Activates user-defined variation of the carrier frequency.

"Predefined"   Activates variation of the carrier frequency by integer 25 kHz steps.

Remote command:

[:SOURce<hw>][:BB:ILS]:MBEacon:FREQuency:MODE on page 120

Carrier Frequency

Requires "Carrier Frequency Mode > User Defined".

Sets the carrier frequency of the signal.

Remote command:

[:SOURce<hw>][:BB:ILS]:MBEacon:FREQuency on page 120

3.3.4.2 Signal settings

Access:

1. Select "ILS Component" > "Marker Beacons". See Chapter 3.3.4, "ILS marker beacons settings", on page 34.

2. Select "ILS" > "Signal".
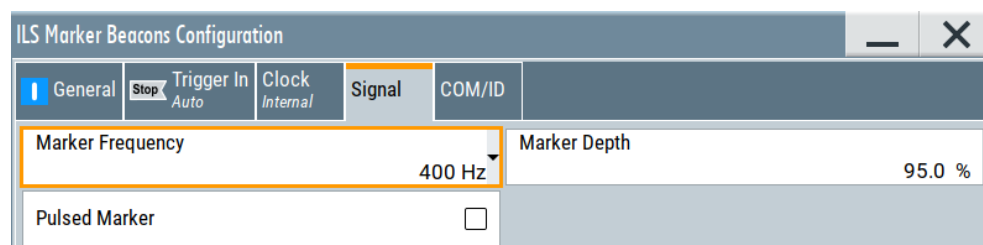
This dialog provides signal settings related to the ILS marker beacons component of the ILS signal.

Settings:

Marker Frequency

Sets the modulation frequency of the marker signal.

Remote command:

[:SOURce<hw>][:BB:ILS]:MBEacon:MARKer:FREQuency on page 121

Marker Depth

Sets the modulation depth of the marker signal.

Remote command:

[:SOURce<hw>][:BB:ILS]:MBEacon[:MARKer]:DEPTh on page 121

Pulsed Marker

Activates the modulation of a pulsed marker signal (morse coding).

"On"   Modulation of pulsed marker signals (morse coding). The duty cycle, the marker on- and off-times depend on the frequency of the marker signal (Table 3-2).

Table 3-2: ILS marker beacons marker signals and morse coding

Signal	Freq.	On	Off	Morse rate	Duty cycle
Outer marker	400 Hz	375 ms	125 ms	2 dots/s	75 %
Middle marker	1300 Hz	1st: 375 ms 2nd: 83 ms	1st: 125 ms 2nd: 83 ms	1.5 dots/s	68.8 %
Inner marker	3000 Hz	83 ms	83 ms	6 dots/s	50 %

"Off"   Modulation of a continuous non-coded marker signal.

Remote command:

[:SOURce<hw>][:BB:ILS]:MBEacon[:MARKer]:PULSed on page 121

3.3.4.3 COM/ID settings

Access:

1. Select "ILS Component" > "Marker Beacons". See Chapter 3.3.4, "ILS marker beacons settings", on page 34.

2. Select "ILS" > "COM/ID".
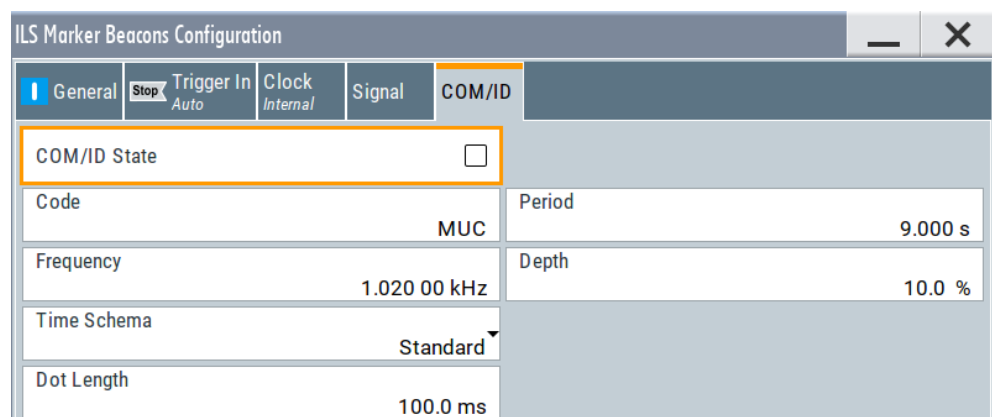
This dialog provides COM/ID settings of the marker beacons component of the ILS signal.

Settings:

COM/ID State

Enables/disables the COM/ID signal.

See also Chapter A, "Morse code settings", on page 164.

Remote command:

[:SOURce<hw>][:BB:ILS]:MBEacon:COMid[:STATe] on page 120

Code

Sets the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport).

The COM/ID tone is sent according to the selected code, see Chapter A, "Morse code settings", on page 164.

If no coding is set, the COM/ID tone is sent uncoded (key down).

Remote command:

[:SOURce<hw>][:BB:ILS]:MBEacon:COMid:CODE on page 117

Period

Sets the period of the COM/ID signal.

Remote command:

[:SOURce<hw>][:BB:ILS]:MBEacon:COMid:PERiod on page 119

Frequency

Sets the frequency of the COM/ID signal.

Remote command:

[:SOURce<hw>][:BB:ILS]:MBEacon:COMid:FREQuency on page 118

Depth

Sets the AM modulation depth of the COM/ID signal.

Remote command:

[:SOURce<hw>][:BB:ILS]:MBEacon:COMid:DEPTh on page 118

Time Schema

Sets the time schema of the Morse code for the COM/ID signal.

"Standard"   The set dot length determines the length of the dash, the symbol space and letter space of the Morse code.

"User"　　　　　　You can set each length value separately.

Remote command:

[:SOURce<hw>][:BB:ILS]:MBEacon:COMid:TSCHema on page 120

Dot Length

Sets the length of a Morse code dot.

If "Time Schema" > "Standard", the dot length value determines also the length of the dash (= 3 times the dot length), symbol space (= dot length) and letter space (= 3 times the dot length).

Remote command:

[:SOURce<hw>][:BB:ILS]:MBEacon:COMid:DOT on page 118

Dash Length

Requires "Time Schema" > "User".

Sets the length of a Morse code dash.

Remote command:

[:SOURce<hw>][:BB:ILS]:MBEacon:COMid:DASH on page 117

Symbol Space

Requires "Time Schema" > "User".

Sets the length of the Morse code symbol space.

Remote command:

[:SOURce<hw>][:BB:ILS]:MBEacon:COMid:SYMBol on page 119

Letter Space

Requires "Time Schema" > "User".

Sets the length of a Morse code letter space.

Remote command:

[:SOURce<hw>][:BB:ILS]:MBEacon:COMid:LETTer on page 119

4 Generating VOR signals

This chapter provides information on very high frequency (VHF) omnidirectional radio range (VOR) signal generation with the R&S SMBV100B. This information includes required options, background information on VOR, generation of VOR signals, configuration and settings.

4.1 Required options

The basic equipment layout for generating VOR signals includes:

● Base unit

● Baseband real-time extension (R&S SMBVB-K520)

● Digital standard VOR (R&S SMBVB-K152)

For more information, see data sheet.

4.2 About VOR

Very high frequency (VHF) omnidirectional radio range (VOR) is used for radio navigation and helps the aircraft to determine its position and stay on course.

A VOR system consists of a ground transmission station and a VOR receiver on the board of the aircraft.

The transmitter stations operate at VHF frequencies of 108 MHz to 118 MHz (see Table 4-1), with the code identification (COM/ID) transmitting on a modulation tone of 1.020 kHz. It emits two types of signals:

● An omnidirectional reference signal (REF) that can consist of two parts:
  – 30 Hz frequency modulated (FM) sine wave on subcarrier 9.96 kHz from amplitude modulation (AM) carrier
  – 1020 Hz AM modulated sine wave morse code

● A directional positioning signal, variable (VAR): 30 Hz AM modulated sine waves with variable phase shift.

The position of the aircraft is determined by measuring azimuth as the difference in phase of those two signals. The magnetic north is defined as the reference point, for which both signals are exactly in phase.

Related settings

For VOR settings at the R&S SMBV100B, see Chapter 4, "Generating VOR signals", on page 39.

Channel frequencies

The column notations in the table below are as follows:

- **Channel** = ICAO channel number
- **Frequency** = VOR Interrogation frequency (MHz)

Table 4-1: VOR ICAO channels and frequencies (MHz)

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
17X	108.00	57X	112.00	87Y	114.00	107X	116.00
17Y	108.05	57Y	112.05	87Y	114.05	107Y	116.05
19X	108.20	58X	112.10	88X	114.10	108X	116.10
19Y	108.25	58Y	112.15	88Y	114.15	108Y	116.15
21X	108.40	59X	112.20	89X	114.20	109X	116.20
21Y	108.45	59Y	112.25	89Y	114.25	109Y	116.25
23X	108.60	70X	112.30	90X	114.30	110X	116.30
23Y	108.65	70Y	112.35	90Y	114.35	110Y	116.35
25X	108.80	71X	112.40	91X	114.40	111X	116.40
25Y	108.85	71Y	112.45	91Y	114.45	111Y	116.45
27X	109.00	72X	112.50	92X	114.50	112X	116.50
27Y	109.05	72Y	112.55	92Y	114.55	112Y	116.55
29X	109.20	73X	112.60	93X	114.60	113X	116.60
29Y	109.25	73Y	112.65	93Y	114.65	113Y	116.65
31X	109.40	74X	112.70	94X	114.70	114X	116.75
31Y	109.45	74Y	112.75	94Y	114.75	114Y	116.75
33X	109.60	75X	112.80	95X	114.80	115X	116.80
33Y	109.65	75Y	112.85	95Y	114.85	115Y	116.85
35X	109.80	76X	112.90	96X	114.90	116X	116.90
35Y	109.85	76Y	112.95	96Y	114.95	116Y	116.95
37X	110.00	77X	113.00	97X	115.00	117X	117.00
37Y	110.05	77Y	113.05	97Y	115.05	117Y	117.05
39X	110.20	78X	113.10	98X	115.10	118X	117.10
39Y	110.25	78Y	113.15	98Y	115.15	118Y	117.15
41X	110.40	79X	113.20	99X	115.20	119X	117.20
41Y	110.45	79Y	113.25	99Y	115.25	119Y	117.25
43X	110.60	80X	113.30	100X	115.30	120X	117.30
43Y	110.65	80Y	113.35	100Y	115.35	120Y	117.35
45X	110.80	81X	113.40	101X	115.40	121X	117.40
45Y	110.85	81Y	113.45	101Y	115.45	121Y	117.45
47X	111.00	82X	113.50	102X	115.50	122X	117.50
47Y	111.05	82Y	113.55	102Y	115.55	122Y	117.55

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
49X	111.20	83X	113.60	103X	115.60	123X	117.60
49Y	111.25	83Y	113.65	103Y	115.65	123Y	117.65
51X	111.40	84X	113.70	104X	115.70	124X	117.70
51Y	111.45	84Y	113.75	104Y	115.75	124Y	117.75
53X	111.60	85X	113.80	105X	115.80	125X	117.80
53Y	111.65	85Y	113.85	105Y	115.85	125Y	117.85
55X	111.80	86X	113.90	106X	115.90	126X	117.90
55Y	111.85	86Y	113.95	106Y	115.95	126Y	117.95

4.3   VOR configuration and settings

Option: R&S SMBVB-K152

Access:

► Select "Baseband" > "VOR".

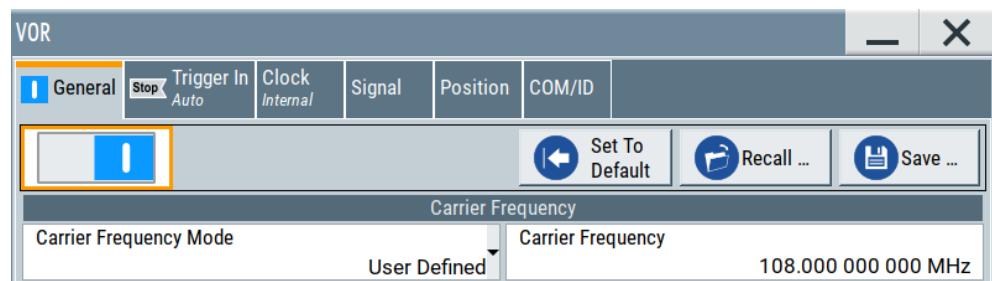The remote commands required to define VOR settings are described in Chapter 7.4, "VOR commands", on page 122.

Settings

4.3.1   General settings

Access:

► Select "VOR" > "General".

This dialog provides general settings of the VOR standard, the default and the "Save/Recall" settings.

By default, a VOR modulation signal is set on an RF carrier with a frequency of 108 MHz or ICAO channel 17X. The 9.96 kHz subcarrier signal is frequency modulated with a 30.00 Hz reference signal. The COM/ID signal has 1.02 kHz frequency, the variable phase signal 30.00 Hz frequency.

Changing a parameter in the avionic standards causes an instant signal change in the R&S SMBV100B. There is no extra measurement cycle to calculate the RMS value of the baseband signal to set the correct RF level.

If the avionics standard is activated for the first time, or after every subsequent on/off sequence, the measurement cycle will take place to determine the correct RF level. Every subsequent parameter change in the avionic standard is performed without another measurement cycle to provide a continuous signal output.

Settings:

State

Activates the avionic standard.

Activation of the standard deactivates a previously active avionic standard. The "VOR/ILS/DME > Carrier Frequency" setting is applied automatically to the RF "Frequency" and displayed in the status bar.

Remote command:
<subsystem>:STATe on page 100

Set To Default

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

Standard	Parameter	Value
VOR/ILS/DME	State	Not affected by "Set to default"
VOR	Carrier Frequency Mode	User Defined
	Carrier Frequency	108.000000 MHz
ILS	ILS Component	Glide Slope (GS)
	ILS GS > Carrier Frequency Mode	User Defined
	ILS GS > Carrier Frequency	334.700000 MHz
DME	DME Mode	Interrogation
	Channel Mode	X Channel
	Carrier Frequency	1.025 GHz

Remote command:

`<subsystem>:PRESet` on page 98

Save/Recall

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

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

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

Remote command:

`<subsystem>:SETTing:CATalog` on page 99

`<subsystem>:SETTing:DELete` on page 99

`<subsystem>:SETTing:LOAD` on page 99

`<subsystem>:SETTing:STORe` on page 99

Carrier Frequency Mode

Sets the mode for the carrier frequency of the signal.

"User Defined"   Activates user-defined setting of the carrier frequency.

"ICAO"   Activates ICAO-conform setting of the carrier frequency via the "ICAO Channel". For standard VOR transmitting frequencies, see Table 4-1.

Remote command:

`[:SOURce<hw>]:BB:VOR:FREQuency:MODE` on page 123

Carrier Frequency

Requires "Carrier Frequency Mode > User Defined".

Sets the carrier frequency of the signal.

Remote command:

`[:SOURce<hw>]:BB:VOR:FREQuency` on page 123

ICAO Channel

Requires "Carrier Frequency Mode" > "ICAO".

Sets the ICAO channel and the corresponding transmitting frequency.

If avionic standard modulation is activated and you change the "RF Frequency", the frequency value of the closest ICAO channel is applied automatically. The "ICAO Channel" is also updated.

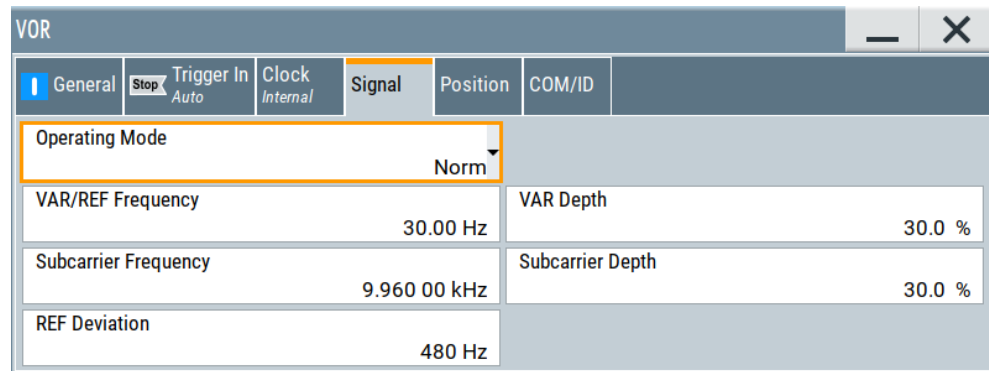For an overview of the VOR ICAO channels and frequencies, see Table 4-1.

Remote command:

`[:SOURce<hw>][:BB]:VOR:ICAO:CHANnel` on page 123

4.3.2 Signal settings

Access:

► Select "VOR" > "Signal".

VOR						─	✕
▌ General	Stop Trigger In Auto	Clock Internal	**Signal**	Position	COM/ID		

Operating Mode		
	Norm ▾	

VAR/REF Frequency		VAR Depth	
	30.00 Hz		30.0 %
Subcarrier Frequency		Subcarrier Depth	
	9.960 00 kHz		30.0 %
REF Deviation			
	480 Hz		

This dialog provides signal settings of the VOR modulation signal.

Settings:

Mode

Selects the operating mode for the VOR modulation signal.

"Norm"   VOR modulation is active.

"Var"   Amplitude modulation of the output signal with the VAR signal compo-
                nent (30Hz signal content) of the VOR signal. The modulation depth
                corresponds to the value set under VAR Depth.

"Subcarrier"   Amplitude modulation of the output signal with the unmodulated FM
                carrier (9960Hz) of the VOR signal. The modulation depth corre-
                sponds to the value set under Subcarrier Depth.

"Subcarrier + FM"

                Amplitude modulation of the output signal with the frequency-modula-
                ted FM carrier (9960Hz) of the VOR signal. The frequency deviation
                corresponds to the value set under REF Deviation, the modulation
                depth corresponds to the value set under "Subcarrier Depth".

Remote command:

`[:SOURce<hw>][:BB]:VOR:MODE` on page 122

VAR/REF Frequency

Sets the frequency of the VAR signal and the REF signal. As the two signals must
have the same frequency, the setting is valid for both signals.

Remote command:

[:SOURce<hw>][:BB]:VOR:VAR:FREQuency on page 125

VAR Depth

Sets the AM modulation depth of the 30 Hz VAR signal.

Note: The sum of "Subcarrier Depth", "VAR Depth" and COM/ID "Depth" must be smaller than 100 %.

Remote command:

[:SOURce<hw>][:BB]:VOR:VAR[:DEPTh] on page 125

Subcarrier Frequency

Sets the frequency of the FM carrier.

Remote command:

[:SOURce<hw>][:BB]:VOR:SUBCarrier[:FREQuency] on page 125

Subcarrier Depth

Sets the AM modulation depth of the FM carrier.

Note: The sum of "Subcarrier Depth", "VAR Depth" and COM/ID "Depth" must be smaller than 100 %.

Remote command:

[:SOURce<hw>][:BB]:VOR:SUBCarrier:DEPTh on page 125

REF Deviation

Sets the frequency deviation of the reference signal on the FM carrier.
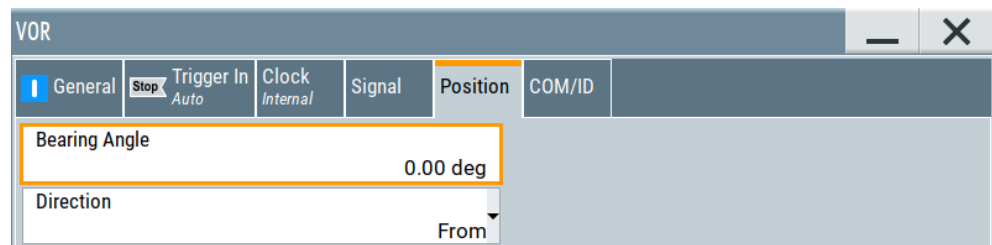
Remote command:

[:SOURce<hw>][:BB]:VOR:REFerence[:DEViation] on page 124

4.3.3 Position settings

Access:

► Select "VOR" > "Position".

This dialog provides position settings related to the VOR modulation signal.

Settings:

Bearing Angle

Sets the phase angle between the 30 Hz VAR signal and the 30 Hz reference signal.

The orientation of the angle depends on the set Direction.

Remote command:
[:SOURce<hw>][:BB]:VOR[:BANGle] on page 126

Direction

Sets the reference position of the phase information.

The angle set under "Bearing Angle" corresponds to the angle between the geographic north and the connection line from beacon to airplane.

"From"   Selection of the beacon as a reference position.

"To"   Selection of the airplane position as a reference position.

Remote command:
[:SOURce<hw>][:BB]:VOR[:BANGle]:DIRection on page 126

4.3.4 COM/ID settings

Access:

► Select "VOR" > "COM/ID".

This dialog provides COM/ID signal settings related to the VOR signal.

Settings:

COM/ID State

Enables/disables the COM/ID signal.

See also Chapter A, "Morse code settings", on page 164.

Remote command:

[:SOURce<hw>][:BB]:VOR:COMid[:STATe] on page 130

Code

Sets the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport).

The COM/ID tone is sent according to the selected code, see Chapter A, "Morse code settings", on page 164.

If no coding is set, the COM/ID tone is sent uncoded (key down).

Remote command:

[:SOURce<hw>][:BB]:VOR:COMid:CODE on page 127

Period

Sets the period of the COM/ID signal.

Remote command:

[:SOURce<hw>][:BB]:VOR:COMid:PERiod on page 129

Frequency

Sets the frequency of the COM/ID signal.

Remote command:

[:SOURce<hw>][:BB]:VOR:COMid:FREQuency on page 128

Depth

Sets the AM modulation depth of the COM/ID signal.

Note: The sum of Subcarrier Depth, VAR Depth and COM/ID > Depth must be smaller than 100 %.

Remote command:

[:SOURce<hw>][:BB]:VOR:COMid:DEPTh on page 127

Time Schema

Sets the time schema of the Morse code for the COM/ID signal.

"Standard"　　　The set dot length determines the length of the dash, the symbol space and letter space of the Morse code.

"User"　　　　　You can set each length value separately.

Remote command:

[:SOURce<hw>][:BB]:VOR:COMid:TSCHema on page 129

Dot Length

Sets the length of a Morse code dot.

If "Time Schema" > "Standard", the dot length value determines also the length of the dash (= 3 times the dot length), symbol space (= dot length) and letter space (= 3 times the dot length).

Remote command:

`[:SOURce<hw>][:BB]:VOR:COMid:DOT` on page 128

Dash Length

Requires "Time Schema" > "User".

Sets the length of a Morse code dash.

Remote command:

`[:SOURce<hw>][:BB]:VOR:COMid:DASH` on page 127

Symbol Space

Requires "Time Schema" > "User".

Sets the length of the Morse code symbol space.

Remote command:

`[:SOURce<hw>][:BB]:VOR:COMid:SYMBol` on page 129

Letter Space

Requires "Time Schema" > "User".

Sets the length of a Morse code letter space.

Remote command:

`[:SOURce<hw>][:BB]:VOR:COMid:LETTer` on page 128

5 Generating DME signals

This chapter provides information on distance measurement equipment (DME) signal generation with the R&S SMBV100B. This information includes required options, background information on DME, generation of DME signals, configuration and settings.

5.1 Required options

The basic equipment layout for generating DME signals includes:

● Base unit
● Baseband real-time extension (R&S SMBVB-K520)
● Digital standard DME (R&S SMBVB-K153)

5.2 About DME

Distance measurement equipment (DME) is a radar system which is used to determine the slant distance of an aircraft (= DME interrogator) to a ground station (= DME transponder). The aircraft antenna transmits shaped RF double pulses to the ground station. After a defined delay (= reply delay), the ground station replies by transmitting a defined pulse sequence to the aircraft. The receiver in the aircraft uses the round-trip time of the double pulses to determine the distance to the ground station.
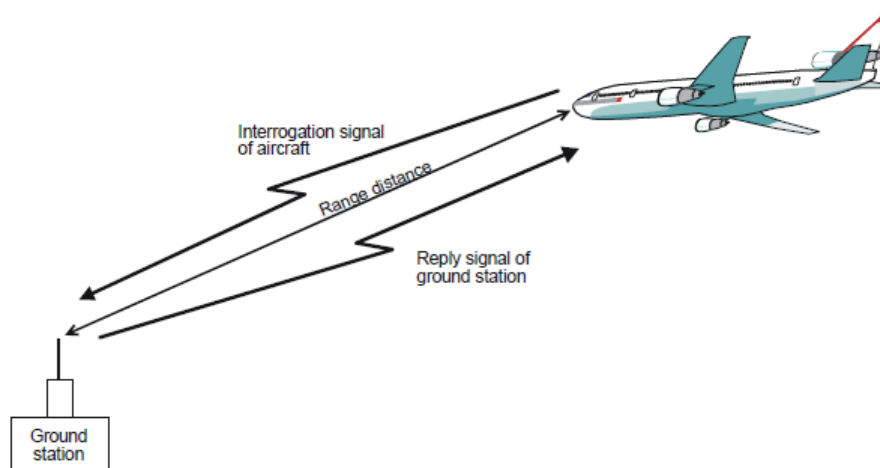
Figure 5-1: DME principle

Most DME ground stations are combined with a VOR system to allow an aircraft to determine its precise position relative to the ground station. The DME channels are

paired with the VOR channels. Channel frequencies range from 1025 MHz to 1150 MHz for the DME interrogator and 962 MHz to 1213 MHz for the DME transponder (see Table 5-1). The frequency difference between received and transmitted signal is always 63 MHz. The channel spacing between consecutive DME channels is always 1 MHz.

Each channel has two different codings (X and Y) that differ regarding their pulse spacing. The assignment of a channel and coding to a ground station always remains the same during operation and is determined by the respective national air traffic control authority.
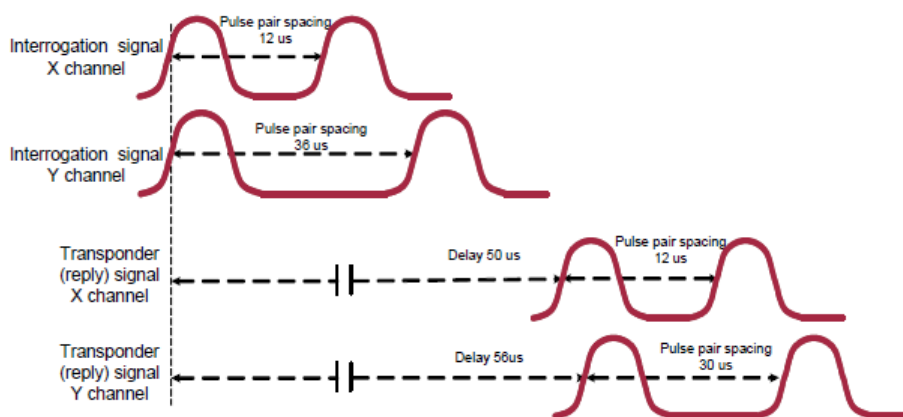

Figure 5-2: Time characteristic of DME signal envelope for X and Y channel

DME interrogator

The aircraft's DME interrogator sends a sequence of pulses that are received at the ground station and, after a defined delay time, are returned at a different frequency. The frequency offset between sent and received signal is always 63 MHz. The receiver in the aircraft filters its own pulse sequence out of all received pulses and in this way determines the time difference between the transmitted and received pulse. The time difference is used for the calculation of the slant range to the ground station. The distance is typically expressed in nautical miles (NM), where 1 NM corresponds to 1852.02 m and a signal round-trip time of 12.359 µs.

As a result, the precise position of the aircraft can be derived from the flight altitude and the azimuth angle between the aircraft and ground station (VOR system).

DME transponder

The DME transponder checks the validity of all received pulses (i.e. the pulse spacing must be consistent with the channel) in its "decoder". A single pulse, for example, is filtered out as an invalid interrogation and no reply to this pulse is sent.

For a valid double pulse reception, 2 consecutive pulses are received by the DME transponder. In this case, the receiver does not react to any further interrogations for 60 µs (= dead time) to ensure that it does not trigger again to its reply signal. The receiver is not ready to process new interrogation pulses until the reply double pulse has been fully transmitted. All pulse interrogations that are received at the DME ground

station during the dead time are not answered. The time gap between two consecutive pulses is always at least 60 µs.

A reply pulse is sent after a defined delay time after a valid interrogation pulse has been received.

Echo rejection

Due to reflection the wanted pulse pair is disturbed by echos. The echo pulse pairs are typically attenuated by a few decibels below and also delayed compared to the originally emitted pulse pair. Nevertheless distance measurements must be correct, unless the echo is too strong.

Velocity tracking

Due to movement, the received pulse pair has a Doppler shift in frequency. DME receivers are able to track this frequency shift.

The velocity is typically expressed in knots (kn): 1 kn corresponds to 0.5144 m/s.

Related settings

For DME settings at the R&S SMBV100B, see Chapter 5.3, "DME configuration and settings", on page 55.

Channel frequencies

The column notations in the table below are as follows:

- **Chan.** = ICAO channel number
- **VOR freq.** = VOR frequency (MHz)
- **DME int. freq.** = DME interrogation frequency (MHz)
- **DME rep. Freq.** = DME reply frequency (MHz)

Table 5-1: DME ICAO channels and frequencies (MHz)

Chan.	VOR freq.	DME Int. freq.	DME rep. freq.	Chan.	VOR freq.	DME Int. freq.	DME rep. freq.
1X 1Y		1025 1025	962 1088	64X 64Y		1088 1088	1151 1025
2X 2Y		1026 1026	963 1089	65X 65Y		1089 1089	1152 1026
3X 3Y		1027 1027	964 1090	66X 66Y		1090 1090	1153 1027
4X 4Y		1028 1028	965 1091	67X 67Y		1091 1091	1154 1028
5X 5Y		1029 1029	966 1092	68X 68Y		1092 1092	1155 1029
6X 6Y		1030 1030	967 1093	69X 69Y		1093 1093	1156 1030

Chan.	VOR freq.	DME Int. freq.	DME rep. freq.	Chan.	VOR freq.	DME Int. freq.	DME rep. freq.
7X		1031	968	70X	112.30	1094	1157
7Y		1031	1094	70Y	112.35	1094	1031
8X		1032	969	71X	112.40	1095	1158
8Y		1032	1095	71Y	112.45	1095	1032
9X		1033	970	72X	112.50	1096	1159
9Y		1033	1096	72Y	112.55	1096	1033
10X		1034	971	73X	112.60	1097	1160
10Y		1034	1097	73Y	112.65	1097	1034
11X		1035	972	74X	112.70	1098	1161
11Y		1035	1098	74Y	112.75	1098	1035
12X		1036	973	75X	112.80	1099	1162
12Y		1036	1099	75Y	112.85	1099	1036
13X		1037	974	76X	112.90	1100	1163
13Y		1037	1100	76Y	112.95	1100	1037
14X		1038	975	77X	113.00	1101	1164
14Y		1038	1101	77Y	113.05	1101	1038
15X		1039	976	78X	113.10	1102	1165
15Y		1039	1102	78Y	113.15	1102	1039
16X		1040	977	79X	113.20	1103	1166
16Y		1040	1103	79Y	113.25	1103	1040
17X	108.00	1041	978	80X	113.30	1104	1167
17Y	108.05	1041	1104	80Y	113.35	1104	1041
18X	108.10	1042	979	81X	113.40	1105	1168
18Y	108.15	1042	1105	81Y	113.45	1105	1042
19X	108.20	1043	980	82X	113.50	1106	1169
19Y	108.25	1043	1106	82Y	113.55	1106	1043
20X	108.30	1044	981	83X	113.60	1107	1170
20Y	108.35	1044	1107	83Y	113.65	1107	1044
21X	108.40	1045	982	84X	113.70	1108	1171
21Y	108.45	1045	1108	84Y	113.75	1108	1045
22X	108.50	1046	983	85X	113.80	1109	1172
22Y	108.55	1046	1109	85Y	113.85	1109	1046
23X	108.60	1047	984	86X	113.90	1110	1173
23Y	108.65	1047	1110	86Y	113.95	1110	1047
24X	108.70	1048	985	87X	114.00	1111	1174
24Y	108.75	1048	1111	87Y	114.05	1111	1048

Chan.	VOR freq.	DME Int. freq.	DME rep. freq.	Chan.	VOR freq.	DME Int. freq.	DME rep. freq.
25X	108.80	1049	986	88X	114.10	1112	1175
25Y	108.85	1049	1112	88Y	114.15	1112	1049
26X	108.90	1050	987	89X	114.20	1113	1176
26Y	108.95	1050	1113	89Y	114.25	1113	1050
27X	109.00	1051	988	90X	114.30	1114	1177
27Y	109.05	1051	1114	90Y	114.35	1114	1051
28X	109.10	1052	989	91X	114.40	1115	1178
28Y	109.15	1052	1115	91Y	114.45	1115	1052
29X	109.20	1053	990	92X	114.50	1116	1179
29Y	109.25	1053	1116	92Y	114.55	1116	1053
30X	109.30	1054	991	93X	114.60	1117	1180
30Y	109.35	1054	1117	93Y	114.65	1117	1054
31X	109.40	1055	992	94X	114.70	1118	1181
31Y	109.45	1055	1118	94Y	114.75	1118	1055
32X	109.50	1056	993	95X	114.80	1119	1182
32Y	109.55	1056	1119	95Y	114.85	1119	1056
33X	109.60	1057	994	96X	114.90	1120	1183
33Y	109.65	1057	1120	96Y	114.95	1120	1057
34X	109.70	1058	995	97X	115.00	1121	1184
34Y	109.75	1058	1121	97Y	115.05	1121	1058
35X	109.80	1059	996	98X	115.10	1122	1185
35Y	109.85	1059	1122	98Y	115.15	1122	1059
36X	109.90	1060	997	99X	115.20	1123	1186
36Y	109.95	1060	1123	99Y	115.25	1123	1060
37X	110.00	1061	998	100X	115.30	1124	1187
37Y	110.05	1061	1124	100Y	115.35	1124	1061
38X	110.10	1062	999	101X	115.40	1125	1188
38Y	110.15	1062	1125	101Y	115.45	1125	1062
39X	110.20	1063	1000	102X	115.50	1126	1189
39Y	110.25	1063	1126	102Y	115.55	1126	1063
40X	110.30	1064	1001	103X	115.60	1127	1190
40Y	110.35	1064	1127	103Y	115.65	1127	1064
41X	110.40	1065	1002	104X	115.70	1128	1191
41Y	110.45	1065	1128	104Y	115.75	1128	1065
42X	110.50	1066	1003	105X	115.80	1129	1192
42Y	110.55	1066	1129	105Y	115.85	1129	1066

Chan.	VOR freq.	DME Int. freq.	DME rep. freq.	Chan.	VOR freq.	DME Int. freq.	DME rep. freq.
43X	110.60	1067	1004	106X	115.90	1130	1193
43Y	110.65	1067	1130	106Y	115.95	1130	1067
44X	110.70	1068	1005	107X	116.00	1131	1194
44Y	110.75	1068	1131	107Y	116.05	1131	1068
45X	110.80	1069	1106	108X	116.10	1132	1195
45Y	110.85	1069	1132	108Y	116.15	1132	1069
46X	110.90	1070	1007	109X	116.20	1133	1196
46Y	110.95	1070	1133	109Y	116.25	1133	1070
47X	111.00	1071	1008	110X	116.30	1134	1197
47Y	111.05	1071	1134	110Y	116.35	1134	1071
48X	111.10	1072	1009	111X	116.40	1135	1198
48Y	111.15	1072	1135	111Y	116.45	1135	1072
49X	111.20	1073	1010	112X	116.50	1136	1199
49Y	111.25	1073	1136	112Y	116.55	1136	1073
50X	111.30	1074	1011	113X	116.60	1137	1200
50Y	111.35	1074	1137	113Y	116.65	1137	1074
51X	111.40	1075	1012	114X	116.70	1138	1201
51Y	111.45	1075	1138	114Y	116.75	1138	1075
52X	111.50	1076	1013	115X	116.80	1139	1202
52Y	111.55	1076	1139	115Y	116.85	1139	1076
53X	111.60	1077	1014	116X	116.90	1140	1203
53Y	111.65	1077	1140	116Y	116.95	1140	1077
54X	111.70	1078	1015	117X	117.00	1141	1204
54Y	111.75	1078	1141	117Y	117.05	1141	1078
55X	111.80	1079	1016	118X	117.10	1142	1205
55Y	111.85	1079	1142	118Y	117.15	1142	1079
56X	111.90	1080	1017	119X	117.20	1143	1206
56Y	111.95	1080	1143	119Y	117.25	1143	1080
57X	112.00	1081	1018	120X	117.30	1144	1207
57Y	112.05	1081	1144	120Y	117.35	1144	1081
58X	112.10	1082	1019	121X	117.40	1145	1208
58Y	112.15	1082	1145	121Y	117.45	1145	1082
59X	112.20	1083	1020	122X	117.50	1146	1209
59Y	112.25	1083	1146	122Y	117.55	1146	1083
60X		1084	1021	123X	117.60	1147	1210
60Y		1084	1147	123Y	117.65	1147	1084

Chan.	VOR freq.	DME Int. freq.	DME rep. freq.	Chan.	VOR freq.	DME Int. freq.	DME rep. freq.
61X		1085	1022	124X	117.70	1148	1211
61Y		1085	1148	124Y	117.75	1148	1085
62X		1086	1023	125X	117.80	1149	1212
62Y		1086	1149	125Y	117.85	1149	1086
63X		1087	1024	126X	117.90	1150	1213
63Y		1087	1150	126Y	117.95	1150	1087

5.3 DME configuration and settings

Option: R&S SMBVB-K153

Access:

► Select "Baseband" > "DME".

The remote commands required to define DME settings are described in Chapter 7.5, "DME commands", on page 130.

Settings:

5.3.1 General settings

Access:

► Select "DME" > "General".
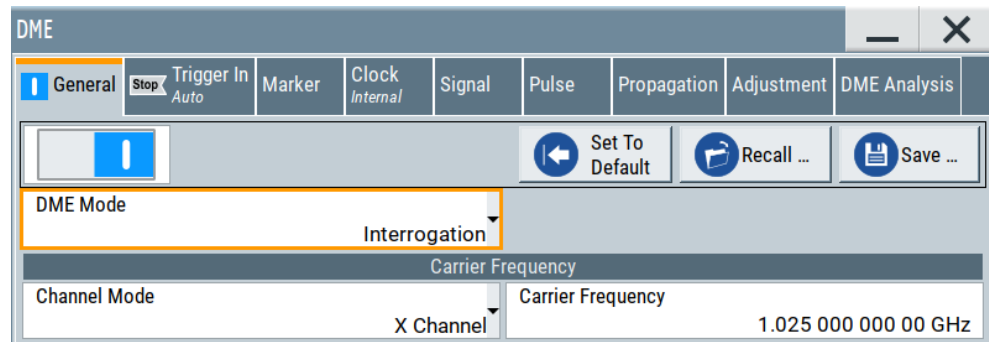
This dialog provides general settings of the DME standard, like enabling the standard and selecting the DME mode.

By default, a DME interrogation mode signal with a carrier frequency of 1.025 GHz (ICAO channel 1X) is set. The pulse signal is of a sequence of cos^2 shaped pulses, which is repeated every 48 Hz. A single pulse has a width of 3.5 µs, the period between two pulses is 12 µs.

Changing a parameter in the avionic standards causes an instant signal change in the R&S SMBV100B. There is no extra measurement cycle to calculate the RMS value of the baseband signal to set the correct RF level.

If the avionics standard is activated for the first time, or after every subsequent on/off sequence, the measurement cycle will take place to determine the correct RF level. Every subsequent parameter change in the avionic standard is performed without another measurement cycle to provide a continuous signal output.

Settings:

State
Activates the avionic standard.

Activation of the standard deactivates a previously active avionic standard. The "VOR/ILS/DME > Carrier Frequency" setting is applied automatically to the RF "Frequency" and displayed in the status bar.

Remote command:
`<subsystem>:STATe` on page 100

Set To Default

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

Standard	Parameter	Value
VOR/ILS/DME	State	Not affected by "Set to default"
VOR	Carrier Frequency Mode	User Defined
	Carrier Frequency	108.000000 MHz
ILS	ILS Component	Glide Slope (GS)
	ILS GS > Carrier Frequency Mode	User Defined
	ILS GS > Carrier Frequency	334.700000 MHz
DME	DME Mode	Interrogation
	Channel Mode	X Channel
	Carrier Frequency	1.025 GHz

Remote command:
`<subsystem>:PRESet` on page 98

Save/Recall

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

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

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

Remote command:
`<subsystem>:SETTing:CATalog` on page 99
`<subsystem>:SETTing:DELete` on page 99
`<subsystem>:SETTing:LOAD` on page 99
`<subsystem>:SETTing:STORe` on page 99

DME Mode

Selects the DME modulation mode. The mode determines the signal type that is simulated. The exact timing of the signal for each mode is determined by the selected X or Y channel.

The timing and shape of the pulses can be freely selected. By default these values are set according to the standard.

"Interrogation"   The interrogation signal of the airborne transmitter is simulated.

"Reply"
The reply signal of the ground-based transponder is simulated.
The trigger is automatically set to external and the default trigger delay either to 50 µs (channel X) or 56 µs (channel Y) depending on the selected channel.
The interval between the pulse pairs can be set to a fixed value (repetition rate) or to random generation (pulse squitter).

Remote command:
[:SOURce<hw>][:BB]:DME:MODE on page 131

Channel Mode
Sets the frequency channel.

Standard compliant X and Y channels differ in the spacing between the two pulses of the pulse pair and the reply delay of the ground station (see Table 5-1).

ICAO indicates the ICAO channel parameters below for selecting the correct channel.

Table 5-2: Pulse spacing and reply delay

Channel	Pulse spacing interrogation mode	Pulse spacing reply mode	Reply delay 1st pulse	Reply delay 2nd pulse
X	12 µs	12 µs	50 µs	50 µs
Y	36 µs	30 µs	56 µs	50 µs

Remote command:
[:SOURce<hw>][:BB]:DME:CSUFfix on page 132

Carrier Frequency
Requires "Channel Mode > X Channel/Y Channel".

Sets the carrier frequency of the signal.

Remote command:
[:SOURce<hw>][:BB]:DME:FREQuency on page 132

ICAO Channel
Requires "Channel Mode > ICAO".

Sets the ICAO channel and the corresponding transmitting frequency.

If avionic standard modulation is activated and you change the "RF Frequency", the frequency value of the closest ICAO channel is applied automatically. The "ICAO Channel" is also updated.

For an overview of the DME ICAO channels and frequencies, see Table 5-1.

Remote command:
[:SOURce<hw>][:BB]:DME:ICAO:CHANnel on page 133

5.3.2 Signal settings

Access:

► Select "DME" > "Signal".

This dialog provides signal settings of the DME signal.

Settings:

Range Distance
Requires "DME Mode" > "Reply".

Sets the simulated distance between the interrogator and the transponder for reply mode. The distance can be given in nautical miles (NM) or µs. 1 nm is 1852.01 meters and corresponds to a run time of 12.359 µs.

The range distance and the external trigger delay are dependent according to:

"Range Distance" = ("Trigger Delay" – X/Y mode delay)/12.359 µs/nm, where

X mode delay = 50 µs, Y mode delay = 56 µs

Changing one value automatically changes the other value.

Remote command:
[:SOURce<hw>][:BB]:DME:RDIStance on page 135
[:SOURce<hw>][:BB]:DME:RDIStance:UNIT on page 136

Number of Replies for Efficiency Calculation
Requires "DME Mode" > "Reply".

Sets the total number of reply pulse pairs for statistical averaging of the reply efficiency. You can select between 10, 50 or 100 pulse pairs.

Use lower values for a more uniform distribution and higher values for a finer control over the reply efficiency. For example, 10 replies for efficiency calculation and a reply efficiency of 70 % result in 7 reply pulses out of 10 received trigger signals. The trigger signals are incoming interrogator pulse pairs at the power sensor.

Remote command:
[:SOURce<hw>][:BB]:DME:EFFiciency:REPLies on page 132

Reply Efficiency

Requires "DME Mode" > "Reply".

The reply efficiency is the probability that a pulse pair is transmitted in reaction to a trigger event. It defines the relation between reply pulse pairs and received trigger signals. The trigger signals are incoming interrogator pulse pairs at the power sensor.

For example, with a set efficiency of 50 %, on average, only every second trigger event leads to the generation of a reply pulse pair.

Remote command:
[:SOURce<hw>][:BB]:DME:ANALysis:EFFiciency? on page 145

Pulse Squitter

Enables squitter pulses.

If enabled, the Pulse Repetition Rate is automatically set to 2700 Hz.

Squitter pulses are random pulse pairs sent by a ground station if the average transmit pulse rate drops to values between 700 pulse pairs per second (pp/s). Squitter pulses ensure that a minimum pulse rate is provided. This setting is crucial for the proper monitoring and adjustment of important pulse parameters of the ground station.

Remote command:
[:SOURce<hw>][:BB]:DME:SQUitter on page 136

Pulse Repetition Rate

Sets the number of DME pulse pairs per second.

Remote command:
[:SOURce<hw>][:BB]:DME:RATE on page 135

Input Source

Selects the input of the DME pulses.

If "DME Mode" > "Interrogation", the setting selects the input for the reply pulses of a ground station.

If "DME Mode" > "Reply", the input of the interrogation pulses of an airplane is selected.

"Ext Triggered"

The pulses are received via the backward User connector. Make sure that you input only the pulse envelope of the demodulated signal at this connector.
If a modulated RF signal is applied, use "Input Source" > "Ext Power Sensor".

"Ext Power Sensor"

> A power sensor, for example the R&S NRP-Z81, is input for modulated RF pulses. An external DME signal is fed into the sensor. The 50 % voltage point of this signal is used by the power sensor to generate the trigger for the R&S SMBV100B.

Remote command:

[:SOURce<hw>][:BB]:DME:PINPut:SOURce on page 137

Reply Delay

Requires "DME Mode" > "Reply".

Sets the delay between the external trigger and the first DME output pulse (50% voltage point of first pulse).

The R&S SMBV100B simulates the defined delay of the DME transponder and twice the run time of the signal (from interrogator to transponder and back).

The reply delay is coupled to the Range Distance via:

Reply delay = Channel X/Y mode delay + range distance * 12.359 µs / NM, where:

X mode delay = 50 µs, Y mode delay = 56 µs

Changing one value automatically changes the other value.

Remote command:

[:SOURce<hw>][:BB]:DME:PINPut:DELay on page 137

Trigger Level

Requires "Input Source" > "Ext Power Sensor".

Displays the trigger level. This level is the 50% voltage point of the first pulse of the external DME interrogation signal.

If the trigger level is too low to be determined, the "Trigger Level" displays "---".

Remote command:

[:SOURce<hw>][:BB]:DME:PINPut:TRIGger:LEVel? on page 138
[:SOURce<hw>][:BB]:DME:PINPut:TRIGger:LEVel:OK? on page 138

Search Trigger Level

Requires "Input Source" > "Ext Power Sensor".

Executes a search procedure to determine the trigger level. This level is the 50% voltage point of the first pulse of the external DME interrogation signal.

Determination of the trigger point requires a connected power sensor. Use a power sensor, for example the R&S NRP-Z81, to receive the external DME signal. Repeat the trigger search function when changing the level of the external DME signal.

Remote command:

[:SOURce<hw>][:BB]:DME:PINPut:TRIGger:SEARch? on page 138

Zero

Activates auto zeroing of the power sensor.

See also section "About zeroing" of chapter "NRP sensor configuration" in the R&S SMBV100B user manual.

Remote command:
n.a.

5.3.3 Pulse settings

Access:

► Select "DME" > "Pulse".
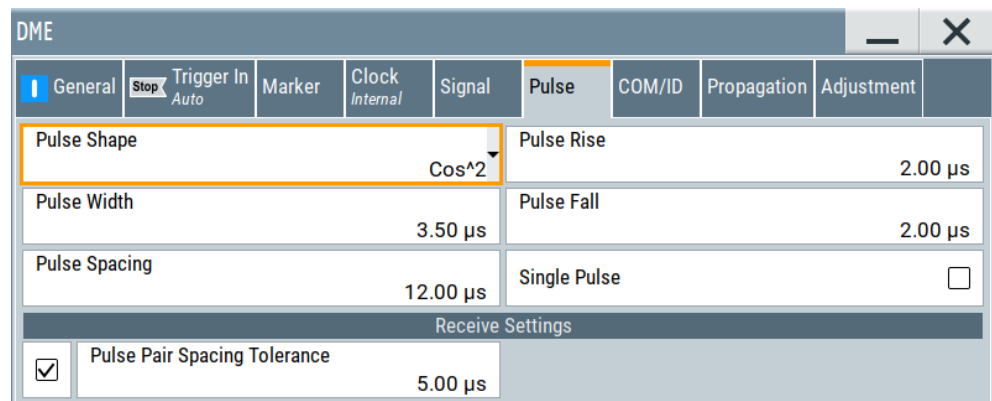
This dialog provides pulse settings of the DME signal.

Settings:

Pulse Shape
Selects the pulse shape.

"Cos^2"	The falling and the rising edge of the pulse are cos^2 shaped.
"Cos Cos^2"	The rising edge is cos shaped and the falling edge is cos^2 shaped.
"Linear"	The falling and the rising edge of the pulse are linearly shaped.
"Gauss"	The pulse has a Gaussian form.

Remote command:
`[:SOURce<hw>][:BB]:DME:SHAPe` on page 140

Pulse Rise
Sets the rise time of the pulse (10% to 90% of the peak voltage).

Remote command:

[:SOURce<hw>][:BB]:DME:RISE on page 140

Pulse Width

Sets the pulse width (50% to 50% of peak voltage).

Remote command:

[:SOURce<hw>][:BB]:DME:WIDTh on page 141

Pulse Fall

Sets the fall time of the pulse (90% to 10% of peak voltage).

Remote command:

[:SOURce<hw>][:BB]:DME:FALL on page 139

Pulse Spacing

Sets the spacing between the first and second pulse of a pulse pair (the time between the half-voltage points on the leading edge of each pulse).

Remote command:

[:SOURce<hw>][:BB]:DME:PPS on page 139

Single Pulse

Activates generation of a single test pulse.

Remote command:

[:SOURce<hw>][:BB]:DME:SINGle on page 140

Receive Settings

Provides settings to activate pulse pair spacing and to set the pulse pair spacing tolerance.

Pulse Pair Spacing State ← Receive Settings

Activates pulse pair spacing.

If deactivated, the response is sent after the first pulse, without checking whether the second pulse is within the pulse pair spacing tolerance time.

Remote command:

[:SOURce<hw>]:BB:DME:PPST:ENABled on page 135

Pulse Pair Spacing Tolerance ← Receive Settings

Sets the pulse pair spacing tolerance.

Example:

"Pulse Pair Spacing Tolerance" = "12.00 µs":

The DME transponder identifies a pulse pair with a spacing 11.5 µs to 12.5 µs as a valid interrogation pair and replies to it. Otherwise, no reply is generated.

Remote command:

[:SOURce<hw>][:BB]:DME:PPST on page 134

5.3.4 COM/ID settings

Access:

1. Select "DME" > "DME Mode" > "Reply".

2. Select "DME" > "COM/ID".

This dialog provides COM/ID signal settings of the DME reply signal.

Settings:

COM/ID State

Enables/disables the COM/ID signal.

The ID signal consists of a regular group of pulses that generates Morse code dots and dashes.

The transmission of the ground signal is interrupted every 40 seconds (ID period) and one ID sequence is transmitted instead. The "key down time" of the ground signal corresponds to the period of transmission for a dot or dash in the Morse code ID sequence (e.g. 100ms for a dot). During the key down times reply pulses are not transmitted, however, they are transmitted between the key down times.

See also Chapter A, "Morse code settings", on page 164.

Remote command:
[:SOURce<hw>][:BB]:DME:ID[:STATe] on page 155

Code

Sets the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport).

The COM/ID tone is sent according to the selected code, see Chapter A, "Morse code settings", on page 164.

If no coding is set, the COM/ID tone is sent uncoded (key down).

Remote command:

[:SOURce<hw>][:BB]:DME:ID:CODE on page 152

Rate

Sets the pulse repetition rate of the COM/ID sequence.

Remote command:

[:SOURce<hw>][:BB]:DME:ID:RATE on page 154

Period

Sets the period of the COM/ID signal.

Remote command:

[:SOURce<hw>][:BB]:DME:ID:PERiod on page 154

Time Schema

Sets the time schema of the Morse code for the COM/ID signal.

"Standard"   The set dot length determines the length of the dash, the symbol space and letter space of the Morse code.

"User"   You can set each length value separately.

Remote command:

[:SOURce<hw>][:BB]:DME:ID:TSCHema on page 155

Dot Length

Sets the length of a Morse code dot.

If "Time Schema" > "Standard", the dot length value determines also the length of the dash (= 3 times the dot length), symbol space (= dot length) and letter space (= 3 times the dot length).

Remote command:

[:SOURce<hw>][:BB]:DME:ID:DOT on page 153

Dash Length

Requires "Time Schema" > "User".

Sets the length of a Morse code dash.

Remote command:

[:SOURce<hw>][:BB]:DME:ID:DASH on page 152

Symbol Space

Requires "Time Schema" > "User".

Sets the length of the Morse code symbol space.

Remote command:

[:SOURce<hw>][:BB]:DME:ID:SYMBol on page 155

Letter Space

Requires "Time Schema" > "User".

Sets the length of a Morse code letter space.

Remote command:

[:SOURce<hw>][:BB]:DME:ID:LETTer on page 153

5.3.5 Propagation settings

Access:

► Select "DME" > "Propagation".
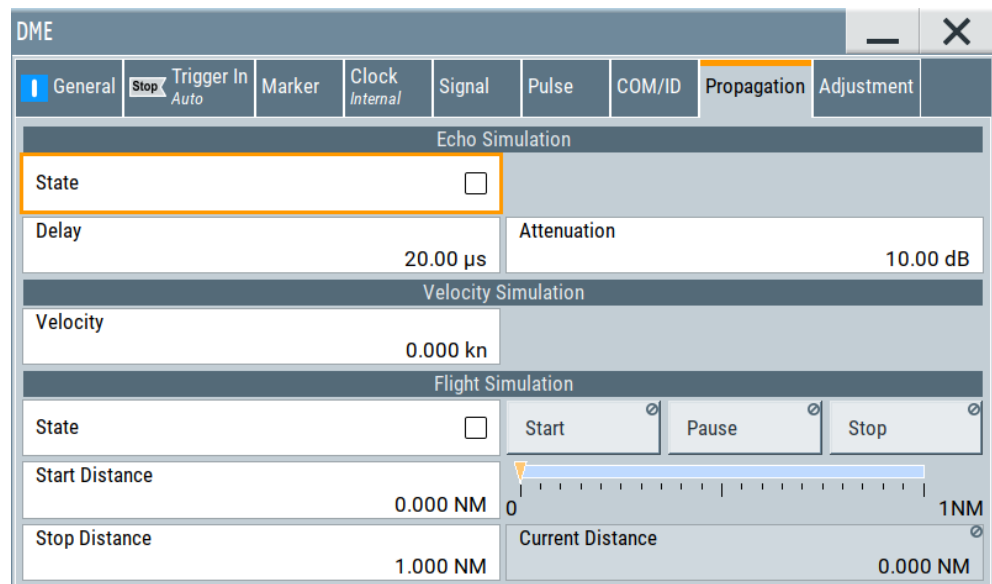
This dialog provides propagation settings of the DME signal necessary for echo rejection testing, velocity tracking and flight simulation.

Settings:

Echo Simulation

Echo Simulation	
State ☐	
Delay 20.00 µs	Attenuation 10.00 dB

Provides settings for DME echo simulation. You can activate the generation of the DME echo pulse pair signal and configure the delay and the attenuation of this signal.

State ← Echo Simulation
Activates the simulation of the DME echo pulse pair signal.

If enabled, the composite DME pulse signal consists of two pulse pairs: The original pulse pair and a delayed and attenuated copy of the original pulse pair. This copy, the echo pulse pair signal, has the same pulse configuration, see Chapter 5.3.3, "Pulse settings", on page 62.

Delay and attenuation of the echo pulse pair signal compared to the original pulse pair signal can be set.

Activation of the DME echo pulse pair signal deactivates DME squitter pulses (Pulse Squitter > Off).

Remote command:
[:SOURce<hw>][:BB]:DME:ECHO on page 141

Delay ← Echo Simulation
Sets the delay between the first original DME pulse pair and the delayed DME echo pulse pair.

Remote command:
[:SOURce<hw>][:BB]:DME:ECHO:DELay on page 142

Attenuation ← Echo Simulation
Sets the attenuation of the DME echo pulse pair signal compared to the original DME pulse pair signal.

A positive attenuation leads to echo pulse pairs with reduced amplitude compared to the original pulse pairs.

Remote command:
[:SOURce<hw>][:BB]:DME:ECHO:ATTenuation on page 142

Velocity Simulation

Velocity Simulation	
Velocity	
	0.000 kn
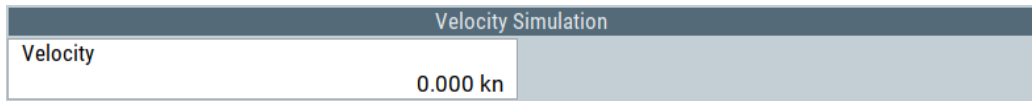
Provides settings for velocity simulation. DME echo simulation is off. You can configure the velocity.

Velocity ← Velocity Simulation

Requires "State" > "Off" of the DME echo pulse signal.

Sets the velocity of the ground station (= DME transponder) relative to the aircraft (= DME interrogator).

A positive/negative value v implies a positive/negative Doppler frequency shift Δf of the carrier frequency f_c:

$$\Delta f = (v/c) \times f_c$$

The speed of light c equals 3×10^8 m/s.

Example:

v = 1000 kn = 514.4 m/s; f_c = 1.025 GHz

Velocity Simulation	
Velocity	
	1 000.000 kn
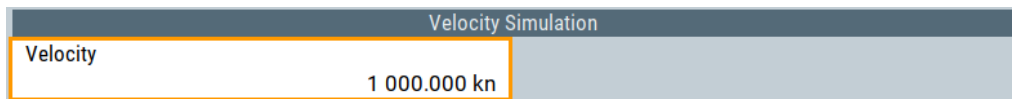
Expected frequency shift: $\Delta f = (514.4 / (3 \times 10^8)) \times 1.025 \times 10^9$ Hz = 1.756 kHz

To verify this frequency shift, select "Baseband" > "Baseband Offsets" > "Frequency Offset".

Baseband Offsets			
	Frequency Offset (Hz)	Phase Offset (deg)	
Baseband	1 756.17	0.00	
BB Input	0.00	0.00	

Remote command:

[:SOURce<hw>][:BB]:DME:VELocity on page 142

Flight Simulation

Flight Simulation				
State	☐	Start	Pause	Stop
Start Distance				
	0.000 NM	0		1NM
Stop Distance		Current Distance		
	1.000 NM			0.000 NM
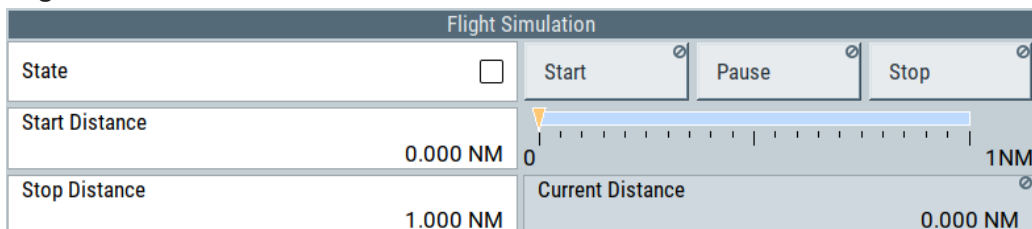
Provides settings for flight simulation. You can activate the simulation and monitor the current distance and propagation of the aircraft within a configurable start distance and stop distance.

If activated, the parameters range distance and the reply delay change dynamically during the simulation. See also "Range Distance" on page 59 and "Reply Delay" on page 61.

State ← Flight Simulation

Activates flight simulation. You can activate the simulation and monitor the current distance and propagation of the aircraft within a configurable start distance and stop distance.

Remote command:

[:SOURce<hw>][:BB]:DME:FLIGht:STATe on page 144

[:SOURce<hw>][:BB]:DME:FLIGht:RSTatus? on page 144

Start Distance ← Flight Simulation

Sets the start distance of the flight simulation.

Remote command:

[:SOURce<hw>][:BB]:DME:FLIGht:DISTance:STARt on page 143

Stop Distance ← Flight Simulation

Sets the stop distance of the flight simulation.

Remote command:

[:SOURce<hw>][:BB]:DME:FLIGht:DISTance:STOP on page 143

Flight simulation player settings ← Flight Simulation

Require flight simulation "State" > "On".
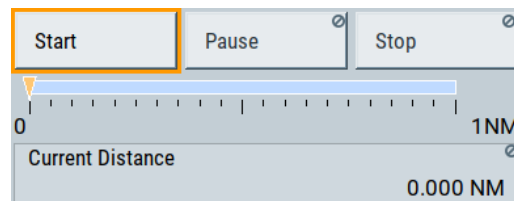
Provides standard player settings and monitoring aircraft distance evolution in a progress bar.

Start ← Flight simulation player settings ← Flight Simulation

Starts the flight simulation with a given start distance.

Remote command:

[:SOURce<hw>][:BB]:DME:FLIGht:STARt on page 144

Restart ← Flight simulation player settings ← Flight Simulation

Restarts a running or stopped flight simulation.

Remote command:

[:SOURce<hw>][:BB]:DME:FLIGht:RESTart on page 143

Pause ← Flight simulation player settings ← Flight Simulation
Pauses a running flight simulation.

Remote command:
[:SOURce<hw>][:BB]:DME:FLIGht:PAUSe on page 143

Resume ← Flight simulation player settings ← Flight Simulation
Resumes a running flight simulation.

Remote command:
[:SOURce<hw>][:BB]:DME:FLIGht:RESume on page 144

Stop ← Flight simulation player settings ← Flight Simulation
Stops the flight simulation and sets the distance position to start distance.

Remote command:
[:SOURce<hw>][:BB]:DME:FLIGht:STOP on page 144

Current Distance ← Flight simulation player settings ← Flight Simulation
Displays the current distance of the aircraft.

Remote command:
[:SOURce<hw>][:BB]:DME:FLIGht:DISTance:CURRent? on page 142

5.3.6 Adjustment settings

Access:

► Select "DME" > "Adjustment".
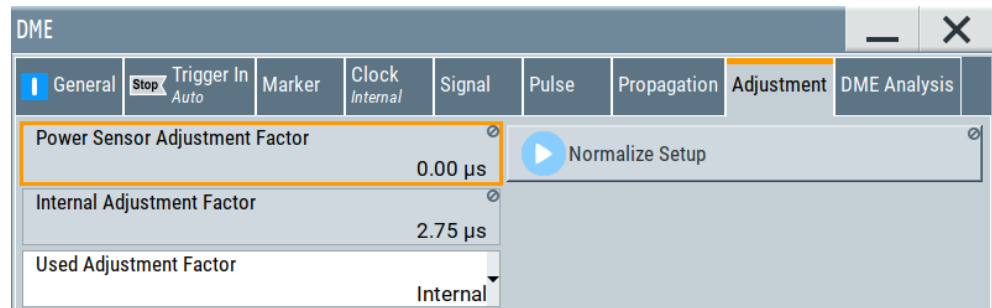
This dialog provides adjustment settings to normalize the setup when triggering the R&S SMBV100B with a power sensor, for example, the R&S NRP-Z81.

For supported Rohde & Schwarz power sensors, see the data sheet. The following step-by-step instructions use the R&S NRP-Z81. These instructions are analogous for compatible power sensors.

To connect a power sensor with the R&S SMBV100B

1. Connect the "Host" connector of the power sensor with the "Sensor" connector on the front panel of the R&S SMBV100B.

    a) Align the "Host" connector along a common axis with the "Sensor" connector.

    b) Rotate the connecting cable, so that the red marking at the "Host" connector matches the position of the red marking at the "Sensor" connector.
The correct position is the left position as seen from the middle of the "Sensor" connector. See label "5" in Figure 5-3.

    c) Insert the "Host" connector into the "Sensor" connector of your sensor hub.

2. Connect the "RF" connector of the R&S NRP-Z81 with the "RF 50Ω" output connector on the front panel of the R&S SMBV100B.

    a) Before connecting, switch off the RF output of the R&S SMBV100B.
In the block diagram, select the block "RF" > "RF Level" > "RF ON" > "Off".

    b) Align the "RF" connector along a common axis with the "RF 50Ω" output connector.

    c) Tighten the "RF" connector of the power sensor.

Figure 5-3 illustrates the test setup.
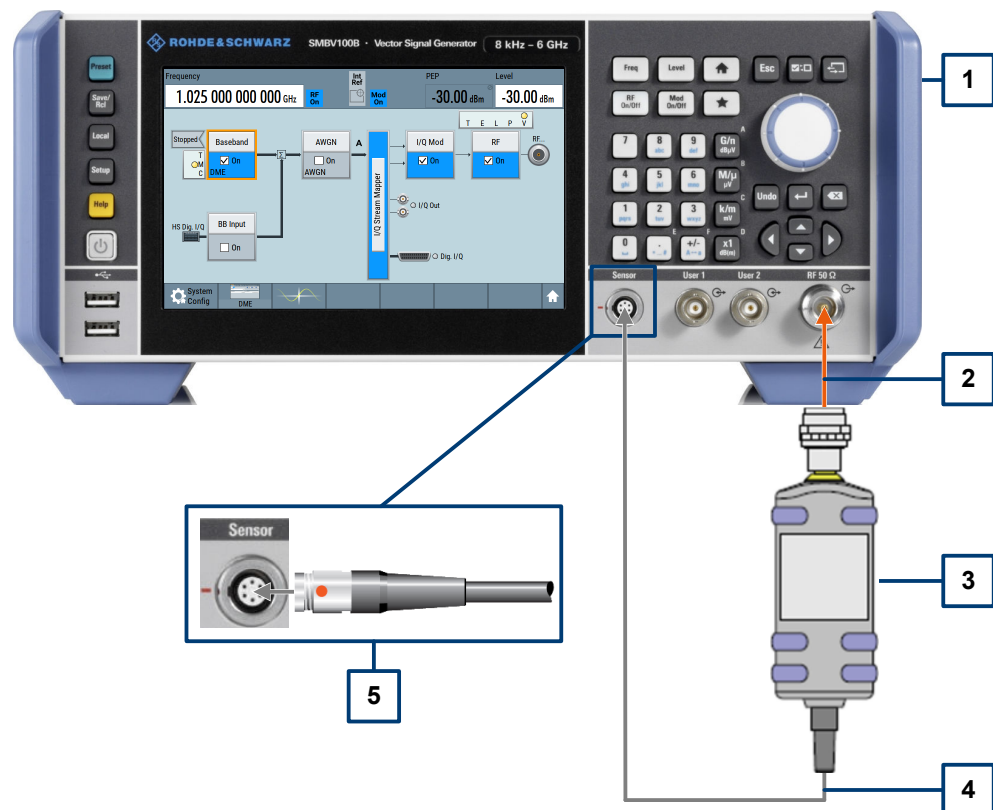
Figure 5-3: Test setup for normalization routine

1 = R&S SMBV100B
2 = RF connection
3 = Power sensor, for example, the R&S NRP-Z81
4 = Sensor control connection
5 = Red markings for "Host" connector (R&S NRP-Z81) with the "Sensor" connector (R&S SMBV100B)

To normalize the test setup

1. Connect the R&S SMBV100B and the power sensor as described in "To connect a power sensor with the R&S SMBV100B" on page 70.

2. To calibrate a measurement setup regarding external pulse input and internal processing delays, use "Normalize Setup".

For DME operation in combination with a power sensor as input channel, the exact trigger point has to be known. Knowing the trigger point can be used to compensate for the pulse shape and the internal delay of the sensor.

As shown in Figure 5-4, the R&S SMBV100B gets interrogation pulses from an external DUT using the same pulse shape. According to the settings, the R&S SMBV100B sends a reply pulse pair 50us after receiving the interrogation pulse pair.

To guarantee, that the 50% edge levels are exactly 50us separated from each other, the R&S SMBV100B has to start the reply pulse before the 50us reply delay period has elapsed.

Using the "Normalize Setup" calibration, an adjustment factor t is measured. This adjustment factor is considered, when generating the reply pulses. The signal output is started earlier to compensate for the trigger point of the sensor. This calibration works best, when both stations use the same pulse shape with the same timing characteristics.
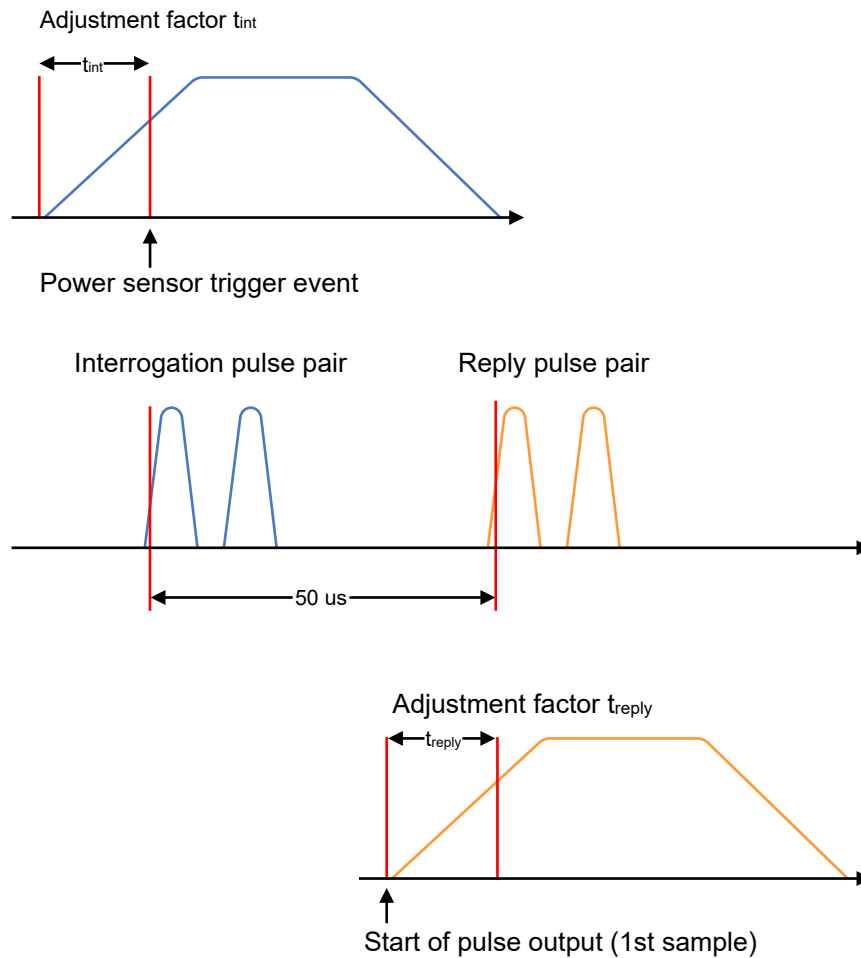
Figure 5-4: Normalization routine

Settings:

Normalize Setup

Requires direct connection between the R&S SMBV100B and a power sensor, for example, the R&S NRP-Z81. See Figure 5-3.

Triggers the start of the normalization routine.

The normalization routine measures the pulse propagation time within the test setup. The propagation time is the time difference between the pulse signal routing time and the time at which the shaped pulse reaches 50 % of the peak voltage. The pulse signal routing time includes the start of a pulse from the internal FPGA of the R&S SMBV100B through the RF chain, the power sensor, and back into the FPGA.

The propagation time value is subtracted from the desired delay to achieve an overall delay. The R&S SMBV100B uses the overall delay to start pulse generation such that the 50 % voltage level of the rising edge of the first pulse occurs at the desired delay.

If "Used Adjustment Factor" > "Power Sensor", this measured time is used rather than the calculated internal adjustment factor. Normalize Setup only measures the rise time of the pulse generated by the R&S SMBV100B.

R&S SMBVB-K153 assumes that the pulse shape of the DUT (when the R&S SMBV100B is in interrogation mode, the DUT is the ground transponder. When the R&S SMBV100B is in reply mode (the DUT is the aircraft interrogator), the rise time of the DUT matches the rise time of the generator. No correction is made for differences in the rise time of the DUT and rise time of the R&S SMBV100B.

See also Figure 5-4.

Remote command:

Power Sensor Adjustment Factor
Displays the power sensor adjustment factor determined during a normalization of the setup.

Remote command:

Internal Adjustment Factor
Displays the internal adjustment factor, the mathematically calculated value of the time, when the pulse reaches its 50% level.

Remote command:

Used Adjustment Factor
Sets the used adjustment factor.

"Internal"   The mathematically calculated value of the time, when the pulse reaches its 50% level. The power sensor trigger hysteresis and the small delay from the power sensor trigger output to the R&S SMBV100B are not considered by the calculation.

"Power Sensor"
                  The adjustment factor measured during a normalization setup.

Remote command:

5.3.7 DME Analysis settings

Configuring and displaying DME analysis settings and results require a connection between R&S SMBV100B and a power sensor, for example, the R&S NRP-Z81.

Access:

1. Connect a power sensor to the R&S SMBV100B.

How to: Chapter "Connecting power sensors to the R&S SMBV100B" in the R&S SMBV100B user manual.

2. Select "DME" > "DME Mode" > "Interrogation".

3. Select "DME" > "DME Analysis".
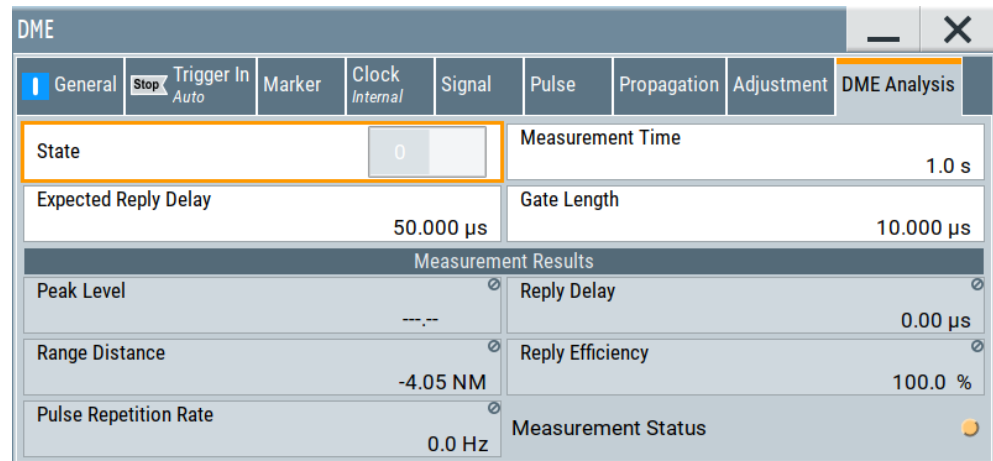
This dialog provides analysis settings and results related to the DME signal.

Settings:

State

Activates DME analysis. The R&S SMBV100B generates interrogation pulse pairs and starts an internal counter for time measurement.

The measurement gate settings determine the measurement window (expected reply delay +/- gate length/2). To evaluate the delay time and reply efficiency of reply pulses, the first pulse of the interrogation pulse pair requires the following. The 50% voltage point of the rising edge of the first pulse is within the measurement window. The delay measurement is averaged within the measurement cycle. The reply efficiency is calculated once for each measurement cycle.

Example: DME measurement time

The gate length is 1 µs and the expected reply delay is 50 µs. The measurement window lies in the range between 49.5 µs and 50.5 µs.
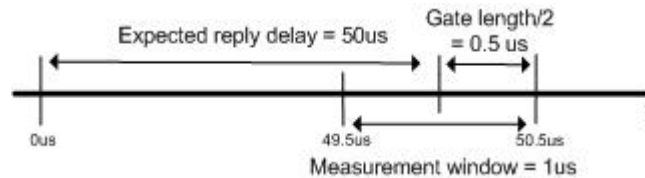
The measurement evaluates only pulse pairs whose 50% voltage point of the rising edge of the first pulse is within the measurement time.

Remote command:

[:SOURce<hw>][:BB]:DME:ANALysis:STATe on page 149

[:SOURce<hw>][:BB]:DME:ANALysis:OK? on page 148

Expected Reply Delay

Sets the expected reply delay. For an illustration between expected reply delay, gate length and measurement time, see Example"DME measurement time" on page 76.

Remote command:

[:SOURce<hw>][:BB]:DME:ANALysis:GATE:EDELay on page 146

Gate Length

Sets the gate length for the measurement window. For an illustration between expected reply delay, gate length and measurement time, see Example"DME measurement time" on page 76.

Remote command:

[:SOURce<hw>][:BB]:DME:ANALysis:GATE[:LENGth] on page 146

Measurement Time

Sets the time of the measurement cycle. For an illustration between expected reply delay, gate length and measurement time, see Example"DME measurement time" on page 76.

Remote command:

[:SOURce<hw>][:BB]:DME:ANALysis:GATE:TIME on page 147

Peak Level

Indicates the measured average peak level of all pulse pairs in a measurement cycle.

Remote command:

[:SOURce<hw>][:BB]:DME:ANALysis:POWer? on page 148

[:SOURce<hw>]:BB:DME:ANALysis:POWer:OK? on page 148

Range Distance

Indicates the measured average range distance of all valid pulse pairs in a measurement cycle.

If there are no valid measurements available in the set measurement window "invalid" is indicated.

Remote command:

[:SOURce<hw>][:BB]:DME:ANALysis:RDIStance? on page 149

Reply Delay

Indicates the measured average reply delay of all valid pulse pairs in a measurement cycle. If there are no valid measurements available in the set measurement window 'invalid' is indicated.

Remote command:

[:SOURce<hw>][:BB]:DME:ANALysis:TIME? on page 150

[:SOURce<hw>]:BB:DME:ANALysis:TIME:OK? on page 150

Reply Efficiency

Indicates the measured reply efficiency in percent. The measurement is the ratio of the number of measured valid reply pulse pairs to transmitted pulse pairs in a measurement cycle.

If there are no valid measurements available, "invalid" is indicated in the set measurement window.

Remote command:

[:SOURce<hw>][:BB]:DME:ANALysis:EFFiciency? on page 145

[:SOURce<hw>]:BB:DME:ANALysis:EFFiciency:OK? on page 146

Pulse Repetition Rate

Indicates the measured mean pulse repetition rate of the DME ground station.

If there are no valid measurements available in the set measurement window "invalid" is indicated.

Remote command:

[:SOURce<hw>][:BB]:DME:ANALysis:PRRate? on page 149

Measurement Status

Displays the status of the measure via a status icon.

If there are no valid measurements available in the set measurement window 'invalid' is indicated.

Remote command:

[:SOURce<hw>]:BB:DME:ANALysis:PRRate:OK? on page 149

6 Signal generation control

This section lists settings provided for defining the signal generation start and for generating signals necessary for synchronization with other instruments.

It covers the following topics:

6.1 Trigger settings

Access:

► Select "ILS"/"VOR"/"DME" > "Trigger In".
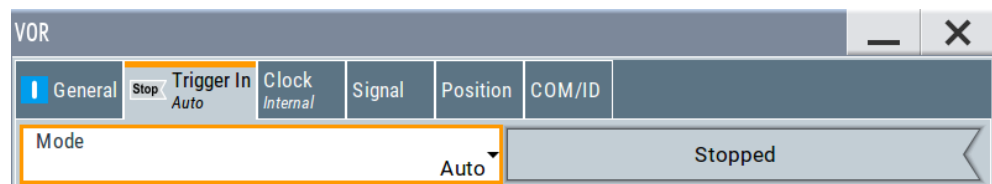
This tab provides settings to select and configure the trigger, like trigger source, trigger mode and trigger delays, and to arm or trigger an internal trigger manually. The header of the tab displays the status of the trigger signal and trigger mode. As in the tabs "Marker" and "Clock", this tab provides also access to the settings of the related connectors.

Routing and activating a trigger signal

1. Define the effect of a trigger event and the trigger signal source.

   a) Select "Trigger In" > "Mode".
   b) Select "Trigger In" > "Source".

2. For external trigger signals, define the connector for signal input. See Chapter 6.4, "Global connectors settings", on page 87.
   You can map trigger signals to one or more User x connectors.

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

3. Activate baseband signal generation. In the block diagram, set "Baseband" > "On".

   The R&S SMBV100B starts baseband signal generation after the configured trigger event.

About baseband trigger signals

This section focuses on the available settings.

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

Settings:

Mode

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

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

Remote command:

[:SOURce<hw>][:BB]:ILS[:TRIGger]:SEQuence on page 157

[:SOURce<hw>]:BB:VOR[:TRIGger]:SEQuence on page 157

[:SOURce<hw>]:BB:DME[:TRIGger]:SEQuence on page 157

Signal Duration

Requires trigger "Mode" > "Single".

Enters the length of the trigger signal sequence.

Use this parameter, for example, for the following applications:
- To output the trigger signal partly.
- To output a predefined sequence of the trigger signal.

Remote command:

`[:SOURce<hw>][:BB]:ILS:TRIGger:SLENgth` on page 159

`[:SOURce<hw>]:BB:VOR:TRIGger:SLENgth` on page 159

`[:SOURce<hw>]:BB:DME:TRIGger:SLENgth` on page 159

Running/Stopped

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

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

Remote command:

`[:SOURce<hw>][:BB]:ILS:TRIGger:RMODe?` on page 157

`[:SOURce<hw>]:BB:VOR:TRIGger:RMODe?` on page 157

`[:SOURce<hw>]:BB:DME:TRIGger:RMODe?` on page 157

Time Based Trigger

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

Activates time-based triggering with a fixed time reference.

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

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

Remote command:

`[:SOURce<hw>][:BB]:ILS:TRIGger:TIME[:STATE]` on page 159

`[:SOURce<hw>]:BB:VOR:TRIGger:TIME[:STATE]` on page 159

`[:SOURce<hw>]:BB:DME:TRIGger:TIME[:STATE]` on page 159

Trigger Time

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

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

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

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

"Date"   Sets the date of the time-based trigger in format YYYY-MM-DD.

Remote command:

`[:SOURce<hw>][:BB]:ILS:TRIGger:TIME:DATE` on page 158

`[:SOURce<hw>]:BB:VOR:TRIGger:TIME:DATE` on page 158

`[:SOURce<hw>]:BB:DME:TRIGger:TIME:DATE` on page 158

"Time"   Sets the time of the time-based trigger in format hh:mm:ss.

Remote command:

[:SOURce<hw>][:BB]:ILS:TRIGger:TIME:TIME on page 158

[:SOURce<hw>]:BB:VOR:TRIGger:TIME:TIME on page 158

[:SOURce<hw>]:BB:DME:TRIGger:TIME:TIME on page 158

Arm

Stops the signal generation until subsequent trigger event occurs.

Remote command:

[:SOURce<hw>][:BB]:ILS:TRIGger:ARM:EXECute on page 160

[:SOURce<hw>]:BB:VOR:TRIGger:ARM:EXECute on page 160

[:SOURce<hw>]:BB:DME:TRIGger:ARM:EXECute on page 160

Execute Trigger

For internal trigger source, executes trigger manually.

Remote command:

[:SOURce<hw>][:BB]:ILS:TRIGger:EXECute on page 160

[:SOURce<hw>]:BB:VOR:TRIGger:EXECute on page 160

[:SOURce<hw>]:BB:DME:TRIGger:EXECute on page 160

Source

The following sources of the trigger signal are available:

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

Remote command:

[:SOURce<hw>][:BB]:ILS:TRIGger:SOURce on page 157

[:SOURce<hw>]:BB:VOR:TRIGger:SOURce on page 157

[:SOURce<hw>]:BB:DME:TRIGger:SOURce on page 157

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

Enables signal output synchronous to the trigger event.

- "On"
  Corresponds to the default state of this parameter.
  The signal calculation starts simultaneously with the trigger event. Because of the processing time of the instrument, the first samples are cut off and no signal is output. After elapsing of the internal processing time, the output signal is synchronous to the trigger event.
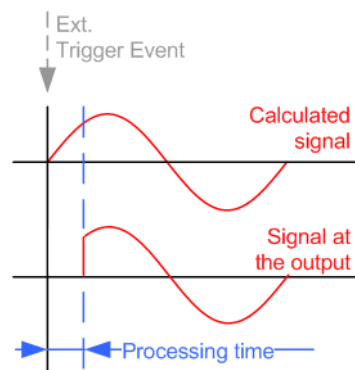
- "Off"
  The signal output begins after elapsing of the processing time. Signal output starts with sample 0. The complete signal is output.
  This mode is recommended for triggering of short signal sequences. Short sequences are sequences with signal duration comparable with the processing time of the instrument.
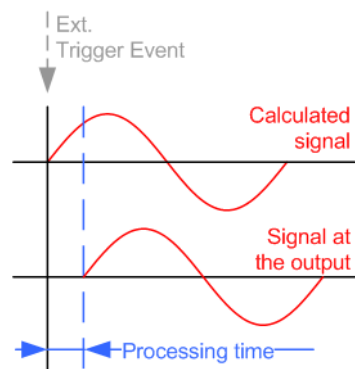
In primary-secondary instrument mode, this setting ensures that once achieved, synchronization is not lost if the baseband signal sampling rate changes.

Remote command:

[:SOURce<hw>][:BB]:ILS:TRIGger:EXTernal:SYNChronize:OUTPut
on page 160

[:SOURce<hw>]:BB:VOR:TRIGger:EXTernal:SYNChronize:OUTPut
on page 160

[:SOURce<hw>]:BB:DME:TRIGger:EXTernal:SYNChronize:OUTPut
on page 160

External / Trigger Inhibit

Applies for external trigger signal.

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

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

Remote command:

[:SOURce<hw>]:BB:VOR:TRIGger[:EXTernal<ch>]:INHibit on page 161
[:SOURce<hw>][:BB]:ILS:TRIGger[:EXTernal<ch>]:INHibit on page 161
[:SOURce<hw>]:BB:DME:TRIGger[:EXTernal<ch>]:INHibit on page 161

External / Trigger Delay

Delays the trigger event of the signal from:

*   The external trigger source

Use this setting to:

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

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

Remote command:

[:SOURce<hw>]:BB:VOR:TRIGger[:EXTernal<ch>]:DELay on page 161
[:SOURce<hw>][:BB]:ILS:TRIGger[:EXTernal<ch>]:DELay on page 161
[:SOURce<hw>]:BB:DME:TRIGger[:EXTernal<ch>]:DELay on page 161

6.2 DME marker settings

Option: R&S SMBVB-K153

Access:

► Select "DME" > "Marker".
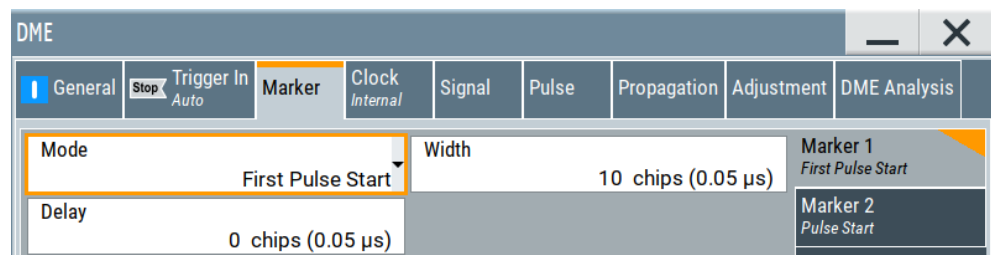
This tab provides settings to select and configure the marker output signal, like the marker mode or marker delay settings.

Routing and activating a marker signal

1. To define the signal shape of an individual marker signal "x", select "Marker" > "Marker x" > "Mode".

2. Optionally, define the connector for signal output. See Chapter 6.4, "Global connectors settings", on page 87.
    You can map marker signals to one or more User x connectors.

3. Activate baseband signal generation. In the block diagram, set "Baseband" > "On".

    The R&S SMBV100B adds the marker signal to the baseband signal. Also, R&S SMBV100B outputs this signal at the configured User x connector.

About marker output signals

This section focuses on the available settings.

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

Settings:

Mode

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

How to: "Routing and activating a marker signal" on page 83

"First Pulse Start"/"Pulse Start"
> Sets the marker at the beginning of the (first) pulse.
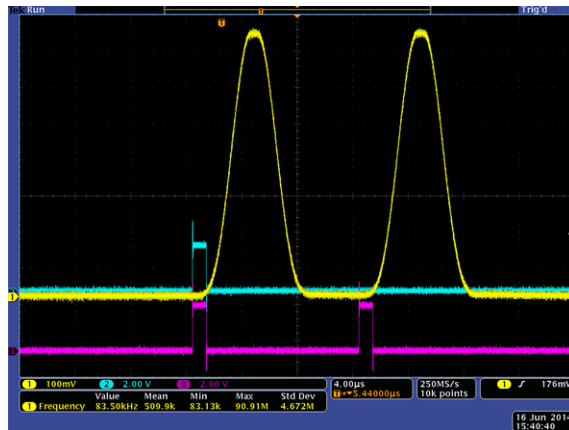
"First Pulse 50% Level"/"Pulse 50% Level"
> Sets the marker to 50 percent of the maximum pulse level of the (first) pulse.
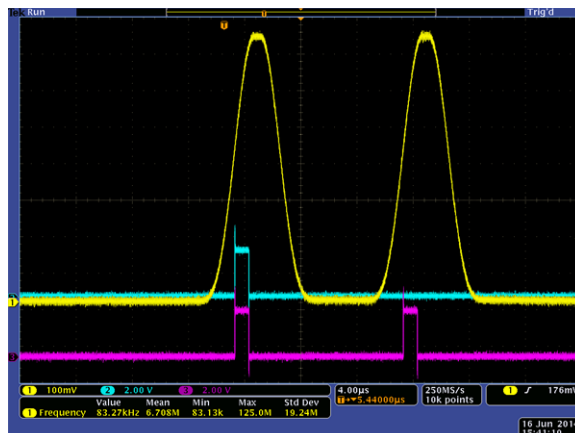
"Received Pulse"

Sets "Marker 2" on the received pulse.
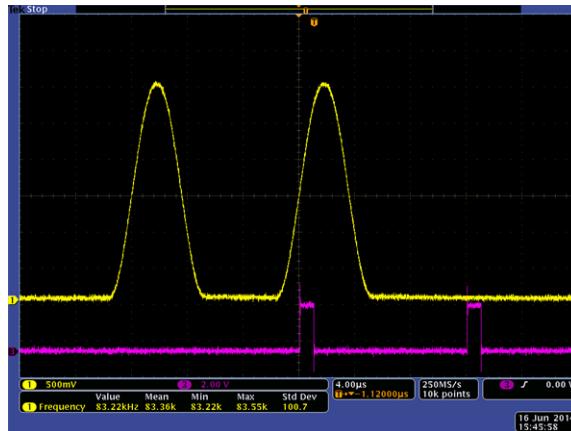
Remote command:

[:SOURce<hw>][:BB]:DME:MARKer<ch>:MODE on page 162

Width

Sets the width of the selected marker.

Remote command:

[:SOURce<hw>][:BB]:DME:MARKer<ch>:WIDTh on page 162

Delay

Delays the marker signal at the marker output relative to the signal generation start.

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

Remote command:

[:SOURce<hw>][:BB]:DME:MARKer<ch>:DELay on page 162

Processing Delay

Requires "Marker 2" > "Mode" > "Received Pulse".

Displays the processing delay. The delay equals the time difference between the position of the markers for the interrogation pulse and for the reply pulse.

Remote command:

[:SOURce<hw>][:BB]:DME:MARKer<ch>:PDELay? on page 162

6.3 Clock settings

Access:

► Select "ILS"/"VOR"/"DME" > "Clock".
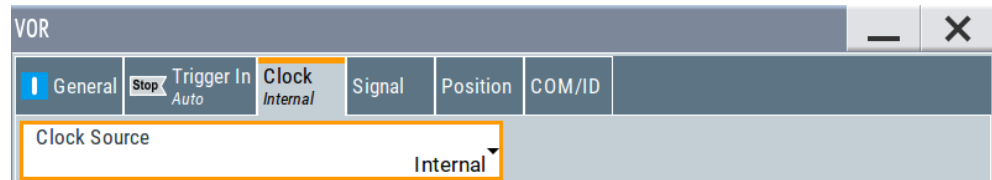
This tab provides settings to select and configure the clock signal, like the clock source and clock mode.

Defining the clock

1. Select "Clock" > "Source" to define the source of clock signal.

2. For external clock signals, define the connector for signal input. See Chapter 6.4, "Global connectors settings", on page 87.
   You can map clock signals to one or more User x connectors.

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

3. Activate baseband signal generation. In the block diagram, set "Baseband" > "On".

   The R&S SMBV100B starts baseband signal generation with a symbol rate that equals the clock rate.

About clock signals

This section focuses on the available settings.

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

Settings:

Clock Source...86

Clock Source
Selects the clock source.
● "Internal"
  The instrument uses its internal clock reference.
How to: "Defining the clock" on page 86

Remote command:
[:SOURce<hw>][:BB]:ILS:CLOCk:SOURce on page 163
[:SOURce<hw>]:BB:VOR:CLOCk:SOURce on page 163
[:SOURce<hw>]:BB:DME:CLOCk:SOURce on page 163

6.4 Global connectors settings

Accesses a dialog to configure global connectors.

The button is available in the following dialogs or tabs:

* "Trigger / Marker / Clock" dialog that is accessible via the "TMC" block in the block diagram.
* "Trigger In", "Marker" and "Clock" tabs that are accessible via the "Baseband" block in the block diagram.
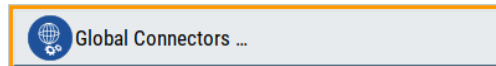
See also chapter "Global connectors settings" in the user manual.

7 Remote-control commands

The following commands are required to perform signal generation with the ILS/VOR/DME option in a remote environment. We assume that the R&S SMBV100B has already been set up for remote operation in a network as described in the R&S SMBV100B documentation. A knowledge about the remote control operation and the SCPI command syntax are assumed.

ⓘ **Conventions used in SCPI command descriptions**

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

Placeholder <Subsystem>

To simplify the description of the remote control commands, the placeholder `<Subsystem>` is introduced. Depending on the avionic standard used as an entry standard, replace this placeholder `<Subsystem>` with for example `SOURce:BB:ILS` for ILS.

ⓘ The replacement of the place holder `<Subsystem>` is mandatory, i.e. remote control commands containing this placeholder are not recognized and accepted by the instrument.

Example:

SCPI command `<subsystem>:STATe`:

- Entry Standard = DME
  `SOURce:BB:DME:STATe`

- Entry Standard = ILS
  `SOURce:BB:ILS:STATe`

- Entry Standard = VOR
  `SOURce:BB:VOR:STATe`

- Invalid command
  `<Subsystem>:STAT`

Common suffixes

The following common suffixes are used in remote commands:

Suffix	Value range	Description
`ENTity<ch>`	1	Optional keyword, provided for compatibility with R&S®SMW200A `ENTity1:SOURce1 = SOURce1`
`SOURce<hw>`	1	Available baseband signals
`OUTPut<ch>`	1 to 3	Available markers

The following commands specific to the ILS/VOR/DME options are described here:

7.1 Programming examples

The following sections provide simple programming examples for the R&S SMBV100B. The purpose of the examples is to present **all** commands for a given task. In real applications, one would rather reduce the examples to an appropriate subset of commands.

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

At the beginning of the most remote control program, an instrument reset or preset is recommended to set the R&S SMBV100B to a definite state. The commands `*RST` and `SYSTem:PRESet` are equivalent for this purpose. `*CLS` also resets the status registers and clears the output buffer.

Example: Saving and recalling a configuration

This example shows how to query and load settings files, saved with the save/recall function for the VOR standard.

For other avionic standards, replace `VOR` by `ILS` or `DME`.

```
SOURce1:BB:VOR:PRESet
// Go to the "settings" directory.
MMEM:CDIR "/var/user/settings"
// List all files in the directory with extension *.vor.
SOURce1:BB:VOR:SETTing:CATalog?
// vor_17x_Norm, vor_17x_Norm_ComID

// Save the VOR configuration in the file "vor_18x_Norm.vor".
SOURce1:BB:VOR:SETTing:STORe "/var/user/settings/vor_18x_Norm"
// Delete the file "vor_17x_Norm.vor".
SOURce1:BB:VOR:SETTing:DELete "/var/user/settings/vor_17x_Norm"
SOURce1:BB:VOR:SETTing:CATalog?
// vor_18x_Norm, vor_17x_Norm_ComID

// Load the file "vor_18x_Norm.vor".
SOURce1:BB:VOR:SETTing:LOAD "/var/user/settings/vor_18x_Norm"
```

```
// Activate VOR signal generation.
SOURce1:BB:VOR:STATe 1
```

Example: Configure and generate a VOR signal

```
SOURce1:BB:VOR:PRESet

// Configure VOR general settings.
SOURce1:BB:VOR:FREQuency:MODE USER
SOURce1:BB:VOR:FREQuency 108000000
SOURce1:BB:VOR:FREQuency:MODE ICAO
SOURce1:BB:VOR:ICAO:CHANnel?
// Response: CH17X

// Configure VOR signal settings.
SOURce1:BB:VOR:MODE NORM
SOURce1:BB:VOR:VAR:FREQuency 30
SOURce1:BB:VOR:VAR:DEPTh 30
SOURce1:BB:VOR:SUBCarrier:FREQuency 9960
SOURce1:BB:VOR:SUBCarrier:DEPTh 30
SOURce1:BB:VOR:REFerence:DEViation 480

// Configure VOR position settings.
SOURce1:BB:VOR:BANGle 1
SOURce1:BB:VOR:BANGle:DIRection FROM

// Configure VOR COM/ID settings.
SOURce1:BB:VOR:COMid:PERiod 9
SOURce1:BB:VOR:COMid:FREQuency 1020
SOURce1:BB:VOR:COMid:DEPTh 11
SOURce1:BB:VOR:COMid:TSCHema USER
SOURce1:BB:VOR:COMid:DOT 0.11
SOURce1:BB:VOR:COMid:DASH 0.29
SOURce1:BB:VOR:COMid:SYMBol 0.11
SOURce1:BB:VOR:COMid:LETTer 0.29
SOURce1:BB:VOR:COMid:STATe 1

// Activate VOR signal generation.
SOURce1:BB:VOR:STATe 1
```

Example: Configure and generate an ILS glide slope signal

```
SOURce1:BB:ILS:PRESet

// Configure ILS localizer general settings.
SOURce1:BB:ILS:TYPE GS
SOURce1:BB:ILS:GS:FREQuency:MODE USER
SOURce1:BB:ILS:GS:FREQuency 334700000
SOURce1:BB:ILS:GS:FREQuency:MODE ICAO
SOURce1:BB:ILS:GS:ICAO:CHANnel?
// Response: CH18X
SOURce1:BB:ILS:GS:FREQuency:SYNChronize 1
```

```
SOURce1:BB:ILS:LOCalizer:ICAO:CHANnel?
// Response: CH18X
SOURce1:BB:ILS:LOCalizer:FREQuency?
// Response: 108100000

// Configure ILS glide slope signal settings.
SOURce1:BB:ILS:GS:MODE NORM
SOURce1:BB:ILS:GS:DDM:POLarity P90_150
SOURce1:BB:ILS:GS:ULOBe:FREQuency 90
SOURce1:BB:ILS:GS:LLOBe:FREQuency 150
SOURce1:BB:ILS:GS:PHASe 0

// Configure ILS glide slope amplitude settings.
SOURce1:BB:ILS:GS:DDM:DIRection UP
SOURce1:BB:ILS:GS:SDM 80
SOURce1:BB:ILS:GS:DDM:COUPling FIX
SOURce1:BB:ILS:GS:DDM:STEP DEC
SOURce1:BB:ILS:GS:DDM:CURRent 0
SOURce1:BB:ILS:GS:DDM:DEPTh 0
SOURce1:BB:ILS:GS:DDM:LOGarithmic 0
SOURce1:BB:ILS:GS:DDM:PCT 0

// Activate ILS signal generation.
SOURce1:BB:ILS:STATe 1
```

Example: Configure and generate an ILS localizer signal

```
SOURce1:BB:ILS:PRESet

// Configure ILS localizer general settings.
SOURce1:BB:ILS:TYPE LOC
SOURce1:BB:ILS:LOCalizer:FREQuency:MODE USER
SOURce1:BB:ILS:LOCalizer:FREQuency 108100000
SOURce1:BB:ILS:LOCalizer:FREQuency:SYNChronize 1
SOURce1:BB:ILS:GS:FREQuency?
// Response: 108100000
SOURce1:BB:ILS:LOCalizer:FREQuency:MODE ICAO
SOURce1:BB:ILS:LOCalizer:ICAO:CHANnel CH26Y
SOURce1:BB:ILS:GS:ICAO:CHANnel?
// Response: CH26Y
SOURce1:BB:ILS:GS:FREQuency?
// Response: 1089500000

// Configure ILS localizer signal settings.
SOURce1:BB:ILS:LOCalizer:MODE NORM
SOURce1:BB:ILS:LOCalizer:DDM:POLarity P90_150
SOURce1:BB:ILS:LOCalizer:LLOBe:FREQuency 90
SOURce1:BB:ILS:LOCalizer:RLOBe:FREQuency 150
SOURce1:BB:ILS:LOCalizer:PHASe 0

// Configure ILS localizer amplitude settings.
SOURce1:BB:ILS:LOCalizer:DDM:DIRection LEFT
SOURce1:BB:ILS:LOCalizer:SDM 40
```

```
SOURce1:BB:ILS:LOCalizer:DDM:COUPling FIX
SOURce1:BB:ILS:LOCalizer:DDM:STEP DEC
SOURce1:BB:ILS:LOCalizer:DDM:CURRent 0
SOURce1:BB:ILS:LOCalizer:DDM:DEPTh 0
SOURce1:BB:ILS:LOCalizer:DDM:LOGarithmic 0
SOURce1:BB:ILS:LOCalizer:DDM:PCT 0

// Configure ILS localizer COM/ID settings.
SOURce1:BB:ILS:LOCalizer:COMid:CODE "MUC"
SOURce1:BB:ILS:LOCalizer:COMid:PERiod 9
SOURce1:BB:ILS:LOCalizer:COMid:FREQuency 1020
SOURce1:BB:ILS:LOCalizer:COMid:DEPTh 10
SOURce1:BB:ILS:LOCalizer:COMid:TSCHema USER
SOURce1:BB:ILS:LOCalizer:COMid:DOT 0.11
SOURce1:BB:ILS:LOCalizer:COMid:DASH 0.29
SOURce1:BB:ILS:LOCalizer:COMid:SYMBol 0.11
SOURce1:BB:ILS:LOCalizer:COMid:LETTer 0.29
SOURce1:BB:ILS:LOCalizer:COMid:STATe 1

// Activate ILS signal generation.
SOURce1:BB:ILS:STATe 1
```

Example: Configure and generate an ILS marker beacons signal

```
SOURce1:BB:ILS:PRESet

// Configure ILS marker beacons general settings.
SOURce1:BB:ILS:TYPE MBE
SOURce1:BB:ILS:MBEacon:FREQuency:MODE USER
SOURce1:BB:ILS:MBEacon:FREQuency 75000000
SOURce1:BB:ILS:MBEacon:MARKer:FREQuency 400
SOURce1:BB:ILS:MBEacon:MARKer:DEPTh 95
SOURce1:BB:ILS:MBEacon:MARKer:PULSed?
// Response: "0"

// Configure ILS marker beacons COM/ID settings.
SOURce1:BB:ILS:MBEacon:COMid:CODE "MUC"
SOURce1:BB:ILS:MBEacon:COMid:PERiod 9
SOURce1:BB:ILS:MBEacon:COMid:FREQuency 1020
SOURce1:BB:ILS:MBEacon:COMid:DEPTh 5
SOURce1:BB:ILS:MBEacon:COMid:TSCHema USER
SOURce1:BB:ILS:MBEacon:COMid:DOT 0.11
SOURce1:BB:ILS:MBEacon:COMid:DASH 0.29
SOURce1:BB:ILS:MBEacon:COMid:SYMBol 0.11
SOURce1:BB:ILS:MBEacon:COMid:LETTer 0.29
SOURce1:BB:ILS:MBEacon:COMid:STATe 1

// Activate ILS signal generation.
SOURce1:BB:ILS:STATe 1
```

Example: Configuring and generating a DME interrogation mode signal

```
SOURce1:BB:DME:PRESet

// Configure DME general settings.
SOURce1:BB:DME:MODE INT
SOURce1:BB:DME:CSUFfix X
SOURce1:BB:DME:FREQuency 1025000000

// Configure DME signal settings.
SOURce1:BB:DME:SQUitter?
// Response: 0
SOURce1:BB:DME:RATE 48
SOURce1:BB:DME:PINPut:SOURce EXT

// Configure DME pulse settings.
SOURce1:BB:DME:SHAPe COS2
SOURce1:BB:DME:RISE 0.000002
SOURce1:BB:DME:WIDTh 0.0000035
SOURce1:BB:DME:FALL 0.000002
SOURce1:BB:DME:PPS 0.000012
SOURce1:BB:DME:SINGle 1
SOURce1:BB:DME:SINGle 0
SOURce1:BB:DME:PPST:ENABled 1
SOURce1:BB:DME:PPST 0.000005

// Configure DME propagation settings.
SOURce1:BB:DME:ECHO:DELay 0.00002
SOURce1:BB:DME:ECHO:ATTenuation 10
SOURce1:BB:DME:VELocity 10
SOURce1:BB:DME:ECHO ON

// Activate DME signal generation.
SOURce1:BB:DME:STATe 1
```

Example: Configuring and querying DME analysis settings and results

```
SOURce1:BB:DME:STATe 1

// Configure DME analysis settings.
SOURce1:BB:DME:ANALysis:GATE:EDELay 0.00005
SOURce1:BB:DME:ANALysis:GATE:LENGth 0.00001
SOURce1:BB:DME:ANALysis:GATE:TIME 1
SOURce1:BB:DME:ANALysis:STATe 1

// Query DME results.
// Query, if measurement results are available.
SOURce1:BB:DME:ANALysis:OK?
// Response: 1
// Query, if power measurement results are available.
SOURce1:BB:DME:ANALysis:POWer:OK?
// Response: 1
SOURce1:BB:DME:ANALysis:POWer?
```

```
// Response in dBm: -43.21
// Query reply delay.
SOURce1:BB:DME:ANALysis:TIME?
// Response in us: 0.02
// Query range distance.
SOURce1:BB:DME:ANALysis:RDIStance?
// Response in NM: -4.05
// Query reply efficiency.
SOURce1:BB:DME:ANALysis:EFFiciency?
// Responce in percent: 100
// Query pulse repetition rate.
SOURce1:BB:DME:ANALysis:PRRate?
// Responce in Hz: 47
```

Example: Configuring and generating a DME reply mode signal

```
SOURce1:BB:DME:PRESet

// Configure DME general settings.
SOURce1:BB:DME:MODE REPL
SOURce1:BB:DME:CSUFfix X
SOURce1:BB:DME:FREQuency 1025000000

// Configure DME signal settings.
SOURce1:BB:DME:RDIStance 10
// Set for 10 reply pulses.
SOURce1:BB:DME:EFFiciency:REPLies 10
// Set 70 percent reply efficiency: 7 correct and 3 false reply pulses.
SOURce1:BB:DME:EFFiciency 70
SOURce1:BB:DME:SQUitter 1
SOURce1:BB:DME:RATE 2700
SOURce1:BB:DME:PINPut:SOURce EXT
// The input source is externally triggered.
SOURce1:BB:DME:PINPut:DELay?
// Reply for 10 NM range distance in seconds: "0.00017359"
// The delay is about 173.6 microseconds.

// Search DME trigger levels determined via a power sensor.
SOURce1:BB:DME:PINPut:SOURce PSEN
SOURce1:BB:DME:PINPut:TRIGger:SEARch
// Executes the search trigger level procedure.
// Query, if the search procedure finds a valid trigger level.
SOURce1:BB:DME:PINPut:TRIGger:SEARch?
// Response: "0"
// The trigger level value is valid.
SOURce1:BB:DME:PINPut:TRIGger:LEVel?
// Response in dBm: "-3.45"
SOURce1:BB:DME:PINPut:TRIGger:LEVel:OK?
// Response: "1"
// The trigger level value is valid.
```

```
// Configure DME pulse settings.
SOURce1:BB:DME:SHAPe COS2
SOURce1:BB:DME:RISE 0.000002
SOURce1:BB:DME:WIDTh 0.0000035
SOURce1:BB:DME:FALL 0.000002
SOURce1:BB:DME:PPS 0.000012
SOURce1:BB:DME:SINGle 1
SOURce1:BB:DME:SINGle 0
SOURce1:BB:DME:PPST:ENABled? 0
SOURce1:BB:DME:PPST:ENABled 1
SOURce1:BB:DME:PPST 0.000002

// Configure DME COM/ID settings.
SOURce1:BB:DME:ID:CODE "MUC"
SOURce1:BB:DME:ID:PERiod 40
SOURce1:BB:DME:ID:RATE 1350
SOURce1:BB:DME:ID:TSCHema USER
SOURce1:BB:DME:ID:DOT 0.11
SOURce1:BB:DME:ID:DASH 0.29
SOURce1:BB:DME:ID:SYMBol 0.11
SOURce1:BB:DME:ID:LETTer 0.29
SOURce1:BB:DME:ID:STATe 1


// Activate DME signal generation.
SOURce1:BB:DME:STATe 1
```

Example: Determining the DME echo rejection

```
SOURce1:BB:DME:PRESet

// Configure e.g. ICAO channel 1X DME reply signal.
SOURce1:BB:DME:MODE REPL
SOURce1:BB:DME:CSUFfix ICAO
SOURce1:BB:DME:ICAO:CHANnel CH1X
SOURce1:BB:DME:CSUFfix X
SOURce1:BB:DME:FREQuency? 962000000
// Specify the DME reply signal.
SOURce1:BB:DME:RDIStance 30
SOURce1:BB:DME:PINPut:DELay? 0.00042077
SOURce1:BB:DME:EFFiciency 100
// Specify the DME echo pulse signal.
SOURce1:BB:DME:ECHO:DELay? 0.0000335
SOURce1:BB:DME:ECHO:ATTenuation 10
SOURce1:BB:DME:ECHO 1
// Output DME reply and echo signal at the RF connector.
SOURce1:BB:DME:STATe ON
SOURce1:POWer:POWer -50
OUTPut1:STATe 1

// Increase the echo signal level.
SOURce1:BB:DME:ECHO:ATTenuation 10
SOURce1:BB:DME:ECHO:ATTenuation 9
```

```
SOURce1:BB:DME:ECHO:ATTenuation 8
SOURce1:BB:DME:ECHO:ATTenuation 7
SOURce1:BB:DME:ECHO:ATTenuation 6
SOURce1:BB:DME:ECHO:ATTenuation 5
SOURce1:BB:DME:ECHO:ATTenuation 4
SOURce1:BB:DME:ECHO:ATTenuation 3
// Result: DUT locks on to the echo signal at -53 dBm.
```

Example: Simulating DME signals for velocity tracking

```
SOURce1:BB:DME:PRESet

// Velocity tracking test:
// Simulate DME ground station, e.g. ICAO channel 1X DME interrogation signal.
SOURce1:BB:DME:MODE INT
SOURce1:BB:DME:CSUFfix ICAO
SOURce1:BB:DME:ICAO:CHANnel CH1X
SOURce1:BB:DME:CSUFfix X
SOURce1:BB:DME:FREQuency? 962000000
// Specify the DME interrogation signal: e.g. 15 NM range distance, 1000 kn velocity
SOURce1:BB:DME:RDIStance 15
SOURce1:BB:DME:ECHO 0
SOURce1:BB:DME:VELocity 1000
// Output DME interrogation signal at the RF connector.
SOURce1:BB:DME:STATe 1
SOURce1:POWer:POWer -50
OUTPut1:STATe 1
// Verify that the DUT locks on the signal and maintains track.

// Outbound to inbound test:
// Simulate DME ground station, e.g. ICAO channel 1X DME interrogation signal.
SOURce1:BB:DME:MODE INT
SOURce1:BB:DME:CSUFfix ICAO
SOURce1:BB:DME:ICAO:CHANnel CH1X
SOURce1:BB:DME:CSUFfix X
SOURce1:BB:DME:FREQuency? 962000000
// Specify the DME interrogation signal: e.g. 200 kn velocity
SOURce1:BB:DME:VELocity 200
// Output DME interrogation signal at the RF connector.
SOURce1:BB:DME:STATe 1
SOURce1:POWer:POWer -50
OUTPut1:STATe 1
// Switch to DME reply signal mode.
SOURce1:BB:DME:MODE REPL

// Inbound to outbound test:
// Simulate DME ground station, e.g. ICAO channel 1X DME reply signal.
SOURce1:BB:DME:MODE REPL
SOURce1:BB:DME:CSUFfix ICAO
SOURce1:BB:DME:ICAO:CHANnel CH1X
SOURce1:BB:DME:CSUFfix X
SOURce1:BB:DME:FREQuency? 962000000
```

```
// Specify the DME reply signal: e.g. 200 kn velocity
SOURce1:BB:DME:VELocity 200
// Output DME reply signal at the RF connector.
SOURce1:BB:DME:STATe 1
SOURce1:POWer:POWer -50
OUTPut1:STATe 1
// Switch to DME interrogation signal mode.
SOURce1:BB:DME:MODE INT
```

Example: Simulating a DME flight scenario

```
SOURce1:BB:DME:PRESet

SOURce1:BB:DME:FLIGHt:DISTance:STARt 0
// Start distance is 0 nautical miles (NM)
SOURce1:BB:DME:FLIGHt:DISTance:STOP 1
// Stop distance is 1 NM.
// Set the velocity.
SOURce1:BB:DME:VELocity 100
SOURce1:BB:DME:FLIGHt:STATe 1
SOURce1:BB:DME:FLIGHt:STARt
// Query the current distance (NM).
SOURce1:BB:DME:FLIGHt:DISTance:CURRent?
// Response: 0.002
// Optionally, pause and resume or restart the flight simulation.
SOURce1:BB:DME:FLIGHt:PAUSe
SOURce1:BB:DME:FLIGHt:RESume
SOURce1:BB:DME:FLIGHt:RESTart
// Check running status to determine if current distance equals stop distance.
SOURce1:BB:DME:FLIGHt:RSTatus?
// Response: "IDLE"
// The simulation is in idle state. The flight simulation stops automatically.
SOURce1:BB:DME:FLIGHt:DISTance:CURRent?
// Response: 1.000
// Optionally, stop the flight simulation during simulation run.
SOURce1:BB:DME:FLIGHt:STOP
```

Example: Configuring trigger settings

```
SOURce1:BB:VOR:TRIGger:SEQuence AAUT
SOURce1:BB:VOR:TRIGger:SOURce EGT1
SOURce1:BB:VOR:TRIGger:EXTernal:SYNChronize:OUTPut 1
SOURce1:BB:VOR:TRIGger:EXTernal:INHibit 100
SOURce1:BB:VOR:TRIGger:DELay:UNIT SAMP
SOURce1:BB:VOR:TRIGger:EXTernal:DELay 10
SOURce1:BB:VOR:TRIGger:EXTernal:RDELay?
// Response in seconds: 0.00000065
SOURce1:BB:VOR:TRIGger:DELay:UNIT TIME
SOURce1:BB:VOR:TRIGger:EXTernal:TDELay 0.00001
SOURce1:BB:VOR:TRIGger:EXTernal:RDELay?
// Response in seconds: 0.00001
```

Example: Configuring DME marker settings

```
SOURce1:BB:DME:MARKer1:MODE PRECeived
SOURce1:BB:DME:MARKer1:WIDTh 10
SOURce1:BB:DME:MARKer1:DELay 1
SOURce1:BB:DME:MARKer1:PDELay?
// Response in seconds: 0.00000123
```

Example: Querying clock settings

```
SOURce1:BB:VOR:CLOCk:SOURce?
// Response: "INT"
```

7.2 General commands

<subsystem>:PRESet
[:SOURce<hw>]:BB:DME:PRESet
[:SOURce<hw>][:BB]:ILS:PRESet
[:SOURce<hw>]:BB:VOR:PRESet

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

Not affected is the state set with the command
`SOURce<hw>:BB:VOR|ILS|DME:STATe`.

Example: See Example"Saving and recalling a configuration" on page 89.

<subsystem>:SETTing:CATalog
[:SOURce<hw>][:BB]:DME:SETTing:CATalog?
[:SOURce<hw>][:BB]:ILS:SETTing:CATalog?
[:SOURce<hw>]:BB:VOR:SETTing:CATalog?

Queries the files with settings in the default directory. Listed are files with the file extension `*.ils/*.vor/*.dme`.

Example: SeeExample"Saving and recalling a configuration" on page 89 .

Usage: Query only

<subsystem>:SETTing:DELete
[:SOURce<hw>]:BB:DME:SETTing:DELete <Filename>
[:SOURce<hw>][:BB]:ILS:SETTing:DELete <Filename>
[:SOURce<hw>]:BB:VOR:SETTing:DELete <Filename>

Deletes the selected file from the default or the specified directory. Deleted are files with extension `*.ils/*.vor/*.dme`.

Setting parameters:
<Filename>   string

Example: SeeExample"Saving and recalling a configuration" on page 89 .

Usage: Setting only

<subsystem>:SETTing:LOAD
[:SOURce<hw>]:BB:DME:SETTing:LOAD <Filename>
[:SOURce<hw>][:BB]:ILS:SETTing:LOAD <Filename>
[:SOURce<hw>]:BB:VOR:SETTing:LOAD <Filename>

Loads the selected file from the default or the specified directory. Loaded are files with extension `*.ils/*.vor/*.dme`.

Setting parameters:
<Filename>   string

Example: See Example"Saving and recalling a configuration" on page 89.

Usage: Setting only

<subsystem>:SETTing:STORe
[:SOURce<hw>]:BB:DME:SETTing:STORe <Filename>
[:SOURce<hw>][:BB]:ILS:SETTing:STORe <Filename>
[:SOURce<hw>]:BB:VOR:SETTing:STORe <Filename>

Saves the current settings into the selected file; the file extension
(`*.ils/*.vor/*.dme`) is assigned automatically.

Setting parameters:

<Filename>   string

Example: See Example"Saving and recalling a configuration" on page 89.

Usage: Setting only

<subsystem>:STATe
[:SOURce<hw>]:BB:DME:STATe <State>
[:SOURce<hw>][:BB]:ILS:STATe <State>
[:SOURce<hw>]:BB:VOR:STATe <State>

Activates/deactivates the avionic standard.

Parameters:

<State>   1 | ON | 0 | OFF

                         *RST: 0

Example: See Example"Configure and generate a VOR signal"
                         on page 90.

7.3 ILS commands

The SOURce:BB:ILS subsystem contains all commands for configuring an ILS signal.

For a description of the trigger and clock commands, see the following sections:

- Chapter 7.6, "Trigger commands", on page 156
- Chapter 7.8, "Clock commands", on page 163

The following commands specific to the R&S SMBVB-K151 option are described here:

7.3.1 General settings

[:SOURce<hw>][:BB]:ILS:TYPE <Type>

Selects the ILS modulation type.

Parameters:

<Type>   GS | LOCalize | GSLope | MBEacon

                         *RST: GS

Example: See Example"Configure and generate an ILS glide slope signal"
                         on page 90.

Manual operation: See "ILS Component" on page 19

7.3.2 ILS glide slope commands

[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:DDM:COUPling <Coupling>

Selects if the DDM value is fixed or is changed with a change of sum of modulation depths (SDM, see `[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:SDM` on page 106).

Parameters:

<Coupling>   FIXed | SDM

                       *RST: FIXed

Example: See Example"Configure and generate an ILS glide slope signal" on page 90.

Manual operation: See "DDM - SDM Coupling" on page 25

[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:DDM:CURRent <Current>

Sets the DDM value alternatively as a current by means of the ILS indicating instrument. The instrument current is calculated according to:

DDM Current µA = DDM Depth [%] × 857,125 µA

A variation of the instrument current automatically leads to a variation of the DDM value and the DDM value in dB.

Parameters:

<Current>   float

                       Range: -8.57125E-4 to 8.57125E-4
                       Increment: 1E-7
                       *RST: 0

Example:	See Example"Configure and generate an ILS glide slope signal" on page 90.
Manual operation:	See "DDM Current" on page 24

[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:DDM:DIRection <Direction>

Sets the simulation mode for the ILS glide slope modulation signal. A change of the setting automatically changes the sign of the DDM value.

Parameters:

<Direction>	UP	DOWN
	UP
	The 150 Hz modulation signal is predominant, the DDM value is negative (the airplane is too low, it must climb).
	DOWN
	The 90 Hz modulation signal is predominant, the DDM value is positive (the airplane is too high, it must descend).
	*RST: UP

Example:	See Example"Configure and generate an ILS glide slope signal" on page 90.
Manual operation:	See "Fly Mode" on page 24

[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:DDM:LOGarithmic <Logarithmic>

Sets the depth of modulation value for ILS glide slope modulation in dB.

See also `[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:DDM[:DEPTh]` on page 103.

Parameters:

<Logarithmic>	float
	Range: -999.9 to 999.9
	Increment: 1E-4
	*RST: 0

Example:	See Example"Configure and generate an ILS glide slope signal" on page 90.
Manual operation:	See "DDM Logarithmic" on page 25

[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:DDM:PCT <Pct>

Sets the difference in depth of modulation between the signal of the upper lobe (90 Hz) and the lower lobe (150 Hz). The maximum value equals the sum of the modulation depths of the 90 Hz and the 150 Hz tone.

See also `[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:DDM[:DEPTh]` on page 103.

Parameters:

<Pct>   float

                            Range: -80.0 to 80.0
                            Increment: 0.01
                            *RST: 0

Example: See Example"Configure and generate an ILS glide slope signal"
                            on page 90.

Manual operation: See "DDM Percent" on page 25

[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:DDM:POLarity <Polarity>

Sets the polarity for DDM calculation (see `[:SOURce<hw>][:BB]:ILS[:
GS|GSLope]:DDM[:DEPTh]` on page 103).

The DDM depth calculation depends on the selected polarity:

- Polarity 90 Hz - 150 Hz (default setting):
  DDM = [AM (90 Hz) - AM (150 Hz)] / 100%

- Polarity 150 Hz - 90 Hz:
  DDM = [AM (150 Hz) - AM (90 Hz)] / 100%

Parameters:

<Polarity>   P90_150 | P150_90

                            *RST: P90_150

Example: See Example"Configure and generate an ILS glide slope signal"
                            on page 90.

Manual operation: See "DDM Polarity" on page 22

[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:DDM:STEP <DdmStep>

Sets the variation of the difference in depth of modulation via the rotary knob.

Parameters:

<DdmStep>   DECimal | PREDefined

                            *RST: DECimal

Example: See Example"Configure and generate an ILS glide slope signal"
                            on page 90.

Manual operation: See "DDM Step" on page 24

[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:DDM[:DEPTh] <Depth>

Sets the difference in depth of modulation between the signal of the upper/left lobe (90 Hz) and the lower/right lobe (150 Hz). The maximum value equals the sum of the modulation depths of the 90 Hz and the 150 Hz tone. The following is true:

```
ILS:GS|GSL:DDM:DEPTh = (AM(90Hz) - AM(150Hz))/100%
```

A variation of the DDM value automatically leads to a variation of the DDM value in dB and the value of the instrument current.

Parameters:

<Depth>   float

Range: -0.8 to 0.8
Increment: 1E-4
*RST: 0

Example: See Example"Configure and generate an ILS glide slope signal" on page 90.

Manual operation: See "DDM Depth" on page 25

[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:FREQuency <CarrierFreq>

Sets the carrier frequency of the signal.

Parameters:

<CarrierFreq>   float

Range: 100E3 to 6E9
Increment: 0.01
*RST: 334.7E6

Example: See Example"Configure and generate an ILS glide slope signal" on page 90.

Manual operation: See "Carrier Frequency" on page 21

[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:FREQuency:MODE <Mode>

Sets the mode for the carrier frequency of the signal.

Parameters:

<Mode>   DECimal | USER | ICAO

DECimal|USER
Activates user-defined variation of the carrier frequency.

ICAO
Activates variation in predefined steps according to standard ILS transmitting frequencies (see Table 3-1).

*RST: USER

Example: See Example"Configure and generate an ILS glide slope signal" on page 90.

Manual operation: See "Carrier Frequency Mode" on page 20

[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:FREQuency:SYNChronize[:STATe] <Mode>

Activates synchronization of the ILS glide slope ICAO channel with the ILS localizer ICAO channel.

The ILS glide slope/localizer frequency of the ICAO channel (Table 3-1) is set automatically.

Parameters:

<Mode>   0 | 1 | OFF | ON

              *RST: 0

Example: See Example"Configure and generate an ILS glide slope signal" on page 90.

Manual operation: See "Sync with Glide Slope/ Sync with Localizer" on page 21

[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:ICAO:CHANnel <Channel>

Sets the ICAO channel and the corresponding transmitting frequency.

If avionic standard modulation is activated and you change the "RF Frequency", the frequency value of the closest ICAO channel is applied automatically. The "ICAO Channel" is also updated.

The ICAO channel settings for ILS glide slope/localizer components are coupled. For an overview of the ILS ICAO channel frequencies, see Table 3-1.

Parameters:

<Channel>   CH18X | CH18Y | CH20X | CH20Y | CH22X | CH22Y | CH24X |
                CH24Y | CH26X | CH26Y | CH28X | CH28Y | CH30X | CH30Y |
                CH32X | CH32Y | CH34X | CH34Y | CH36X | CH36Y | CH38X |
                CH38Y | CH40X | CH40Y | CH42X | CH42Y | CH44X | CH44Y |
                CH46X | CH46Y | CH48X | CH48Y | CH50X | CH50Y | CH52X |
                CH52Y | CH54X | CH54Y | CH56X | CH56Y

                *RST: CH18X

Example: See Example"Configure and generate an ILS glide slope signal" on page 90.

Manual operation: See "ICAO Channel" on page 21

[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:LLOBe[:FREQuency] <Frequency>

Sets the modulation frequency of the antenna lobe arranged at the bottom viewed from the air plane for the ILS glide slope modulation signal.

Parameters:

<Frequency>   float

                Range: 100 to 200
                Increment: 0.05
                *RST: 150

Example: See Example"Configure and generate an ILS glide slope signal" on page 90.

Manual operation: See "Down Frequency" on page 23

[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:MODE <Mode>

Sets the operating mode for the ILS glide slope modulation signal.

Parameters:

<Mode>   NORM | ULOBe | LLOBe

NORM
ILS glide slope modulation is active.

ULOBe
Amplitude modulation of the output signal with the upper lobe (90Hz) signal component of the ILS glide slope signal is active.

LLOBe
Amplitude modulation of the output signal with the lower lobe (150Hz) signal component of the ILS glide slope signal is active.

*RST: NORM

Example: See Example"Configure and generate an ILS glide slope signal" on page 90.

Manual operation: See "Operating Mode" on page 22

[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:PHASe <Phase>

Sets the phase between the modulation signals of the upper and lower antenna lobe of the ILS glide slope signal.

Zero crossing of the lower lobe (150 Hz) signal serves as a reference. The angle refers to the period of the signal of the right antenna lobe.

Parameters:

<Phase>   float

Range: -60 to 120
Increment: 0.01
*RST: 0.0

Example: See Example"Configure and generate an ILS glide slope signal" on page 90.

Manual operation: See "Up/Down Phase" on page 23

[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:SDM <Sdm>

Sets the arithmetic sum of the modulation depths of the upper lobe (90 Hz) and lower lobe (150 Hz) for the ILS glide slope signal contents.

The RMS modulation depth of the sum signal depends on the phase setting of both modulation tones.

Parameters:

<Sdm>   float

                         Range: 0 to 100
                         Increment: 0.1
                         *RST: 80

Example: See Example"Configure and generate an ILS glide slope signal"
                         on page 90.

Manual operation: See "Sum of Depth" on page 24

[:SOURce<hw>][:BB]:ILS[:GS|GSLope]:ULOBe[:FREQuency] <Frequency>

Sets the modulation frequency of the antenna lobe arranged at the top viewed from the
air plane for the ILS glide slope modulation signal.

Parameters:

<Frequency>   float

                         Range: 60 to 120
                         Increment: 0.03
                         *RST: 90

Example: See Example"Configure and generate an ILS glide slope signal"
                         on page 90.

Manual operation: See "Up Frequency" on page 23

7.3.3 ILS localizer commands

[:SOURce<hw>][:BB:ILS]:LOCalizer:COMid:CODE <Code>

Sets the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport).

The COM/ID tone is sent according to the selected code, see Chapter A, "Morse code settings", on page 164.

If no coding is set, the COM/ID tone is sent uncoded (key down).

Parameters:

<Code>	string

Example:	See Example"Configure and generate an ILS localizer signal" on page 91.
Manual operation:	See "Code" on page 32

[:SOURce<hw>][:BB]:ILS:LOCalizer:COMid:DASH <Dash>

Sets the length of a Morse code dash.

Parameters:

<Dash>	float	
	Range:	0.05 to 1
	Increment:	1E-4
	*RST:	0.3

Example:	See Example"Configure and generate an ILS localizer signal" on page 91.
Manual operation:	See "Dash Length" on page 33

[:SOURce<hw>][:BB]:ILS:LOCalizer:COMid:DEPTh <Depth>

Sets the AM modulation depth of the COM/ID signal.

Parameters:

<Depth>	float	
	Range:	0 to 100
	Increment:	0.1
	*RST:	10

Example:	See Example"Configure and generate an ILS localizer signal" on page 91.
Manual operation:	See "Depth" on page 33

[:SOURce<hw>][:BB]:ILS:LOCalizer:COMid:DOT <Dot>

Sets the length of a Morse code dot.

Parameters:

<Dot>   float

Range:	0.05 to 1
Increment:	1E-4
*RST:	0.1

Example: See Example"Configure and generate an ILS localizer signal" on page 91.

Manual operation: See "Dot Length" on page 33

[:SOURce<hw>][:BB]:ILS:LOCalizer:COMid:FREQuency <Frequency>

Sets the frequency of the COM/ID signal.

Parameters:

<Frequency>   float

Range:	0.1 to 20E3
Increment:	0.01
*RST:	1020

Example: See Example"Configure and generate an ILS localizer signal" on page 91.

Manual operation: See "Frequency" on page 33

[:SOURce<hw>][:BB]:ILS:LOCalizer:COMid:LETTer <Letter>

Sets the length of a Morse code letter space.

Parameters:

<Letter>   float

Range:	0.05 to 1
Increment:	1E-4
*RST:	0.3

Example: See Example"Configure and generate an ILS localizer signal" on page 91.

Manual operation: See "Letter Space" on page 34

[:SOURce<hw>][:BB]:ILS:LOCalizer:COMid:PERiod <Period>

Sets the period of the COM/ID signal.

Parameters:

<Period>   float

                          Range: 0 to 120
                          Increment: 1E-3
                          *RST: 9

Example: See Example"Configure and generate an ILS localizer signal"
                          on page 91.

Manual operation: See "Period" on page 33

[:SOURce<hw>][:BB]:ILS:LOCalizer:COMid:SYMBol <Symbol>

Sets the length of the Morse code symbol space.

Parameters:

<Symbol>   float

                          Range: 0.05 to 1
                          Increment: 1E-4
                          *RST: 0.1

Example: See Example"Configure and generate an ILS localizer signal"
                          on page 91.

Manual operation: See "Symbol Space" on page 33

[:SOURce<hw>][:BB]:ILS:LOCalizer:COMid:TSCHema <TSchema>

Sets the time schema of the Morse code for the COM/ID signal.

Parameters:

<TSchema>   STD | USER

                          STD
                          Activates the standard time schema of the Morse code.
                          The set `dot length` determines the `dash length`, which is 3
                          times the dot length.

                          USER
                          Activates the user-defined time schema of the Morse code.
                          Dot and dash length, as well as `symbol` and `letter space`
                          can be set separately.
                          *RST: STD

Example: See Example"Configure and generate an ILS localizer signal"
                          on page 91.

Manual operation: See "Time Schema" on page 33

[:SOURce<hw>][:BB]:ILS:LOCalizer:COMid[:STATe] <State>

Enables/disables the COM/ID signal.

Parameters:

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

Example:	See Example"Configure and generate an ILS localizer signal" on page 91.
Manual operation:	See "COM/ID State" on page 32

[:SOURce<hw>][:BB]:ILS:LOCalizer:DDM:COUPling <Coupling>

Selects if the DDM value is fixed or is changed with a change of sum of modulation depths (SDM, see `[:SOURce<hw>][:BB]:ILS:LOCalizer:SDM` on page 116).

Parameters:

<Coupling>	FIXed | SDM
	*RST: FIXed

Example:	See Example"Configure and generate an ILS localizer signal" on page 91.
Manual operation:	See "DDM - SDM Coupling" on page 30

[:SOURce<hw>][:BB]:ILS:LOCalizer:DDM:CURRent <Current>

Sets the DDM value alternatively as a current by means of the ILS indicating instrument. The instrument current is calculated according to:

DDM µA = DDM × 857,1 µA

A variation of the instrument current automatically leads to a variation of the DDM value and the DDM value in dB.

Parameters:

<Current>	float
	Range: -9.6775E-4 to 9.6775E-4 Increment: 1E-7 *RST: 0

Example:	See Example"Configure and generate an ILS localizer signal" on page 91.
Manual operation:	See "DDM Current" on page 31

[:SOURce<hw>][:BB]:ILS:LOCalizer:DDM:DIRection <Direction>

Sets the simulation mode for the ILS-LOC modulation signal. A change of the setting automatically changes the sign of the DDM value.

Parameters:

<Direction>	LEFT | RIGHt

LEFT

The 150 Hz modulation signal is predominant, the DDM value is negative (the airplane is too far to the right, it must turn to the left).

RIGHT

The 90 Hz modulation signal is predominant, the DDM value is positive (the airplane is too far to the left, it must turn to the right).

*RST: LEFT

Example:	See Example"Configure and generate an ILS localizer signal" on page 91.
Manual operation:	See "Fly Mode" on page 30

[:SOURce<hw>][:BB]:ILS:LOCalizer:DDM:LOGarithmic <Logarithmic>

Sets the modulation depth in dB for the ILS localizer modulation signal.

See also `[:SOURce<hw>][:BB]:ILS:LOCalizer:DDM[:DEPTh]` on page 113.

Parameters:

<Logarithmic>   float

           Range: -999.9 to 999.9
           Increment: 1E-4
           *RST: 0

Example:	See Example"Configure and generate an ILS localizer signal" on page 91.
Manual operation:	See "DDM Logarithmic" on page 31

[:SOURce<hw>][:BB]:ILS:LOCalizer:DDM:PCT <Pct>

Sets the difference in depth of modulation between the signal of the left lobe (90 Hz) and the right lobe (150 Hz). The maximum value equals the sum of the modulation depths of the 90 Hz and the 150 Hz tone.

See also `[:SOURce<hw>][:BB]:ILS:LOCalizer:DDM[:DEPTh]` on page 113.

Parameters:

<Pct>   float

           Range: -80.0 to 80.0
           Increment: 0.01
           *RST: 0

Example:	See Example"Configure and generate an ILS localizer signal" on page 91.
Manual operation:	See "DDM Percent" on page 31

[:SOURce<hw>][:BB]:ILS:LOCalizer:DDM:POLarity <Polarity>

Sets the polarity for DDM calculation (see `[:SOURce<hw>][:BB]:ILS:LOCalizer:DDM[:DEPTh]`).

The DDM depth calculation depends on the selected polarity:

- Polarity 90 Hz - 150 Hz (default setting):
  DDM = [AM (90 Hz) - AM (150 Hz)] / 100%
- Polarity 150 Hz - 90 Hz:
  DDM = [AM (150 Hz) - AM (90 Hz)] / 100%

Parameters:

<Polarity>	P90_150 | P150_90
	*RST: P90_150

Example:	See Example"Configure and generate an ILS localizer signal" on page 91.
Manual operation:	See "DDM polarity" on page 28

[:SOURce<hw>][:BB]:ILS:LOCalizer:DDM[:DEPTh] <Depth>

Sets the difference in depth of modulation between the signal of the upper/left lobe (90 Hz) and the lower/right lobe (150 Hz). The maximum value equals the sum of the modulation depths of the 90 Hz and the 150 Hz tone.The following is true:

```
ILS:LOC:DDM:DEPTh = (AM(90Hz) - AM(150Hz))/100%
```

A variation of the DDM value automatically leads to a variation of the DDM value in dB and the value of the instrument current.

Parameters:

<Depth>	float	
	Range:	-0.4 to 0.4
	Increment:	1E-4
	*RST:	0

Example:	See Example"Configure and generate an ILS localizer signal" on page 91.
Manual operation:	See "DDM Depth" on page 31

[:SOURce<hw>][:BB]:ILS:LOCalizer:DDM:STEP <DdmStep>

Sets the variation step of the DDM values.

Parameters:

<DdmStep>	DECimal | PREDefined
	*RST: DECimal

Example:	See Example"Configure and generate an ILS localizer signal" on page 91.

Manual operation: See "DDM Step" on page 30

[:SOURce<hw>][:BB]:ILS:LOCalizer:FREQuency <CarrierFreq>

Sets the carrier frequency of the signal.

Parameters:

<CarrierFreq>   float

                Range: 100E3 to 6E9
                Increment: 0.01
                *RST: 108.1E6

Example: See Example"Configure and generate an ILS localizer signal" on page 91.

Manual operation: See "Carrier Frequency" on page 27

[:SOURce<hw>][:BB]:ILS:LOCalizer:FREQuency:MODE <IlsLocFreqMode>

Sets the mode for the carrier frequency of the signal.

Parameters:

<Mode>   DECimal | ICAO

                DECimal
                Activates user-defined variation of the carrier frequency.

                ICAO
                Activates variation in predefined steps according to standard ILS transmitting frequencies (see Table 3-1).

                *RST: DECimal

Example: See Example"Configure and generate an ILS localizer signal" on page 91.

Manual operation: See "Carrier Frequency Mode" on page 26

[:SOURce<hw>][:BB]:ILS:LOCalizer:FREQuency:SYNChronize[:STATe] <Mode>

Activates synchronization of the ILS localizer ICAO channel with the ILS glide slope ICAO channel.

The ILS glide slope/localizer frequency of the ICAO channel (Table 3-1) is set automatically.

Parameters:

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

Example: See Example"Configure and generate an ILS localizer signal" on page 91.

Manual operation: See "Sync with Glide Slope/ Sync with Localizer" on page 21

[:SOURce<hw>][:BB]:ILS:LOCalizer:ICAO:CHANnel <SelIcaoChan>

Sets the ICAO channel and the corresponding transmitting frequency.

If avionic standard modulation is activated and you change the "RF Frequency", the frequency value of the closest ICAO channel is applied automatically. The "ICAO Channel" is also updated.

The ICAO channel settings for ILS glide slope/localizer components are coupled. For an overview of the ILS ICAO channel frequencies, see Table 3-1.

Parameters:

<Channel>   CH18X | CH18Y | CH20X | CH20Y | CH22X | CH22Y | CH24X |
CH24Y | CH26X | CH26Y | CH28X | CH28Y | CH30X | CH30Y |
CH32X | CH32Y | CH34X | CH34Y | CH36X | CH36Y | CH38X |
CH38Y | CH40X | CH40Y | CH42X | CH42Y | CH44X | CH44Y |
CH46X | CH46Y | CH48X | CH48Y | CH50X | CH50Y | CH52X |
CH52Y | CH54X | CH54Y | CH56X | CH56Y

             *RST: CH18X

Example: See Example"Configure and generate an ILS localizer signal" on page 91.

Manual operation: See "ICAO Channel" on page 27

[:SOURce<hw>][:BB]:ILS:LOCalizer:LLOBe[:FREQuency] <Frequency>

Sets the modulation frequency of the antenna lobe arranged at the left viewed from the air plane for the ILS localizer modulation signal.

Parameters:

<Frequency>   float

             Range: 60 to 120
             Increment: 0.03
             *RST: 90

Example: See Example"Configure and generate an ILS localizer signal" on page 91.

Manual operation: See "Left Frequency" on page 29

[:SOURce<hw>][:BB]:ILS:LOCalizer:MODE <Mode>

Sets the operating mode for the ILS localizer modulation signal.

Parameters:

<Mode>   NORM | LLOBe | RLOBe

             NORM
             ILS localizer modulation is active.

             LLOBe
             Amplitude modulation of the output signal with the left lobe (90Hz) signal component of the ILS localizer signal is active.

RLOBe

Amplitude modulation of the output signal with the right lobe (150Hz) signal component of the ILS localizer signal is active.

*RST: NORM

Example: See Example"Configure and generate an ILS localizer signal" on page 91.

Manual operation: See "Operating Mode" on page 28

[:SOURce<hw>][:BB]:ILS:LOCalizer:PHASe <Phase>

Sets the phase between the modulation signals of the left and right antenna lobe of the ILS localizer signal.

The zero crossing of the right lobe (150 Hz) signal serves as a reference. The angle refers to the period of the signal of the right antenna lobe.

Parameters:

<Phase>   float

Range: -60 to 120
Increment: 0.01
*RST: 0

Example: See Example"Configure and generate an ILS localizer signal" on page 91.

Manual operation: See "Left/Right Phase" on page 29

[:SOURce<hw>][:BB]:ILS:LOCalizer:RLOBe[:FREQuency] <Frequency>

Sets the modulation frequency of the antenna lobe arranged at the right viewed from the air plane for the ILS localizer modulation signal.

Parameters:

<Frequency>   float

Range: 100 to 200
Increment: 0.05
*RST: 150

Example: See Example"Configure and generate an ILS localizer signal" on page 91.

Manual operation: See "Right Frequency" on page 29

[:SOURce<hw>][:BB]:ILS:LOCalizer:SDM <Sdm>

Sets the arithmetic sum of the modulation depths of the left lobe (90 Hz) and right lobe (150 Hz) for the ILS localizer signal contents.

The RMS modulation depth of the sum signal depends on the phase setting of both modulation tones.

Parameters:

<Sdm>	float

Range: 0 to 100
Increment: 0.1
*RST: 40

Example: See Example"Configure and generate an ILS localizer signal"
on page 91.

Manual operation: See "Sum of Depth" on page 30

7.3.4 ILS marker beacons commands

[:SOURce<hw>][:BB:ILS]:MBEacon:COMid:CODE <Code>

Sets the coding of the COM/ID signal by the international short name of the airport
(e.g. MUC for the Munich airport).

The COM/ID tone is sent according to the selected code, see Chapter A, "Morse code
settings", on page 164.

If no coding is set, the COM/ID tone is sent uncoded (key down).

Parameters:

<Code>	string

Example: See Example"Configure and generate an ILS marker beacons
signal" on page 92.

Manual operation: See "Code" on page 37

[:SOURce<hw>][:BB:ILS]:MBEacon:COMid:DASH <Dash>

Sets the length of a Morse code dash.

Parameters:

<Dash>   float

                             Range: 0.05 to 1
                             Increment: 1E-4
                             *RST: 0.3

Example: See Example"Configure and generate an ILS marker beacons
                             signal" on page 92.

Manual operation: See "Dash Length" on page 38

[:SOURce<hw>][:BB:ILS]:MBEacon:COMid:DEPTh <Depth>

Sets the AM modulation depth of the COM/ID signal.

Parameters:

<Depth>   float

                             Range: 0 to 100
                             Increment: 0.1
                             *RST: 5

Example: See Example"Configure and generate an ILS marker beacons
                             signal" on page 92.

Manual operation: See "Depth" on page 37

[:SOURce<hw>][:BB:ILS]:MBEacon:COMid:DOT <Dot>

Sets the length of a Morse code dot.

Parameters:

<Dot>   float

                             Range: 0.05 to 1
                             Increment: 1E-4
                             *RST: 0.1

Example: See Example"Configure and generate an ILS marker beacons
                             signal" on page 92.

Manual operation: See "Dot Length" on page 38

[:SOURce<hw>][:BB:ILS]:MBEacon:COMid:FREQuency <Frequency>

Sets the frequency of the COM/ID signal.

Parameters:

<Frequency>   float

                             Range: 0.1 to 20E3
                             Increment: 0.01
                             *RST: 1020

Example:	See Example"Configure and generate an ILS marker beacons signal" on page 92.
Manual operation:	See "Frequency" on page 37

[:SOURce<hw>][:BB:ILS]:MBEacon:COMid:LETTer <Letter>

Sets the length of a Morse code letter space.

Parameters:

<Letter>	float	
	Range:	0.05 to 1
	Increment:	1E-4
	*RST:	0.3

Example:	See Example"Configure and generate an ILS marker beacons signal" on page 92.
Manual operation:	See "Letter Space" on page 38

[:SOURce<hw>][:BB:ILS]:MBEacon:COMid:PERiod <Period>

Sets the period of the COM/ID signal.

Parameters:

<Period>	float	
	Range:	0 to 120
	Increment:	1E-3
	*RST:	9

Example:	See Example"Configure and generate an ILS marker beacons signal" on page 92.
Manual operation:	See "Period" on page 37

[:SOURce<hw>][:BB:ILS]:MBEacon:COMid:SYMBol <Symbol>

Sets the length of the Morse code symbol space.

Parameters:

<Symbol>	float	
	Range:	0.05 to 1
	Increment:	1E-4
	*RST:	0.1

Example:	See Example"Configure and generate an ILS marker beacons signal" on page 92.
Manual operation:	See "Symbol Space" on page 38

[:SOURce<hw>][:BB:ILS]:MBEacon:COMid:TSCHema <Tschema>

Sets the time schema of the Morse code for the COM/ID signal.

Parameters:

<Tschema>   STD | USER

                  STD
Activates the standard time schema of the Morse code.
The set `dot length` determines the `dash length`, which is 3 times the dot length.

                  USER
Activates the user-defined time schema of the Morse code.
Dot and dash length, as well as `symbol` and `letter space` can be set separately.

                  *RST: STD

Example: See Example"Configure and generate an ILS marker beacons signal" on page 92.

Manual operation: See "Time Schema" on page 37

[:SOURce<hw>][:BB:ILS]:MBEacon:COMid[:STATe] <State>

Enables/disables the COM/ID signal.

Parameters:

<State>   1 | ON | 0 | OFF

                  *RST: 0

Example: See Example"Configure and generate an ILS marker beacons signal" on page 92.

Manual operation: See "COM/ID State" on page 37

[:SOURce<hw>][:BB:ILS]:MBEacon:FREQuency <CarrierFreq>

Sets the carrier frequency for the ILS marker beacon signal.

Parameters:

<CarrierFreq>   float

                  Range: 100E3 to 6E9
Increment: 0.01
*RST: 75E6

Example: See Example"Configure and generate an ILS marker beacons signal" on page 92.

Manual operation: See "Carrier Frequency" on page 35

[:SOURce<hw>][:BB:ILS]:MBEacon:FREQuency:MODE <Mode>

Sets the mode for the carrier frequency of the signal.

Parameters:

<Mode>   USER | PREDefined

                         *RST: USER

Example: See Example"Configure and generate an ILS marker beacons
                         signal" on page 92.

Manual operation: See "Carrier Frequency Mode" on page 35

[:SOURce<hw>][:BB:ILS]:MBEacon:MARKer:FREQuency <Frequency>

Sets the modulation frequency of the marker signal for the ILS marker beacon modulation signal.

Parameters:

<Frequency>   400 | 1300 | 3000

                         *RST: 400
                         Default unit: Hz

Example: See Example"Configure and generate an ILS marker beacons
                         signal" on page 92.

Manual operation: See "Marker Frequency" on page 35

[:SOURce<hw>][:BB:ILS]:MBEacon[:MARKer]:DEPTh <Depth>

Sets the modulation depth of the marker signal for the ILS marker beacon signal.

Parameters:

<Depth>   float

                         Range: 0 to 100
                         Increment: 0.1
                         *RST: 95

Example: See Example"Configure and generate an ILS marker beacons
                         signal" on page 92.

Manual operation: See "Marker Depth" on page 36

[:SOURce<hw>][:BB:ILS]:MBEacon[:MARKer]:PULSed <Pulsed>

Activates the modulation of a pulsed marker signal (morse coding).

Parameters:

<Pulsed>   1 | ON | 0 | OFF

                         *RST: 0

Example: See Example"Configure and generate an ILS marker beacons
                         signal" on page 92.

Manual operation: See "Pulsed Marker" on page 36

7.4 VOR commands

The `SOURce:BB:VOR` subsystem contains all commands for configuring a VOR signal.

For a description of the trigger and clock commands, see the following sections:

- Chapter 7.6, "Trigger commands", on page 156
- Chapter 7.8, "Clock commands", on page 163

The following commands specific to the R&S SMBVB-K152 option are described here:

7.4.1 VOR general commands

[:SOURce<hw>][:BB]:VOR:MODE <Mode>

Sets the operating mode for the VOR modulation signal.

Parameters:

<Mode>　　　　　　　NORM | VAR | SUBCarrier | FMSubcarrier

NORM
VOR modulation is active.

VAR
Amplitude modulation of the output signal with the variable signal component (30Hz signal content) of the VOR signal.
The modulation depth of the 30 Hz signal can be set with `[:SOURce<hw>][:BB]:VOR:VAR[:DEPTh]`.

SUBCarrier
Amplitude modulation of the output signal with the unmodulated FM carrier (9960Hz) of the VOR signal.
The modulation depth of the 30 Hz signal can be set with `[:SOURce<hw>][:BB]:VOR:SUBCarrier:DEPTh`.

FMSubcarrier
Amplitude modulation of the output signal with the frequency modulated FM carrier (9960Hz) of the VOR signal.
The modulation depth of the 30 Hz signal can be set with `[:SOURce<hw>][:BB]:VOR:SUBCarrier:DEPTh`.
The frequency deviation can be set with `[:SOURce<hw>][:BB]:VOR:REFerence[:DEViation]`.

*RST:　　　　NORM

Example:　　　　　　See Example"Configure and generate a VOR signal"
on page 90.

Manual operation: See "Mode" on page 44

7.4.2 VOR signal commands

[:SOURce<hw>]:BB:VOR:FREQuency <CarrierFreq>

Sets the carrier frequency of the signal.

Parameters:

<CarrierFreq>   float

                        Range: 100E3 to 6E9
                        Increment: 0.01
                        *RST: 108E6

Example: See Example"Configure and generate a VOR signal"
                        on page 90.

Manual operation: See "Carrier Frequency" on page 43

[:SOURce<hw>]:BB:VOR:FREQuency:MODE <Mode>

Sets the mode for the carrier frequency of the signal.

Parameters:

<Mode>   DECimal | ICAO

                        DECimal
                        Activates user-defined variation of the carrier frequency.

                        ICAO
                        Activates variation in predefined steps according to standard
                        VOR transmitting frequencies (see Table 4-1).

                        *RST: DECimal

Example: See Example"Configure and generate a VOR signal"
                        on page 90.

Manual operation: See "Carrier Frequency Mode" on page 43

[:SOURce<hw>][:BB]:VOR:ICAO:CHANnel <Channel>

Sets the ICAO channel and the corresponding transmitting frequency.

If avionic standard modulation is activated and you change the "RF Frequency", the frequency value of the closest ICAO channel is applied automatically. The "ICAO Channel" is also updated.

The carrier frequency is set automatically to the value of the ICAO channel. For an overview of the VOR ICAO channel frequencies, see Table 4-1.

Parameters:

<Channel>   CH17X | CH17Y | CH19X | CH19Y | CH21X | CH21Y | CH23X |
                 CH23Y | CH25X | CH25Y | CH27X | CH27Y | CH29X | CH29Y |
                 CH31X | CH31Y | CH33X | CH33Y | CH35X | CH35Y | CH37X |
                 CH37Y | CH39X | CH39Y | CH41X | CH41Y | CH43X | CH43Y |
                 CH45X | CH45Y | CH47X | CH47Y | CH49X | CH49Y | CH51X |
                 CH51Y | CH53X | CH53Y | CH55X | CH55Y | CH57X | CH57Y |
                 CH58X | CH58Y | CH59X | CH59Y | CH70X | CH70Y | CH71X |
                 CH71Y | CH72X | CH72Y | CH73X | CH73Y | CH74X | CH74Y |
                 CH75X | CH75Y | CH76X | CH76Y | CH77X | CH77Y | CH78X |
                 CH78Y | CH79X | CH79Y | CH80X | CH80Y | CH81X | CH81Y |
                 CH82X | CH82Y | CH83X | CH83Y | CH84X | CH84Y | CH85X |
                 CH85Y | CH86X | CH86Y | CH87X | CH87Y | CH88X | CH88Y |
                 CH89X | CH89Y | CH90X | CH90Y | CH91X | CH91Y | CH92X |
                 CH92Y | CH93X | CH93Y | CH94X | CH94Y | CH95X | CH95Y |
                 CH96X | CH96Y | CH97X | CH97Y | CH98X | CH98Y | CH99X |
                 CH99Y | CH100X | CH100Y | CH101X | CH101Y | CH102X |
                 CH102Y | CH103X | CH103Y | CH104X | CH104Y | CH105X |
                 CH105Y | CH106X | CH106Y | CH107X | CH107Y | CH108X |
                 CH108Y | CH109X | CH109Y | CH110X | CH110Y | CH111X |
                 CH111Y | CH112X | CH112Y | CH113X | CH113Y | CH114X |
                 CH114Y | CH115X | CH115Y | CH116X | CH116Y | CH117X |
                 CH117Y | CH118X | CH118Y | CH119X | CH119Y | CH120X |
                 CH120Y | CH121X | CH121Y | CH122X | CH122Y | CH123X |
                 CH123Y | CH124X | CH124Y | CH125X | CH125Y | CH126X |
                 CH126Y

                 *RST: CH17X

Example: See Example"Configure and generate a VOR signal"
                 on page 90.

Manual operation: See "ICAO Channel" on page 43

[:SOURce<hw>][:BB]:VOR:REFerence[:DEViation] <Deviation>

Sets the frequency deviation of the reference signal on the FM carrier.

Parameters:

<Deviation>   integer

                 Range: 0 to 960
                 *RST: 480
                 Default unit: Hz

Example: See Example"Configure and generate a VOR signal"
                 on page 90.

Manual operation: See "REF Deviation" on page 45

[:SOURce<hw>][:BB]:VOR:SUBCarrier:DEPTh <Depth>

Sets the AM modulation depth of the FM carrier.

Parameters:
<Depth>   float

Range: 0 to 100
Increment: 0.1
*RST: 30

Example: See Example"Configure and generate a VOR signal"
on page 90.

Manual operation: See "Subcarrier Depth" on page 45

[:SOURce<hw>][:BB]:VOR:SUBCarrier[:FREQuency] <Frequency>

Sets the frequency of the FM carrier.

Parameters:
<Frequency>   float

Range: 5E3 to 15E3
Increment: 0.01
*RST: 9.96E3

Example: See Example"Configure and generate a VOR signal"
on page 90.

Manual operation: See "Subcarrier Frequency" on page 45

[:SOURce<hw>][:BB]:VOR:VAR:FREQuency <Frequency>

Sets the frequency of the variable and the reference signal. As the two signals must
have the same frequency, the setting is valid for both signals.

Parameters:
<Frequency>   float

Range: 10 to 60
Increment: 0.01
*RST: 30

Example: See Example"Configure and generate a VOR signal"
on page 90.

Manual operation: See "VAR/REF Frequency" on page 44

[:SOURce<hw>][:BB]:VOR:VAR[:DEPTh] <Depth>

Sets the AM modulation depth of the 30 Hz variable signal.

Parameters:

<Depth>   float

Range: 0 to 100
Increment: 0.1
*RST: 30

Example: See Example"Configure and generate a VOR signal"
on page 90.

Manual operation: See "VAR Depth" on page 45

7.4.3   VOR position commands

[:SOURce<hw>][:BB]:VOR[:BANGle] <BAngle>

Sets the bearing angle between the VAR signal and the reference signal.

The orientation of the angle can be set with `[:SOURce<hw>][:BB]:VOR[:BANGle]:DIRection`.

Parameters:

<BAngle>   float

Range: 0 to 360
Increment: 0.01
*RST: 0

Example: See Example"Configure and generate a VOR signal"
on page 90.

Manual operation: See "Bearing Angle" on page 46

[:SOURce<hw>][:BB]:VOR[:BANGle]:DIRection <Direction>

Sets the reference position of the phase information.

Parameters:

<Direction>   FROM | TO

FROM
The bearing angle is measured between the geographic north
and the connection line from beacon to airplane.

TO
The bearing angle is measured between the geographic north
and the connection line from airplane to beacon.

*RST: FROM

Example: See Example"Configure and generate a VOR signal"
on page 90.

Manual operation: See "Direction" on page 46

7.4.4 VOR COM/ID commands

[:SOURce<hw>][:BB]:VOR:COMid:CODE <Code>

Sets the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport).

The COM/ID tone is sent according to the selected code, see Chapter A, "Morse code settings", on page 164.

If no coding is set, the COM/ID tone is sent uncoded (key down).

Parameters:

<Code>   string

Example: See Example"Configure and generate a VOR signal"
                       on page 90.

Manual operation: See "Code" on page 47

[:SOURce<hw>][:BB]:VOR:COMid:DASH <Dash>

Sets the length of a Morse code dash.

Parameters:

<Dash>   float

                       Range: 0.05 to 1
                       Increment: 1E-4
                       *RST: 0.3
                       Default unit: s

Example: See Example"Configure and generate a VOR signal"
                       on page 90.

Manual operation: See "Dash Length" on page 48

[:SOURce<hw>][:BB]:VOR:COMid:DEPTh <Depth>

Sets the AM modulation depth of the COM/ID signal.

Parameters:

<Depth>   float

                         Range: 0 to 100
                         Increment: 0.1
                         *RST: 10

Example: See Example"Configure and generate a VOR signal" on page 90.

Manual operation: See "Depth" on page 47

[:SOURce<hw>][:BB]:VOR:COMid:DOT <Dot>

Sets the length of a Morse code dot.

Parameters:

<Dot>   float

                         Range: 0.05 to 1
                         Increment: 1E-4
                         *RST: 0.1
                         Default unit: s

Example: See Example"Configure and generate a VOR signal" on page 90.

Manual operation: See "Dot Length" on page 47

[:SOURce<hw>][:BB]:VOR:COMid:FREQuency <Frequency>

Sets the frequency of the COM/ID signal.

Parameters:

<Frequency>   float

                         Range: 0.1 to 20E3
                         Increment: 0.01
                         *RST: 1020

Example: See Example"Configure and generate a VOR signal" on page 90.

Manual operation: See "Frequency" on page 47

[:SOURce<hw>][:BB]:VOR:COMid:LETTer <Letter>

Sets the length of a Morse code letter space.

Parameters:

<Letter>   float

                         Range: 0.05 to 1
                         Increment: 1E-4
                         *RST: 0.3
                         Default unit: s

Example: See Example"Configure and generate a VOR signal"
                               on page 90.

Manual operation: See "Letter Space" on page 48

[:SOURce<hw>][:BB]:VOR:COMid:PERiod <Period>

Sets the period of the COM/ID signal.

Parameters:
<Period>   float

                               Range: 0 to 120
                               Increment: 1E-3
                               *RST: 9
                               Default unit: s

Example: See Example"Configure and generate a VOR signal"
                               on page 90.

Manual operation: See "Period" on page 47

[:SOURce<hw>][:BB]:VOR:COMid:SYMBol <Symbol>

Sets the length of the Morse code symbol space.

Parameters:
<Symbol>   float

                               Range: 0.05 to 1
                               Increment: 1E-4
                               *RST: 0.1
                               Default unit: s

Example: See Example"Configure and generate a VOR signal"
                               on page 90.

Manual operation: See "Symbol Space" on page 48

[:SOURce<hw>][:BB]:VOR:COMid:TSCHema <Tschema>

Sets the time schema of the Morse code for the COM/ID signal.

Parameters:
<Tschema>   STD | USER

                               STD
                               Activates the standard time schema of the Morse code.
                               The set `dot length` determines the `dash length`, which is 3
                               times the dot length.

                               USER
                               Activates the user-defined time schema of the Morse code.
                               Dot and dash length, as well as `symbol` and `letter space`
                               can be set separately.

	*RST:	STD

Example:	See Example"Configure and generate a VOR signal" on page 90.

Manual operation:	See "Time Schema" on page 47

[:SOURce<hw>][:BB]:VOR:COMid[:STATe] <State>

Enables/disables the COM/ID signal.

Parameters:

<State>	1	ON	0	OFF
	*RST: 0

Example:	See Example"Configure and generate a VOR signal" on page 90.

Manual operation:	See "COM/ID State" on page 47

7.5 DME commands

The `SOURce:BB:DME` subsystem contains all commands for configuring a DME signal.

For a description of the trigger, marker and clock commands, see the following sections:

- Chapter 7.6, "Trigger commands", on page 156
- Chapter 7.7, "DME marker commands", on page 161
- Chapter 7.8, "Clock commands", on page 163

The following commands specific to the R&S SMBVB-K153 option are described here:

7.5.1 DME general commands

[:SOURce<hw>][:BB]:DME:MODE <Mode>

Selects the mode of the DME modulation. The mode determines the signal type that is simulated. The exact timing of the signal for each mode is determined by the channel selected with `[:SOURce<hw>][:BB]:DME:CSUFfix`.

Parameters:

<Mode>   INTerrogation | REPLy

INTerrogation
The interrogation signal of the airborne transmitter is simulated.

REPLy
The reply signal of the ground based transponder is simulated. The trigger is automatically set to external and the default trigger delay either to 50 us (channel X) or 56 us (channel Y) depending on the selected channel (`[:SOURce<hw>][:BB]:DME:CSUFfix`).

The interval between the pulse pairs can be set to a fixed value (repetition rate, `[:SOURce<hw>][:BB]:DME:RATE`) or to random generation (pulse squitter, `[:SOURce<hw>][:BB]:DME:SQUitter`).

The trigger signal is input via the Pulse Ext connector.

*RST: INTerrogation

Example: See Example"Configuring and generating a DME interrogation mode signal" on page 93.

Manual operation: See "DME Mode" on page 57

7.5.2 DME signal commands

[:SOURce<hw>][:BB]:DME:CSUFfix <CSuffix>

Sets the channel that is simulated. Standard compliant X and Y channels differ in the spacing between the two pulses of the pulse pair and the delay of the ground station.

Parameters:

<CSuffix>	X | Y | ICAO
	*RST: X
Example:	See Example"Configuring and generating a DME interrogation mode signal" on page 93.
Manual operation:	See "Channel Mode" on page 58

[:SOURce<hw>][:BB]:DME:EFFiciency <Efficiency>

Sets the relation between reply pulse pairs and received trigger signals, e.g. with a set efficiency of 50% only every second trigger event leads to the generation of a reply pulse pair.

Parameters:

<Efficiency>	integer
	Range: 0 to 100
	*RST: 100
Example:	See Example"Configuring and generating a DME reply mode signal" on page 94.

[:SOURce<hw>][:BB]:DME:EFFiciency:REPLies <NoOfReplies>

Sets the number of reply pulses. Use this number to specify absolute values of false or correct pulses during reply efficiency measurements.

Parameters:

<NoOfReplies>	10 | 50 | 100
	10, 50 or 100 reply pulses
	*RST: 100
Example:	See Example"Configuring and generating a DME reply mode signal" on page 94.
Manual operation:	See "Number of Replies for Efficiency Calculation" on page 59

[:SOURce<hw>][:BB]:DME:FREQuency <CarreierFreq>

Sets the carrier frequency of the signal.

Parameters:

<CarreierFreq>	float
	Range: 100E3 to 6E9
	Increment: 0.01
	*RST: 1025E6

Example: See Example"Configuring and generating a DME interrogation mode signal" on page 93.

Manual operation: See "Carrier Frequency" on page 58

[:SOURce<hw>][:BB]:DME:ICAO:CHANnel <Channel>

Sets the ICAO channel and the corresponding transmitting frequency.

If avionic standard modulation is activated and you change the "RF Frequency", the frequency value of the closest ICAO channel is applied automatically. The "ICAO Channel" is also updated.

The carrier frequency is set automatically to the value of the ICAO channel. For an overview of the DME ICAO channel frequencies, see Table 5-1.

Parameters:

<Channel>

CH1X | CH1Y | CH2X | CH2Y | CH3X | CH3Y | CH4X | CH4Y |
CH5X | CH5Y | CH6X | CH6Y | CH7X | CH7Y | CH8X | CH8Y |
CH9X | CH9Y | CH10X | CH10Y | CH11X | CH11Y | CH12X |
CH12Y | CH13X | CH13Y | CH14X | CH14Y | CH15X | CH15Y |
CH16X | CH16Y | CH17X | CH17Y | CH18X | CH18Y | CH19X |
CH19Y | CH20X | CH20Y | CH21X | CH21Y | CH22X | CH22Y |
CH23X | CH23Y | CH24X | CH24Y | CH25X | CH25Y | CH26X |
CH26Y | CH27X | CH27Y | CH28X | CH28Y | CH29X | CH29Y |
CH30X | CH30Y | CH31X | CH31Y | CH32X | CH32Y | CH33X |
CH33Y | CH34X | CH34Y | CH35X | CH35Y | CH36X | CH36Y |
CH37X | CH37Y | CH38X | CH38Y | CH39X | CH39Y | CH40X |
CH40Y | CH41X | CH41Y | CH42X | CH42Y | CH43X | CH43Y |
CH44X | CH44Y | CH45X | CH45Y | CH46X | CH46Y | CH47X |
CH47Y | CH48X | CH48Y | CH49X | CH49Y | CH50X | CH50Y |
CH51X | CH51Y | CH52X | CH52Y | CH53X | CH53Y | CH54X |
CH54Y | CH55X | CH55Y | CH56X | CH56Y | CH57X | CH57Y |
CH58X | CH58Y | CH59X | CH59Y | CH60X | CH60Y | CH61X |
CH61Y | CH62X | CH62Y | CH63X | CH63Y | CH64X | CH64Y |
CH65X | CH65Y | CH66X | CH66Y | CH67X | CH67Y | CH68X |
CH68Y | CH69X | CH69Y | CH70X | CH70Y | CH71X | CH71Y |
CH72X | CH72Y | CH73X | CH73Y | CH74X | CH74Y | CH75X |
CH75Y | CH76X | CH76Y | CH77X | CH77Y | CH78X | CH78Y |
CH79X | CH79Y | CH80X | CH80Y | CH81X | CH81Y | CH82X |
CH82Y | CH83X | CH83Y | CH84X | CH84Y | CH85X | CH85Y |
CH86X | CH86Y | CH87X | CH87Y | CH88X | CH88Y | CH89X |
CH89Y | CH90X | CH90Y | CH91X | CH91Y | CH92X | CH92Y |
CH93X | CH93Y | CH94X | CH94Y | CH95X | CH95Y | CH96X |
CH96Y | CH97X | CH97Y | CH98X | CH98Y | CH99X | CH99Y |
CH100X | CH100Y | CH101X | CH101Y | CH102X | CH102Y |
CH103X | CH103Y | CH104X | CH104Y | CH105X | CH105Y |
CH106X | CH106Y | CH107X | CH107Y | CH108X | CH108Y |
CH109X | CH109Y | CH110X | CH110Y | CH111X | CH111Y |
CH112X | CH112Y | CH113X | CH113Y | CH114X | CH114Y |
CH115X | CH115Y | CH116X | CH116Y | CH117X | CH117Y |
CH118X | CH118Y | CH119X | CH119Y | CH120X | CH120Y |
CH121X | CH121Y | CH122X | CH122Y | CH123X | CH123Y |
CH124X | CH124Y | CH125X | CH125Y | CH126X | CH126Y
*RST: CH1X

Example: See Example"Configuring and generating a DME interrogation
mode signal" on page 93.

Manual operation: See "ICAO Channel" on page 58

[:SOURce<hw>][:BB]:DME:PPST <SpacTolerance>

Sets the pulse pair spacing tolerance.

You have to enable the pulse pair spacing tolerance with the command `[:
SOURce<hw>][:BB]:DME:PPS` for this value to be considered.

Parameters:

<SpacTolerance>   float

                          Range: 0 to (200E-6)/2
                          Increment: 20E-9
                          *RST: 5E-6

Example: See Example"Configuring and generating a DME reply mode
                          signal" on page 94.

Manual operation: See "Pulse Pair Spacing Tolerance" on page 63

[:SOURce<hw>]:BB:DME:PPST:ENABled <TolerEnabled>

Enables the pulse pair spacing tolerance.

If this function is not enabled, the response is sent after the first pulse, without check-
ing whether the second pulse is within the pulse pair spacing tolerance time.

You can set the pulse pair spacing tolerance with `[:SOURce<hw>][:BB]:DME:PPST`.

Parameters:

<TolerEnabled>   1 | ON | 0 | OFF

                          *RST: 1

Example: See Example"Configuring and generating a DME reply mode
                          signal" on page 94.

Manual operation: See "Pulse Pair Spacing State" on page 63

[:SOURce<hw>][:BB]:DME:RATE <Rate>

If `[:SOURce<hw>][:BB]:DME:MODE` is set to *INTerrogation*, sets the pulse repetition
rate.

If `[:SOURce<hw>][:BB]:DME:MODE` is set to *REPLy*, indicates the mean pulse repe-
tition rate in squitter mode.

Parameters:

<Rate>   integer

                          Range: 10 to 6000
                          *RST: 48

Example: See Example"Configuring and generating a DME reply mode
                          signal" on page 94.

Manual operation: See "Pulse Repetition Rate" on page 60

[:SOURce<hw>][:BB]:DME:RDIStance <RDistance>

Sets the simulated distance between the interrogator and the transponder for reply
mode (`:BB:DME:MODE:REPLy`).

The distance can be given in nautic miles (NM) or µs with the command `[:SOURce<hw>][:BB]:DME:RDIStance:UNIT`.

If the unit is not provided next to the value, the value is considered to be in the current unit (last unit set via GUI or the SCPI). The query always provides the value in the unit set with `[:SOURce<hw>][:BB]:DME:RDIStance:UNIT`.

The range distance and the external trigger delay are interdependent according to:

Range distance = (trigger delay – X/Y mode delay)/12.359 µs/nm

(X mode delay = 50 µs, Y mode delay is 56 µs)

Changing one value automatically changes the other value.

Parameters:

<RDistance>	float
	Range: -4.046 (X), -4.531 (Y) to 400
	Increment: 0.001
	*RST: 0

Example: See Example"Configuring and generating a DME reply mode signal" on page 94.

Manual operation: See "Range Distance" on page 59

[:SOURce<hw>][:BB]:DME:RDIStance:UNIT <Unit>

Sets the unit for the range distance that can be defined with the `[:SOURce<hw>][:BB]:DME:RDIStance`.

The distance can be given in nautic miles (NM) or µs. 1 nm is 1852.01 meters and corresponds to a run time of 12.359 µs.

Parameters:

<Unit>	US | NM
	*RST: NM

Example: See Example"Configuring and generating a DME reply mode signal" on page 94.

Manual operation: See "Range Distance" on page 59

[:SOURce<hw>][:BB]:DME:SQUitter <Squitter>

Activates/deactivates the random pulse repetition rate.

The average repetition rate is 2700 pp/s. The pulse spacing is distributed randomly in the range of 60 µs to about 1500 µs according to EUROCAE EN-54 6.2.12. The squitter pulses are constantly sent by the ground station in order to ensure proper operation and in order to ease synchronization of the aircraft interrogator to the ground station.

Parameters:

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

Example:	See Example"Configuring and generating a DME reply mode signal" on page 94.
Manual operation:	See "Pulse Squitter" on page 60

[:SOURce<hw>][:BB]:DME:PINPut:DELay <Delay>

Sets the delay between the external trigger and the first DME output pulse (50% voltage point of first pulse).

Setting takes effect, if `[:SOURce<hw>][:BB]:DME:PINPut:SOURce` is set to *EXTernal*.

For DME `reply mode`, this setting simulates the defined delay of the DME transponder and twice the run time of the signal (from interrogator to transponder and back). The delay is a measure of the range distance, thus, the two values are interdependent according to:

Delay = X/Y mode delay + range distance * 12.359 nm/µs

(X mode delay = 50 µs, Y mode delay is 56 µs)

Changing one value automatically changes the other value.

Parameters:

<Delay>	float	
	Range:	4E-6 to 5E-3
	Increment:	20E-9
	*RST:	50E-6

Example:	See Example"Configuring and generating a DME reply mode signal" on page 94.
Manual operation:	See "Reply Delay" on page 61

[:SOURce<hw>][:BB]:DME:PINPut:SOURce <PulsInpSource>

Selects the trigger mode for DME modulation signals.

Parameters:

<PulsInpSource>	EXTernal | PSENsor
	EXTernal The signals are triggered by an external trigger event. The trigger signal is supplied via the Pulse Ext connector.
	PSENsor The signals are triggered by a connected power sensor, for example, the R&S NRP-Z81.
	*RST: EXTernal

Example:	See Example"Configuring and generating a DME reply mode signal" on page 94.
Manual operation:	See "Input Source" on page 60

[:SOURce<hw>][:BB]:DME:PINPut:TRIGger:LEVel?

Queries the last measured value of the trigger power level.

This level is the 50% voltage point of the first pulse of the external DME interrogation signal.

Return values:

<TriggerLevel>   float

Range: -200 to 200
Increment: 0.01
*RST: 0

Example: See Example"Configuring and generating a DME reply mode signal" on page 94.

Usage: Query only

Manual operation: See "Trigger Level" on page 61

[:SOURce<hw>][:BB]:DME:PINPut:TRIGger:LEVel:OK?

Queries, if the search trigger level procedure determines a valid trigger level or not.

Use this query for quick check, if there is a valid trigger level without running the search trigger level procedure via the following command:

Return values:

<IsTrigLevOk>   1 | ON | 0 | OFF

1|ON
Valid trigger level
0|OFF
Invalid trigger level
*RST: n.a. (no preset. default: 0)

Example: See Example"Configuring and generating a DME reply mode signal" on page 94.

Usage: Query only

Manual operation: See "Trigger Level" on page 61

[:SOURce<hw>][:BB]:DME:PINPut:TRIGger:SEARch?

Determines the trigger level that is the 50% voltage point of first pulse of the external DME interrogation signal.

Determination of the trigger point requires a connected power sensor. Use a power sensor, for example the R&S NRP-Z81, to receive the external DME signal. Repeat the trigger search function when changing the level of the external DME signal.

Return values:

<Search>   1 | ON | 0 | OFF

                            1|ON
                            No trigger level found

                            0|OFF
                            Trigger level found

                            *RST: 0

Example: See Example"Configuring and generating a DME reply mode signal" on page 94.

Usage: Query only

Manual operation: See "Search Trigger Level" on page 61

7.5.3   DME pulse commands

[:SOURce<hw>][:BB]:DME:FALL <Fall>

Sets the fall time of the pulse (90% to 10% of peak voltage).

Parameters:

<Fall>   float

                            Range: 0.5E-6 to 10E-6
                            Increment: 10E-9
                            *RST: 2E-6

Example: See Example"Configuring and generating a DME reply mode signal" on page 94.

Manual operation: See "Pulse Fall" on page 63

[:SOURce<hw>][:BB]:DME:PPS <Pps>

Sets the spacing between the first and second pulse of a pulse pair (time between half-voltage points on the leading edge of each pulse).

Available only for `[:SOURce<hw>][:BB]:DME:SINGle`OFF

Parameters:

<Pps>   float

                             Range: 1E-6 to 200E-6
                             Increment: 20E-9
                             *RST: 12E-6

Example: See Example"Configuring and generating a DME reply mode signal" on page 94.

Manual operation: See "Pulse Spacing" on page 63

[:SOURce<hw>][:BB]:DME:RISE <Rise>

Sets the rise time of the pulse (10% to 90% of peak voltage).

Parameters:

<Rise>   float

                             Range: 0.5E-6 to 10E-6
                             Increment: 10E-9
                             *RST: 2E-6

Example: See Example"Configuring and generating a DME reply mode signal" on page 94.

Manual operation: See "Pulse Rise" on page 62

[:SOURce<hw>][:BB]:DME:SHAPe <Shape>

Sets the pulse shape.

Parameters:

<Shape>   COS2 | LIN | COS | GAUSs

                             COS2|
                             The rising edge is cos shaped and the falling edge is cos^2 shaped.

                             LIN
                             The falling and the rising edge of the pulse are shaped linear.

                             COS
                             The falling and the rising edge of the pulse are cos^2 shaped.

                             *RST: COS2

Example: See Example"Configuring and generating a DME reply mode signal" on page 94.

Manual operation: See "Pulse Shape" on page 62

[:SOURce<hw>][:BB]:DME:SINGle <Single>

Activates/deactivates generation of a single test pulse.

Parameters:

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

Example:	See Example"Configuring and generating a DME reply mode signal" on page 94.
Manual operation:	See "Single Pulse" on page 63

[:SOURce<hw>][:BB]:DME:WIDTh <Width>

Sets the pulse width (50% to 50% of peak voltage).

Parameters:

<Width>	float
	Range: 1E-6 to 100E-6
	Increment: 20E-9
	*RST: 3.5E-6

Example:	See Example"Configuring and generating a DME reply mode signal" on page 94.
Manual operation:	See "Pulse Width" on page 63

7.5.4 DME propagation commands

[:SOURce<hw>][:BB]:DME:ECHO <ExtendetState>

Enables the simulation of DME echo pulse pair signals.

Parameters:

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

Example:	See Example"Determining the DME echo rejection" on page 95.
Manual operation:	See "State" on page 67

[:SOURce<hw>][:BB]:DME:ECHO:ATTenuation <EchoAtten>

Sets the attenuation of the DME echo pulse pair signal compared to the original DME pulse pair signal.

Parameters:

<EchoAtten>   float

                        Range: 0 to 50
                        Increment: 0.01
                        *RST: 10
                        Default unit: dB

Example: See Example"Determining the DME echo rejection" on page 95.

Manual operation: See "Attenuation" on page 67

[:SOURce<hw>][:BB]:DME:ECHO:DELay <EchoDel>

Sets the delay between the first original DME pulse pair signal and second DME echo pulse pair signal.

Parameters:

<EchoDel>   float

                        Range: 15.5E-6 to 204E-6
                        Increment: 1E-8
                        *RST: 20E-6

Example: See Example"Determining the DME echo rejection" on page 95.

Manual operation: See "Delay" on page 67

[:SOURce<hw>][:BB]:DME:VELocity <DmeVelocity>

Sets the delay between the DME echo pulse signal and the original DME pulse signal.

Parameters:

<DmeVelocity>   float

                        Range: -1E4 to 1E4
                        Increment: 1E-3
                        *RST: 0

Example: See Example"Simulating DME signals for velocity tracking" on page 96.

Manual operation: See "Velocity" on page 68

[:SOURce<hw>][:BB]:DME:FLIGht:DISTance:CURRent?

Queires the current distance of the aircraft in the flight simulation.

Return values:

<CurrentDistance>　　　　float

　　　　　　　　　　　　Range:　　　　-400 to 400
　　　　　　　　　　　　Increment:　0.001
　　　　　　　　　　　　*RST:　　　　0

Example:　　　　　　　See Example"Simulating a DME flight scenario" on page 97.

Usage:　　　　　　　　Query only

Manual operation:　　See "Current Distance" on page 70

[:SOURce<hw>][:BB]:DME:FLIGht:DISTance:STARt <StartDistance>

Sets the start distance of the flight simulation.

Parameters:

<StartDistance>　　　　float

　　　　　　　　　　　　Range:　　　　-400 to 400
　　　　　　　　　　　　Increment:　0.001
　　　　　　　　　　　　*RST:　　　　0

Example:　　　　　　　See Example"Simulating a DME flight scenario" on page 97.

Manual operation:　　See "Start Distance" on page 69

[:SOURce<hw>][:BB]:DME:FLIGht:DISTance:STOP <StopDistance>

Sets the stop distance of the flight simulation.

Parameters:

<StopDistance>　　　　float

　　　　　　　　　　　　Range:　　　　-400 to 400
　　　　　　　　　　　　Increment:　0.001
　　　　　　　　　　　　*RST:　　　　1

Example:　　　　　　　See Example"Simulating a DME flight scenario" on page 97.

Manual operation:　　See "Stop Distance" on page 69

[:SOURce<hw>][:BB]:DME:FLIGht:PAUSe

Pauses a running flight simulation.

Example:　　　　　　　See Example"Simulating a DME flight scenario" on page 97.

Usage:　　　　　　　　Event

Manual operation:　　See "Pause" on page 70

[:SOURce<hw>][:BB]:DME:FLIGht:RESTart

Restarts a running or stopped flight simulation.

Example: See Example"Simulating a DME flight scenario" on page 97.

Usage: Event

Manual operation: See "Restart" on page 69

[:SOURce<hw>][:BB]:DME:FLIGht:RESume

Resumes a running flight simulation.

Example: See Example"Simulating a DME flight scenario" on page 97.

Usage: Event

Manual operation: See "Resume" on page 70

[:SOURce<hw>][:BB]:DME:FLIGht:RSTatus?

Queries the status of the flight simulation.

Return values:
<RunningStatus> OFF | IDLE | RUNNing | PAUSed

*RST: OFF

Example: See Example"Simulating a DME flight scenario" on page 97.

Usage: Query only

Manual operation: See "State" on page 69

[:SOURce<hw>][:BB]:DME:FLIGht:STARt

Starts the flight simulation with a given start distance.

Example: See Example"Simulating a DME flight scenario" on page 97.

Usage: Event

Manual operation: See "Start" on page 69

[:SOURce<hw>][:BB]:DME:FLIGht:STATe <SimState>

Activates flight simulation.

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

*RST: 0

Example: See Example"Simulating a DME flight scenario" on page 97.

Manual operation: See "State" on page 69

[:SOURce<hw>][:BB]:DME:FLIGht:STOP

Stops the flight simulation and sets the distance position to start distance.

Example: See Example"Simulating a DME flight scenario" on page 97.

Usage: Event

Manual operation: See "Stop" on page 70

7.5.5 DME analysis commands

[:SOURce<hw>][:BB]:DME:ANALysis:EFFiciency?

Queries the measured reply efficiency in percent. The measurement is the ratio of the number of measured valid reply pulse pairs to transmitted pulse pairs in a measurement cycle.

Return values:

<Efficiency>   float

Range: 0 to 100
Increment: 0.1
*RST: 100

Example: See Example"Configuring and generating a DME interrogation mode signal" on page 93.

Usage: Query only

Manual operation: See "Reply Efficiency" on page 60
See "Reply Efficiency" on page 77

[:SOURce<hw>]:BB:DME:ANALysis:EFFiciency:OK?

Queries if there are valid reply efficiency measurement values available in the set measurement window.

Return values:

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

Example:	See Example"Configuring and generating a DME interrogation mode signal" on page 93.
Usage:	Query only
Manual operation:	See "Reply Efficiency" on page 77

[:SOURce<hw>]:BB:DME:ANALysis:GATE:COUNt <Count>

Sets the number of pulse pairs which are sent from the R&S SMBV100B (= interrogator) to the ground station in one measurement cycle. Only reply pulses for which the 50% voltage point of the rising edge of the first pulse is within the measurement window are used to evaluate the delay time and reply efficiency.

Parameters:

<Count>	integer
	Range: 1 to 10000
	Increment: 1
	*RST: 100

Example:	See Example"Configuring and generating a DME interrogation mode signal" on page 93.

[:SOURce<hw>][:BB]:DME:ANALysis:GATE:EDELay <Edelay>

Sets the expected reply delay. The expected reply delay and the gate length determine the measurement window (expected reply delay +/- gate length/2).

Parameters:

<Edelay>	float
	Range: 0 to 150E-6
	Increment: 1E-7
	*RST: 50E-6

Example:	See Example"Configuring and generating a DME interrogation mode signal" on page 93.
Manual operation:	See "Expected Reply Delay" on page 76

[:SOURce<hw>][:BB]:DME:ANALysis:GATE[:LENGth] <Length>

Sets the gate length for the measurement window.

The measurement gate settings determine the measurement window (expected reply delay +/- gate length/2). Only reply pulses for which the 50% voltage point of the rising edge of the first pulse is within the measurement window are used to evaluate the delay time and reply efficiency. The delay measurement is averaged within the measurement cycle. The reply efficiency is calculated once for each measurement cycle.

The gate length is 1 µs and the expected reply delay is 50 µs. The measurement window lies in the range between 49.5 and 50.5 µs. Only pulse pairs are used for the measurement whose 50% voltage point of the rising edge of the first pulse is within this range.
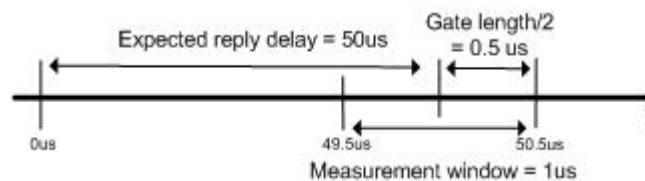
Parameters:

<Length>   integer

Range: 100E-9 to 326E-6
Increment: 100E-9
*RST: 10E-6

Example: See Example"Configuring and generating a DME interrogation mode signal" on page 93.

Manual operation: See "Gate Length" on page 76

[:SOURce<hw>][:BB]:DME:ANALysis:GATE:TIME <MeasurementTime>

Sets the DME analysis measurement time.

Parameters:

<MeasurementTime> float

Range: 0.1 to 20
Increment: 0.1
*RST: 1

Example: See Example"Configuring and generating a DME interrogation mode signal" on page 93.

Manual operation: See "Measurement Time" on page 76

[:SOURce<hw>][:BB]:DME:ANALysis:NORMalize?

Performs a normalization of the test setup. The delay due to the test setup is measured and subsequently considered in the reply measurements.

Return values:

<Normalize>   1 | ON | 0 | OFF

Example: See Example"Configuring and generating a DME interrogation mode signal" on page 93.

Usage:	Query only
Manual operation:	See "Normalize Setup" on page 73

[:SOURce<hw>][:BB]:DME:ANALysis:OK?

Queries if there are DME measurement values in the set measurement window.

Return values:

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

Example:	See Example"Configuring and generating a DME interrogation mode signal" on page 93.
Usage:	Query only
Manual operation:	See "State" on page 75

[:SOURce<hw>][:BB]:DME:ANALysis:POWer?

Queries the measured average peak level of all valid pulse pairs in a measurement cycle.

Return values:

<Power>	float
	Range: -200 to 200
	Increment: 0.01
	*RST: 0

Example:	See Example"Configuring and generating a DME interrogation mode signal" on page 93.
Usage:	Query only
Manual operation:	See "Peak Level" on page 76

[:SOURce<hw>]:BB:DME:ANALysis:POWer:OK?

Queries if there are peak level measurement values available in the set measurement window.

Return values:

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

Example:	See Example"Configuring and generating a DME interrogation mode signal" on page 93.
Usage:	Query only
Manual operation:	See "Peak Level" on page 76

[:SOURce<hw>][:BB]:DME:ANALysis:PRRate?

Queries the measured mean pulse repetition rate of the DME ground station. All received pulses of the DME ground station are considered.

Return values:

<Rate>   float

                            Range: 0 to 10000
                            Increment: 0.1
                            *RST: 0

Example: See Example"Configuring and generating a DME interrogation mode signal" on page 93.

Usage: Query only

Manual operation: See "Pulse Repetition Rate" on page 77

[:SOURce<hw>]:BB:DME:ANALysis:PRRate:OK?

Queries if there are valid pulse repetition measurement values available in the set measurement window.

Return values:

<Ok>   0 | 1 | OFF | ON

                           *RST: 1

Example: See Example"Configuring and generating a DME interrogation mode signal" on page 93.

Usage: Query only

Manual operation: See "Measurement Status" on page 77

[:SOURce<hw>][:BB]:DME:ANALysis:RDIStance?

Queries the measured average range distance of all valid pulse pairs in a measurement cycle.

Return values:

<RangeDistance>   float

Example: See Example"Configuring and generating a DME interrogation mode signal" on page 93.

Usage: Query only

Manual operation: See "Range Distance" on page 76

[:SOURce<hw>][:BB]:DME:ANALysis:STATe <State>

Activates the DME analysis.

Activation requires a connection between R&S SMBV100B and a power sensor, for example, the R&S NRP-Z81.

Parameters:

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

Example: See Example"Configuring and generating a DME interrogation mode signal" on page 93.

Manual operation: See "State" on page 75

[:SOURce<hw>][:BB]:DME:ANALysis:TIME?

Queries the measured average reply delay of all valid pulse pairs in a measurement cycle.

Return values:

<Time>	float
	Range: -1E-3 to 1E-3
	Increment: 10E-9
	*RST: 0

Example: See Example"Configuring and generating a DME interrogation mode signal" on page 93.

Usage: Query only

Manual operation: See "Reply Delay" on page 77

[:SOURce<hw>]:BB:DME:ANALysis:TIME:OK?

Queries if there are valid measurement values available in the set measurement window.

Return values:

<Ok>	0 | 1 | OFF | ON

Example: See Example"Configuring and generating a DME interrogation mode signal" on page 93.

Usage: Query only

Manual operation: See "Reply Delay" on page 77

[:SOURce<hw>]:BB:DME:ANALysis:TRIGger:SEARch?

Determines the trigger level = 50% voltage point of first pulse of the external DME interrogation signal.

Determination of the trigger point requires a connected power sensor. Use the R&S NRP-Z81 to receive the external DME signal. Repeat the trigger search function when changing the level of the external DME signal.

Return values:

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

Example:	See Example"Configuring and generating a DME interrogation mode signal" on page 93.
Usage:	Query only

[:SOURce<hw>][:BB]:DME:ANALysis:IAFactor?

Queries the internal adjustment factor, the mathematically calculated value of the time, when the pulse reaches its 50% level.

Return values:

<InternalAdjFact>	float
	Range: 0 to 200
	Increment: 10E-9
	*RST: 0

Example:	See Example"Configuring and generating a DME interrogation mode signal" on page 93.
Usage:	Query only
Manual operation:	See "Internal Adjustment Factor" on page 74

[:SOURce<hw>][:BB]:DME:ANALysis:PSAFactor?

Queries the power sensor adjustment factor determined during a normalization of the setup. You can normalize the setup with `[:SOURce<hw>][:BB]:DME:ANALysis:NORMalize?`.

Return values:

<PowSensAdjFact>	float
	Range: 0 to 200
	Increment: 10E-9
	*RST: 0

Example:	See Example"Configuring and generating a DME interrogation mode signal" on page 93.
Usage:	Query only
Manual operation:	See "Power Sensor Adjustment Factor" on page 74

[:SOURce<hw>][:BB]:DME:ANALysis:UAFactor <UsedFactor>

Sets which internal adjustment factor is used.

Parameters:

<UsedFactor>	INTernal | PSENsor

INTernal

The mathematically calculated value of the time, when the pulse reaches its 50% level. Query the internal adjustment factor with `[:SOURce<hw>][:BB]:DME:ANALysis:IAFactor?`

PSENsor

The adjustment factor measured during a normalization setup. Query the power sensor adjustment factor with `[:SOURce<hw>][:BB]:DME:ANALysis:PSAFactor?`

*RST: INTernal

Example: See Example"Configuring and generating a DME interrogation mode signal" on page 93.

Manual operation: See "Used Adjustment Factor" on page 74

7.5.6 DME COM/ID commands

[:SOURce<hw>][:BB]:DME:ID:CODE <Code>

Sets the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport).

The COM/ID tone is sent according to the selected code, see Chapter A, "Morse code settings", on page 164.

If no coding is set, the COM/ID tone is sent uncoded (key down).

Parameters:

<Code>   string

Example: See Example"Configuring and generating a DME reply mode signal" on page 94.

Manual operation: See "Code" on page 65

[:SOURce<hw>][:BB]:DME:ID:DASH <Dash>

Sets the length of a Morse code dash.

Available only if `[:SOURce<hw>][:BB]:DME:ID:TSCHema` is set to *USER*.

Parameters:

<Dash>   float

	Range:	0.05 to 1
	Increment:	1E-4
	*RST:	0.3

Example: See Example"Configuring and generating a DME reply mode signal" on page 94.

Manual operation: See "Dash Length" on page 65

[:SOURce<hw>][:BB]:DME:ID:DOT <Dot>

Sets the length of a Morse code dot.

Parameters:

<Dot>   float

	Range:	0.05 to 1
	Increment:	1E-4
	*RST:	0.1

Example: See Example"Configuring and generating a DME reply mode signal" on page 94.

Manual operation: See "Dot Length" on page 65

[:SOURce<hw>][:BB]:DME:ID:LETTer <Letter>

Sets the length of a Morse code letter space.

Available only if `[:SOURce<hw>][:BB]:DME:ID:TSCHema` is set to *USER*.

Parameters:

<Letter>   float

	Range:	0.05 to 1
	Increment:	1E-4
	*RST:	0.3

Example: See Example"Configuring and generating a DME reply mode signal" on page 94.

Manual operation: See "Letter Space" on page 66

[:SOURce<hw>][:BB]:DME:ID:PPP[:STATe] <PairOfPulsePair>

Sets the state of the pair of pulse pairs for the ID signal generation. When enabled a pair of pulse pairs is transmitted during the set `[:SOURce<hw>][:BB]:DME:ID:RATE`.

Parameters:

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

Example: See Example"Configuring and generating a DME reply mode signal" on page 94.

[:SOURce<hw>][:BB]:DME:ID:PPS <PulsePairSpacin>

Sets the morse pulse pair spacing.

Parameters:

<PulsePairSpacin>	float
	Range: 2E-6 to 300E-6
	Increment: 20E-9
	*RST: 100E-6

Example: See Example"Configuring and generating a DME reply mode signal" on page 94.

[:SOURce<hw>][:BB]:DME:ID:PERiod <Period>

Sets the period of the COM/ID signal.

Parameters:

<Period>	integer
	Range: 10 to 120
	*RST: 40

Example: See Example"Configuring and generating a DME reply mode signal" on page 94.

Manual operation: See "Period" on page 65

[:SOURce<hw>][:BB]:DME:ID:PRESet

Sets the default settings for the ID signal.

Example: See Example"Configuring and generating a DME reply mode signal" on page 94.

Usage: Event

[:SOURce<hw>][:BB]:DME:ID:RATE <Rate>

Sets the pulse repetition rate of the ID sequence.

Parameters:

<Rate>	float
	Range: 100 to 10E3
	Increment: 0.01
	*RST: 1350

Example:　　　　　　　See Example"Configuring and generating a DME reply mode signal" on page 94.

Manual operation:　　　See "Rate" on page 65

[:SOURce<hw>][:BB]:DME:ID:SYMBol <Symbol>

Sets the length of the Morse code symbol space.

Available only if `[:SOURce<hw>][:BB]:DME:ID:TSCHema` is set to *USER*.

Parameters:
<Symbol>　　　　　　　float

　　　　　　　　　　　Range:　　　0.05 to 1
　　　　　　　　　　　Increment:　1E-4
　　　　　　　　　　　*RST:　　　0.1

Example:　　　　　　　See Example"Configuring and generating a DME reply mode signal" on page 94.

Manual operation:　　　See "Symbol Space" on page 65

[:SOURce<hw>][:BB]:DME:ID:TSCHema <TSchema>

Sets the time schema of the Morse code for the COM/ID signal.

Parameters:
<TSchema>　　　　　　STD | USER

　　　　　　　　　　　*RST:　　　　STD

Example:　　　　　　　See Example"Configuring and generating a DME reply mode signal" on page 94.

Manual operation:　　　See "Time Schema" on page 65

[:SOURce<hw>][:BB]:DME:ID[:STATe] <State>

Enables/disables the COM/ID signal.

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

　　　　　　　　　　　*RST:　　　　0

Example:　　　　　　　See Example"Configuring and generating a DME reply mode signal" on page 94.

Manual operation:　　　See "COM/ID State" on page 64

7.6 Trigger commands

[:SOURce<hw>]:BB:DME[:TRIGger]:SEQuence <TriggerMode>
[:SOURce<hw>][:BB]:ILS[:TRIGger]:SEQuence <TriggerMode>
[:SOURce<hw>]:BB:VOR[:TRIGger]:SEQuence <TriggerMode>

Selects the trigger mode:

- `AUTO` = auto
- `RETRigger` = retrigger
- `AAUTo` = armed auto
- `ARETrigger` = armed retrigger
- `SINGle` = single

Parameters:

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

                *RST: AUTO

Example: See Example"Configuring trigger settings" on page 97.

Manual operation: See "Mode" on page 79

[:SOURce<hw>]:BB:DME:TRIGger:SOURce <TriggerSource>
[:SOURce<hw>][:BB]:ILS:TRIGger:SOURce <TriggerSource>
[:SOURce<hw>]:BB:VOR:TRIGger:SOURce <TriggerSource>

Selects the trigger signal source and determines the way the triggering is executed. Provided are:

- Internal triggering by a command (`INTernal`)
- External trigger signal via one of the User x connectors
  `EGT1`: External global trigger
- In primary-secondary instrument mode, the external baseband synchronization signal (`BBSY`)
- `EXTernal`: Setting only
  Provided only for backward compatibility with other Rohde & Schwarz signal generators.
  The R&S SMBV100B accepts this value and maps it automatically as follows:
  `EXTernal = EGT1`

Parameters:

<TriggerSource>   INTernal|EGT1|EXTernal|BBSY

                *RST: INTernal

Example: See Example"Configuring trigger settings" on page 97.

Manual operation: See "Source" on page 81

[:SOURce<hw>]:BB:DME:TRIGger:RMODe?
[:SOURce<hw>][:BB]:ILS:TRIGger:RMODe?
[:SOURce<hw>]:BB:VOR:TRIGger:RMODe?

Queries the signal generation status.

Return values:

<RunMode>   STOP | RUN

                      *RST: STOP

Example: See Example"Configuring trigger settings" on page 97.

Usage: Query only

Manual operation: See "Running/Stopped" on page 80

[:SOURce<hw>]:BB:DME:TRIGger:TIME:DATE <Year>, <Month>, <Day>
[:SOURce<hw>][:BB]:ILS:TRIGger:TIME:DATE <Year>, <Month>, <Day>
[:SOURce<hw>]:BB:VOR:TRIGger:TIME:DATE <Year>, <Month>, <Day>

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

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

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

Parameters:

<Year>   integer

                      Range: 1980 to 9999

<Month>   integer

                      Range: 1 to 12

<Day>   integer

                      Range: 1 to 31

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

Manual operation: See "Trigger Time" on page 80

[:SOURce<hw>]:BB:DME:TRIGger:TIME:TIME <Hour>, <Minute>, <Second>
[:SOURce<hw>][:BB]:ILS:TRIGger:TIME:TIME <Hour>, <Minute>, <Second>
[:SOURce<hw>]:BB:VOR:TRIGger:TIME:TIME <Hour>, <Minute>, <Second>

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

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

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

Parameters:

<Hour>   integer

                      Range: 0 to 23

<Minute>	integer
	Range: 0 to 59
<Second>	integer
	Range: 0 to 59

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

Manual operation: See "Trigger Time" on page 80

[:SOURce<hw>]:BB:DME:TRIGger:TIME[:STATE] <State>
[:SOURce<hw>][:BB]:ILS:TRIGger:TIME[:STATE] <State>
[:SOURce<hw>]:BB:VOR:TRIGger:TIME[:STATE] <State>

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

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

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

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

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

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

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

Manual operation: See "Time Based Trigger" on page 80

[:SOURce<hw>]:BB:DME:TRIGger:SLENgth <SeqLength>
[:SOURce<hw>][:BB]:ILS:TRIGger:SLENgth <SeqLength>
[:SOURce<hw>]:BB:VOR:TRIGger:SLENgth <SeqLength>

Defines the length of the signal sequence that is output in the `SINGle` trigger mode.

Parameters:
<SeqLength>	integer
	Range: 1 samples to 2^32-1 samples
	*RST: 100

Example: See Example"Configuring trigger settings" on page 97.

Manual operation: See "Signal Duration" on page 79

[:SOURce\<hw>]:BB:DME:TRIGger:ARM:EXECute
[:SOURce\<hw>][:BB]:ILS:TRIGger:ARM:EXECute
[:SOURce\<hw>]:BB:VOR:TRIGger:ARM:EXECute

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

Example:	See Example"Configuring trigger settings" on page 97.
Usage:	Event
Manual operation:	See "Arm" on page 81

[:SOURce\<hw>]:BB:DME:TRIGger:EXECute
[:SOURce\<hw>][:BB]:ILS:TRIGger:EXECute
[:SOURce\<hw>]:BB:VOR:TRIGger:EXECute

Executes a trigger.

Example:	See Example"Configuring trigger settings" on page 97.
Usage:	Event
Manual operation:	See "Execute Trigger" on page 81

[:SOURce\<hw>]:BB:DME:TRIGger:EXTernal:SYNChronize:OUTPut \<Output>
[:SOURce\<hw>][:BB]:ILS:TRIGger:EXTernal:SYNChronize:OUTPut \<Output>
[:SOURce\<hw>]:BB:VOR:TRIGger:EXTernal:SYNChronize:OUTPut \<Output>

Enables signal output synchronous to the trigger event.

Parameters:

\<Output>	1 | ON | 0 | OFF
	*RST: 1
Example:	See Example"Configuring trigger settings" on page 97.
Manual operation:	See "Sync. Output to External Trigger/Sync. Output to Trigger" on page 81

[:SOURce\<hw>]:BB:DME:TRIGger:OBASeband:DELay \<Delay>
[:SOURce\<hw>][:BB]:ILS:TRIGger:OBASeband:DELay \<Delay>
[:SOURce\<hw>]:BB:VOR:TRIGger:OBASeband:DELay \<Delay>

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

Parameters:

\<Delay>	float	
	Range:	0 samples to $2^{32}-1$ samples
	Increment:	1 sample
	*RST:	0 samples
Example:	See Example"Configuring trigger settings" on page 97.	

[:SOURce<hw>]:BB:DME:TRIGger:OBASeband:INHibit <Inhibit>
[:SOURce<hw>][:BB]:ILS:TRIGger:OBASeband:INHibit <Inhibit>
[:SOURce<hw>]:BB:VOR:TRIGger:OBASeband:INHibit <Inhibit>

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

Parameters:

<Inhibit>   integer

                             Range: 0 to 67108863
                             *RST: 0

Example: See Example"Configuring trigger settings" on page 97.

[:SOURce<hw>]:BB:DME:TRIGger[:EXTernal<ch>]:DELay <Delay>
[:SOURce<hw>][:BB]:ILS:TRIGger[:EXTernal<ch>]:DELay <Delay>
[:SOURce<hw>]:BB:VOR:TRIGger[:EXTernal<ch>]:DELay <Delay>

Sets the trigger delay.

Parameters:

<Delay>   float

                             Range: 0 to 65535
                             Increment: 0.01
                             *RST: 0

Example: See Example"Configuring trigger settings" on page 97.

Manual operation: See "External / Trigger Delay" on page 83

[:SOURce<hw>]:BB:DME:TRIGger[:EXTernal<ch>]:INHibit <Inhibit>
[:SOURce<hw>][:BB]:ILS:TRIGger[:EXTernal<ch>]:INHibit <Inhibit>
[:SOURce<hw>]:BB:VOR:TRIGger[:EXTernal<ch>]:INHibit <Inhibit>

Specifies the duration by which a restart is inhibited.

Parameters:

<Inhibit>   integer

                             Range: 0 to 67108863
                             *RST: 0

Example: See Example"Configuring trigger settings" on page 97.

Manual operation: See "External / Trigger Inhibit" on page 82

7.7 DME marker commands

[:SOURce<hw>][:BB]:DME:MARKer<ch>:DELay <Delay>

Sets the delay between the marker signal at the marker outputs relative to the signal generation start.

Parameters:

<Delay>   integer

Range: 0 to 127
*RST: 0

Example: See Example"Configuring DME marker settings" on page 98.

Manual operation: See "Delay" on page 85

[:SOURce<hw>][:BB]:DME:MARKer<ch>:MODE <Mode>

Sets the mode for the selected marker.

Parameters:

<Mode>   FPSTart | FP50P | PSTart | P50P | PRECeived

FPSTart: first pulse start
FP50: first pulse 50%
PSTart: pulse start
P50: pulse 50%
PRECeived: received pulse
*RST: PSTart

Example: See Example"Configuring DME marker settings" on page 98.

Manual operation: See "Mode" on page 84

[:SOURce<hw>][:BB]:DME:MARKer<ch>:PDELay?

Queries the marker processing delay, internally measured value. This command is available only for "Marker 2 Mode > Received Pulse".

Return values:

<ProcessedDelay>   float

Range: 0 to 1
Increment: 10E-9
*RST: 0

Example: See Example"Configuring DME marker settings" on page 98.

Usage: Query only

Manual operation: See "Processing Delay" on page 85

[:SOURce<hw>][:BB]:DME:MARKer<ch>:WIDTh <Width>

Sets the width of the corresponding marker in chips (0.05us).

Parameters:

<Width>   integer

                           Range: 1 to 127
                           *RST: 10

Example: See Example"Configuring DME marker settings" on page 98.

Manual operation: See "Width" on page 85

7.8 Clock commands

[:SOURce<hw>]:BB:DME:CLOCk:SOURce <Source>
[:SOURce<hw>][:BB]:ILS:CLOCk:SOURce <Source>
[:SOURce<hw>]:BB:VOR:CLOCk:SOURce <Source>

Selects the clock source:

* INTernal: Internal clock reference

Parameters:

<Source>   INTernal

                           *RST: INTernal

Example: See Example"Querying clock settings" on page 98.

Manual operation: See "Clock Source" on page 86

Annex

A Morse code settings

The COM/ID tone is sent according to the selected code (see Table A-1). The length of the Morse code can be varied. For selected standard time scheme, the selected dot length determines the setting of all other length parameters of the Morse code (dash length, symbol space and letter space) . For selected user time scheme, all length parameters of the code can be set independently. If no coding is entered, the COM/ID tone is sent uncoded (key down).

ⓘ   The following values are default values:
- A dot (.) has a tone duration of 100 ms
- A dash (-) has a tone duration of 300ms
- The time between two tones is 100ms
- The time between two letters is 300ms

After each word, a word space is entered. The word repetition rate is 7 words per minute. Since the word length can vary between 900 ms and 4500 ms, the word space between the words varies accordingly.

Example:

ID code = MUC

The word length = (300+100+300)+300+(100+100+100+100+300)+300+(300+100+100+100+300+100+100) = 3100 ms

Table A-1: Morse code

Letter	Morse code	Letter	Morse code
A	. -	N	- .
B	- . . .	O	- - -
C	- . - .	P	. - - .
D	- . .	Q	- - . -
E	.	R	. - .
F	. . - .	S	. . .
G	- - .	T	-
H	. . . .	U	. . -
I	. .	V	. . . -
J	. - - -	W	. - -
K	- . -	X	- . . -

Letter	Morse code	Letter	Morse code
L	. - . .	Y	- . - -
M	- -	Z	- - . .

Glossary: Specifications and references

Symbols

1GP74: Rohde & Schwarz Application Note 1GP74 "Test of DME/TACAN Transponders"

1MA193: Rohde & Schwarz Application Note 1MA193 "Aeronautical radio navigation measurement solutions"

V

Videos: Rohde & Schwarz "Test & Measurement Fundamentals" YouTube channel:
https://www.youtube.com/playlist?list=PLKxVoO5jUTlvsVtDcqrVn0ybqBVlLj2z8
Videos:
Videos: "Understanding VOR", "Testing VOR with the R&S SMBV100B Signal Generator", "Understanding ILS", "Testing ILS with the R&S SMBV100B Signal Generator"

List of commands

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