Avionics Standards
Digital Standards for R&S®SMBV
Operating Manual

1176.8600.02 ─ 05

Test & Measurement

Operating Manual

ROHDE&SCHWARZ

This document describes the avionics software options.
Described are the following software options:

- R&S®SMBV-K111
  1419.2396.xx
- R&S®SMBV-K151
  1419.2621.xx
- R&S®SMBV-K152
  1419.2664.xx
- R&S®SMBV-K153
  1419.2667.xx

This manual describes firmware version FW 3.20.281.xx and later of the R&S®SMBV100A.

Mühldorfstr. 15, 81671 München, Germany
Phone: +49 89 41 29 - 0
Fax: +49 89 41 29 12 164
Email: info@rohde-schwarz.com
Internet: www.rohde-schwarz.com

The following abbreviations are used throughout this manual: R&S®SMBV100A is abbreviated as R&S SMBV, R&S®WinIQSIM2™ is abbreviated as R&S WinIQSIM2

Contents

1 Preface 7
1.1 About this Manual 7
1.2 Documentation Overview 7
1.3 Typographical Conventions 9
1.4 Notes on Screenshots 9
2 Welcome to the Avionics Options 10
2.1 Accessing the Avionics Dialog 11
2.2 Scope 12
3 About the Avionics Options 13
3.1 The Ground Based Augmentation System (GBAS) 13
3.2 The Instrument Landing System (ILS) 19
3.3 VHF Omni Directional Radio Range (VOR) 21
3.4 Distance Measurement Equipment (DME) 22
4 GBAS Configuration and Settings 24
4.1 General Settings 24
4.2 VDB Transmitters Configuration Settings 27
4.3 Scheduling Settings 30
4.4 Message Configuration Settings 30
4.4.1 Message Type 2 Parameters 31
4.4.2 Message Type 4 Parameters 33
4.4.3 Differential GNSS Parameters 41
4.5 Filter/Clipping Settings 42
4.5.1 Filter Settings 43
4.5.2 Modulation Settings 45
4.5.3 Clipping Settings 45
4.6 Global Settings 46
5 ILS Configuration and Settings 47
5.1 General Settings 47
5.2 System Configuration Settings - Glide Slope 49
5.2.1 Signal Settings 49

5.2.2 Amplitude Settings 51
5.3 System Configuration Settings Localizer 53
5.3.1 Signal Settings 54
5.3.2 Amplitude Settings 55
5.3.3 COM/ID Settings 58
5.4 System Configuration Settings Marker Beacons 60
5.4.1 Signal Settings 60
5.4.2 COM/ID Settings 61
6 VOR Configuration and Settings 63
6.1 General Settings 63
6.2 System Configuration Settings 65
6.2.1 Signal Settings 65
6.2.2 Position Settings 66
6.2.3 COM/ID Settings 67
7 DME Configuration and Settings 70
7.1 General Settings 70
7.2 System Configuration Settings 72
7.2.1 Signal Settings 72
7.2.2 Pulse Settings 75
7.2.3 Receive Settings 76
7.2.4 DME Analysis 77
7.2.5 COM/ID Settings 79
7.2.6 Adjustment Factors 82
8 Trigger/Marker/Clock Settings 85
8.1 Trigger Settings 85
8.2 Marker Settings GBAS 90
8.3 Marker Settings DME 92
8.4 Clock Settings 94
8.5 Global Settings 96
9 How to Work with the GBAS Option 97
9.1 Generating GBAS Signals with Several Frequency Channels 97
9.2 Generating a GBAS Signal for Receiver Sensitivity Tests 98

9.3 Generating a GBAS Signal for VDB Slot Detection 99
9.4 Generating a GBAS Signal for Message Format Detection 100
9.5 Generating a GPS and a GBAS Signal for Multi Mode Receiver Tests 101

10 Remote-Control Commands 106
10.1 Primary Settings 107
10.2 GBAS Settings 110
10.2.1 Programming Examples 110
10.2.2 General Settings 115
10.2.3 VDB Transmission Configuration Settings 116
10.2.4 Scheduling Settings 119
10.2.5 Message Configuration 120
10.2.6 Filter, Clipping, Modulation Settings 136
10.3 ILS Settings 139
10.3.1 General Settings 139
10.3.2 ILS Glide Slope Settings 139
10.3.3 ILS Localizer Settings 144
10.3.4 ILS Marker Beacon Settings 152
10.4 VOR Settings 156
10.4.1 VOR General Settings 156
10.4.2 VOR System Configuration Settings 157
10.4.3 VOR COM/ID Settings 161
10.5 DME Settings 164
10.5.1 DME General Settings 164
10.5.2 DME System Configuration Settings 165
10.5.3 DME Analysis Settings 172
10.5.4 DME COM/ID Settings 178
10.6 Trigger Settings 181
10.7 Marker Settings DME 187
10.8 Marker Settings GBAS 188
10.9 Clock Settings 191

A Annex 194
A.1 Morse Code Settings 194
A.2 ICAO Channel Frequencies 195

A.2.1 ILS Channel Frequencies....195
A.2.2 VOR Channel Frequencies....195
A.2.3 DME Channel Frequencies....196
A.3 Default Settings....199
A.3.1 GBAS....199
A.3.2 ILS....199
A.3.3 DME....201
A.3.4 VOR....201
A.4 Supported File Formats....202
A.4.1 Waypoint File Format....202
A.4.2 GBAS Differential File Format....203
Glossary: Specifications and References....206
List of Commands....207
Index....214

1 Preface

1.1 About this Manual

This operating manual provides all the information **specific to the Avionics options**. All general instrument functions and settings common to all applications and operating modes are described in the main R&S SMBV operating manual.

The main focus in this manual is on the provided settings and the tasks required to generate a signal. The following topics are included:

- **Welcome to the Avionics options R&S SMBV-K111/-K151/-K152/-K1153**
  Introduction to and getting familiar with the options
- **About the Avionics options**
  Background information on basic terms and principles in the context of the signal generation
- **GBAS/ ILS/ VOR/ DME Configuration and Settings**
  A concise description of all functions and settings available to configure signal generation with their corresponding remote control command for the specific standard
- **Remote Control Commands**
  Remote commands required to configure and perform signal generation in a remote environment, sorted by tasks
  (Commands required to set up the instrument or to perform common tasks on the instrument are provided in the main R&S SMBV operating manual)
  Programming examples demonstrate the use of many commands and can usually be executed directly for test purposes
- **Annex**
  Reference material
- **List of remote commands**
  Alphabetical list of all remote commands described in the manual
- **Index**

1.2 Documentation Overview

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

- Online Help system on the instrument,
- "Quick Start Guide" printed manual,
- Documentation CD-ROM with:
  – Online help system (*.chm) as a standalone help,
  – Operating Manuals for base unit and options,
  – Service Manual,
  – Data sheet and specifications,
  – Links to useful sites on the R&S internet.

Online Help

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

Quick Start Guide

The Quick Start Guide is delivered with the instrument in printed form and in PDF format on the Documentation CD-ROM. It provides the information needed to set up and start working with the instrument. Basic operations and an example of setup are described. The manual includes also general information, e.g., Safety Instructions.

Operating Manuals

The Operating Manuals are a supplement to the Quick Start Guide. Operating Manuals are provided for the base unit and each additional (software) option.

These manuals are available in PDF format - in printable form - on the Documentation CD-ROM delivered with the instrument. In the Operating Manual for the base unit, all instrument functions are described in detail. Furthermore, it provides an introduction to remote control and a complete description of the remote control commands with programming examples. Information on maintenance, instrument interfaces and error messages is also given.

In the individual option manuals, the specific functions of the option are described in detail. For additional information on default settings and parameters, refer to the data sheets. Basic information on operating the R&S SMBV is not included in the option manuals.

Service Manual

The Service Manual is available in PDF format - in printable form - on the Documentation CD-ROM delivered with the instrument. It describes how to check compliance with rated specifications, on instrument function, repair, troubleshooting and fault elimination. It contains all information required for repairing the instrument by the replacement of modules.

This manual can also be orderd in printed form (see ordering information in the data sheet).

Release Notes

The release notes describe new and modified functions, eliminated problems, and last minute changes to the documentation. The corresponding firmware version is indicated on the title page of the release notes. The current release notes are provided in the Internet.

Web Help

The web help provides online access to the complete information on operating the R&S SMBV and all available options, without downloading. The content of the web help corresponds to the user manuals for the latest product version.

The web help is available on the R&S SMBV product page at the Downloads > Web Help area.

Application Notes

Application notes, application cards, white papers and educational notes are further publications that provide more comprehensive descriptions and background information.

The latest versions are available for download from the Rohde & Schwarz website, at http://www.rohde-schwarz.com/appnotes.

1.3 Typographical Conventions

The following text markers are used throughout this documentation:

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

1.4 Notes on Screenshots

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

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

2 Welcome to the Avionics Options

The GBAS Option

The R&S SMBV-K111 is a firmware application that adds functionality to generate signals in accordance with the Ground Based Augmentation System (GBAS).

The most important R&S SMBV-K111 features at a glance:

- Generation of the VHF Data Broadcast (VDB) Signal-in-Space signal transmitted from the Ground Based Augmentation System (GBAS) ground subsystem to the airbone subsystem
- User-definable transmission band and support of single and multiple frequency transmission (up to 11 frequency channels simultaneously), for example for adjacent channel emissions measurements
- Configuration of GBAS application data, for example the parameters of message type 2 and 4, incl. the Final Approach Segment (FAS) data definition and Terminal Area Path (TAP) data
- Import of differential Global Navigation Satellite System (GNSS) data (message type 1 and 11)
- Encoding, timing and power settings according to the specification RTCA DO-246D.

Realtime signal changes for the flight navigation standards ILS, VOR and DME

Changing a parameter in the standards will cause an instant signal change in the R&S SMBV without a measurement cylcle to calculate the RMS value of the baseband signal in order to set the correct RF level. If the standards are switched ON 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 standards will be performed without another measurement cycle in order to provide a continous signal output.

The ILS Option

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

The most important R&S SMBV-K151 features at a glance:

- Generation of glide slope, localizer and marker beacons signals
- Configuration of user definable carrier frequencies or selection of carrier frequencies as defined by ICAO.
- Adjustable COM/ID settings.

The VOR Option

The R&S SMBV-K152 is a firmware application that adds functionality to generate signals in accordance with the VHF Omni Directional Radio Range radio navigation sys-

tem. It is used to determine the aircraft position by receiving radio signals from a network of ground beacons.

The most important R&S SMBV-K152 features at a glance:

- Configuration of user definable carrier frequencies or selection of carrier frequencies as defined by ICAO.
- User defined position settings.
- Adjustable COM/ID settings.

The DME Option

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

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

- Generation of DME interrogation and reply signals.
- Configuration of user definable carrier frequencies or selection of carrier frequencies as defined by ICAO.
- Adjustable COM/ID settings.

This operating 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 software and are described in the R&S SMBV operating manual. The latest version is available for download at the product homepage.

Installation

You can find detailed installation instructions in the delivery of the option or in the R&S SMBV Service Manual.

2.1 Accessing the Avionics Dialog

To open the dialog with Avionics settings

► In the block diagram of the R&S SMBV, select "Baseband > Avionic Standards" > "GBAS"/"ILS"/"DME"/ "VOR".

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".

2.2 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, this includes:

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

For a description of such tasks, see the R&S SMBV operating manual.

3 About the Avionics Options

The following topics summarize some background information on the related avionics standards. The provided overview information is intended as explanation of the used terms and does not aim to be comprehensive.

Brief overview of the avionics standards

- **Landing systems:** ILS (Instrument Landing System), MLS (Microwave Landing System)
  Landing systems are ground-based approach systems that provides precision guidance to an aircraft approaching and (blind) landing on a runway.
- **Radio/Flight navigation systems:** VOR (VHF Omnidirectional Radio), DME (Distance measuring equipment), TACAN (Tactical Air Navigation), ADF (Automatic Direction Finder)
  The radio navigation systems are aircraft systems that support the pilots to determine the aircraft positions and stay on course. These systems are more and more obsolete. However, due to security reasons, these flight navigation systems are still in use.
- **Radar systems:** RSR (EnRoute Surveillance Radar), ASR (Airport Surveillance Radar), PAR (Precision Approach Radar), ASDE (Airport Surface Detection Equipment), SSR (Secondary Surveillance Radar)
  Radar systems are divided into two groups, primary (RSR, ASR, PAR and ASDE) and secondary (SSR). The radar systems are used in air traffic control to mainly detects and measures the position of aircraft, i.e. its range and bearing.

3.1 The Ground Based Augmentation System (GBAS)

The R&S SMBV-K111 option enables you to define and configure the very high frequency (VHF) Data Broadcast (VDB) Signal-in-Space transmitted from the Ground Based Augmentation System (GBAS) ground subsystem to the airbone subsystem. This implementation is in line with the specification RTCA DO-246D. The instrument generates the GBAS signal at the physical layer and includes configuration of the application data.

The GBAS is a ground based augmentation system that could among other things enhance satellite navigation to provide a position estimation of less than one meter. The GBAS is intended to improve aircraft safety and to enhance satellite navigation and the full range of precision approach and landing procedures, as well as the terminal area operations. GBAS could replace the Instrument Landing System (ILS) and the Microwave Landing System (MLS) in many applications.

GBAS components

The illustration on figure 3-1 is a simplified representation of the GBAS three main components:

- the GNSS satellite subsystem

- the airborne subsystem
- the GBAS ground subsystem.

The ground equipment consists of four reference GNSS receivers at exactly defined positions around the airport, GBAS ground station, and a VHF data broadcast transmitter (VDB).

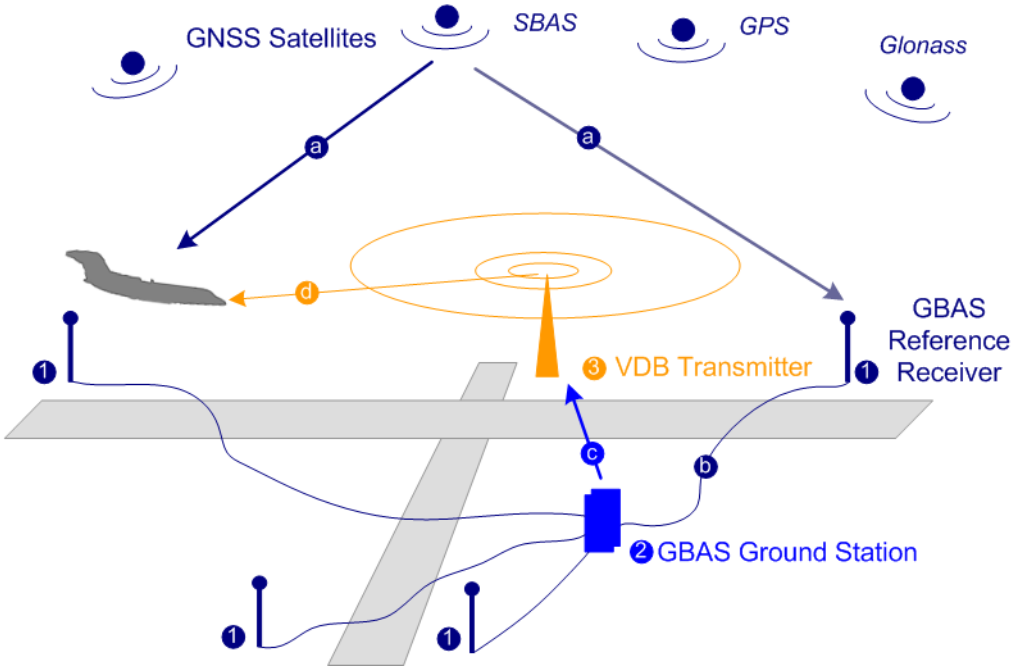


Fig. 3-1: GBAS components and signals (simplified representation)

1 = GNSS reference receiver
2 = GBAS ground station
3 = VHF data broadcast (VDB) transmitter
a = GNSS navigation message
b = Pseudorange
c = GBAS Correction message
d = VDB signal

The GBAS GNSS reference receivers receive the *GNSS navigation message*, perform pseudorange measurements and transmits this information to the GBAS ground station. The GBAS ground station determines errors in the calculated positions, adds additional parameters and approach path information, produces a *GBAS correction message* and sends it the VDB transmitter. The VDB transmitter modulates and encodes this message and *broadcasts* it to the airbone GBAS equipment, for example a GBAS receiver in the airplane. The GBAS equipment in the airplane is a high-precision multimode receiver that evaluates the message and applies corrections parameters to improve the navigation algorithms from GPS.

This list outlines the three signals transmitted between the components and are referred as GBAS Signal-in-Space:

- GNSS satellite to GBAS ground subsystem navigation signal
- GNSS satellite to GBAS airbone subsystem navigation signal
- GBAS ground subsystem to GBAS airbone subsystem VHF data broadcast

This firmware option enables you to generate the VHF data broadcast

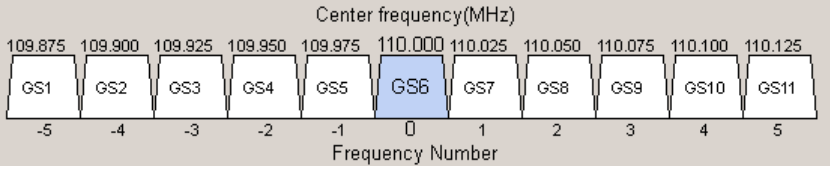
Carrier frequencies and frequency channels

The VHF data broadcast is defined for carrier frequencies within the range of 108.025 MHz to 117.975 MHz and carrier spacing of 25.0 kHz.

The R&S SMBV supports the whole requred frequency range; you can modulate the VHF signal on any one of these carrier frequencies. Moreover, this firmware option supports two frequency allocation modes, a single frequency and a multiple frequency transmission.

Wenn you chose the frequency allocation mode, consider the follwoing:

- **Single frequency** mode is suitable to simulate the signal of up to eight VDB transmitters modulated on the same carrier frequency.
  The signal calculation is fast and optimized for time sensitive applications.
  This mode is also the choice if the DUT or the analyzing equipment supports single band decoding.
- **Multiple frequency channels** mode is suitable to allocate the VDB transmitters to up to 8 out of 11 adjacent frequency channels.
  The generated signal is optimized for reduced adjacent and co-channel interference to neighboring systems. The setting time, however, increase significantly compared to the single frequency mode.



The frequency related settings are split into several dialogs. To allocate the VDB in the frequency domain, set the central frequency ("Status Bar > Frequency"), define the frequency allocation mode ("GBAS > Multiple Frequency Channels") and use the VDB transmitter configuration settings, see "Freq. Num" on page 28.

For step-by-step instruction, refer to chapter 9.1, "Generating GBAS Signals with Several Frequency Channels", on page 97.

Broadcast timing structure

The broadcast is a Time Division Multiple Access (TDMA). According to [1], the TDMA timing structure uses a two level hierarchy, composed of 500 ms long frames, each divided into 8 VDB time slots (A - H), see figure 3-2.

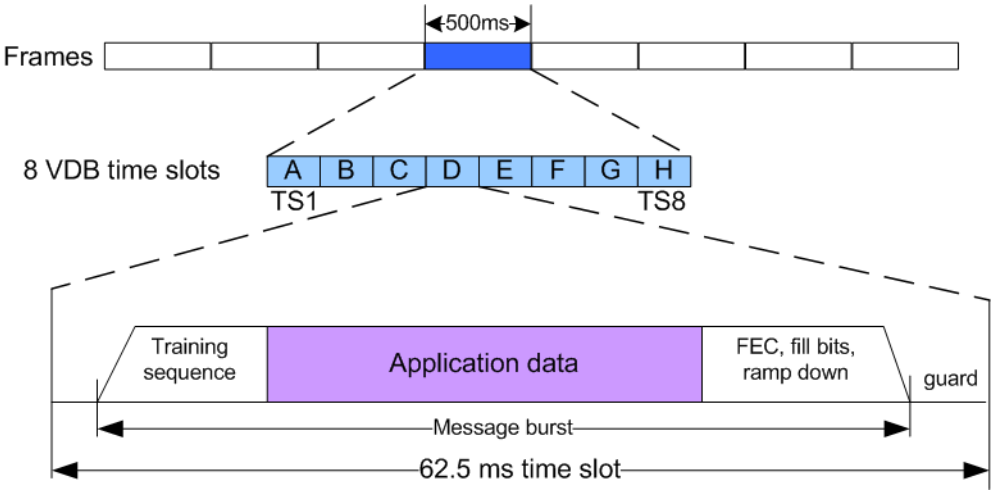


Fig. 3-2: TDMA timing structure (simplified representation)

A VDB time slot is the minimum resource that an individual VDB transmitter can use. During one time slot a VDB transmitter transmits exactly one bursts.

The GBAS specification RTCA DO-246D defines the TDMA timing structure, including timing budget of the VDB bursts, burst data contents and message encoding in great details. The R&S SMBV generates the required training sequence, encodes the message according to RTCA DO-246D and applies the D8PSK modulation automatically, so that you can concentrate on the configuration of the mandatory application data. Optional application data defined in RTCA DO-246D is beyond the scope of this implementation.

To allocate the VDB in the time domain, use the scheduling settings, see chapter 4.3, "Scheduling Settings", on page 30.

Refer to figure 3-3 for illustration on how a multi frequency TDMA scheduling is performed in this implementation.

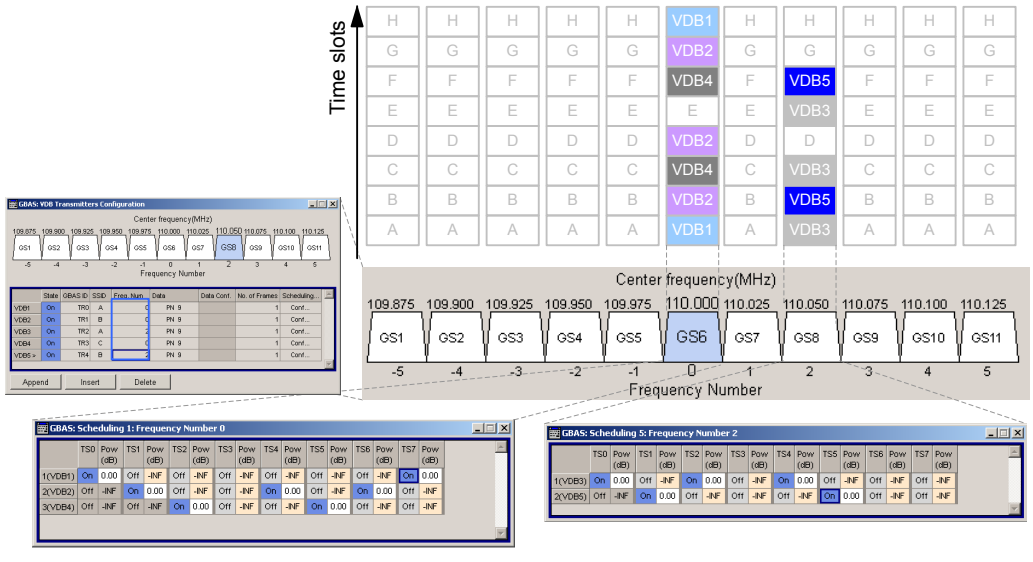


Fig. 3-3: Example of a multi frequency TDMA scheduling

For step-by-step instruction, refer to chapter 9.3, "Generating a GBAS Signal for VDB Slot Detection", on page 99.

Power settings

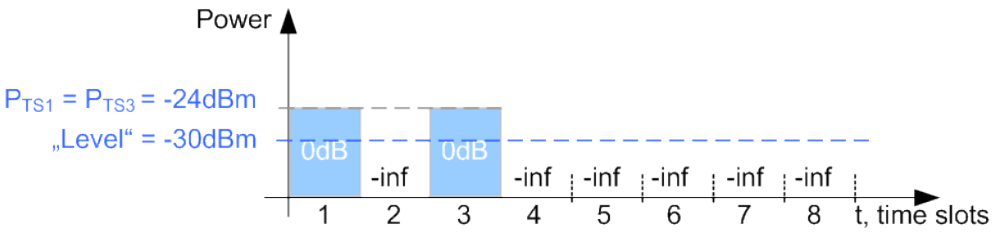
In the R&S SMBV, the following parameters have impact on the signal power of the time slots:

- **RF output power** ("Status Bar > Level")
  Defines the RMS level of the generated signal
- **Relative power per time slot** ("GABS > VDB Transmitters Configuration > VDB# > Scheduling > Pow")
  Sets the relative power of a VDB per time slot (TS).
- **Power generation mode** ("GBAS > Gated Power Mode")
  Defines the way the absolute power of a VDB per time slot is calculated.
  The absolute power of a single time slot depends on the power settings of the remaining time slots.
  See example "Calculating the power per time slot in "Gated Power Mode > Off"" on page 17 and example "Calculating the power per time slot in "Gated Power Mode > On"" on page 18 for explanation on how the parameter "Gated Power Mode" influence the calculation.

For step-by-step instruction, refer to chapter 9.2, "Generating a GBAS Signal for Receiver Sensitivity Tests", on page 98.

Example: Calculating the power per time slot in "Gated Power Mode > Off"

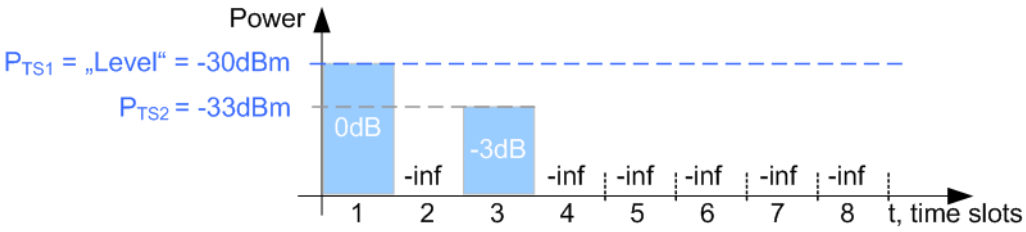
- "Level = - 30 dBm"
- "TS1 > State > On", relative power "TS1 > Pow(dB) = 0 dB"
- "TS3 > State > On", relative power "TS3 > Pow(dB) = 0 dB"
- "TS2/TS4/TS5/TS6/TS7/TS8 > State > Off"
  "TS2/TS4/TS5/TS6/TS7/TS8 > Pow(dB) = -inf"



The absolute power of both scheduled time slots is $P_{TS1} = P_{TS3} = -24$ dBm.

Example: Calculating the power per time slot in "Gated Power Mode > On"

- "Level = - 30 dBm"
- "TS1 > State > On", relative power "TS1 > Pow(dB) = 0 dB"
- "TS3 > State > On", relative power "TS3 > Pow(dB) = -3 dB"
- "TS2/TS4/TS5/TS6/TS7/TS8 > State > Off"
  "TS2/TS4/TS5/TS6/TS7/TS8 > Pow(dB) = -inf"



The absolute power of the scheduled time slots is:

- P_{TS1} = -30 dBm
- P_{TS3} = -33 dBm.

Supported message types

The GBAS specification RTCA DO-246D defines the following mandatory message types. This implementation supports all required message types. Refer totable 3-1 for information on where to find the related settings.

Table 3-1: Overview of the required message types

Message Type	Description	Related settings
1	Differential Corrections 100 sec smoothed pseudor-anges	chapter 4.4.3, "Differential GNSS Parame-ters", on page 41
2	GBAS Related Data	chapter 4.4.1, "Message Type 2 Parame-ters", on page 31
4	Final Approach Segment (FAS) Construction Data	"FAS Data Set" on page 35
	Terminal Area Path (TAP) Construction Data	"TAP Data Set" on page 39
11	Differential Corrections 30 sec smoothed pseudor-anges	chapter 4.4.3, "Differential GNSS Parame-ters", on page 41

For step-by-step instruction, refer to chapter 9.4, "Generating a GBAS Signal for Mes-sage Format Detection", on page 100.

Rohde&Schwarz solution for radio analysis

If your task requires verifications and measurements of GBAS installations on the ground and in the air, consider to use the R&S®EVS300 ILS/VOR analyzer.

This instrument is a portable level and modulation analyzer. If equipped with the required options, it is capable to performe VHF data link measurements on GBAS as well as measurements on conventional ILS ground systems and VOR systems.

3.2 The Instrument Landing System (ILS)

The instrument landing system is used during the landing approach and monitors the correct approach path to the runway.

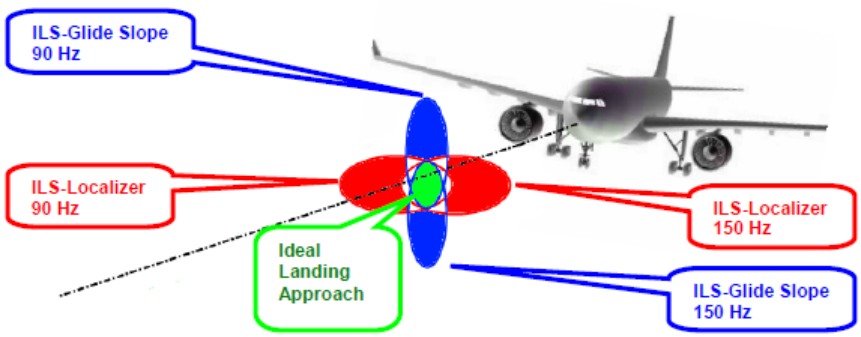


Fig. 3-4: Approach navigation using instrument landing system (ILS) [1MA193]

An ILS system consists of three independent subsystems:

- A glide slope for vertical guidance.
- A localizer for horizontal guidance.
- (optional) marker beacons

Glide Slope

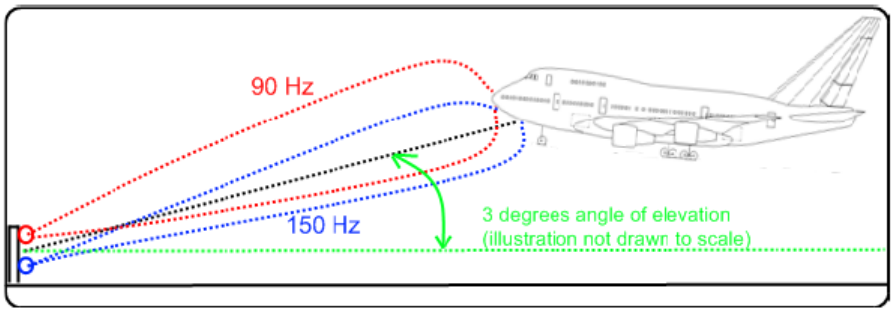
The glide slope transmitter is located near the end of the runway (nearest to the start of the aircraft approach).

Typically, vertically aligned antennas transmit two intersecting main beams on top of one another at carrier frequencies between 329 MHz and 335 MHz. 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 singal 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.

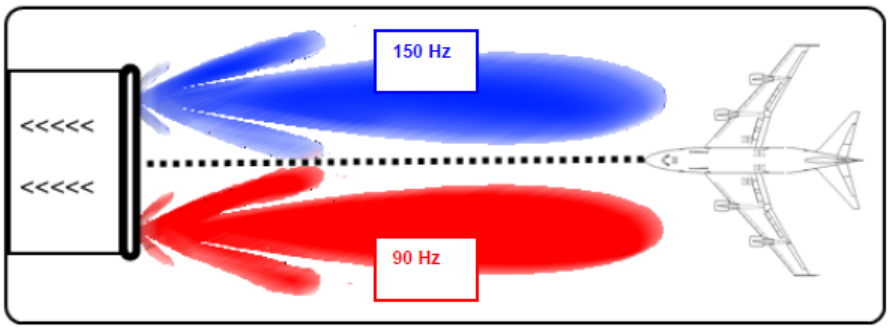


Localizer

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. 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 singal strength from both beams is equal: the aircraft is in the center, on the right course.



Marker Beacons

Marker beacon (MB) receivers are used for a rough distance measurement. They are available only for some ILS installations.[1MA193]

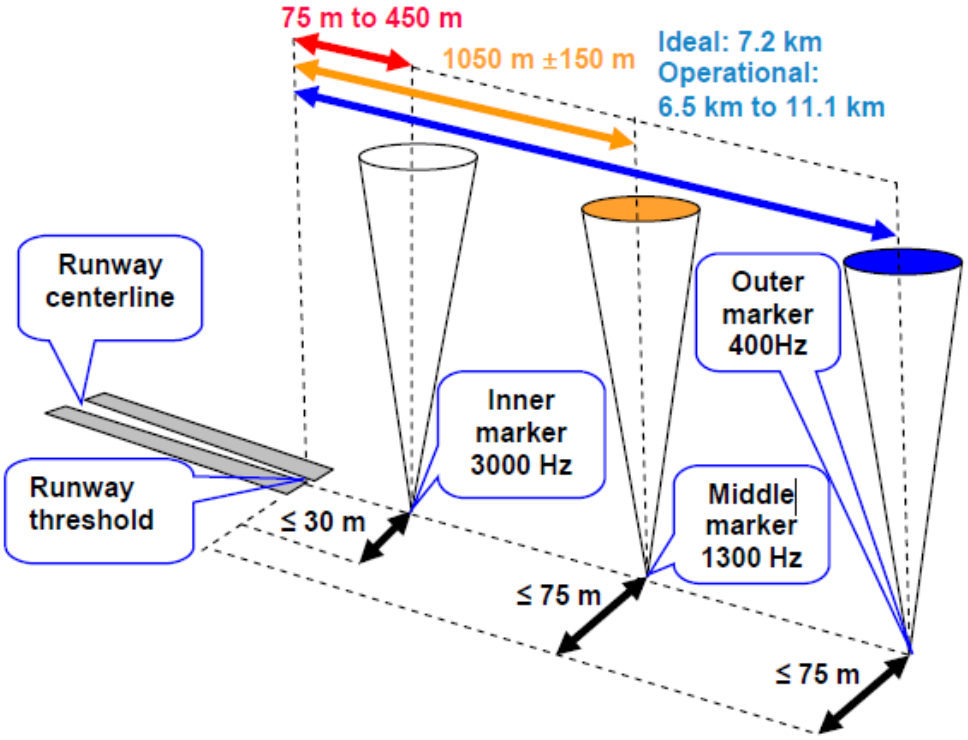


Fig. 3-5: Marker beacon placement with respect to runway

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).

3.3 VHF Omni Directional Radio Range (VOR)

Very high frequency (VHF) omnidirectional radio range (VOR) is used for radio navigation and helps aircrafts to determine their 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, with the code identification (COM/ID) transmitting on a modulation tone of 1.020 kHz. It emitts two type 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.

3.4 Distance Measurement Equipment (DME)

DME is a radar system used to determine the slant distance of an aircraft (= DME interrogator) to a ground station (= DME transponder). For this purpose, shaped RF double pulses are transmitted by the aircraft to the ground station and, after a defined delay (= reply delay), the ground station sends the pulses back again. The receiver in the aircraft uses the round trip time of the double pulses to determine the distance to the ground station.

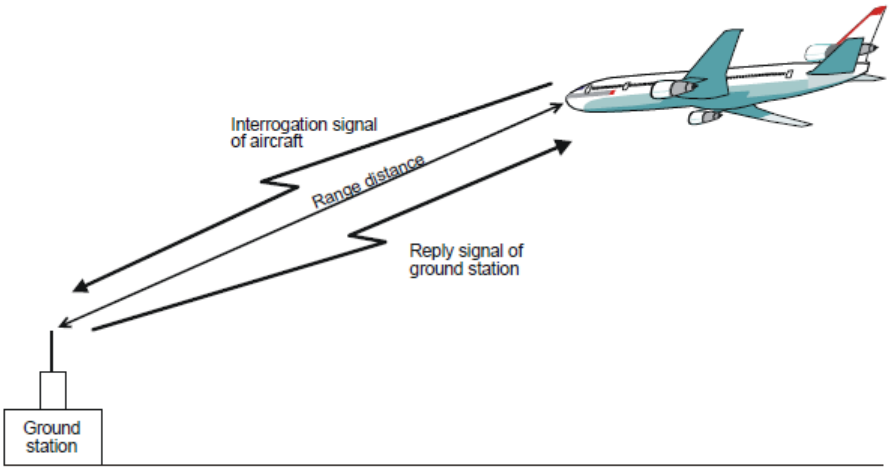


Fig. 3-6: DME principle

Most DME ground stations are combined with a VOR system in order to allow an aircraft to determine its precise position relative to this station. The DME channels are paired with the VOR channels and range from 1025 MHz to 1150 MHz for the aircraft transmitter and 962 MHz to 1213 MHz for the ground stations. The frequency delta between received and transmitted signal is always 63 MHz. The channel spacing between the various DME channels is always 1 MHz.

Each channel has two different codings (X and Y) that differ with regard to 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 ATC authority.

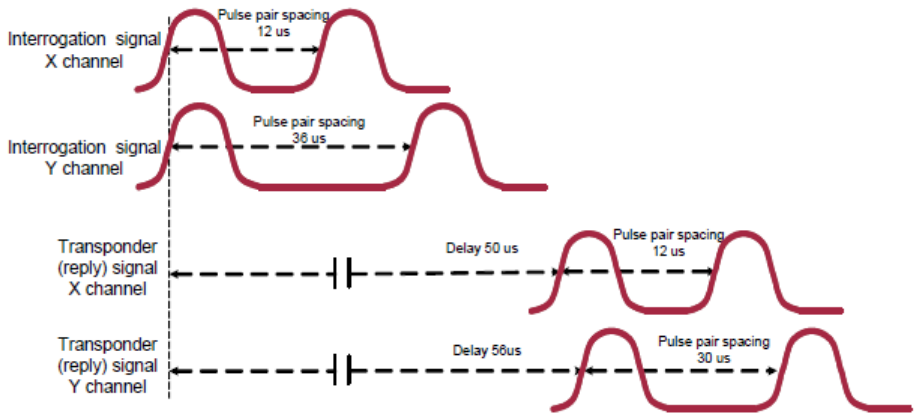


Fig. 3-7: Time characteristic of DME signal envelope for X and Y channel

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 the 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. It then uses this time to calculate the slant range to the ground station. The distance is usually indicated in nautical miles (NM), where 1 NM corresponds to 1852.02 m and a signal round trip time of 12.359 us. As a result, by taking the flight altitude above ground as well as the azimuth angle between the aircraft and ground station (VOR system) into consideration, it is possible to determine the precise position of the aircraft.

DME Transponder

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

After a valid DME double pulse is received (i.e. after the 2nd pulse is received), the receiver at first does not react to any further interrogations for 60 us (= dead time) to ensure that it does not trigger again to its own transmitted reply. The receiver is therefore 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. This ensures that the gap between two consecutive pulses is always at least 60 us.

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

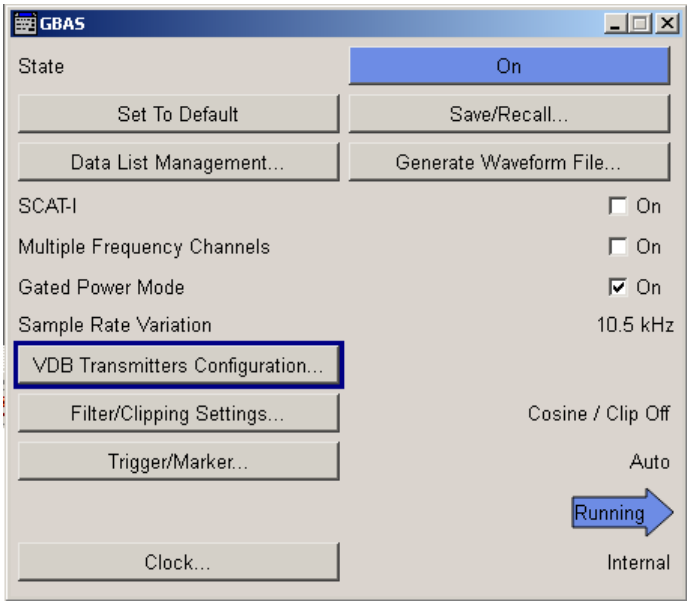
4 GBAS Configuration and Settings

► To access the GBAS settings, select "Baseband > Avionics > GBAS".

The remote commands required to define these settings are described in chapter 10.2, "GBAS Settings", on page 110.

4.1 General Settings

This dialog provides access to the default and the "Save/Recall" settings, as well as to the general settings of the option and the dialogs with further cinfiguration settings. The dialog dispalys an indication of the selected key parameters.



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

Remote command:
`<subsystem>:STATe` on page 108

Set To Default
Calls the default settings. The values of the main parameters are listed in chapter A.3, "Default Settings", on page 199.

Remote command:
`<subsystem>:PRESet` on page 108

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

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

Remote command:
`<subsystem>:SETTing:CATalog` on page 108
`<subsystem>:SETTing:STORe` on page 109
`<subsystem>:SETTing:STORe:FAST` on page 109
`<subsystem>:SETTing:LOAD` on page 109
`<subsystem>:SETTing:DELete` on page 108

Data List Management
Accesses the "Data List Management" dialog. In this dialog you can create and edit a data list.

The instrument stores all data lists as files with the predefined file extension `*.dm_iqd`. You can define the file name and the directory they are stored in.

To use an existing data list as a data source,
- select "VDB Transmitters Configuration > VDB# > Data Source > Data List" and
- select "Data Config > Select Data List > navigate to the list file *.dm_iqd > Select".

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

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

Remote command:
`[:SOURce<hw>]:BB:GBAS:WAVeform:CREate` on page 115

SCAT-I
Enables using of SCAT-I header information instead of the default LAAS (GBAS) header.

The modulation and TDMA schemes of both systems are identical; the header start byte is set as listed in table 4-1.

Table 4-1: Header start byte

Landing system	Header start byte
LAAS (GBAS)	0xAAh
SCAT-I	0x99h

Remote command:
`[:SOURce<hw>]:BB:GBAS:SCATi` on page 115

Multiple Frequency Channels
Enables the configuration of VHF Data Broadcast (VDB) transmissions on more than one frequency channels.

See "Carrier frequencies and frequency channels" on page 15.

Remote command:
[:SOURce<hw>]:BB:GBAS:MFCHannels on page 115

Gated Power Mode
Enables gated power mode, see "Power settings" on page 17.

Remote command:
[:SOURce<hw>]:BB:GBAS:GPOW on page 116

Sample Rate Variation/Sample Rate Info
Sets/displays the used sample rate variation. You can set the sample rate value in the "Filter/Clipping Settings" dialog.

This setting can be used for testing the symbol rate tolerance.

The RTCA DO-246D specification defines a symbol rate of the GBAS data broadcast as 10500 symbols/sec. Because of the used modulation (see Modulation Type), each symbol defines one of eight states. This results in a nominal bit rate of 31500 bits/s.

Remote command:
[:SOURce<hw>]:BB:GBAS:MSET:SRATe? on page 138
[:SOURce<hw>]:BB:GBAS:SRINfo? on page 116

VDB Transmitters Configuration
Access the "VDB Transmitters Configuration" dialog, see chapter 4.2, "VDB Transmitters Configuration Settings", on page 27.

Filter / Clipping
Access to the dialog for setting baseband filtering, clipping and modulation, see chapter 4.5, "Filter/Clipping Settings", on page 42.

Trigger/Marker
Accesses the dialog for selecting the trigger source, for configuring the marker signals and for setting the time delay of an external trigger signal, see chapter 8.1, "Trigger Settings", on page 85 and chapter 8.2, "Marker Settings GBAS", on page 90.

The currently selected trigger source is displayed to the right of the button.

Execute Trigger
Executes trigger manually.

You can execute the trigger manually only if you select an internal trigger source and a trigger mode other than "Auto".

Remote command:
[:SOURce<hw>]:BB:GBAS:TRIGger:EXECute on page 183
[:SOURce<hw>]:BB:ILS:TRIGger:EXECute on page 183
[:SOURce<hw>]:BB:VOR:TRIGger:EXECute on page 183
[:SOURce<hw>]:BB:DME:TRIGger:EXECute on page 183

Arm
For trigger modes "Armed Auto" and "Armed Retrigger", stops the signal generation until subsequent trigger event occurs.

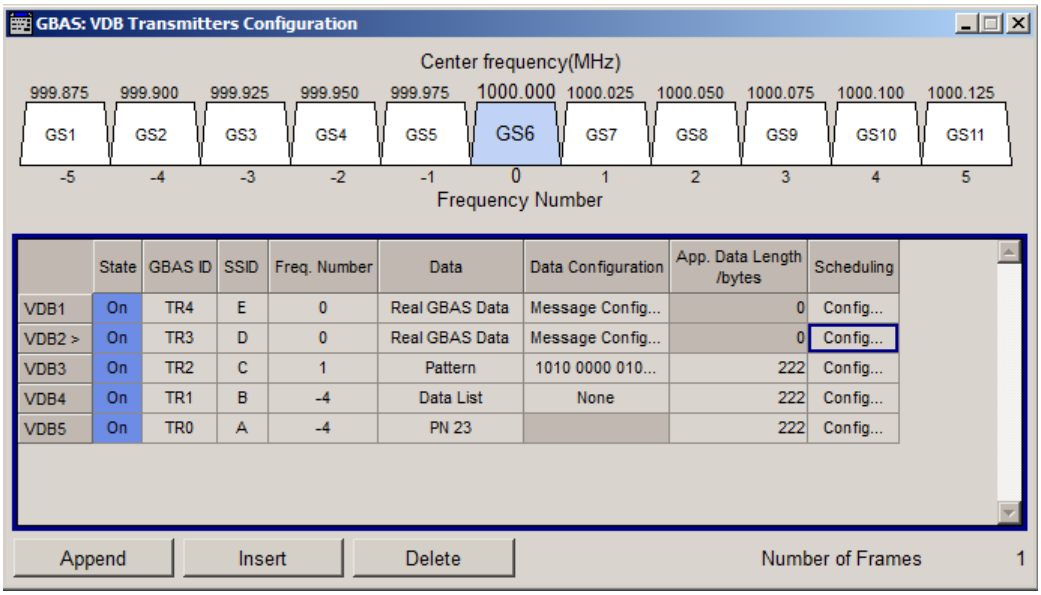
Remote command:
`[:SOURce<hw>]:BB:GBAS:TRIGger:ARM:EXECute` on page 182
`[:SOURce<hw>]:BB:ILS:TRIGger:ARM:EXECute` on page 182
`[:SOURce<hw>]:BB:VOR:TRIGger:ARM:EXECute` on page 182
`[:SOURce<hw>]:BB:DME:TRIGger:ARM:EXECute` on page 182

Clock
Accesses the dialog for selecting the clock source, see "Clock" on page 27.

4.2 VDB Transmitters Configuration Settings

To access this dialog:

1. Select "GBAS > Main dialog > VDB Transmitters Configuration".



The dialog comprises the settings, necessary to configure the VHF Data Broadcast (VDB) signals.
The graph visualizes 11 adjacent frequency channels, symmetrically located around the current central frequency. To define the central frequency, set the parameter "Status Bar > Frequency". In the graph, the central frequency is referred as frequency number 0.
The frequency channel of the selected VDB is highlighted.

2. Select "VDB Transmitters Configuration > Append" to add new VDB transmitter.

State
Enables the selected VHF Data Broadcast (VDB) transmitter.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:STATe` on page 117

GBAS ID
Sets the GBAS ID, that is a four-character (24-bit) alphanumeric field that identifies the ground station broadcasting the message. Permitted are capital letter, numbers and "space".

To identify a ground station, the airbone receive examine the combination of the GBAS ID and the SSID.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:GID` on page 117

SSID
Sets the Station Slot Identifier SSID of the of the ground station.

According to RTCA DO-246D, the SSID is a numeric value from 0 to 7, corresponding to the letter designation (A through H) of the first time slot assigned to a particular ground reference station, where slot A = 0 and slot H = 7. All messages in all time slots employed by a particular ground station use the same SSID.

To identify a ground station, the airbone receive examine the combination of the "GBAS ID" on page 28 and the SSID.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:SSID` on page 117

Freq. Num
Sets the frequency number and defines the frequency band the corresponding VDB is using, see "Carrier frequencies and frequency channels" on page 15.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:FNUMber` on page 118

Data/Data Config
Select the data source for the VDB.

The following standard data sources are available:

- "All 0, All 1"
  An internally generated sequence containing 0 data or 1 data.
- "PNxx"
  An internally generated pseudo-random noise sequence.
- "Pattern"
  An internally generated sequence according to a bit pattern.
  Use the "Pattern" box to define the bit pattern.
- "Data List/Select DList"
  A binary data from a data list, internally or externally generated.
  Select "Select DList" to access the standard "Select List" dialog.
  – Select the "Select Data List > navigate to the list file *.dm_iqd > Select" to select an existing data list.

– Use the "New" and "Edit" functions to create internally new data list or to edit an existing one.
– Use the standard "File Manager" function to transfer external data lists to the instrument.

See also "Main Dialog > Data List Management".

"Real GBAS Data"
Enables you to configure the content of the GBAS messages.
Select "Data Config > Config." to access the provided settings.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:DATA` on page 118
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:DATA:DSELection` on page 118
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:DATA:PATTern` on page 119

App. Data Length/bytes
Sets the application data length.

For "Data/Data Config > Real GBAS Data" the value of the application data length is not variable but is automatically set and calculated.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:DLENgth` on page 118

No. of Frames
Displays the automatically calculated number of frames of the selected VDB.

Remote command:
`[:SOURce<hw>]:BB:GBAS:NOFRames?` on page 119

Scheduling
Accesses the dialog for configuring the scheduling in the time domain, see chapter 4.3, "Scheduling Settings", on page 30.

Append, Insert, Delete
You can configure up to 8 VDB transmitters. Use the appropriate general functions:

"Append" Adds a new row in the table of VDB transmitters.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB:APPend` on page 116

"Insert" Adds a new row above the currently selected one.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:INSert` on page 116

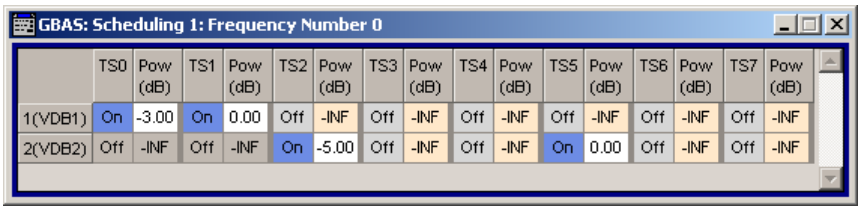
"Delete" Deletes the selected row.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:DELete` on page 117

4.3 Scheduling Settings

To access this dialog:

1. Select "GBAS > Main dialog > VDB Transmitters Configuration".
2. Select "VDB Transmitters Configuration > VDB# > Scheduling > Config"



The dialog comprises the settings, necessary to configure the time domain scheduling of the VDB transmitters on the selected frequency. The transmisson is based on TDMA and hence on one particular frequency you can allocate only one VDB transmitter per one time slot (TS).
For more information, see "Broadcast timing structure" on page 15.

TS0..TS7
Enables the VDB in the corresponding time slot (TS).

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:SCH:TS<st>:STATe` on page 119

Pow(dB)
Sets the relative power of a VDB per time slot (TS).

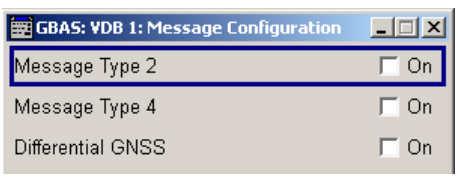
See "Power settings" on page 17 for more information.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:SCH:TS<st>:POWer` on page 119

4.4 Message Configuration Settings

To access this dialog:

1. Select "GBAS > Main dialog > VDB Transmitters Configuration".
2. Select "VDB Transmitters Configuration > VDB# > Data > Real GBAS Data"
3. Select "Data Config > Msg. Config".



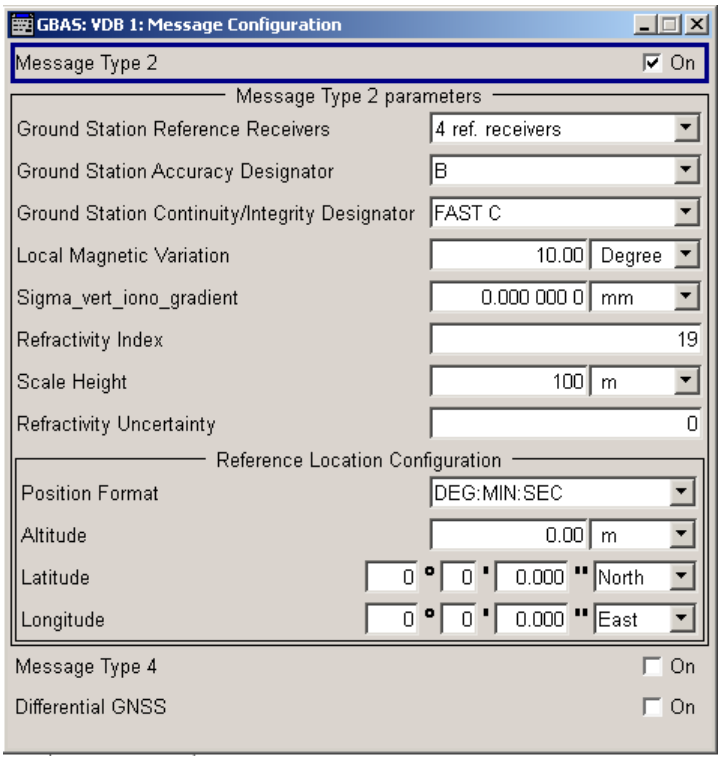
The dialog comprises the settings, necessary to configure the messages of each of the VDB transmitters.

4. Select "Message Configuration > Message Type 2/4 > On" to enable configuration of the particular message.
5. Select "Message Configuration > Differential GNSS > On" to enable the load of a file containing differential GBAS settings.

4.4.1 Message Type 2 Parameters

The dialog comprises the parameters of message type 2, according to RTCA DO-246D, Table 2.14.

Message type 2 carries information on the exact location for which the are referenced as well as other GBAS related parameters.



Provided are the following settings:

Message Type 2
Enables you to configure the parameters of message type 2, according to RTCA DO-246D, Table 2.14.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:MT2State` on page 130

Ground Station Reference Receivers
Selects the number of the GNSS reference receivers installed in this system.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:GSRReceivers` on page 126

Ground Station Accuracy Designator
Selects the letter designator indicating the minimum signal-in-space accuracy performance provided by the ground station.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:GSADesignator` on page 126

Ground Station Continuity/Integrity Designator
Selects the numerical designator that indicates the operational status of GBAS.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:GCID` on page 125

Local Magnetic Variation
Sets the published local magnetic variation at the differential reference point. A positive value represents an east variation (clockwise from true north).

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:LMVariation` on page 128

Sigma_vert_iono_gradient
Sets the parameter $\sigma_{vert\_iono\_gradient}$, that is the standard deviation of a normal distribution associated with the residual ionospheric uncertainty due to spatial decorrelation.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:SVIGradient` on page 134

Refractivity Index
Sets the estimated tropospheric refractivity index N_R at the reference point

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:RFINdex` on page 131

Scale Height
Sets the parameter scale height (h_0), used for scaling the tropospheric refractivity as a function of differential altitude.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:SHEight` on page 133

Refractivity Uncertainty
Sets the parameter σ_N, that is the standard deviation of a normal distribution associated with the residual tropospheric uncertainty.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:RUNCertainty` on page 133

Reference Location Configuration
The coordinates of the ground station reference point are defined in WGS84 coordinates. In this coordinate system, a location is identified by three coordinates, the altitude, the latitude and the longitude. The last two can be displayed in decimal or DMS format. Use the parameter "Position Format" to select the display format.

Table 4-2: Reference location configuration

Parameter	Description
"Position Format"	Sets the format in which the Latitude and Longitude are displayed. • "DEG:MIN:SEC" The display format is Degree:Minute:Second and Direction, i.e. `XX°XX'XX.XX" Direction`, where direction can be North/South and East/West. • "Decimal Degree" The display format is decimal degree, i.e. `+/-XX.XXXXX°`, where "+" indicates North and East and "-" indicates South and West.
"Altitude"	Sets the altitude of the ground station reference point, that is the height above the ellipsoid (HAE) altitude.
"Latitude"	Sets the latitude of the ground station reference point.
"Longitude"	Sets the longitude of the ground station reference point.

Remote command:
to enter the coordinates in Degree:Minute:Second format
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:LOCation:COORdinates:DMS` on page 129
to enter the coordinates in decimal degree format
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:LOCation:COORdinates:DECimal` on page 129

4.4.2 Message Type 4 Parameters

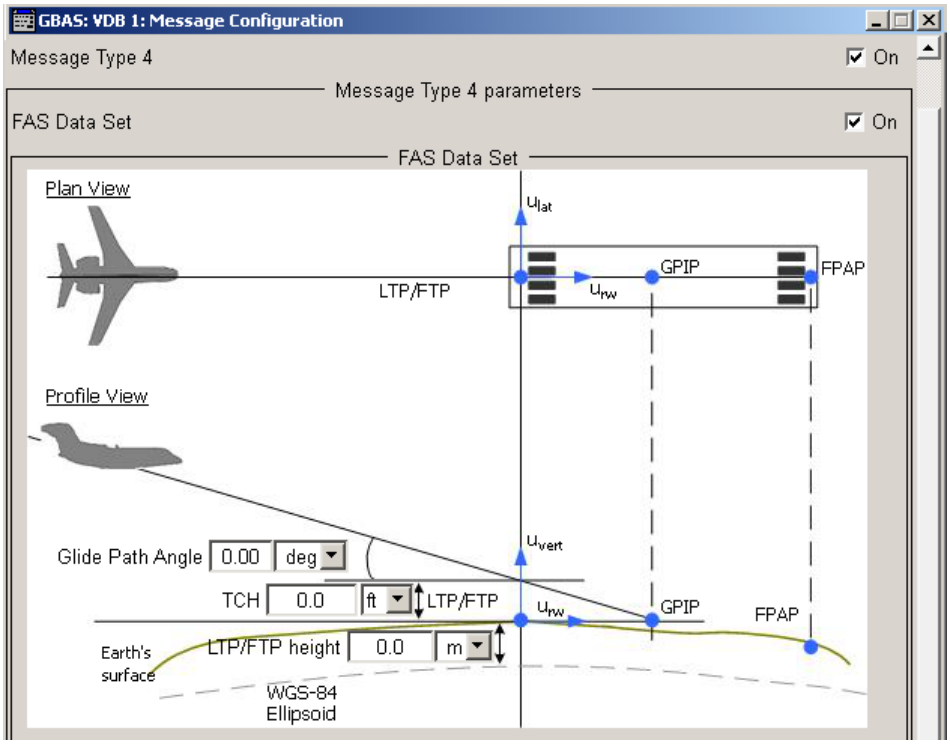
To access this settings:

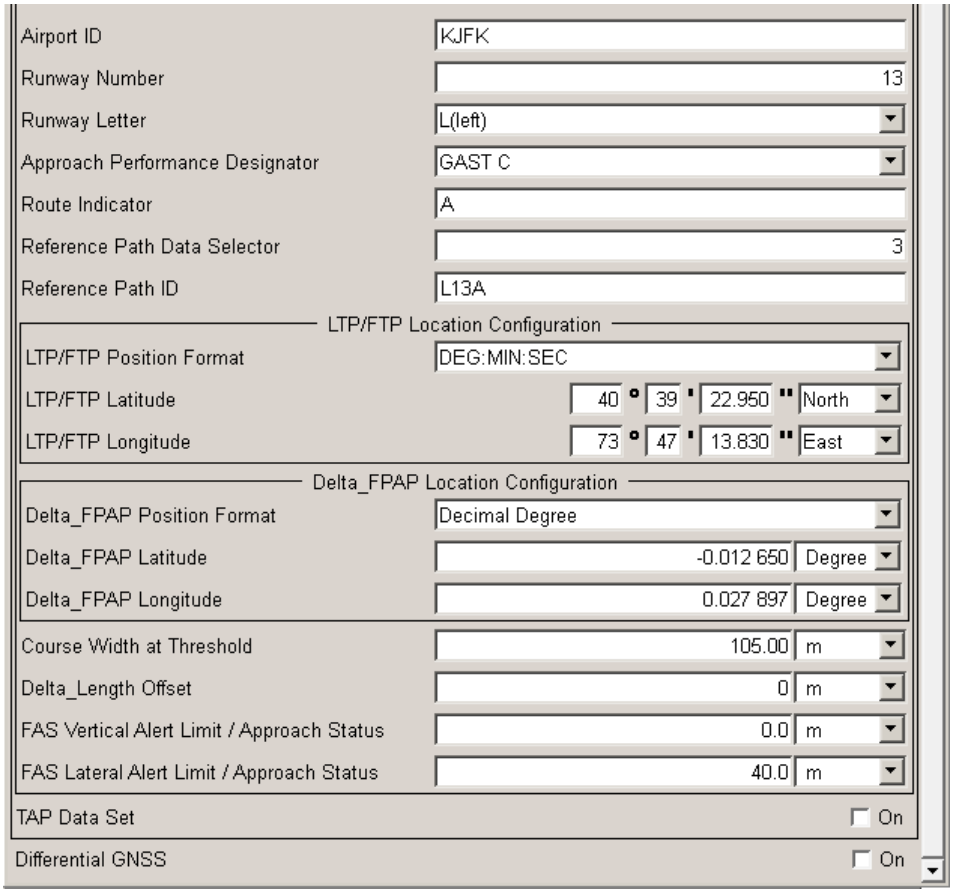
1. Select "GBAS > Main dialog > VDB Transmitters Configuration".
2. Select "VDB Transmitters Configuration > VDB# > Data > Real GBAS Data"
3. Select "Data Config > Msg. Config".
4. Select "Message Configuration > Message Type 4 > On"
5. Enable "FAS Data Set > On"
6. Enable "TAP Data Set > On"

   The dialog comprises the parameters of message type 4, according to RTCA DO-246D, Table 2.14.
   According to the RTCA DO-246D, the Message Type 4 contains one or more data sets that contain approach data, associated vertical/lateral alert limits, and/or the Terminal Area Path (TAP). With the settings provided in this dialog, you can configure the Final Approach Segment (FAS) data set, the TAP data set or both.

Message Type 4

Enables you to configure the parameters of message type 4, according to RTCA DO-246D, Table 2.18.





Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:MT4State` on page 130

FAS Data Set
Enables you to configure the parameters of the Final Approach Segment (FAS) data set.

Provided are the parameters necessary to configure a single precision approach. The FAS path is a line in space that defines the path an airplane follows on its final approach. This line is defined by the Landing Threshold Point/Fictitious Threshold Point (LTP/FTP), Flight Path Alignment Point (FPAP), Threshold Crossing Height (TCH), and the Glide Path Angle (GPA).

The dialog displays also two graphs, a "Plan View" and a "Profile View", to visualize a typical final approach path.

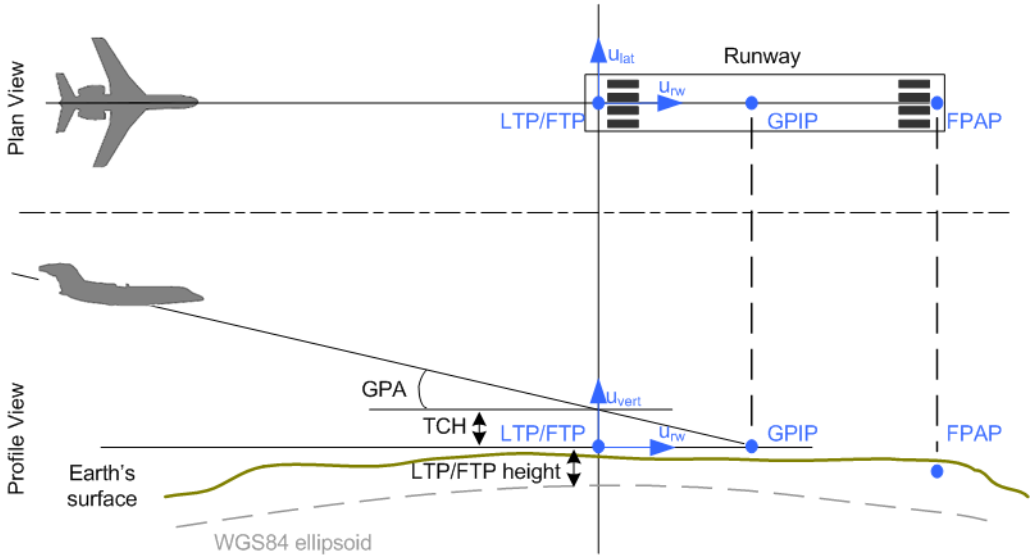


Fig. 4-1: Final Approach Segment (FAS) diagram, according to RTCA DO-246D

LTP/FTP = Landing Threshold Point/Fictitious Threshold Point; point at the center of the landing runway, defined by its WGS84 coordinates
GPIP = Glide Path Intercept Point; the point where the final approach path intercepts the local level plane
FPAP = Flight Path Alignment Point; point at the end of the runway that in conjunction with the LTP/FTP defines the geodesic plane of the precision final approach, landing and flight path.
TCH = Threshold Crossing Height
GAP = Glide Path Angle; angle at the TCH that describes the intended angle of descent at the final approach path.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:FDSState` on page 124

Plan View/Profile View Parameters ← FAS Data Set
The following parameters define the approach path (see also figure 4-1):

"Glide Path Angle"
Sets the angle of the FAS path (glide path) with respect to the horizontal plane tangent to the WGS84 ellipsoid at the LTP/FTP.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:GPANgle` on page 126

"TCH"
Sets the threshold crossing height (TCH) , that is the height of the FAS path above the LTP/FTP defined in either feet or meters.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:ATCHeight` on page 120
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:ATUSelector` on page 120

"LTP/FTP Height"
Sets the height of the LTP/FTP above the WGS84 ellipsoid.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:LFLocation:HEIGht` on page 128

Airport ID ← FAS Data Set
Sets the airport identification as three or four alphanumeric characters used to designate airport facilities. Permitted are upper letters, numbers and "space".

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:AID` on page 120

Runway Number ← FAS Data Set
Sets the approach runway number.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:RNUMber` on page 132

Runway Letter ← FAS Data Set
Sets the runway letter, to distinguish between parallel runways. The conventional designation is used.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:RLETter` on page 131

Approach Performance Designator ← FAS Data Set
Sets the general information about the approach design. The conventional designation is used.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:APDesignator` on page 120

Route Indicator ← FAS Data Set
Sets the route indicator, that is a single alphabetic character used to differentiate between multiple approaches to the same runway end. Allowed are the upper case letters, excluding “I” and “O”, or the “space” character.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:RUINdicator` on page 133

Reference Path Data Selector ← FAS Data Set
Sets the reference path data selector (RPDS), that is a numerical identifier that is unique on a frequency in the broadcast region and used to select the FAS.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:RPDF` on page 132

Reference Path ID ← FAS Data Set
Sets the reference path identifier as three or four alphanumeric characters used to designate the reference path.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:RPIF` on page 132

LTP/FTP Location Configuration ← FAS Data Set
The coordinates of the LTP/FTP are defined in WGS84 coordinates. In this coordinate system, a location is identified by three coordinates, the altitude, the latitude and the longitude. The last two can be displayed in decimal or DMS format. Use the parameter "Position Format" to select the display format.

Use the parameter LTP/FTP Height to define the altitude.

Table 4-3: LTP/FTP location configuration

Parameter	Description
"Position Format"	Sets the format in which the Latitude and Longitude are displayed. • "DEG:MIN:SEC" The display format is Degree:Minute:Second and Direction, i.e. `XX°XX'XX.XX" Direction`, where direction can be North/South and East/West. • "Decimal Degree" The display format is decimal degree, i.e. `+/-XX.XXXXX°`, where "+" indicates North and East and "-" indicates South and West.
"Latitude"	Sets the latitude of the LTP/FTP in arc seconds.
"Longitude"	Sets the longitude of the LTP/FTP in arc seconds.

Remote command:
to enter the coordinates in Degree:Minute:Second format
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:LFLocation:COORdinates:DMS` on page 127
to enter the coordinates in decimal degree format
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:LFLocation:COORdinates:DECimal` on page 126

Delta_FPAP Location Configuration ← FAS Data Set
The Delta FPAD (ΔFPAD) represents the difference of latitude/longitude of the runway Flight Path Alignment Point (FPAP) from the LTP/FTP.

The Delta FPAD coordinates are defined in WGS84 coordinates. In this coordinate system, a location is identified by three coordinates, the altitude, the latitude and the longitude. The last two can be displayed in decimal or DMS format. Use the parameter "Position Format" to select the display format.

Table 4-4: Delta_FPAP location configuration

Parameter	Description
"Position Format"	Sets the format in which the Latitude and Longitude are displayed. • "DEG:MIN:SEC" The display format is Degree:Minute:Second and Direction, i.e. `XX°XX'XX.XX" Direction`, where direction can be North/South and East/West. • "Decimal Degree" The display format is decimal degree, i.e. `+/-XX.XXXXX°`, where "+" indicates North and East and "-" indicates South and West.
"Latitude"	Sets the difference of latitude of the FPAP in arc seconds. Positive values indicate the FPAP latitude north of LTP/FTP latitude.
"Longitude"	Sets the difference of longitude of the FPAP in arc seconds. Positive values indicate the FPAP longitude east of LTP/FTP longitude.

Remote command:
to enter the coordinates in Degree:Minute:Second format
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:DFLocation:COORdinates:DMS` on page 121
to enter the coordinates in decimal degree format
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:DFLocation:COORdinates:DECimal` on page 121

Course Width at Threshold ← FAS Data Set
Sets the lateral displacement from the path defined by the FAS at the LTP/FTP at which full-scale course deviation indicator (CDI) deflection is attained.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:CWAThreshold` on page 121

Delta_Length Offset ← FAS Data Set
Sets the parameter delta length (ΔLength) offset, that is the distance from the stop end of the runway to the FPAP.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:DLOFfset` on page 124

FAS Vertical Alert Limit / Approach Status ← FAS Data Set
Sets the value of the broadcast vertical alert limit.

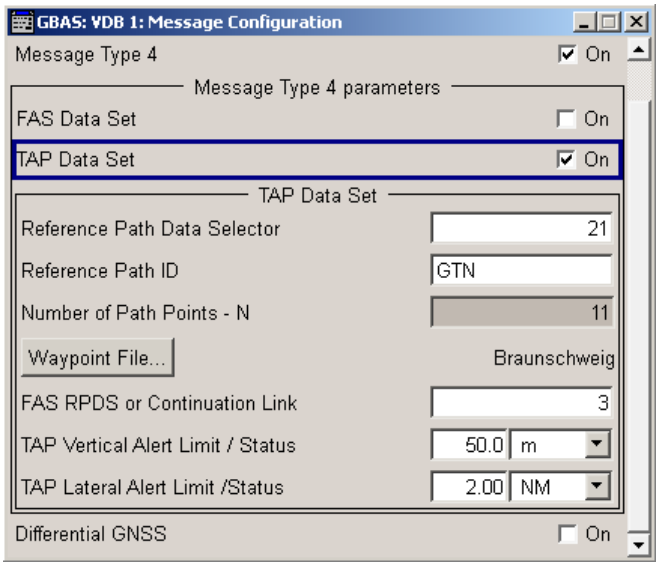
Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:FVAA` on page 125

FAS Lateral Alert Limit / Approach Status ← FAS Data Set
Sets the value of the broadcast lateral alert limit.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:FLAA` on page 124

TAP Data Set
Enables you to configure the parameters of the Terminal Area Path (TAP) data set.

A TAP defines the initial fix (IF), track-to-fix (TF) and radius-to-fix (RF) legs and provides additional support for terminal area operations.



Remote command:
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:TDSState on page 134

Reference Path Data Selector ← TAP Data Set
Sets the reference path data selector, that is a numerical identifier that is unique on a frequency in the broadcast region and used to select the TAP.

Remote command:
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:RPDT on page 132

Reference Path ID ← TAP Data Set
Sets the reference path identifier as three or four alphanumeric characters used to designate the reference path.

Remote command:
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:RPIT on page 133

Number of Path Points - N ← TAP Data Set
Indicates the total number of path points included in this TAP.

Remote command:
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:NOPPoint on page 131

Waypoint File ← TAP Data Set
Accesses the "Select Waypoint File" dialog to select predefined or user defined waypoint files.

A waypoint file is description of a moving scenario, like for example a sequence of positions. A waypoint file must have the extension `*.txt` and file format as described in chapter A.4.1, "Waypoint File Format", on page 202.

Use the "Predefined Files" fuction, to load a predefined file.

Remote command:
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:WAYPoint:PREDefined:CATalog? on page 135
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:WAYPoint:USER:CATalog? on page 135
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:WAYPoint:PREDefined:FILE on page 135
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:WAYPoint:USER:FILE on page 135
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:WAYPoint:FILE? on page 136

Predefined Files ← TAP Data Set
Access a list with predefined files.

FAS RPDS or Continuation Link ← TAP Data Set
Sets the FAS reference path data selector (RPDS) or the continuation link. Continuation link is the RPDS for the next segment that is a continuation of the previous segment.

Remote command:
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:FRCLink on page 125

TAP Vertical Alert Limit / Status ← TAP Data Set
Sets the value of the broadcast vertical alert limit.

Remote command:
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:TVAS on page 134

TAP Lateral Alert Limit / Status ← TAP Data Set
Sets the value of the broadcast lateral alert limit.

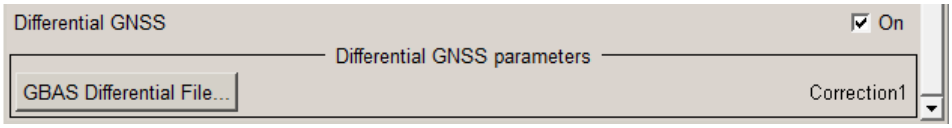
Remote command:
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:TLAS on page 134

4.4.3 Differential GNSS Parameters

Differential GNSS is an approach that uses known GNSS reference locations to determine channel correction parameters. The retrieved information is transmitted to other GNSS receivers to increase the accuracy of their position information.

To access this settings:

1. Select "GBAS > Main dialog > VDB Transmitters Configuration".
2. Select "VDB Transmitters Configuration > VDB# > Data > Real GBAS Data"
3. Select "Data Config > Msg. Config".
4. Select "Message Configuration > Differential GNSS > On".



The dialog enables you to load a file with GBAS differential data. Per default, the `Correction1.rs_gbas` file is used.

5. Select "GBAS Differential File" and load your user defined file.
   Refer to chapter A.4.2, "GBAS Differential File Format", on page 203 for description of the required file format.

Differential GNSS
Enables the use of differential GNSS data.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:DG:STATe` on page 122

GBAS Differential File...
Accesses the "Select Proprietary File" dialog to select a file containing differential GBAS information. The differential GBAS file must have the extension `*.rs_gbas` and file format as described in chapter A.4.2, "GBAS Differential File Format", on page 203.

Use the "Predefined Files" fuction, to load a predefined file.

Remote command:
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:DG:PREDefined:CATalog?` on page 123
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:DG:USER:CATalog?` on page 123
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:DG:PREDefined:FILE` on page 123
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:DG:USER:FILE` on page 123
`[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:DG:FILE?` on page 124

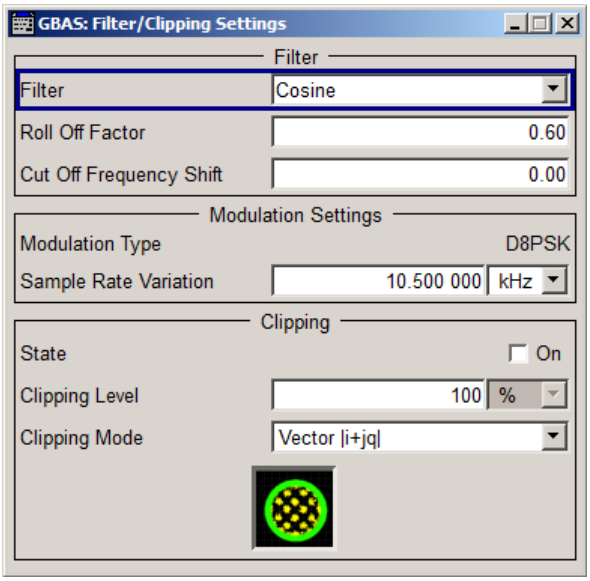
Predefined Files
Access a list with predefined files.

4.5 Filter/Clipping Settings

To access this dialog:

1. Select "Main dialog > Multiple Frequency Channels > Off".

2. Select "Main dialog > Filter/Clipping Settings".



The dialog comprises the settings, necessary to configure the baseband filter and to enable clipping, as well as information on the applied modulation type and sample rate.

4.5.1 Filter Settings

Selection and configuration of baseband filter is enabled in single freqency mode, i.e. "Multiple Frequency Channels > Off"

Provided are the following settings for configuring the baseband filter:

Filter
Selects the baseband filter.

Remote command:
`[:SOURce<hw>]:BB:GBAS:FILTer:TYPE` on page 136

Roll Off Factor or BxT
Sets the filter parameter.

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

The Roll Off Factor affects the steepness of the filter flanks. A "Roll Off Factor" = 0 results in the steepest flanks; values near to 1 make the flanks more flat.

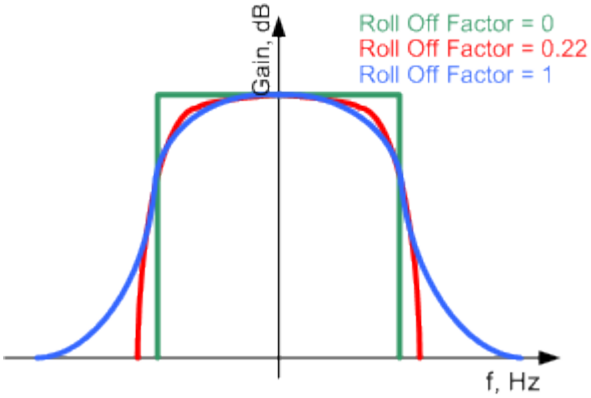


Fig. 4-2: Example of the frequency response of a filter with different Roll Off Factors

Remote command:
[:SOURce<hw>]:BB:GBAS:FILTer:PARameter:APCO25 on page 136
[:SOURce<hw>]:BB:GBAS:FILTer:PARameter:COSine on page 136
[:SOURce<hw>]:BB:GBAS:FILTer:PARameter:GAUSs on page 136
[:SOURce<hw>]:BB:GBAS:FILTer:PARameter:PGAuss on page 136
[:SOURce<hw>]:BB:GBAS:FILTer:PARameter:RCOSine on page 137
[:SOURce<hw>]:BB:GBAS:FILTer:PARameter:SPHase on page 137

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

Remote command:
[:SOURce<hw>]:BB:GBAS:FILTer:PARameter:LPASs on page 136
[:SOURce<hw>]:BB:GBAS:FILTer:PARameter:LPASSEVM on page 136

Cut Off Frequency Shift
(available for filter parameter Cosine only.)

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

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

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

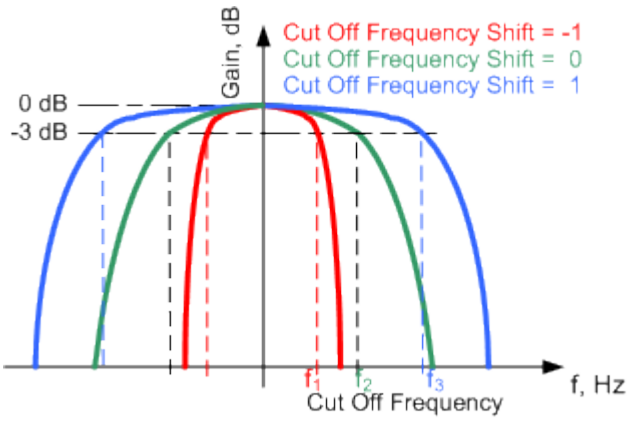


Fig. 4-3: Example of the frequency response of a filter with different Cut Off Frequency Shift

Remote command:
`[:SOURce<hw>]:BB:GBAS:FILTer:PARameter:COSine:COFS` on page 136

4.5.2 Modulation Settings

Provided are the following settings:

Modulation Type
According to the GBAS standard, symbols are converted to differentially-encoded 8 phase shift keyed (D8PSK) carrier phase shifts.

Remote command:
`[:SOURce<hw>]:BB:GBAS:MSET:MTYPe?` on page 138

Sample Rate Variation/Sample Rate Info
Sets/displays the used sample rate variation. You can set the sample rate value in the "Filter/Clipping Settings" dialog.

This setting can be used for testing the symbol rate tolerance.

The RTCA DO-246D specification defines a symbol rate of the GBAS data broadcast as 10500 symbols/sec. Because of the used modulation (see Modulation Type), each symbol defines one of eight states. This results in a nominal bit rate of 31500 bits/s.

Remote command:
`[:SOURce<hw>]:BB:GBAS:MSET:SRATe?` on page 138
`[:SOURce<hw>]:BB:GBAS:SRINfo?` on page 116

4.5.3 Clipping Settings

Provided are the following settings:

Clipping State
Switches baseband clipping on and off.

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

Remote command:
[:SOURce<hw>]:BB:GBAS:CLIPping:STATe on page 137

Clipping Level
Sets the limit for clipping.

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

Remote command:
[:SOURce<hw>]:BB:GBAS:CLIPping:LEVel on page 137

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

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

Remote command:
[:SOURce<hw>]:BB:GBAS:CLIPping:MODE on page 138

4.6 Global Settings

The buttons in this section lead to dialogs for general trigger, clock and mapping settings.

Global Trigger/Clock Settings
Calls the "Global Trigger/Clock/Input Settings" dialog.

This dialog is used among other things for setting the trigger threshold, the input impedance and the polarity of the clock and trigger inputs.

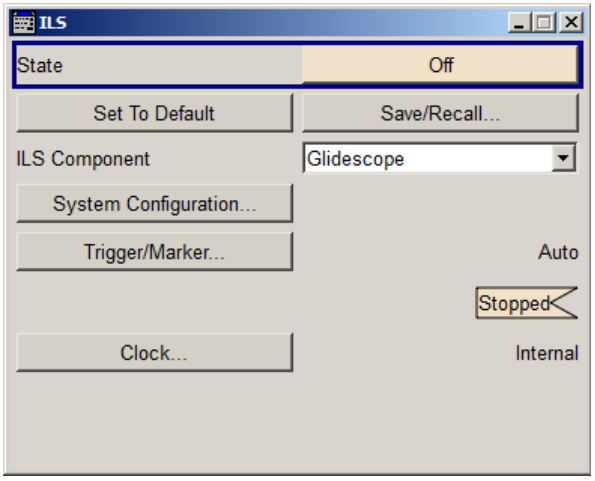
The parameters in this dialog affect all digital modulations and standards, and are described in chapter "Global Trigger/Clock/Input Settings" in the Operating Manual.

5 ILS Configuration and Settings

► To access this dialog select "Baseband Block > ILS".

5.1 General Settings

This dialog provides access to the general settings of the ILS standard, like enabling the standard and selecting the ILS component.



Changing a parameter in the ILS standard will cause an instant signal change in the R&S SMBV without a measurement cylcle to calculate the RMS value of the baseband signal in order to set the correct RF level. If the standard is switched ON 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 ILS standard will be performed without another measurement cycle in order to provide a continous signal output.

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

Remote command:
`<subsystem>:STATe` on page 108

Set To Default
Calls the default settings. The values of the main parameters are listed in chapter A.3, "Default Settings", on page 199.

Remote command:
`<subsystem>:PRESet` on page 108

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

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

Remote command:
`<subsystem>:SETTing:CATalog` on page 108
`<subsystem>:SETTing:STORe` on page 109
`<subsystem>:SETTing:STORe:FAST` on page 109
`<subsystem>:SETTing:LOAD` on page 109
`<subsystem>:SETTing:DELete` on page 108

ILS Component
Selects 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 139

System Configuration
Accesses the "System Configuration" dialog, see:

- chapter 5.2, "System Configuration Settings - Glide Slope", on page 49 for the glide slope settings
- chapter 5.3, "System Configuration Settings Localizer", on page 53 for the localizer settings
- chapter 5.4, "System Configuration Settings Marker Beacons", on page 60 for the marker beacons settings

Trigger/Marker...
Accesses the dialog for selecting the trigger source, for configuring the marker signals and for setting the time delay of an external trigger signal, see chapter 8.1, "Trigger Settings", on page 85 .

The currently selected trigger source is displayed to the right of the button.

Execute Trigger
Executes trigger manually.

You can execute the trigger manually only if you select an internal trigger source and a trigger mode other than "Auto".

Remote command:
`[:SOURce<hw>]:BB:GBAS:TRIGger:EXECute` on page 183
`[:SOURce<hw>]:BB:ILS:TRIGger:EXECute` on page 183
`[:SOURce<hw>]:BB:VOR:TRIGger:EXECute` on page 183
`[:SOURce<hw>]:BB:DME:TRIGger:EXECute` on page 183

Arm
For trigger modes "Armed Auto" and "Armed Retrigger", stops the signal generation until subsequent trigger event occurs.

Remote command:
`[:SOURce<hw>]:BB:GBAS:TRIGger:ARM:EXECute` on page 182
`[:SOURce<hw>]:BB:ILS:TRIGger:ARM:EXECute` on page 182
`[:SOURce<hw>]:BB:VOR:TRIGger:ARM:EXECute` on page 182
`[:SOURce<hw>]:BB:DME:TRIGger:ARM:EXECute` on page 182

Clock...
Accesses the dialog for selecting the clock source, see chapter 8.4, "Clock Settings", on page 94.

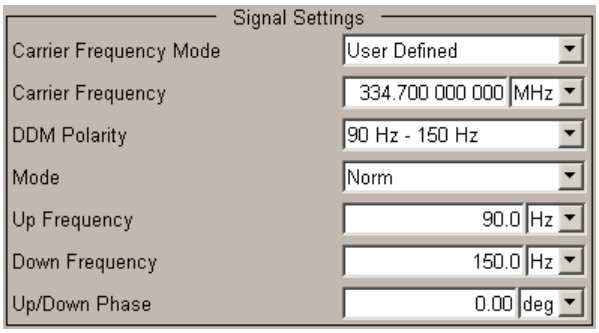
5.2 System Configuration Settings - Glide Slope

To access this dialog:

1. Select "ILS Component > Glide slope".
2. Select "ILS > System Configuration".

5.2.1 Signal Settings

The dialog comprises the settings, necessary to configure the ILS Glide slope (ILS-GS) modulation signal.



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 the standardized ILS-GS transmitting frequencies (see chapter A.2.1, "ILS Channel Frequencies", on page 195). The start value can be selected in the field "ICAO Channel" below.
The selection is effective on both ILS modulations. A change to modulation ILS-GS automatically causes the RF frequency to be adapted to the glide slope value which is coupled to the localizer setting (see chapter A.2.1, "ILS Channel Frequencies", on page 195).

Remote command:
`[:SOURce<hw>]:BB:ILS:LOCalizer:FREQuency:MODE` on page 150
`[:SOURce<hw>]:BB:ILS[:GS|GSLope]:FREQuency:MODE` on page 142

Carrier Frequency
Available only for "Carrier Frequency Mode > User Defined".

Sets the carrier frequency of the signal.

Remote command:
`[:SOURce<hw>]:BB:ILS[:GS|GSLope]:FREQuency` on page 142

ICAO Channel
Available only for "Carrier Frequency Mode > ICAO".

Selects the ICAO channel and sets the corresponding transmitting frequency. The ICAO channel settings for ILS-GS and ILS-LOC are coupled.

Refer to chapter A.2, "ICAO Channel Frequencies", on page 195 for an overview of the standard defined ILS transmitting frequencies.

Remote command:
`[:SOURce<hw>]:BB:ILS:LOCalizer:ICAO:CHANnel` on page 150
`[:SOURce<hw>]:BB:ILS[:GS|GSLope]:ICAO:CHANnel` on page 142

DDM Polarity
Defines the polarity for DDM calculation (see "DDM Depth" on page 52).

Remote command:
`[:SOURce<hw>]:BB:ILS[:GS|GSLope]:DDM:POLarity` on page 141

Mode
Selects the operating mode for the ILS (ILS-GS) modulation signal.

"Norm" ILS-GS modulation is active.

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

The modulation depth of the 90-Hz signal results from the settings of the parameters Sum of Depth (SDM) 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-GS signal.

The modulation depth of the 150-Hz signal results from the settings of parameters Sum of Depth (SDM) 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 143

Up Frequency
Sets the modulation frequency of the upper antenna lobe.

Remote command:
`[:SOURce<hw>]:BB:ILS[:GS|GSLope]:ULOBe[:FREQuency]` on page 144

Down Frequency
Sets the modulation frequency of the lower antenna lobe.

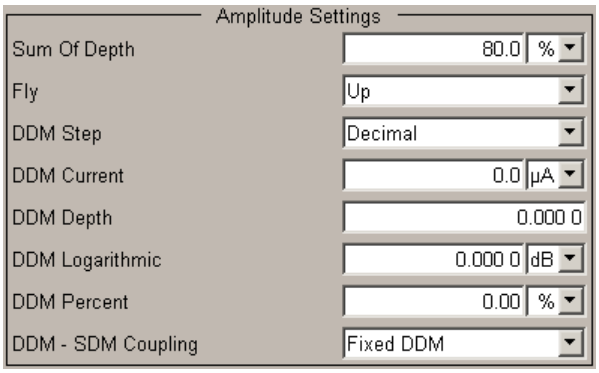
Remote command:
`[:SOURce<hw>]:BB:ILS[:GS|GSLope]:LLOBe[:FREQuency]` on page 143

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 143

5.2.2 Amplitude Settings

The dialog comprises the settings, necessary to configure the ILS-GS amplitude.



Sum of Depth (SDM)
Sets the arithmetic sum of the modulation depths of the upper lobe (90Hz) and lower lobe (150Hz) ILS-GS 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 144

Fly
Selects the simulation mode for the ILS-GS 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 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).

Remote command:
`[:SOURce<hw>]:BB:ILS[:GS|GSLope]:DDM:DIRection` on page 140

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 values.

Remote command:
n.a.

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

DDM uA = DDM × 857,125 uA

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 140

DDM Depth
Sets the difference in depth of modulation between the upper lobe (90Hz) and the lower lobe (150Hz) tone of the ILS-GS modulation signal.

The DDM value is calculated with the formula:
- "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 value of the instrument current and the DDM value in dB.

Remote command:
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:DDM:DEPTh on page 142

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 141

DDM Percent
Sets the difference in depth of modulation between the upper lobe (90Hz) and the lower lobe (150Hz) tone of the ILS-GS 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)]
- "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 141

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 values stays constant when the SDM is changed.

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

Remote command:
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:DDM:COUPling on page 140

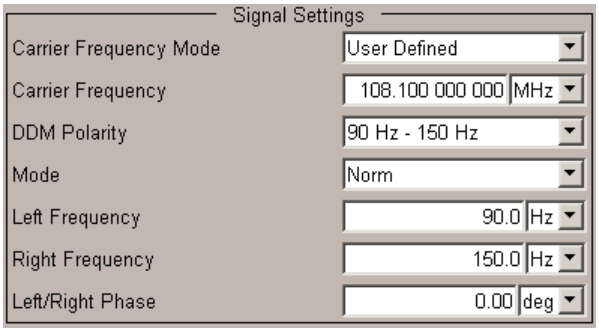
5.3 System Configuration Settings Localizer

To access this dialog,

1. Select "ILS > ILS Component > Localizer".
2. Select "ILS > System Configuration"

5.3.1 Signal Settings

The dialog comprises the settings, necessary to configure the ILS localizer (ILS-LOC) modulation signal.



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 the standardized ILS-GS transmitting frequencies (see chapter A.2.1, "ILS Channel Frequencies", on page 195). The start value can be selected in the field "ICAO Channel" below.
The selection is effective on both ILS modulations. A change to modulation ILS-GS automatically causes the RF frequency to be adapted to the glide slope value which is coupled to the localizer setting (see chapter A.2.1, "ILS Channel Frequencies", on page 195).

Remote command:
`[:SOURce<hw>]:BB:ILS:LOCalizer:FREQuency:MODE` on page 150
`[:SOURce<hw>]:BB:ILS[:GS|GSLope]:FREQuency:MODE` on page 142

Carrier Frequency
Available only for "Carrier Frequency Mode > User Defined".

Sets the carrier frequency of the signal.

Remote command:
`[:SOURce<hw>]:BB:ILS:LOCalizer:FREQuency` on page 150

ICAO Channel
Available only for "Carrier Frequency Mode > ICAO".

Selects the ICAO channel and sets the corresponding transmitting frequency. The ICAO channel settings for ILS-GS and ILS-LOC are coupled.

Remote command:
`[:SOURce<hw>]:BB:ILS:LOCalizer:ICAO:CHANnel` on page 150

DDM polarity
Defines the polarity for DDM calculation (see "DDM Depth" on page 57).

Remote command:
`[:SOURce<hw>]:BB:ILS:LOCalizer:DDM:POLarity` on page 149

Mode
Selects the operating mode for the ILS-LOC modulation signal.

"Norm" ILS-LOC modulation is active.

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

The modulation depth of the 90Hz 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 (150Hz) signal component of the ILS-LOC signal.

The modulation depth of the 150Hz signal results from the settings of parameters Sum of Depth and DDM Depth according to:

- parameter "Fly" = "Right"
  AM (150 Hz) = 0,5 × (SDM + DDM × 100%)
- parameter "Fly" = "Left"
  AM (150 Hz) = 0,5 × (SDM - DDM × 100%)

Remote command:
`[:SOURce<hw>]:BB:ILS:LOCalizer:MODE` on page 151

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 150

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

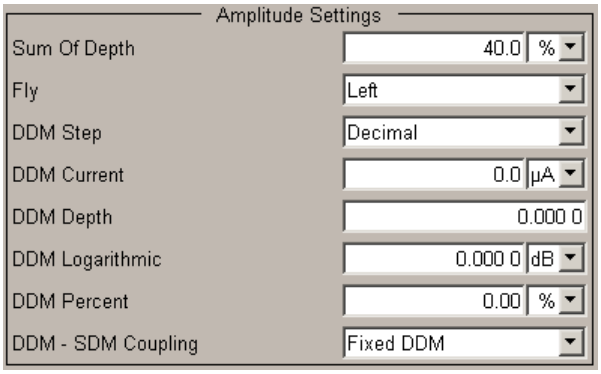
Remote command:
`[:SOURce<hw>]:BB:ILS:LOCalizer:RLOBe[:FREQuency]` on page 151

Left/Right Phase
Sets the phase between the modulation signals of the left and right antenna lobe. The zero crossing of the right lobe (150Hz) 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 151

5.3.2 Amplitude Settings

The dialog comprises the settings, necessary to configure the ILS-LOC amplitude.



Sum of Depth
Sets the arithmetic sum of the modulation depths of the left lobe (90Hz) and right lobe (150Hz) ILS-LOC signal contents. The RMS modulation depth of the sum signal depends on the phase setting of both modulation tones. The sum of "Sum of Depth" on page 56 and "Depth" on page 59 must be smaller than 100 PCT.

Remote command:
`[:SOURce<hw>]:BB:ILS:LOCalizer:SDM` on page 152

Fly
Selects the simulation mode for the ILS-LOC 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 148

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 values.

Remote command:
tbd

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

DDM uA = DDM × 967.75 uA

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 148

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-LOC 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 149

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 148

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 to formula:
- "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 149

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

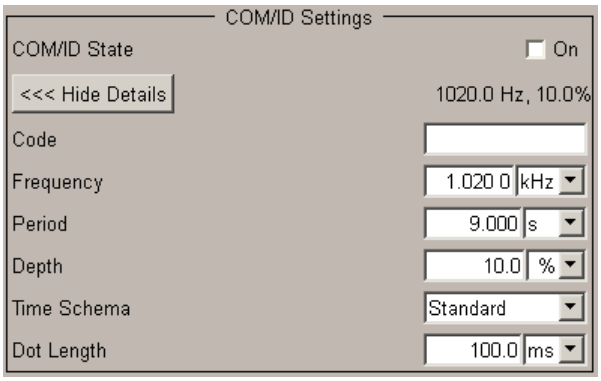
"Fixed DDM" The absolute DDM values stays constant when the SDM is changed.

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

Remote command:
[:SOURce<hw>]:BB:ILS:LOCalizer:DDM:COUPling on page 147

5.3.3 COM/ID Settings

The dialog comprises the settings, necessary to configure the COM/ID settings available for the ILS-LOC modulation.



State
Enables/disables an additional communication/identification (COM/ID) signal.

Remote command:
[:SOURce<hw>]:BB:ILS:LOCalizer:COMid[:STATe] on page 147

Show/Hide Details
Reveals the detailed setting options for the COM/ID signal.

Once the details are revealed, the labeling on the button changes to "Hide Details". Use this to hide the detailed setting options display again.

Code
Sets the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport). If no coding is entered, the COM/ID tone is sent uncoded (key down).

Remote command:
[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:CODE on page 145

Frequency
Sets the frequency of the COM/ID signal.

Remote command:
[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:FREQuency on page 146

Period
Sets the period of the COM/ID signal in seconds.

Remote command:
[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:PERiod on page 146

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

Remote command:
[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:DEPTh on page 145

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

- "Standard"
  The set dot length determines the length of the dash, the symbol space and letter space.
- "User"
  You can set each length value seperately.

Remote command:
[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:TSCHema on page 147

Dot Length
Sets the length of a Morse dot in seconds.

For "Time Schema > Standard" this value determines also the length of the dash (3xDot length), symbol space (= Dot length) and letter space (3xDot length).

Remote command:
[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:DOT on page 146

Symbol Space
Available only for "Time Schema > User".

Sets the length of a symbol space in milliseconds.

Remote command:
[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:SYMBol on page 147

Dash Length
Available only for "Time Schema > User".

Sets the length of a Morse dash in milliseconds.

Remote command:
[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:DASH on page 145

Letter Space
Available only for "Time Schema > User".

Sets the length of a letter space in milliseconds.

Remote command:
[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:LETTer on page 146

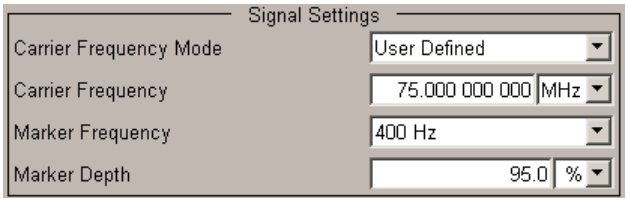
5.4 System Configuration Settings Marker Beacons

To access this dialog:

1. Select "ILS > ILS Component > Marker Beacons".
2. Select "System Configuration".

5.4.1 Signal Settings

This section covers the different signal settings available for the marker beacons modulation.



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 in predefined steps according to the standardized ILS transmitting frequencies .

Remote command:
`[:SOURce<hw>]:BB:ILS:MBEacon:FREQuency:MODE` on page 155

Carrier Frequency
Available only for "Carrier Frequency Mode > User Defined".

Sets the carrier frequency of the signal.

Remote command:
`[:SOURce<hw>]:BB:ILS:MBEacon:FREQuency` on page 155

Marker Frequency
Sets the modulation frequency of the marker signal.

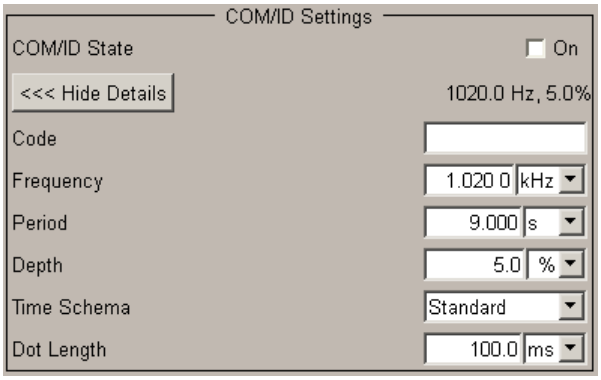
Remote command:
`[:SOURce<hw>]:BB:ILS:MBEacon:MARKer:FREQuency` on page 155

Marker Depth
Sets the modulation depth of the marker signal.

Remote command:
`[:SOURce<hw>]:BB:ILS:MBEacon[:MARKer]:DEPTh` on page 155

5.4.2 COM/ID Settings

The dialog comprises the settings, necessary to configure the COM/ID settings available for the ILS marker beacon modulation.



State
Enables/disables an additional communication/identification (COM/ID) signal.

Remote command:
`[:SOURce<hw>]:BB:ILS:MBEacon:COMid[:STATe]` on page 155

Show/Hide Details
Reveals the detailed setting options for the COM/ID signal.

Once the details are revealed, the labeling on the button changes to "Hide Details". Use this to hide the detailed setting options display again.

Code
Sets the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport). If no coding is entered, the COM/ID tone is sent uncoded (key down).

Remote command:
`[:SOURce<hw>]:BB:ILS:MBEacon:COMid:CODE` on page 152

Frequency
Sets the frequency of the COM/ID signal.

Remote command:
`[:SOURce<hw>]:BB:ILS:MBEacon:COMid:FREQuency` on page 153

Period
Sets the period of the COM/ID signal in seconds.

Remote command:
`[:SOURce<hw>]:BB:ILS:MBEacon:COMid:PERiod` on page 154

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

Remote command:
`[:SOURce<hw>]:BB:ILS:MBEacon:COMid:DEPTh` on page 153

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

- "Standard"
  The set dot length determines the length of the dash, the symbol space and letter space.
- "User"
  You can set each length value seperately.

Remote command:
`[:SOURce<hw>]:BB:ILS:MBEacon:COMid:TSCHema` on page 154

Dot Length
Sets the length of a Morse dot in seconds.

For "Time Schema > Standard" this value determines also the length of the dash (3xDot length), symbol space (= Dot length) and letter space (3xDot length).

Remote command:
`[:SOURce<hw>]:BB:ILS:MBEacon:COMid:DOT` on page 153

Dash Length
Available only for "Time Schema > User".

Sets the length of a Morse dash in milliseconds.

Symbol Space
Available only for "Time Schema > User".

Sets the length of a symbol space in milliseconds.

Remote command:
`[:SOURce<hw>]:BB:ILS:MBEacon:COMid:SYMBol` on page 154

Letter Space
Available only for "Time Schema > User".

Sets the length of a letter space in milliseconds.

Remote command:
`[:SOURce<hw>]:BB:ILS:MBEacon:COMid:LETTer` on page 153

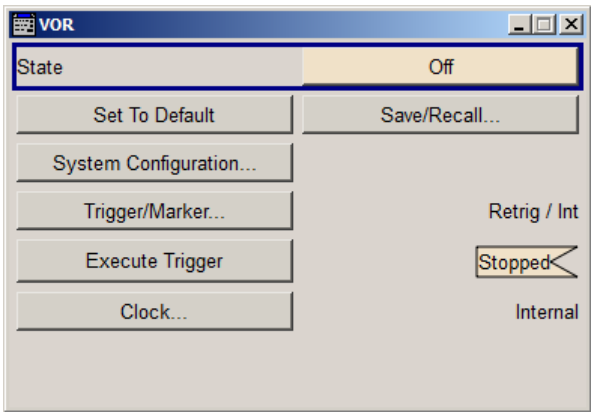
6 VOR Configuration and Settings

► To access this dialog select "Baseband Block > VOR".

This section contains information about the VOR configuration settings.

6.1 General Settings

This dialog provides access to the general settings of the VOR standard.



Changing a parameter in the VOR standard will cause an instant signal change in the R&S SMBV without a measurement cylcle to calculate the RMS value of the baseband signal in order to set the correct RF level. If the standard is switched ON 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 VOR standard will be performed without another measurement cycle in order to provide a continous signal output.

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

Remote command:
`<subsystem>:STATe` on page 108

Set To Default
Calls the default settings. The values of the main parameters are listed in chapter A.3, "Default Settings", on page 199.

Remote command:
`<subsystem>:PRESet` on page 108

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

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

Remote command:
`<subsystem>:SETTing:CATalog` on page 108
`<subsystem>:SETTing:STORe` on page 109
`<subsystem>:SETTing:STORe:FAST` on page 109
`<subsystem>:SETTing:LOAD` on page 109
`<subsystem>:SETTing:DELete` on page 108

System Configuration
Accesses the "System Configuration" dialog for configuration of the VOR modulation, see chapter 6.2, "System Configuration Settings", on page 65.

Trigger/Marker...
Accesses the dialog for selecting the trigger source, for configuring the marker signals and for setting the time delay of an external trigger signal, see chapter 8.1, "Trigger Settings", on page 85 .

The currently selected trigger source is displayed to the right of the button.

Execute Trigger
Executes trigger manually.

You can execute the trigger manually only if you select an internal trigger source and a trigger mode other than "Auto".

Remote command:
`[:SOURce<hw>]:BB:GBAS:TRIGger:EXECute` on page 183
`[:SOURce<hw>]:BB:ILS:TRIGger:EXECute` on page 183
`[:SOURce<hw>]:BB:VOR:TRIGger:EXECute` on page 183
`[:SOURce<hw>]:BB:DME:TRIGger:EXECute` on page 183

Arm
For trigger modes "Armed Auto" and "Armed Retrigger", stops the signal generation until subsequent trigger event occurs.

Remote command:
`[:SOURce<hw>]:BB:GBAS:TRIGger:ARM:EXECute` on page 182
`[:SOURce<hw>]:BB:ILS:TRIGger:ARM:EXECute` on page 182
`[:SOURce<hw>]:BB:VOR:TRIGger:ARM:EXECute` on page 182
`[:SOURce<hw>]:BB:DME:TRIGger:ARM:EXECute` on page 182

Clock...
Accesses the dialog for selecting the clock source, see chapter 8.4, "Clock Settings", on page 94.

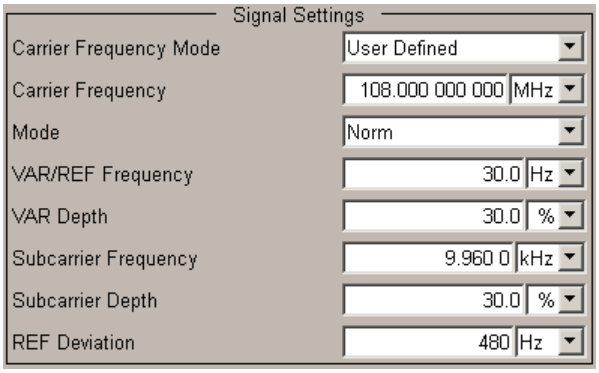
6.2 System Configuration Settings

To access this dialog:

► Select "VOR > System Configuration".

6.2.1 Signal Settings

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



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 the standardized VOR transmitting frequencies (see chapter A.2.2, "VOR Channel Frequencies ", on page 195). The start value can be selected in the field "ICAO Channel".

Remote command:
`[:SOURce<hw>]:BB:VOR:FREQuency:MODE` on page 158

Carrier Frequency
Available only for "Carrier Frequency Mode > User Defined".

Sets the carrier frequency of the signal.

Remote command:
`[:SOURce<hw>]:BB:VOR:FREQuency` on page 158

ICAO Channel
Available only for "Carrier Frequency Mode > ICAO".

Selects the ICAO channel and the corresponding transmitting frequency. Refer to chapter A.2.2, "VOR Channel Frequencies ", on page 195 for an overview of the standard defined VOR transmitting frequencies.

Remote command:
`[:SOURce<hw>]:BB:VOR:ICAO:CHANnel` on page 158

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 component (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 corresponds to the value set under "Subcarrier Depth".
"Subcarrier + FM"	Amplitude modulation of the output signal with the frequency-modulated 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 156

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 160

VAR Depth
Sets the AM modulation depth of the 30Hz 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 160

Subcarrier Frequency
Sets the frequency of the FM carrier.

Remote command:
`[:SOURce<hw>]:BB:VOR:SUBCarrier[:FREQuency]` on page 160

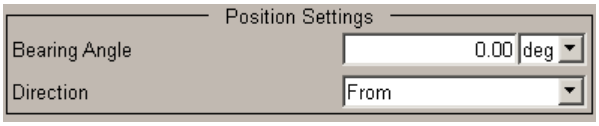
Subcarrier Depth
Sets the AM modulation depth of the FM carrier.

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 159

6.2.2 Position Settings

The dialog comprises the settings, necessary to configure the different position settings available for the VOR modulation.



Bearing Angle
Sets the phase angle between the 30Hz VAR signal and the 30Hz reference signal. The orientation of the angle depends on the selected "Direction".

Remote command:
`[:SOURce<hw>]:BB:VOR:BANGle` on page 160

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.

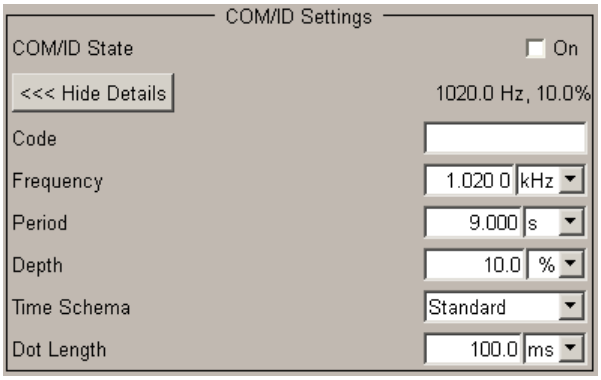
"From" Selection of the beacon as a reference position.

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

Remote command:
`[:SOURce<hw>]:BB:VOR:BANGle:DIRection` on page 161

6.2.3 COM/ID Settings

The dialog comprises the settings, necessary to configure the COM/ID settings available for the VOR modulation.



State
Enables/disables an additional communication/identification (COM/ID) signal.

Remote command:
`[:SOURce<hw>]:BB:VOR:COMid[:STATe]` on page 163

Show/Hide Details
Reveals the detailed setting options for the COM/ID signal.

Once the details are revealed, the labeling on the button changes to "Hide Details". Use this to hide the detailed setting options display again.

Code
Sets the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport). If no coding is entered, the COM/ID tone is sent uncoded (key down).

Remote command:
`[:SOURce<hw>]:BB:VOR:COMid:CODE` on page 161

Frequency
Sets the frequency of the COM/ID signal.

Remote command:
`[:SOURce<hw>]:BB:VOR:COMid:FREQuency` on page 162

Period
Sets the period of the COM/ID signal in seconds.

Remote command:
`[:SOURce<hw>]:BB:VOR:COMid:PERiod` on page 163

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 162

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

- "Standard"
  The set dot length determines the length of the dash, the symbol space and letter space.
- "User"
  You can set each length value seperately.

Remote command:
`[:SOURce<hw>]:BB:VOR:COMid:TSCHema` on page 163

Dot Length
Sets the length of a Morse dot in seconds.

For "Time Schema > Standard" this value determines also the length of the dash (3xDot length), symbol space (= Dot length) and letter space (3xDot length).

Remote command:
`[:SOURce<hw>]:BB:VOR:COMid:DOT` on page 162

Dash Length
Available only for "Time Schema > User".

Sets the length of a Morse dash in milliseconds.

Symbol Space
Available only for "Time Schema > User".

Sets the length of a symbol space in milliseconds.

Remote command:
`[:SOURce<hw>]:BB:VOR:COMid:SYMBol` on page 163

Letter Space
Available only for "Time Schema > User".

Sets the length of a letter space in milliseconds.

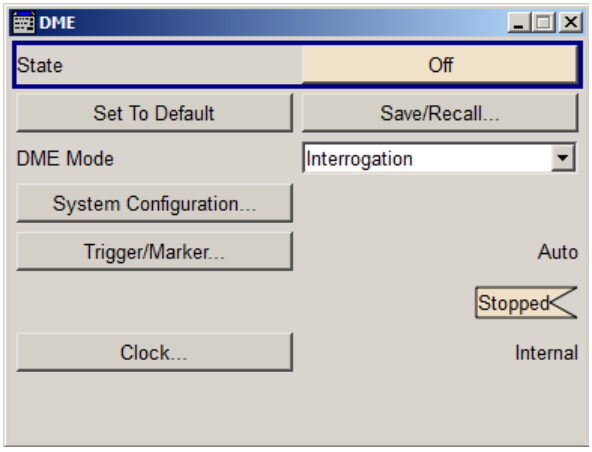
Remote command:
`[:SOURce<hw>]:BB:VOR:COMid:LETTer` on page 162

7 DME Configuration and Settings

► To access this dialog select "Baseband Block > DME".

7.1 General Settings

This dialog provides access to the general settings of the DME standard, like enabling the standard and selecting the DME mode.



Changing a parameter in the DME standard will cause an instant signal change in the R&S SMBV without a measurement cylcle to calculate the RMS value of the baseband signal in order to set the correct RF level. If the standard is switched ON 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 DME standard will be performed without another measurement cycle in order to provide a continous signal output.

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

Remote command:
`<subsystem>:STATe` on page 108

Set To Default
Calls the default settings. The values of the main parameters are listed in chapter A.3, "Default Settings", on page 199.

Remote command:
`<subsystem>:PRESet` on page 108

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

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

Remote command:
`<subsystem>:SETTing:CATalog` on page 108
`<subsystem>:SETTing:STORe` on page 109
`<subsystem>:SETTing:STORe:FAST` on page 109
`<subsystem>:SETTing:LOAD` on page 109
`<subsystem>:SETTing:DELete` on page 108

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 164

System Configuration
Accesses the "System Configuration" dialog for configuration of the interrogation or reply modulation, see chapter 7.2, "System Configuration Settings", on page 72.

Trigger/Marker...
Accesses the dialog for selecting the trigger source, for configuring the marker signals and for setting the time delay of an external trigger signal, see chapter 8.1, "Trigger Settings", on page 85 .

The currently selected trigger source is displayed to the right of the button.

Execute Trigger
Executes trigger manually.

You can execute the trigger manually only if you select an internal trigger source and a trigger mode other than "Auto".

Remote command:
`[:SOURce<hw>]:BB:GBAS:TRIGger:EXECute` on page 183
`[:SOURce<hw>]:BB:ILS:TRIGger:EXECute` on page 183
`[:SOURce<hw>]:BB:VOR:TRIGger:EXECute` on page 183
`[:SOURce<hw>]:BB:DME:TRIGger:EXECute` on page 183

Arm
For trigger modes "Armed Auto" and "Armed Retrigger", stops the signal generation until subsequent trigger event occurs.

Remote command:
`[:SOURce<hw>]:BB:GBAS:TRIGger:ARM:EXECute` on page 182
`[:SOURce<hw>]:BB:ILS:TRIGger:ARM:EXECute` on page 182
`[:SOURce<hw>]:BB:VOR:TRIGger:ARM:EXECute` on page 182
`[:SOURce<hw>]:BB:DME:TRIGger:ARM:EXECute` on page 182

Clock...
Accesses the dialog for selecting the clock source, see chapter 8.4, "Clock Settings", on page 94.

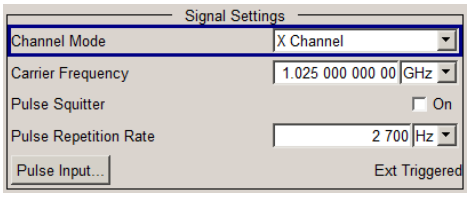
7.2 System Configuration Settings

To access this dialog:

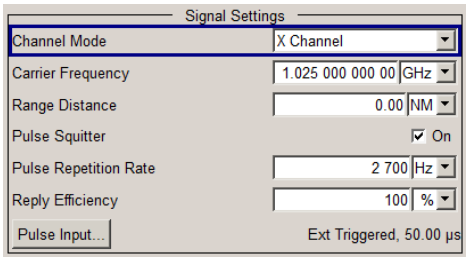
1. Select "DME > DME Mode > Interrogation".
2. Select "System Configuration".

7.2.1 Signal Settings

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



Signal settings for "DME Mode > Interrogation"



Signal settings for "DME Mode > Reply"

Channel Mode
Selects 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 reply delay of the ground station (see chapter A.2.3, "DME Channel Frequencies", on page 196). ICAO indicates the ICAO channel parameters below for selecting the correct channel.

Table 7-1: 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 165

Carrier Frequency
Available only for "Channel Mode > X Channel"/ "Channel Mode > Y Channel".

Sets the carrier frequency of the signal.

Remote command:
`[:SOURce<hw>]:BB:DME:FREQuency` on page 166

ICAO Channel
Available only for "Channel Mode > ICAO".

Selects the corresponding channel as indicated by ICAO. Refer to chapter A.2.3, "DME Channel Frequencies", on page 196 for an overview of the standard defined DME transmitting frequencies.

Remote command:
`[:SOURce<hw>]:BB:DME:ICAO:CHANnel` on page 166

Range Distance
Available only for "DME Mode > Reply".

Sets the simulated distance between the interrogator and the transponder for reply mode. 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.

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 168
`[:SOURce<hw>]:BB:DME:RDIStance:UNIT` on page 169

Pulse Squitter
Enables/disables squitter pulses.

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). The squitter pulses ensure that a minimum pulse rate is provided which is cruical for the proper monitoring and adjustment of important pulse paramaters of the ground station.

Remote command:
`[:SOURce<hw>]:BB:DME:SQUitter` on page 170

Pulse Repetition Rate
Sets the number of DME pulse pairs per second.

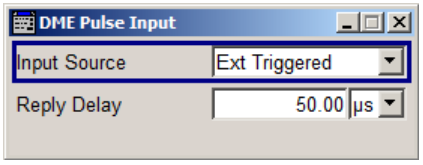
Remote command:
`[:SOURce<hw>]:BB:DME:RATE` on page 168

Reply Efficiency
Available only for "DME Mode > Reply".

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.

Remote command:
`[:SOURce<hw>]:BB:DME:ANALysis:EFFiciency?` on page 173

Pulse Input
Opens a dialog for configuration of the pulse input settings.



Input Source ← Pulse Input
Selects the input of the DME pulses. In case "DME Mode >Interrogation" the setting selects the input for the reply pulses of a ground station, while for "DME Mode > Reply" the input of the interogation pulses of an airplane is choosen.

"Ext Triggered"
The pulses are received via the backward TRIG connector. Please make sure that only the demodulated pulse envelope is input at this connector. If a modulated RF signal is applied, use the "Ext Power Sensor" mode.

"Ext Power Sensor"
The R&S NRP-Z81 power sensor as an input for modulated RF pulses. An external DME signal is fed into a sensor. The 50% voltage point of this signal is used by the R&S NRP-Z81 power sensor sensor to generate the trigger for the R&S SMBV.

Remote command:
`[:SOURce<hw>]:BB:DME:PINPut:SOURce` on page 170

Reply Delay ← Pulse Input
Sets the delay between the external trigger and the first DME output pulse (50% voltage point of first pulse).

For DME Reply mode this 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, where

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

Changing one value automatically changes the other value.

Remote command:
`[:SOURce<hw>]:BB:DME:PINPut:DELay` on page 171

Search Trigger Level ← Pulse Input
Available only for "Trigger Mode > Ext Power Sensor".

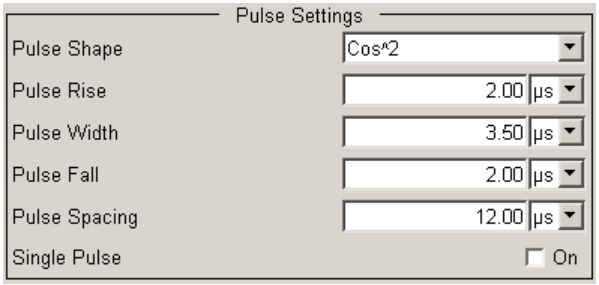
Determines the trigger level = 50% voltage point of first pulse of the external DME interrogation signal.

After connecting the R&S NRP-Z81 sensor to the external interrogation signal source, "Search Trigger Level" determines the trigger point. The search function has to be executed with each change of the level of the external DME signal.

Remote command:
`[:SOURce<hw>]:BB:DME:PINPut:TRIGger:SEARch?` on page 172

7.2.2 Pulse Settings

The dialog comprises the settings, necessary to configure the pulse settings available for DME interrogation.



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 linear shaped.

"Gauss" The pulse has a gaussian form.

Remote command:
`[:SOURce<hw>]:BB:DME:SHAPe` on page 169

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 169

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

Remote command:
[:SOURce<hw>]:BB:DME:WIDTh on page 172

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

Remote command:
[:SOURce<hw>]:BB:DME:FALL on page 165

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 167

Single Pulse
Activates/deactivates generation of a single test pulse.

Remote command:
[:SOURce<hw>]:BB:DME:SINGle on page 170

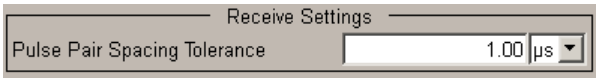
DME Analysis
Available only for "DME Mode > Interrogation".

Accesses the "DME Analysis" dialog.

For a description of the available settings, refer to chapter 7.2.4, "DME Analysis", on page 77.

7.2.3 Receive Settings

The dialog comprises the settings, necessary to configure the receiving of the pulse.



Pulse Pair Spacing Tolerance
Determines the pulse pair spacing tolerance.

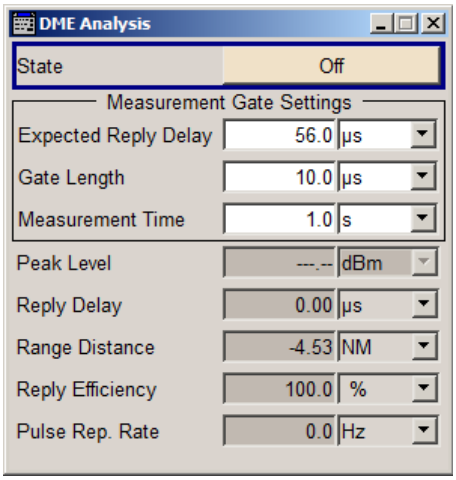
If the spacing is e.g. 12 us, the reply station will see a pulse pair with a spacing of 11.5 to 12.5 us as a valid interrogation pair and will respond to it. Otherwise, no reply will be generated.

Remote command:
[:SOURce<hw>]:BB:DME:PPS on page 167

7.2.4 DME Analysis

The settings in this dialog are available only if an R&S NRP-Z81 power sensor is connected to the R&S SMBV.

1. To access this dialog:
2. Select "DME > DME Mode > Interrogation".
3. Select "System Configuration > DME Analysis".



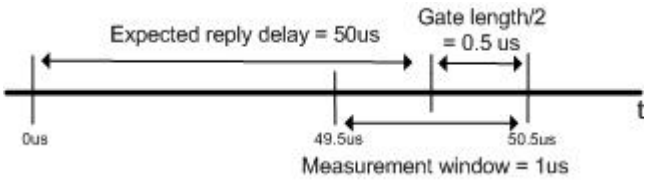
The "DME Analyisis" dialog comprises the settings to configure the parameters of the reply signal of the ground station transponder.

State
Activates the DME analysis. The R&S SMBV 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). 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.

Example:

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.



Remote command:
[:SOURce<hw>]:BB:DME:ANALysis:STATe on page 176

Expected Reply Delay
Sets the expected reply delay.

Remote command:
[:SOURce<hw>]:BB:DME:ANALysis:GATE:EDELay on page 173

Gate Length
Sets the gate length for the measurement window.

Remote command:
[:SOURce<hw>]:BB:DME:ANALysis:GATE[:LENGth] on page 174

Measurement Time
Sets the time for the measurement cycle.

Remote command:
[:SOURce<hw>]:BB:DME:ANALysis:GATE:COUNt on page 173

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 175
[:SOURce<hw>]:BB:DME:ANALysis:POWer:OK? on page 175

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 176

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 176
`[:SOURce<hw>]:BB:DME:ANALysis:TIME:OK?` on page 177

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 in the set measurement window 'invalid' is indicated.

Remote command:
`[:SOURce<hw>]:BB:DME:ANALysis:EFFiciency?` on page 173
`[:SOURce<hw>]:BB:DME:ANALysis:EFFiciency:OK?` on page 173

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.

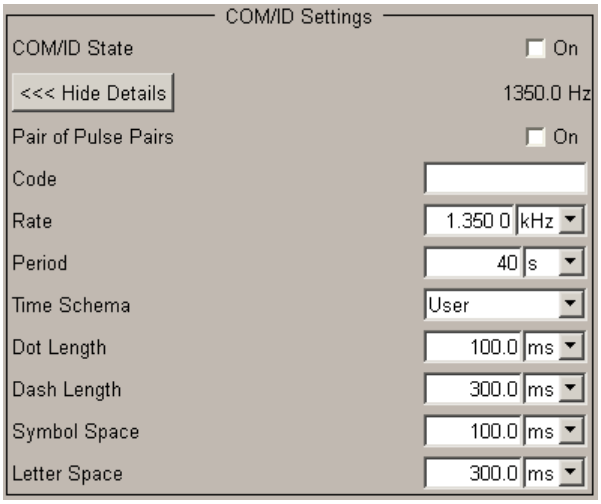
Remote command:
`[:SOURce<hw>]:BB:DME:ANALysis:PRRate?` on page 175
`[:SOURce<hw>]:BB:DME:ANALysis:PRRate:OK?` on page 176

7.2.5 COM/ID Settings

To access this dialog:

1. Select "DME > DME Mode > Reply".
2. Select "DME > System Configuration".

The dialog comprises the settings, necessary to configure the COM/ID settings available for the DME reply modulation.



COM/ID State
Enables/disables an additional communication/identification (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.

Remote command:
`[:SOURce<hw>]:BB:DME:ID[:STATe]` on page 181

Show/Hide Details
Reveals the detailed setting options for the COM/ID signal.

Once the details are revealed, the labeling on the button changes to "Hide Details". Use this to hide the detailed setting options display again.

Pair of Pulse Pairs
Enables the transmission of a pair of pulse pairs during the set "Rate".

The ID signal consists of a regular group of pulses that generates Morse code dots and dashes. To form the regular pulse groups, two pulse pairs are separated by 100 us. This is called a pair of pairs. These pair combinations are transmitted at a regular rate of 1350 pairs of pairs, see figure 7-1. This results in a repetition rate of 1350 Hz, which is an audible tone for an ident.

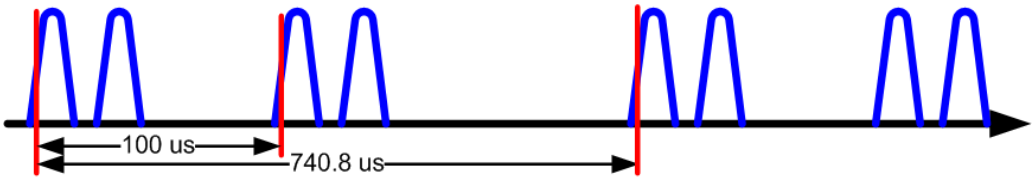


Fig. 7-1: Signal with enabled pair of puse pairs

If the "Pair of Pulse Pairs" is disabled only a single pulse pair is transmitted in the selected "Rate", see figure 7-2.

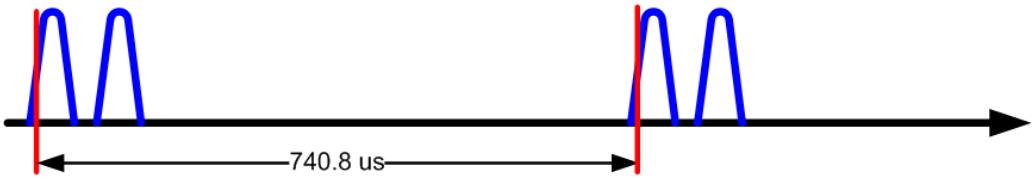


Fig. 7-2: Signal with disabled pair of puse pairs

Remote command:
`[:SOURce<hw>]:BB:DME:ID:PPP[:STATe]` on page 179

Pulse Pair Spacing
Sets the value for the pulse pair spacing when "Pair of Pulse Pairs" is enabled.

Remote command:
`[:SOURce<hw>]:BB:DME:ID:PPS` on page 180

Code
Sets the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport). If no coding is entered, the COM/ID tone is sent uncoded (key down).

Remote command:
`[:SOURce<hw>]:BB:DME:ID:CODE` on page 178

Rate
Sets the pulse repetition rate of the ID sequence.

Remote command:
`[:SOURce<hw>]:BB:DME:ID:RATE` on page 180

Period
Sets the period of the COM/ID signal in seconds.

Remote command:
`[:SOURce<hw>]:BB:DME:ID:PERiod` on page 180

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

- "Standard"
  The set dot length determines the length of the dash, the symbol space and letter space.
- "User"
  You can set each length value seperately.

Remote command:
`[:SOURce<hw>]:BB:DME:ID:TSCHema` on page 181

Dot Length
Sets the length of a Morse dot in seconds.

For "Time Schema > Standard" this value determines also the length of the dash (3xDot length), symbol space (= Dot length) and letter space (3xDot length).

Remote command:
[:SOURce<hw>]:BB:DME:ID:DOT on page 179

Dash Length
Available only for "Time Schema > User".

Sets the length of a Morse dash in milliseconds.

Remote command:
[:SOURce<hw>]:BB:DME:ID:DASH on page 178

Symbol Space
Available only for "Time Schema > User".

Sets the length of a symbol space in milliseconds.

Remote command:
[:SOURce<hw>]:BB:DME:ID:SYMBol on page 180

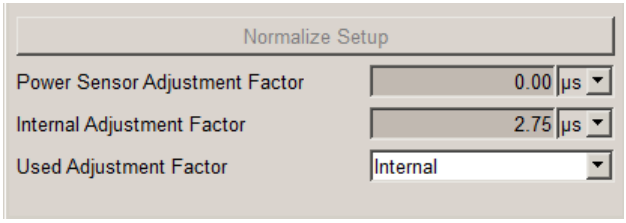
Letter Space
Available only for "Time Schema > User".

Sets the length of a letter space in milliseconds.

Remote command:
[:SOURce<hw>]:BB:DME:ID:LETTer on page 179

7.2.6 Adjustment Factors

The dialog comprises the settings, necessary to normalize the setup when triggering the instrument with a power sensor.



In order to calibrate a measurement setup regarding external pulse input and internal processing delays, the "Normalize Setup" functionality can be used.

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

As shown in figure 7-3, the R&S SMBV gets interrogation pulses from an external DUT using the same pulse shape. According to the settings, the R&S SMBV should send a reply pulse pair 50us after receiving the interrogation pulse pair.

In order to to guarantee, that the 50% edge levels are exactly 50us separated from each other, the R&S SMBV 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 taken into account, 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.

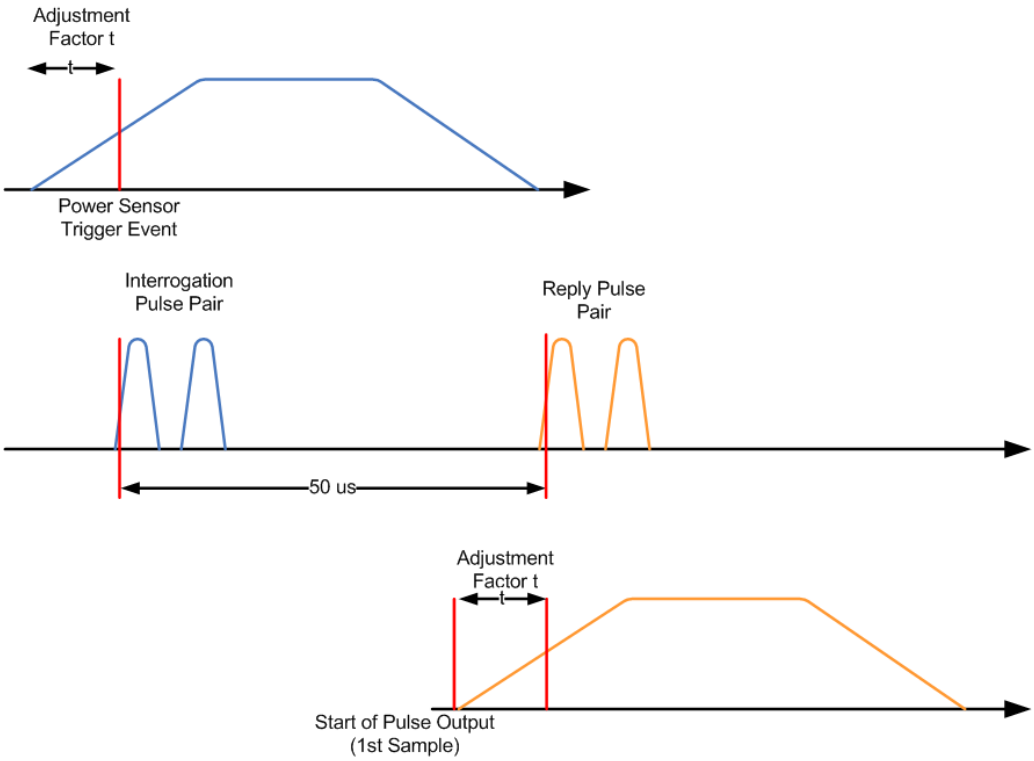


Fig. 7-3: Normalize setup

Normalize Setup
Available only if an R&S NRP-Z81 power sensor is connected to the R&S SMBV.

Performs a normalization of the test setup. The delay due to the test setup is measured and subsequently considered in the reply measurements.

Remote command:
`[:SOURce<hw>]:BB:DME:ANALysis:NORMalize?` on page 174

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

Remote command:
`[:SOURce<hw>]:BB:DME:ANALysis:PSAFactor?` on page 177

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

Remote command:
`[:SOURce<hw>]:BB:DME:ANALysis:IAFactor?` on page 177

Used Adjustment Factor
Selects which internal adjustment factor should be used.

"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 SMBV are not considered by the calculation.

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

Remote command:
`[:SOURce<hw>]:BB:DME:ANALysis:UAFactor` on page 178

8 Trigger/Marker/Clock Settings

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

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

The "Marker Delay" section is where a marker signal delay can be defined, either without restriction or restricted to the dynamic section, i.e., the section in which it is possible to make settings without restarting signal and marker generation.

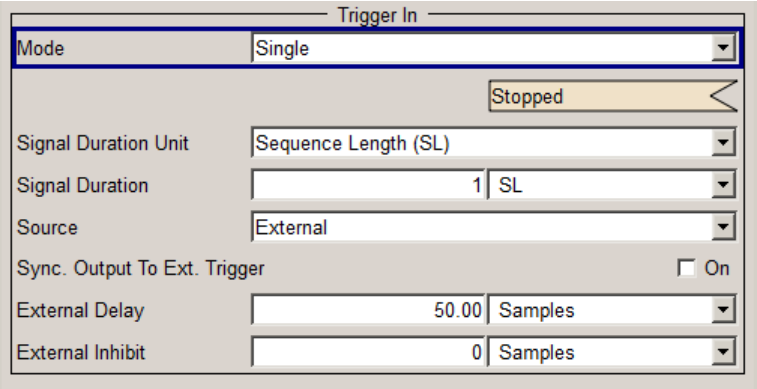
The "Clock Settings" section is where the clock source is selected and - in the case of an external source - the clock type.

The buttons in the last section lead to submenu for general trigger, clock and mapping settings.

8.1 Trigger Settings

To access this dialog, select "GBAS >Trigger/Marker..." /"ILS > Trigger..."/"VOR > Trigger..."/"DME >Trigger/Marker...".

This dialog provides access to the settings necessary to select and configure the trigger.



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

- "Auto"
  The signal is generated continuously.
- "Retrigger"
  The signal is generated continuously. A trigger event (internal or external) causes a restart.
- "Armed_Auto"

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

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

Remote command:
`[:SOURce<hw>]:BB:GBAS[:TRIGger]:SEQuence` on page 186
`[:SOURce<hw>]:BB:ILS[:TRIGger]:SEQuence` on page 186
`[:SOURce<hw>]:BB:VOR[:TRIGger]:SEQuence` on page 186
`[:SOURce<hw>]:BB:DME[:TRIGger]:SEQuence` on page 186

Signal Duration Unit
Available only for R&S SMBV-K111 (GBAS) option.

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

Remote command:
`[:SOURce<hw>]:BB:GBAS:TRIGger:SLUNit` on page 185

Trigger Signal Duration
Enters the length of the signal sequence to be output in the "Single" trigger mode.

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

Remote command:
`[:SOURce<hw>]:BB:GBAS:TRIGger:SLENgth` on page 184
`[:SOURce<hw>]:BB:ILS:TRIGger:SLENgth` on page 185
`[:SOURce<hw>]:BB:VOR:TRIGger:SLENgth` on page 185
`[:SOURce<hw>]:BB:DME:TRIGger:SLENgth` on page 184

Arm
For trigger modes "Armed Auto" and "Armed Retrigger", stops the signal generation until subsequent trigger event occurs.

Remote command:
`[:SOURce<hw>]:BB:GBAS:TRIGger:ARM:EXECute` on page 182
`[:SOURce<hw>]:BB:ILS:TRIGger:ARM:EXECute` on page 182
`[:SOURce<hw>]:BB:VOR:TRIGger:ARM:EXECute` on page 182
`[:SOURce<hw>]:BB:DME:TRIGger:ARM:EXECute` on page 182

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

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

Remote command:
[:SOURce<hw>]:BB:GBAS:TRIGger:RMODe? on page 184
[:SOURce<hw>]:BB:ILS:TRIGger:RMODe? on page 184
[:SOURce<hw>]:BB:VOR:TRIGger:RMODe? on page 184
[:SOURce<hw>]:BB:DME:TRIGger:RMODe? on page 184

Execute Trigger
Executes trigger manually.

You can execute the trigger manually only if you select an internal trigger source and a trigger mode other than "Auto".

Remote command:
[:SOURce<hw>]:BB:GBAS:TRIGger:EXECute on page 183
[:SOURce<hw>]:BB:ILS:TRIGger:EXECute on page 183
[:SOURce<hw>]:BB:VOR:TRIGger:EXECute on page 183
[:SOURce<hw>]:BB:DME:TRIGger:EXECute on page 183

Trigger Source
Selects trigger source. This setting is effective when a trigger mode other than "Auto" has been selected.

- "Internal"
  The trigger event is executed by "Execute Trigger".
- "External"
  The trigger event is the active edge of an external trigger signal, supplied at the TRIGGER connector.
  Use the "Global Trigger/Clock Settings" dialog to define the polarity, the trigger threshold and the input impedance of the trigger signal.

Remote command:
[:SOURce<hw>]:BB:GBAS:TRIGger:SOURce on page 185
[:SOURce<hw>]:BB:ILS:TRIGger:SOURce on page 185
[:SOURce<hw>]:BB:VOR:TRIGger:SOURce on page 185
[:SOURce<hw>]:BB:DME:TRIGger:SOURce on page 185

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

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

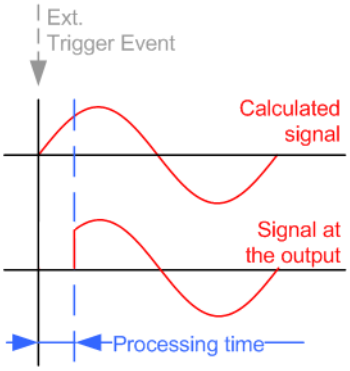
For R&S SMBV instruments:

For two or more R&S SMBVs configured to work in a master-slave mode for synchronous signal generation, configure this parameter depending on the provided system trigger event and the properties of the output signal. See below for an overview of the required settings.

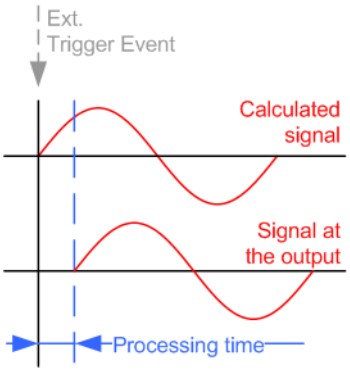
Typical Applications

- All instruments are synchronous to the external trigger event
  - System Trigger = common External Trigger event for the master and the slave instruments
  - "Sync. Output to External Trigger" = ON
- All instruments are synchronous among themselves but starting the signal from first symbol is more important than synchronicity with external trigger event
  - System Trigger = common External Trigger event for the master and the slave instruments
  - "Sync. Output to External Trigger" = OFF
- All instruments are synchronous among themselves
  - System Trigger = internal trigger signal of the master R&S SMBV for the slave instruments
  - "Sync. Output to External Trigger" = OFF

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



"Off" The signal output begins after elapsing of the processing time and starts with sample 0, i.e. the complete signal is output.
This mode is recommended for triggering of short signal sequences with signal duration comparable with the processing time of the instrument.



Remote command:
`[:SOURce<hw>]:BB:GBAS:TRIGger:EXTernal:SYNChronize:OUTPut` on page 183
`[:SOURce<hw>]:BB:ILS:TRIGger:EXTernal:SYNChronize:OUTPut` on page 183
`[:SOURce<hw>]:BB:VOR:TRIGger:EXTernal:SYNChronize:OUTPut` on page 183
`[:SOURce<hw>]:BB:DME:TRIGger:EXTernal:SYNChronize:OUTPut` on page 183

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

Remote command:
`[:SOURce<hw>]:BB:GBAS:TRIGger[:EXTernal<ch>]:DELay` on page 185
`[:SOURce<hw>]:BB:ILS:TRIGger[:EXTernal<ch>]:DELay` on page 185
`[:SOURce<hw>]:BB:VOR:TRIGger[:EXTernal<ch>]:DELay` on page 185
`[:SOURce<hw>]:BB:DME:TRIGger[:EXTernal<ch>]:DELay` on page 185
`[:SOURce<hw>]:BB:GBAS:TRIGger:OBASeband:DELay` on page 184
`[:SOURce<hw>]:BB:ILS:TRIGger:OBASeband:DELay` on page 184
`[:SOURce<hw>]:BB:VOR:TRIGger:OBASeband:DELay` on page 184
`[:SOURce<hw>]:BB:DME:TRIGger:OBASeband:DELay` on page 184

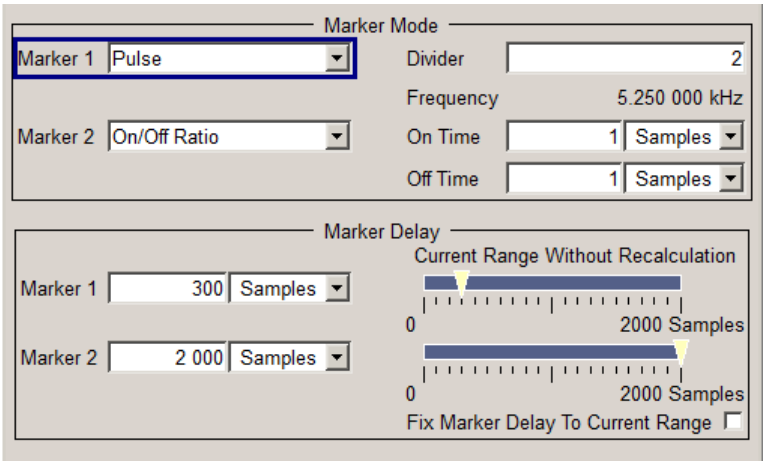
Trigger Inhibit
For external trigger signal or trigger signal from the other path, sets the duration a new trigger event subsequent to triggering is suppressed. In "Retrigger" mode for example, a new trigger event will not cause a restart of the signal generation until the specified inhibit duration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

Remote command:
`[:SOURce<hw>]:BB:GBAS:TRIGger[:EXTernal<ch>]:INHibit` on page 186
`[:SOURce<hw>]:BB:ILS:TRIGger[:EXTernal<ch>]:INHibit` on page 186
`[:SOURce<hw>]:BB:VOR:TRIGger[:EXTernal<ch>]:INHibit` on page 186
`[:SOURce<hw>]:BB:DME:TRIGger[:EXTernal<ch>]:INHibit` on page 186
`[:SOURce<hw>]:BB:GBAS:TRIGger:OBASeband:INHibit` on page 184
`[:SOURce<hw>]:BB:ILS:TRIGger:OBASeband:INHibit` on page 184
`[:SOURce<hw>]:BB:VOR:TRIGger:OBASeband:INHibit` on page 184
`[:SOURce<hw>]:BB:DME:TRIGger:OBASeband:INHibit` on page 184

8.2 Marker Settings GBAS

The marker settings are available only for option R&S SMBV-K111(GBAS).

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



Marker Mode
Marker configuration for up to two marker channels. The settings are used to select the marker mode defining the shape and periodicity of the markers. The contents of the dialog change with the selected marker mode; the settings are self-explanatory.

"1PPS" Marker signal for every start of second.

"Pulse" Regular marker signal.
Enter a divider to define the clock frequency. The software derives the frequency by dividing the sample rate by this divider; the dialog indicates the resulting pulse frequency.

Remote command:
[:SOURce<hw>]:BB:GBAS:TRIGger:OUTPut<ch>:PULSe:DIVider on page 189
[:SOURce<hw>]:BB:GBAS:TRIGger:OUTPut<ch>:PULSe:FREQuency? on page 189

"Pattern" Marker signal that is defined by a 64-bit long pattern.

Remote command:
[:SOURce<hw>]:BB:GBAS:TRIGger:OUTPut<ch>:PATTern on page 189

"ON/OFF Ratio" Regular marker signal defined by an ON/OFF ratio.
A marker period lasts one ON and OFF cycle.
The "ON Time" and "OFF Time" are each expressed as a number of samples.

Remote command:
[:SOURce<hw>]:BB:GBAS:TRIGger:OUTPut<ch>:ONTime on page 190
[:SOURce<hw>]:BB:GBAS:TRIGger:OUTPut<ch>:OFFTime on page 190

"Trigger" A received internal or external trigger signal is output at the marker connector.

Remote command:
[:SOURce<hw>]:BB:GBAS:TRIGger:OUTPut<ch>:MODE on page 188

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

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

Remote command:
[:SOURce<hw>]:BB:GBAS:TRIGger:OUTPut<ch>:DELay on page 190

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

Remote command:
[:SOURce<hw>]:BB:GBAS:TRIGger:OUTPut<ch>:DELay:MINimum? on page 190
[:SOURce<hw>]:BB:GBAS:TRIGger:OUTPut<ch>:DELay:MAXimum? on page 190

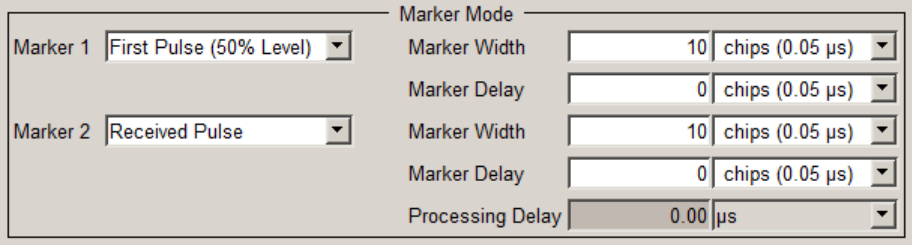
"Fix marker delay to current range"
Restricts the marker delay setting range to the dynamic range.

Remote command:
`[:SOURce<hw>]:BB:GBAS:TRIGger:OUTPut:DELay:FIXed` on page 190

8.3 Marker Settings DME

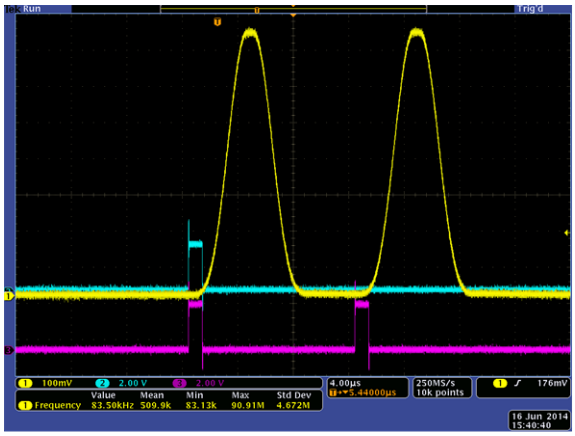
The marker settings are available only for options R&S SMBV-K111 /-K153 (DME).

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



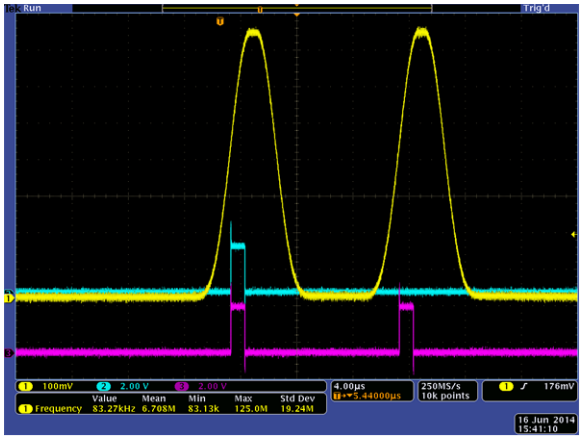
Marker x
Selects a marker signal for the associated marker channel. The settings are used to select the marker mode defining the shape and periodicity of the markers. The contents of the dialog change with the selected marker mode.

"First Pulse (Start) / Pulse Start"
Sets the marker at the begining of the pulse.



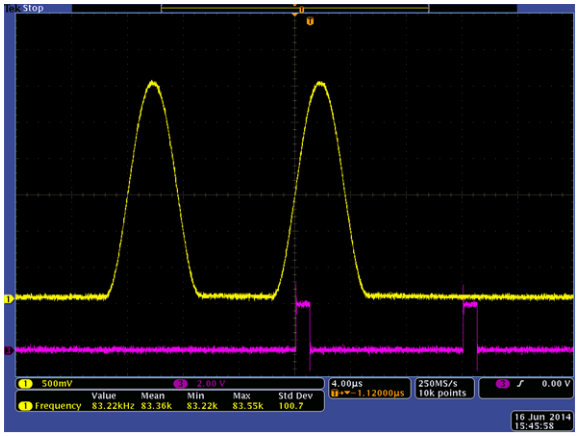
"First Pulse (50% Level) / Pulse (50% Level)"

Sets the markers to the point, where the level of the pulse has reached 50%.



"Received Pulse"

Sets "Marker 2" on the received pulse.



Remote command:

`[:SOURce<hw>]:BB:DME:MARKer<ch>:MODE` on page 188

Marker Width

Sets the width of the corresponding marker.

Remote command:

`[:SOURce<hw>]:BB:DME:MARKer<ch>:WIDTh` on page 188

Marker Delay

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

Remote command:

`[:SOURce<hw>]:BB:DME:MARKer<ch>:DELay` on page 187

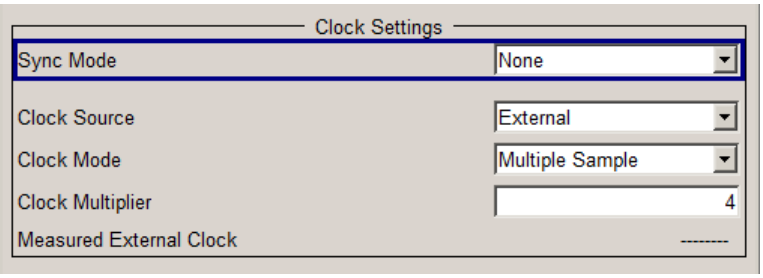
Processing Delay
Displays the processing delay, the delay between the position of the markers for the interrogation pulse and the corresponding marker positions for the reply pulse, when "Marker 2" is set to "Received Pulse".

Remote command:
`[:SOURce<hw>]:BB:DME:MARKer<ch>:PDELay?` on page 188

8.4 Clock Settings

To access this dialog, select "GBAS > Clock..."/"ILS > Clock..."/"VOR > Clock..."/"DME > Clock...".

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



Sync. Mode
(for R&S SMBV only)

Selects the synchronization mode.

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

Note: If several instruments are connected, the connecting cables from the master instrument to the slave one and between each two consecutive slave instruments must have the same length and type. Avoid unnecessary cable length and branching points.

- "None"
  The instrument is working in stand-alone mode.
- "Sync. Master"
  The instrument provides all connected instruments with its synchronisation (including the trigger signal) and reference clock signal.
- "Sync. Slave"
  The instrument receives the synchronisation and reference clock signal from another instrument working in a master mode.

Remote command:
`[:SOURce<hw>]:BB:GBAS:CLOCk:SYNChronization:MODE` on page 193
`[:SOURce<hw>]:BB:ILS:CLOCk:SYNChronization:MODE` on page 193
`[:SOURce<hw>]:BB:VOR:CLOCk:SYNChronization:MODE` on page 193
`[:SOURce<hw>]:BB:DME:CLOCk:SYNChronization:MODE` on page 193

Set Synchronization Settings
(for R&S SMBV only)

Performs an automatic adjustment of the instrument's settings required for the synchronization mode, selected with the parameter "Synchronization Mode".

Remote command:
[:SOURce<hw>]:BB:GBAS:CLOCk:SYNChronization:EXECute on page 192
[:SOURce<hw>]:BB:ILS:CLOCk:SYNChronization:EXECute on page 192
[:SOURce<hw>]:BB:VOR:CLOCk:SYNChronization:EXECute on page 192
[:SOURce<hw>]:BB:DME:CLOCk:SYNChronization:EXECute on page 192

Clock Source
Selects the clock source.

- "Internal"
  The internal clock reference is used to generate the symbol clock.
- "External"
  The external clock reference is fed in as the symbol clock or multiple thereof via the CLOCK connector.
  The symbol rate must be correctly set to an accuracy of +/-2 % (see data sheet).
  The polarity of the clock input can be changed with the aid of "Global Trigger/Clock Settings".

Remote command:
[:SOURce<hw>]:BB:GBAS:CLOCk:SOURce on page 192
[:SOURce<hw>]:BB:ILS:CLOCk:SOURce on page 192
[:SOURce<hw>]:BB:VOR:CLOCk:SOURce on page 192
[:SOURce<hw>]:BB:DME:CLOCk:SOURce on page 192

Clock Mode
Enters the type of externally supplied clock.

Remote command:
[:SOURce<hw>]:BB:ILS:CLOCk:MODE on page 191
[:SOURce<hw>]:BB:VOR:CLOCk:MODE on page 191
[:SOURce<hw>]:BB:DME:CLOCk:MODE on page 191
[:SOURce<hw>]:BB:GBAS:CLOCk:MODE on page 191

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

Remote command:
[:SOURce<hw>]:BB:GBAS:CLOCk:MULTiplier on page 191
[:SOURce<hw>]:BB:ILS:CLOCk:MULTiplier on page 192
[:SOURce<hw>]:BB:VOR:CLOCk:MULTiplier on page 192
[:SOURce<hw>]:BB:DME:CLOCk:MULTiplier on page 191

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

Remote command:
CLOCk:INPut:FREQuency?

8.5 Global Settings

The buttons in this section lead to dialogs for general trigger, clock and mapping settings.

Global Trigger/Clock Settings
Calls the "Global Trigger/Clock/Input Settings" dialog.

This dialog is used among other things for setting the trigger threshold, the input impedance and the polarity of the clock and trigger inputs.

The parameters in this dialog affect all digital modulations and standards, and are described in chapter "Global Trigger/Clock/Input Settings" in the Operating Manual.

9 How to Work with the GBAS Option

Testing GBAS receivers can be a challenging task. The main error sources that influence the performance of a GBAS airborne device are typically caused by distortion on the VHF link or mismatch in the application data. The former could be caused by interference, multipath effects as well as ground and/or surface reflections. The latter is usually related to a bias in the differential corrections (message type 1 and 11) and/or mismatch between the TAP/FAS data transmited on the link and the actually wanted flight path by the air traffic control (ATC) (message type 4).

The following step-by-step instructions demonstrate how to perform some signal generation tasks with the GBAS option and generate signals suitable for GBAS testing. The following sections focus on the R&S SMBV configuration. Necessary configuration in VDB receivers, devices under test (DUT) or other test equipment are beyond the scope of this description.

9.1 Generating GBAS Signals with Several Frequency Channels

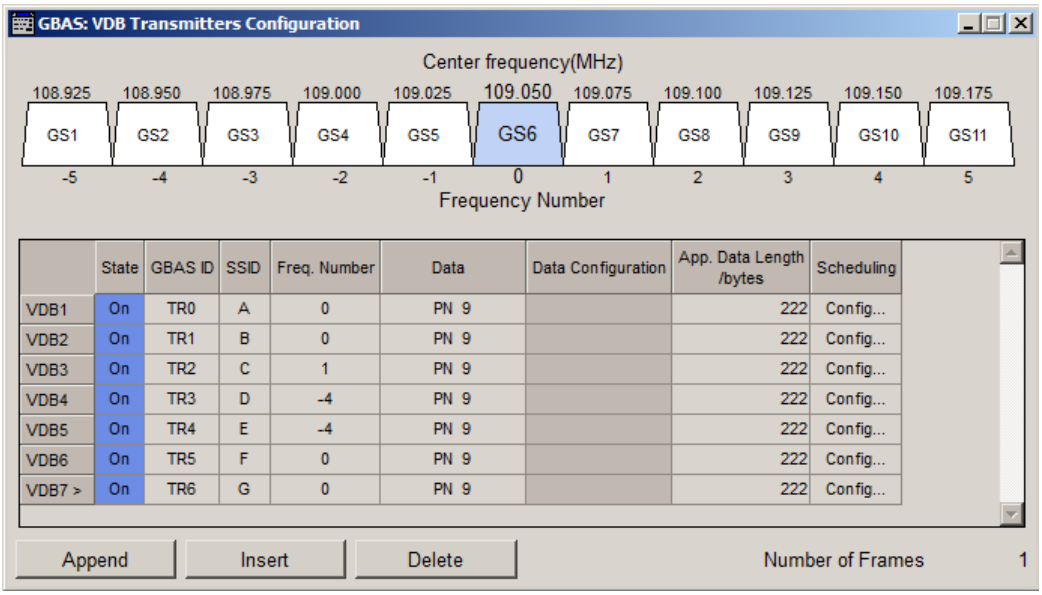
With the R&S SMBV, you can generate simulataneously multiple frequency GBAS signal. Multiple frequency signals are suitable for testing the capability of VDB receivers of tuning frequencies in the frequency range, as specified in RTCA DO-246D.

This example shows how to use the multiple frequency function to generate a GBAS signal, containing GBAS Frequency Channels 39 to 45.

To enable the generation of several frequency channels

1. Calculate the channel number of the central frequency.
   (39 + 45)/2 = 42
2. For frequency channel number 42, calculate the channel frequency.
   Channel frequency = 108.025 MHz + 42*25 kHz = 109.075 MHz
3. Select "Status Bar > Frequency = 109.075 MHz" to set the center frequency.
4. Select "Baseband > Avionics > GBAS" and select "Multiple Frequency Channels > On".
5. Select "VDB Transmitters Configuration"

   The graph confirms the selected center frequency.
   The R&S SMBV selects the 10 adjacent frequency channels, symmetrically located around the central one. The central frequency is referred as frequency number 0.
6. Use the "Append" function to enable seven VDBs, VDB#1 to VBD#7.
7. In the VDB table, for each VDB, select different "Feq. Num." to allocated them to different frequency channels.



8. Select "GBAS > State > On"
9. Select "RF > State > On"

   The R&S SMBV generates a GBAS signal, composed of seven adjicent frequency channels.

The generated GBAS signal is suitable for unwanted emissions measurements, adjacent and co-channels rejections masurements and carrier frequency stability measurements.

9.2 Generating a GBAS Signal for Receiver Sensitivity Tests

Sensitivity tests are very essential for the performance of VDB receivers and used to measure their ability to demodulate GBAS signal at low power level. To perform a sensitivity test it is suffisient to generate a single frequency signal. We use the advantages of the gated power mode and vary the level of the generated GBAS signal. The goal of the test is to find out the signal with the minimum level that the DUT requires to correctly detect the GBAS signal.

To generate a GBAS signal for sensitivity tests

1. Press PRESET to set the R&S SMBV to a definite state.
2. Select "Staus Bar > Frequency = 108.4 MHz"
3. Select "Staus Bar > Level = -10 dBm"
4. Select "Baseband > Avionics > GBAS"

5. Select "Gated Power Mode > On"
6. Select "VDB Transmitter Configuration", use the default configuration and select "VDB#1 > Schedulling > Config".
7. In the "GBAS Scheduling 1" dialog, enable:
   a) "TS1 > State > On", relative power "TS1 > Pow(dB) = 0 dB"
   b) "TS3 > State > On", relative power "TS3 > Pow(dB) = -15 dB"
   c) "TS2/TS4/TS5/TS6/TS7/TS8 > State > Off"
   d) "TS2/TS4/TS5/TS6/TS7/TS8 > Pow(dB) = -inf"
8. Select "GBAS > State > On"
9. Select "RF > State > On"

   The R&S SMBV generates a single frequency signal; the VDB transmission is allocated on two time slots, TS1 and TS3 with different relative power (see also example "Calculating the power per time slot in "Gated Power Mode > On"" on page 18). The signal is generated at physical layer and the bursts carry arbitrary data (PN9).
10. In the R&S SMBV, vary the relative power of TS3 and measure the received power level at the VDB receiver.
    For example, to simulate conditions of weak signal, reduce the relative power down to -60 dBm.
11. Check whether the received signal is correcty decodded.

    The sensitvity level of the receiver is the level at that the receiver does not detect any signal on TS3.

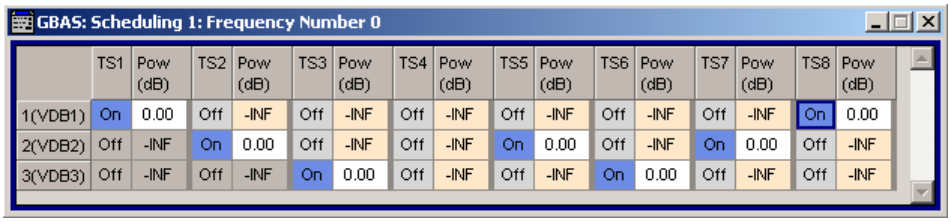
9.3 Generating a GBAS Signal for VDB Slot Detection

The goal of VDB slot detection tests is to prove correct detection of all time slots from which each VDB message was received.

To generate a GBAS signal for slot detection tests

1. Press PRESET to set the R&S SMBV to a definite state.
2. Select "Staus Bar > Frequency = 110 MHz"
3. Select "Baseband > Avionics > GBAS" and select "Multiple Frequency Channels > Off".
4. Select "VDB Transmitters Configuration"

   The graph confirms the selected center frequency.
5. Use the "Append" function to enable three VDBs, VDB#1 to VBD#3.
6. Select "VDB#1 > Schedulling > Config" and allocate VDB#1, VDB#2 and VDB#3 as follwoing:



7. Select "GBAS > State > On"
8. Select "RF > State > On"

   The signal is generated at physical layer and the bursts carry arbitrary data (PN9). Prove that the VDB receiver detects the correct time slots. For example, the transmission of VDB#2 on frequency channel with 110 MHz carrier frequency and time slots TS2, TS5 and TS7.

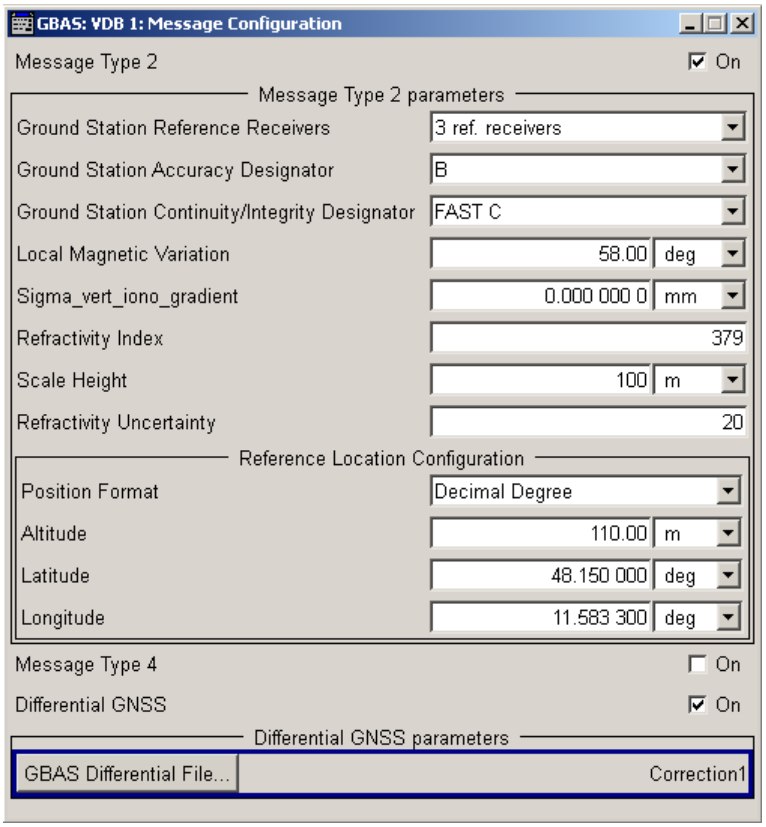
9.4 Generating a GBAS Signal for Message Format Detection

Message format detection tests verify wheteher the VDB receiver receives and decoded correctly parameters in the GBAS messages. The generated VDB signal in this example contains real application data. Enabled are GBAS Message Type 2 and Message Type 1.

To generate a GBAS signal for testing of correct message detection

1. Press PRESET to set the R&S SMBV to a definite state.
2. Select "Staus Bar > Frequency = 110 MHz"
3. Select "Baseband > Avionics > GBAS" and select "Multiple Frequency Channels > Off".
4. Select "VDB Transmitters Configuration"

   The graph confirms the selected center frequency.
5. Select "VDB#1 > Data > Real GBAS Data" and select "Data Config > Message Config".
6. Enable "Message Type 2 > On".
   Configre the settings as required. For this example, enable a reference location with coorrdinates "Altitude = 110m", "Latitude = 48.150 deg" and "Longitude = 11.5833 deg"
7. Enable "Differantial GNSS > On" ans select "GBAS Differential File > Predefined Files > Correction1"



8. Select "GBAS > State > On"
9. Select "RF > State > On"
10. At the VDB receiver, verify that:
    - the received values of each parameter are within the allowed value range
    - the received parameters are decoded correctly
    - the VDB messages are discarded if they do not comply to the standards.

9.5 Generating a GPS and a GBAS Signal for Multi Mode Receiver Tests

GBAS airborne receivers are based on the multi mode receiver (MMR) technology. A multi mode receiver consists of a GPS antenna, a VHF antenna and processing equipment and supports simultaneous signal reception of different landing and precision navigation systems, like GPS, GBAS and ILS.

In this example, we use two R&S SMBV to generate a GPS signal and a GBAS signal for MMR testing. The aim of this GBAS test is to measure the resulting (improved) augmentation.

Overview of required relevant options

Instrument#1

- option GPS (R&S SMBV-K44)
- GNSS global option R&S SMBV-K91 (Extension to 12 Satellites)
- generation of more than 12 satellites requires additionally GNSS global option R&S SMBV-K96 (Extension to 24 Satellites)
- GNSS Extension for Obscuration Simulation and Automatic Multipath (R&S SMBV-K101)

Instrument#2

- option GBAS (R&S SMBV-K111)

Connecting and configuring the two R&S SMBV instruments for synchronous signal generation

In this following, only the related settings are discussed. For detailed information on cabling and required configuration, refer to:

- R&S SMBV Operating Manual, section "Synchronous Signal Generation"
- Application Note 1GP84 "Time Synchronous Signals with Multiple R&S SMBV100A Vector Signal Generators "

► Connect the instruments to work in master-slave mode, see figure 9-1.

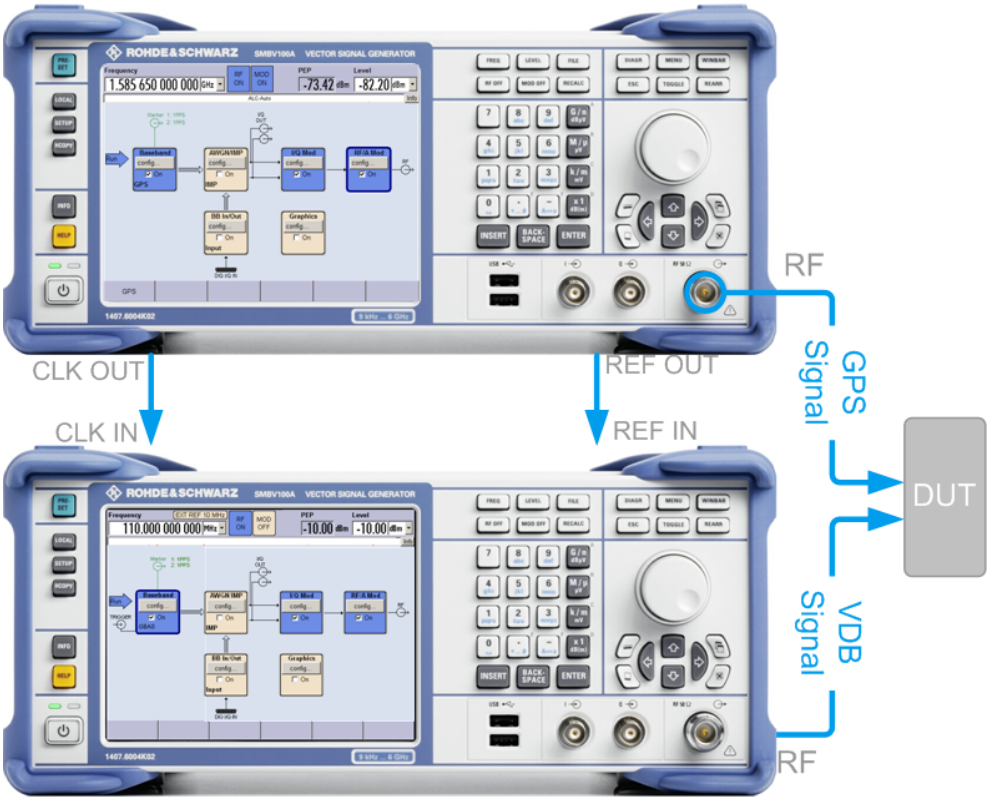


Fig. 9-1: Example of test setup

The required steps are beyong the scope of this description. For details, see the proposed reference descriptions.

The first R&S SMBV provides the second one with its system clock, trigger and frequency reference signals.

Generating a GPS signal

To configure the instrument#1 to generate a GPS signal with 12 or more satellites, follow these general guidelines.

For details, see R&S SMBV Satellite Navigation operating manual.

1. Select "Baseband > GPS"
2. Select "GPS > Simulation Mode > Auto Localization"
3. Select "User Environment > Vehicle Type > Aircraft"
4. Select "Localization Data", select "Waypoint/Attitude File" and load a suitable `*.xtd` file, describing the movement of airplane the DUT is installed in.
5. Select "GPS > Navigation Data > Almanac" and select a suitable file.

6. Open the "GPS > Real Time S.P.O.T." to observe the current satellites constellation.
7. Select "GPS > State > On"
8. Select "RF > State > On"

Generating a GBAS signal

To configure the instrument#2 to generate a GBAS signal, follow the steps described in "To generate a GBAS signal for testing of correct message detection" on page 100

1. Configure the required reference location
2. Select a suitable "GBAS Differential File" (message type 1), containing ephemeris as well as ionospheric corrections.
3. Select "GBAS > State > On"
4. Select "RF > State > On"
5. In the instrument#1, trigger the signal generation.
6. At the multi mode receiver, measure the resulting bias.
   Is the augmentation improved?

   The multi mode receiver should calculate the plane position with ideally less error than in the case of a standalone GPS.
   The differential GPS correction parameters transmited by the VHF link (message types 1 and 11) enhance the navigation algorithm and should lead to a better position fix.

Possible extensions

With this test setup you can simulated different conditions and perform a number of measurement, like:

- Use the AWGN generator of the R&S SMBV and superimpose noise on the generated GBAS signal
- Simulate the GNSS signal in multipath environment
- Use the ephemeris parameters in the navigation message to simulate satellite failure
- Simulate the effects caused by obscuration and multipath on the GNSS signal, like reflections and absorption from different surfaces
- Use the clock correction parameters to simulate satellite clock errors
- Change the ionospheric parameters in the atmospheric message

The full range of GBAS test include flight testing. Consider a test setup with two R&S SMBVs, where:

- the first R&S SMBV simulates a GBAS signal with message type 4 corresponding to the Path to be followed (TAP and FAS)
- the second R&S SMBV simulates a real time errors in the actual path followed by the airplane when compared to the TAP path the Air Traffic Controller (ATC) is asking for.

Consider a hadrware in the loop (HIL) setup with the second R&S SMBV.

10 Remote-Control Commands

The following commands are required to perform signal generation with the Avionics option in a remote environment. We assume that the R&S SMBV has already been set up for remote operation in a network as described in the R&S SMBV 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 SMBV operating 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:GBAS` for GBAS.

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` on page 108:

- Entry Standard = DME
  `SOURce:BB:DME:STATe`
- Entry Standard = GBAS
  `SOURce:BB:GBAS: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
SOURce<hw>	[1]	available baseband signals
OUTPut<ch>	1 .. 2	available markers R&S SMBV supports two markers
EXTernal<ch>	1 .. 2	external trigger connectors

The following commands specific to the Avionics standards are described here:

- Primary Settings....107
- GBAS Settings....110
- ILS Settings....139
- VOR Settings....156
- DME Settings....164
- Trigger Settings....181
- Marker Settings DME....187
- Marker Settings GBAS....188
- Clock Settings....191

10.1 Primary Settings

<subsystem>:STATe....108
[:SOURce<hw>]:BB:DME:STATe....108
[:SOURce<hw>]:BB:GBAS:STATe....108
[:SOURce<hw>]:BB:ILS:STATe....108
[:SOURce<hw>]:BB:VOR:STATe....108
<subsystem>:PRESet....108
[:SOURce<hw>]:BB:DME:PRESet....108
[:SOURce<hw>]:BB:GBAS:PRESet....108
[:SOURce<hw>]:BB:ILS:PRESet....108
[:SOURce<hw>]:BB:VOR:PRESet....108
<subsystem>:SETTing:CATalog....108
[:SOURce<hw>]:BB:DME:SETTing:CATalog?....108
[:SOURce<hw>]:BB:GBAS:SETTing:CATalog?....108
[:SOURce<hw>]:BB:ILS:SETTing:CATalog?....108
[:SOURce<hw>]:BB:VOR:SETTing:CATalog?....108
<subsystem>:SETTing:DELete....108
[:SOURce<hw>]:BB:DME:SETTing:DELete....108
[:SOURce<hw>]:BB:GBAS:SETTing:DELete....109
[:SOURce<hw>]:BB:ILS:SETTing:DELete....109
[:SOURce<hw>]:BB:VOR:SETTing:DELete....109
<subsystem>:SETTing:LOAD....109
[:SOURce<hw>]:BB:DME:SETTing:LOAD....109
[:SOURce<hw>]:BB:GBAS:SETTing:LOAD....109
[:SOURce<hw>]:BB:ILS:SETTing:LOAD....109
[:SOURce<hw>]:BB:VOR:SETTing:LOAD....109
<subsystem>:SETTing:STORe....109

[:SOURce<hw>]:BB:DME:SETTing:STORe 109
[:SOURce<hw>]:BB:GBAS:SETTing:STORe 109
[:SOURce<hw>]:BB:ILS:SETTing:STORe 109
[:SOURce<hw>]:BB:VOR:SETTing:STORe 109
<subsystem>:SETTing:STORe:FAST 109
[:SOURce<hw>]:BB:DME:SETTing:STORe:FAST 109
[:SOURce<hw>]:BB:GBAS:SETTing:STORe:FAST 109
[:SOURce<hw>]:BB:ILS:SETTing:STORe:FAST 110
[:SOURce<hw>]:BB:VOR:SETTing:STORe:FAST 110

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

Activates/deactivates the VOR modulation.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

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

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

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

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

Refer to section "MMEM Subsystem" in the R&S SMBV manual for general information on file handling in the default and a specific directories.

Return values:

<Catalog> <filename1>,<filename2>,...

Returns a string of file names separated by commas.

Usage: Query only

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

[:SOURce<hw>]:BB:GBAS: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 specified directory. Deleted are files with the file extension `*.dme`/`*.gbas`/`*.ils`/`*.vor`.

Refer to section "MMEM Subsystem" in the R&S SMBV manual for general information on file handling in the default and a specific directories.

Setting parameters:
<Filename> string

Usage: Setting only

<subsystem>:SETTing:LOAD
[:SOURce<hw>]:BB:DME:SETTing:LOAD <Filename>
[:SOURce<hw>]:BB:GBAS: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 sepcified directory. Load are files with extension `*.dme`/`*.gbas`/`*.ils`/`*.vor` .

Refer to section "MMEM Subsystem" in the R&S SMBV manual for general information on file handling in the default and a specific directories.

Setting parameters:
<Filename> string

Usage: Setting only

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

Stores the current settings into the selected file; the file extensions `*.dme`/`*.gbas`/ `*.ils`/`*.vor` is assined automatically.

Refer to section "MMEM Subsystem" in the R&S SMBV operating manual for general information on file handling in the default and a specific directories.

Setting parameters:
<Filename> string

Usage: Setting only

<subsystem>:SETTing:STORe:FAST
[:SOURce<hw>]:BB:DME:SETTing:STORe:FAST <FastSave>
[:SOURce<hw>]:BB:GBAS:SETTing:STORe:FAST <Fast>

[:SOURce<hw>]:BB:ILS:SETTing:STORe:FAST <FastSave>
[:SOURce<hw>]:BB:VOR:SETTing:STORe:FAST <FastSave>

Determines whether the instrument performs an absolute or a differential storing of the settings.

Enable this function to accelerate the saving process by saving only the settings with values different to the default ones.

Note: This function is not affected by the "Preset" function.

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

10.2 GBAS Settings

10.2.1 Programming Examples

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

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

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

Example: Generating a GBAS signal for sensitivity tests

The following example uses the gated power mode.

```
*RST
SOURce1:FREQuency:CW 108.4MHz
SOURce1:POWer:LEVel:IMMediate:AMPLitude  -10

SOURce1:BB:GBAS:GPOW ON
SOURce1:BB:GBAS:VDB1:SCH:TS1:STATe ON
SOURce1:BB:GBAS:VDB1:SCH:TS1:POWer 0
SOURce1:BB:GBAS:VDB1:SCH:TS3:STATe ON
SOURce1:BB:GBAS:VDB1:SCH:TS3:POWer -15
SOURce1:BB:GBAS:STATe ON
OUTput1:STATe ON
```

```
// vary (reduce) the relative power of TS3
SOURce1:BB:GBAS:VDB1:SCH:TS3:POWer -45
```

Example: Generating a GBAS signal for VDB slot detection

The following is an example on how to configure transmission of two VDBs on a common carrier frequency of 100 MHz. VDB#1 and VDB#2 use different time slots.

```
*RST
SOURce1:FREQuency:CW 110MHz

SOURce1:BB:GBAS:MFCHannels OFF
// enable 2 VDBs
SOURce1:BB:GBAS:VDB:APPend
SOURce1:BB:GBAS:VDB1:SCH:TS1:STATe ON
SOURce1:BB:GBAS:VDB1:SCH:TS1:POWer 0
SOURce1:BB:GBAS:VDB1:SCH:TS8:STATe ON
SOURce1:BB:GBAS:VDB1:SCH:TS8:POWer 0
SOURce1:BB:GBAS:VDB2:SCH:TS2:STATe ON
SOURce1:BB:GBAS:VDB2:SCH:TS2:POWer 0
SOURce1:BB:GBAS:VDB2:SCH:TS5:STATe ON
SOURce1:BB:GBAS:VDB2:SCH:TS5:POWer 0
SOURce1:BB:GBAS:VDB2:SCH:TS7:STATe ON
SOURce1:BB:GBAS:VDB2:SCH:TS7:POWer 0

SOURce1:BB:GBAS:VDB2:STATe?
// Response: 1
SOURce1:BB:GBAS:STATe ON
OUTput1:STATe ON
// generate a waveform and store it in the default directory
SOURce1:BB:GBAS:WAVeform:CREate "gbas_slot_detection"
// store the settings in a file in the default directory
SOURce1:BB:GBAS:SETTing:STORe:FAST?
// Respone: 1
SOURce1:BB:GBAS:SETTing:STORe "gbas_slot_detection"
```

Example: Generating a GBAS signal for message format detection

The following is an example on how to generate a VDB signal with real application data and enabled GBAS Message Type 2 and Message Type 1.

```
*RST
SOURce1:FREQuency:CW 110MHz

SOURce1:BB:GBAS:MFCHannels OFF
SOURce1:BB:GBAS:VDB1:DATA RGData
SOURce1:BB:GBAS:VDB1:MCONfig:MT2State ON
SOURce1:BB:GBAS:VDB1:MCONfig:GSRReceivers GW3R
SOURce1:BB:GBAS:VDB1:MCONfig:GSADesignator GADB
SOURce1:BB:GBAS:VDB1:MCONfig:GCID FC
SOURce1:BB:GBAS:VDB1:MCONfig:LMVariation 58
```

```
SOURce1:BB:GBAS:VDB1:MCONfig:SVIGradient 0
SOURce1:BB:GBAS:VDB1:MCONfig:RFINdex 379
SOURce1:BB:GBAS:VDB1:MCONfig:SHEight 100
SOURce1:BB:GBAS:VDB1:MCONfig:RUNCertainty 20
SOURce1:BB:GBAS:VDB1:MCONfig:LOCation:COORdinates:DECimal 11.5833, 48.150, 110
SOURce1:BB:GBAS:VDB1:MCONfig:LOCation:COORdinates:DMS?
// Response: 11,34,59.88,EAST,48,9,0,NORT,110

SOURce1:BB:GBAS:VDB1:MCONfig:DG:STATe ON
SOURce1:BB:GBAS:VDB1:MCONfig:DG:PREDefined:CATalog?
// Response: Correction1
SOURce1:BB:GBAS:VDB1:MCONfig:DG:PREDefined:FILE "Correction1"
SOURce1:BB:GBAS:VDB1:MCONfig:DG:FILE?
// Response: "Correction1.rs_gbas"

SOURce1:BB:GBAS:VDB1:SSID?
// Response: A
SOURce1:BB:GBAS:VDB1:GID?
// REsponse: TR0
SOURce1:BB:GBAS:VDB1:NOFRames?
// Response: 20
SOURce1:BB:GBAS:VDB1:FNUMber?
// Response: 0

SOURce1:BB:GBAS:STATe ON
OUTput1:STATe ON

SOURce1:BB:GBAS:SETTing:STORe "gbas_msg_fmt_detection"
SOURce1:BB:GBAS:SETTing:CATalog?
// Response: gbas_msg_fmt_detection,gbas_slot_detection
```

Example: Generating a GBAS signal containing message type 4

The following is an example on how to generate a VDB signal with real application data and enabled GBAS Message Type 4.

```
*RST
SOURce1:FREQuency:CW 110MHz

SOURce1:BB:GBAS:MFCHannels OFF
SOURce1:BB:GBAS:VDB1:DATA RGData
SOURce1:BB:GBAS:VDB1:MCONfig:MT4State ON

SOURce1:BB:GBAS:VDB1:MCONfig:FDSState ON
SOURce1:BB:GBAS:VDB1:MCONfig:GPANgle 30
SOURce1:BB:GBAS:VDB1:MCONfig:ATUSelector MET
SOURce1:BB:GBAS:VDB1:MCONfig:ATCHeight 1200
SOURce1:BB:GBAS:VDB1:MCONfig:LFLocation:HEIGht 103
SOURce1:BB:GBAS:VDB1:MCONfig:AID KJFK
SOURce1:BB:GBAS:VDB1:MCONfig:RNUMber 13
SOURce1:BB:GBAS:VDB1:MCONfig:RLETter LETL
```

```
SOURce1:BB:GBAS:VDB1:MCONfig:APDesignator GC
SOURce1:BB:GBAS:VDB1:MCONfig:RUINdicator "A"
SOURce1:BB:GBAS:VDB1:MCONfig:RPDF 3
SOURce1:BB:GBAS:VDB1:MCONfig:RPIF "L13A"
SOURce1:BB:GBAS:VDB1:MCONfig:LFLocation:COORdinates:DECimal -0.012650,0.027897
SOURce1:BB:GBAS:VDB1:MCONfig:LFLocation:COORdinates:DMS?
// Response: 73,47,13.83,EAST,40,39,22.95,NORT
SOURce1:BB:GBAS:VDB1:MCONfig:DFLocation:COORdinates:DECimal -0.012650, 0.027897
SOURce1:BB:GBAS:VDB1:MCONfig:DFLocation:COORdinates:DMS?
// Response: 0,0,45.54,WEST,0,1,40.429,NORT
SOURce1:BB:GBAS:VDB1:MCONfig:CWAThreshold 105
SOURce1:BB:GBAS:VDB1:MCONfig:DLOFfset 0
SOURce1:BB:GBAS:VDB1:MCONfig:FVAA 0
SOURce1:BB:GBAS:VDB1:MCONfig:FLAA 40

SOURce1:BB:GBAS:VDB1:MCONfig:TDSState ON
SOURce1:BB:GBAS:VDB1:MCONfig:RPDT 21
SOURce1:BB:GBAS:VDB1:MCONfig:RPIT "GTN"
SOURce1:BB:GBAS:VDB1:MCONfig:WAYPoint:PREDefined:CATalog?
// Response: Braunschweig
SOURce1:BB:GBAS:VDB1:MCONfig:WAYPoint:PREDefined:FILE "Braunschweig"
SOURce1:BB:GBAS:VDB1:MCONfig:WAYPoint:FILE?
// Response: "Braunschweig.txt"
SOURce1:BB:GBAS:VDB1:MCONfig:NOPPoint?
// Response: 11
// to query user waypoint files in the default directory
// SOURce1:BB:GBAS:VDB1:MCONfig:WAYPoint:USER:CATalog?
// Response: gbas_waypoint
SOURce1:BB:GBAS:VDB1:MCONfig:FRCLink 3
SOURce1:BB:GBAS:VDB1:MCONfig:TVAS 50
SOURce1:BB:GBAS:VDB1:MCONfig:TLAS 2

SOURce1:BB:GBAS:STATe ON
OUTput1:STATe ON
```

Example: Adjusting clock, marker and trigger settings

The following example lists the provided commands:

```
// *****************************************************************
// Clock settings
// *****************************************************************
SOURce1:BB:GBAS:CLOCk:SOURce INTernal

// *****************************************************************
// Configure and enable standard marker signal
// *****************************************************************
SOURce1:BB:GBAS:TRIGger:OUTPut1:MODE RATio
SOURce1:BB:GBAS:TRIGger:OUTPut1:ONTime 40
SOURce1:BB:GBAS:TRIGger:OUTPut1:OFFTime 20
```

```
// ********************************************************************
// Configure and enable signal generation
// ********************************************************************
SOURce1:BB:GBAS:TRIGger:SOURce INTernal
SOURce1:BB:GBAS:TRIGger:SEQuence ARETrigger
SOURce1:BB:GBAS:STAT ON
SOURce1:BB:GBAS:TRIGger:EXECute
SOURce1:BB:GBAS:TRIGger:ARM:EXECute
SOURce1:BB:GBAS:TRIGger:RMODe?
// Stopped
SOURce1:BB:GBAS:TRIGger:EXECute
SOURce1:BB:GBAS:TRIGger:RMODe?
// Run
```

Example: Quering the default filter, clipping and modulation settings

The follwoing is a general example on working with these settings.

```
SOURce1:BB:GBAS:PRESet

SOURce1:BB:GBAS:SRINfo?
// Response: "10.5 kHz"
SOURce1:BB:GBAS:FILTer:TYPE?
// Response: COS
SOURce1:BB:GBAS:FILTer:PARameter:COSine?
// Response: 0.6
SOURce1:BB:GBAS:FILTer:PARameter:COSine:COFS?
// Response:0
SOURce1:BB:GBAS:MSET:MTYPe?
// Response: "D8PSK"
SOURce1:BB:GBAS:MSET:SRATe?
// Response: 10500

SOURce1:BB:GBAS:MFCHannels ON
SOURce1:BB:GBAS:MSET:SRATe?
// Response: 525000
SOURce1:BB:GBAS:SRINfo?
// Response: "525 kHz"

SOURce1:BB:GBAS:CLIPping:STATe?
// Response: 0
SOURce1:BB:GBAS:CLIPping:LEVel?
// Response: 100
SOURce1:BB:GBAS:CLIPping:MODE?
// Response: VECTor
```

10.2.2 General Settings

[:SOURce<hw>]:BB:GBAS:VERSion?

Queries the specification according to that the settings are implement.

Return values:
<Version> string

Example: `SOURce1:BB:GBAS:VERSion?`
Response: "RTCA DO-246D"

Usage: Query only

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

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

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

Setting parameters:
<Filename> string

Example: see example "Generating a GBAS signal for VDB slot detection" on page 111

Usage: Setting only

Manual operation: See "Generate Waveform File" on page 25

[:SOURce<hw>]:BB:GBAS:SCATi <SCAT>

Enables using of SCAT-I header information instead of the default LAAS (GBAS) header.

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

Example: `SOURce1:BB:GBAS:SCATi 0`

Manual operation: See "SCAT-I" on page 25

[:SOURce<hw>]:BB:GBAS:MFCHannels <MFCh>

Enables the configuration of multiple frequency channels.

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

Example: see example "Generating a GBAS signal for VDB slot detection" on page 111

Manual operation: See "Multiple Frequency Channels" on page 26

[:SOURce<hw>]:BB:GBAS:GPOW <GPow>

Enables gated power mode.

Parameters:

<GPow> 0 | 1 | OFF | ON

*RST: 1

Example: see example "Generating a GBAS signal for sensitivity tests" on page 110

Manual operation: See "Gated Power Mode" on page 26

[:SOURce<hw>]:BB:GBAS:SRINfo?

Queries the used sample rate.

Return values:

<SRInfo> string

Example: see example "Quering the default filter, clipping and modulation settings" on page 114

Usage: Query only

Manual operation: See "Sample Rate Variation/Sample Rate Info" on page 26

10.2.3 VDB Transmission Configuration Settings

[:SOURce<hw>]:BB:GBAS:VDB:APPend

Appends a new VDB to the end of the VDB list.

Example: see example "Generating a GBAS signal for VDB slot detection" on page 111

Usage: Event

Manual operation: See "Append, Insert, Delete" on page 29

[:SOURce<hw>]:BB:GBAS:VDB<ch>:INSert

Inserts a new VDB before the selected one.

Example: see example "Generating a GBAS signal for VDB slot detection" on page 111

Usage: Event

Manual operation: See "Append, Insert, Delete" on page 29

[:SOURce<hw>]:BB:GBAS:VDB<ch>:DELete

Deletes the selected VDB.

Example: see example "Generating a GBAS signal for VDB slot detection" on page 111

Usage: Event

Manual operation: See "Append, Insert, Delete" on page 29

[:SOURce<hw>]:BB:GBAS:VDB<ch>:STATe <VState>

Enables the selected VHF Data Broadcast (VDB) transmiter.

Parameters:

<VState> 0 | 1 | OFF | ON

*RST: 1

Example: see example "Generating a GBAS signal for VDB slot detection" on page 111

Manual operation: See "State" on page 28

[:SOURce<hw>]:BB:GBAS:VDB<ch>:GID <GId>

Sets the GBAS ID.

Parameters:

<GId> string

A four-character (24-bit) alphanumeric field that identifies the ground station broadcasting the message.
Permited are capital letter, numbers and "space".

Example: see example "Generating a GBAS signal for message format detection" on page 111

Manual operation: See "GBAS ID" on page 28

[:SOURce<hw>]:BB:GBAS:VDB<ch>:SSID <Ssid>

Sets the Station Slot Identifier SSID of the of the ground station.

Parameters:

<Ssid> A | B | C | D | E | F | G | H

*RST: A

Example: see example "Generating a GBAS signal for message format detection" on page 111

Manual operation: See "SSID" on page 28

[:SOURce<hw>]:BB:GBAS:VDB<ch>:FNUMber <FNum>

Sets the frequency number the corresponding VDB is using.

Parameters:

<FNum> integer

Range: -5 to 5
*RST: 0

Example: see example "Generating a GBAS signal for message format detection" on page 111

Manual operation: See "Freq. Num" on page 28

[:SOURce<hw>]:BB:GBAS:VDB<ch>:DLENgth <DataLen>

Sets the application data length.

Parameters:

<DataLen> integer

Range: 1 to 65495
*RST: 222

Manual operation: See "App. Data Length/bytes" on page 29

[:SOURce<hw>]:BB:GBAS:VDB<ch>:DATA <Data>

Selects the data source, e.g. a sequence of 0 or 1, a pseudo-random sequence with different lenght, a pattern or a data list (`DLISt`).

Parameters:

<Data> ZERO | ONE | PATTern | PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | RGData

*RST: PN9

Example: see example "Generating a GBAS signal for message format detection" on page 111

Manual operation: See "Data/Data Config" on page 28

[:SOURce<hw>]:BB:GBAS:VDB<ch>:DATA:DSELection <DSelection>

Selects the data list for the data source.

Parameters:

<DSelection> string

Example:

```
SOURce1:BB:GBAS:VDB2:DATA DLISt
SOURce1:BB:GBAS:VDB2:DATA:DSELection
"/var/user/gbas_dl.dm_iqd "
```

Manual operation: See "Data/Data Config" on page 28

[:SOURce<hw>]:BB:GBAS:VDB<ch>:DATA:PATTern <Pattern>

Selects the bit pattern for the data source.

Parameters:
<Pattern> integer

Example:
```
SOURce1:BB:GBAS:VDB2:DATA PATTern
SOURce1:BB:GBAS:VDB2:DATA:PATTern #HB8A,12
```

Manual operation: See "Data/Data Config" on page 28

[:SOURce<hw>]:BB:GBAS:NOFRames?

Queries the number of VD frames.

Return values:
<NOFrame> integer
Range: 1 to 12500
*RST: 1

Usage: Query only

Manual operation: See "No. of Frames" on page 29

10.2.4 Scheduling Settings

[:SOURce<hw>]:BB:GBAS:VDB<ch>:SCH:TS<st>:STATe <State>

Enables the VDB in the corresponding time slot (TS).

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

Example: see example "Generating a GBAS signal for sensitivity tests" on page 110

Manual operation: See "TS0..TS7" on page 30

[:SOURce<hw>]:BB:GBAS:VDB<ch>:SCH:TS<st>:POWer <Power>

Sets the relative power of a VDB per time slot (TS).

Parameters:
<Power> float
Range: -21 to 0
Increment: 0.01
*RST: 0

Example: see example "Generating a GBAS signal for sensitivity tests" on page 110

Manual operation: See "Pow(dB)" on page 30

10.2.5 Message Configuration

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:AID <AId>

Sets the airport ID.

Parameters:
<AId> string

Example: see example "Generating a GBAS signal containing message type 4" on page 112

Manual operation: See "Airport ID" on page 37

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:APDesignator <ApPerDes>

Sets the approach performance designator.

Parameters:
<ApPerDes> GAB | GC | GCD
*RST: GAB

Example: see example "Generating a GBAS signal containing message type 4" on page 112

Manual operation: See "Approach Performance Designator" on page 37

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:ATCHeight <Tch>

Sets the approach threshold crossing height.

Parameters:
<Tch> float
Range: 0 to 1638.35
Increment: 0.05
*RST: 0

Example: see example "Generating a GBAS signal containing message type 4" on page 112

Manual operation: See "Plan View/Profile View Parameters" on page 36

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:ATUSelector <TchUnit>

Sets the units the approach TCH is experssed in, see `[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:ATCHeight`.

Parameters:
<TchUnit> FEET | MET
*RST: FEET

Example: see example "Generating a GBAS signal containing message type 4" on page 112

Manual operation: See "Plan View/Profile View Parameters" on page 36

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:CWAThreshold <CrWdAtTh>

Sets the course width at threshold.

Parameters:

<CrWdAtTh> float

Range: 80 to 143.75
Increment: 0.01
*RST: 80

Example: see example "Generating a GBAS signal containing message type 4" on page 112

Manual operation: See "Course Width at Threshold" on page 39

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:DFLocation:COORdinates:DECimal <Longitude>, <Latitude>

Defines the coordinates of the Delta FPAD location in decimal format.

Parameters:

<Longitude> float

Range: -1.0 to 1.0
Increment: 1E-6
*RST: 0

<Latitude> float

Range: -1.0 to 1.0
Increment: 1E-6
*RST: 0

Example: see example "Generating a GBAS signal containing message type 4" on page 112

Manual operation: See "Delta_FPAP Location Configuration" on page 38

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:DFLocation:COORdinates:DMS <LongitudeDeg>, <LongitudeMin>, <LongitudeSec>, <LongitudeDir>, <LatitudeDeg>, <LatitudeMin>, <LatitudeSec>, <LatitudeDir>

Defines the coordinates of the Delta FPAD location in degrees, minutes and seconds.

Parameters:

<LongitudeDeg> integer

Range: 0 to 1.0
*RST: 0

<LongitudeMin> integer
Defines the longitude minutes.
Range: 0 to 59
*RST: 0

<LongitudeSec> float
Defines the longitude seconds.
Range: 0 to 59.999
Increment: 0.001
*RST: 0

<LongitudeDir> EAST | WEST
Defines the longitude direction.
*RST: EAST

<LatitudeDeg> integer
Defines the latitude degrees.
Range: 0 to 1.0
*RST: 0

<LatitudeMin> integer
Defines the latitude minutes.
Range: 0 to 59
*RST: 0

<LatitudeSec> float
Defines the latitude seconds.
Range: 0 to 59.999
Increment: 0.001
*RST: 0

<LatitudeDir> NORTh | SOUTh
Defines the latitude direction.
*RST: NORT

Example: see example "Generating a GBAS signal containing message type 4" on page 112

Manual operation: See "Delta_FPAP Location Configuration" on page 38

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:DG:STATe <DiffGnssState>

Enables the use of differential GNSS data.

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

Example: see example "Generating a GBAS signal for message format detection" on page 111

Manual operation: See "Differential GNSS" on page 42

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:DG:PREDefined:CATalog?
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:DG:USER:CATalog?

Queries the names of the existing user defined/predefined GBAS differential files.

Per default, the instrument stores user defined files in the `/var/user/` directory. Use the command `MMEM:CDIRectory` to change the default directory to the currently used one.

Only files with extension `*.rs_gbas` are listed.

Example: see example "Generating a GBAS signal for message format detection" on page 111

Usage: Query only

Manual operation: See "GBAS Differential File..." on page 42

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:DG:PREDefined:FILE <Filename>

Loads the selected predeifned file (extension `*.rs_gbas`).

Setting parameters:

<Filename> string

Only the file name is required

Example: see example "Generating a GBAS signal for message format detection" on page 111

Usage: Setting only

Manual operation: See "GBAS Differential File..." on page 42

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:DG:USER:FILE <Filename>

Loads the selected user-defined file (extension `*.rs_gbas`).

Per default, the instrument stores user defined files in the `/var/user/` directory. Use the command `MMEM:CDIRectory` to change the default directory to the currently used one.

Setting parameters:

<Filename> string

For files stored in the default directory, only the file name is required.

Example: `SOURce1:BB:GBAS:VDB3:MCONfig:DG:USER:CATalog?`
Response: `gbas_correction`
`SOURce1:BB:GBAS:VDB3:MCONfig:DG:USER:FILE "gbas_correction"`

Usage: Setting only

Manual operation: See "GBAS Differential File..." on page 42

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:DG:FILE?

Queries the currently selected GBAS differential file.

Return values:
<Filename> string
filename with file extension (`*.rs_gbas`)

Example: see example "Generating a GBAS signal for message format detection" on page 111

Usage: Query only

Manual operation: See "GBAS Differential File..." on page 42

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:DLOFfset <DelLenOff>

Sets the Delta_Length offset.

Parameters:
<DelLenOff> float
Range: 0 to 2032
Increment: 8
*RST: 0

Example: see example "Generating a GBAS signal for message format detection" on page 111

Manual operation: See "Delta_Length Offset" on page 39

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:FDSState <Fdss>

Enables the configuration of Final Approach Segment (FAS) data set.

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

Example: see example "Generating a GBAS signal for message format detection" on page 111

Manual operation: See "FAS Data Set" on page 35

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:FLAA <FasVt>

Sets the value of the broadcast lateral alert limit.

Parameters:

<FasVt> float

Range: 0 to 50.8
Increment: 0.2
*RST: 0

Example: see example "Generating a GBAS signal containing message type 4" on page 112

Manual operation: See "FAS Lateral Alert Limit / Approach Status" on page 39

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:FRCLink <Rpcl>

Sets the FAS RPDS or continuation link.

Parameters:

<Rpcl> integer

Range: 0 to 255
*RST: 0

Example: see example "Generating a GBAS signal containing message type 4" on page 112

Manual operation: See "FAS RPDS or Continuation Link" on page 41

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:FVAA <Fvaa>

Sets the value of the broadcast vertical alert limit.

Parameters:

<Fvaa> float

Range: 0 to 25.4
Increment: 0.1
*RST: 0

Example: see example "Generating a GBAS signal containing message type 4" on page 112

Manual operation: See "FAS Vertical Alert Limit / Approach Status" on page 39

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:GCID <Gcid>

Sets the ground station continuity/integrity designator.

Parameters:

<Gcid> FC | FD

*RST: FC

Example: see example "Generating a GBAS signal for message format detection" on page 111

Manual operation: See "Ground Station Continuity/Integrity Designator" on page 32

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:GPANgle <Gpa>

Sets the glide path angle.

Parameters:

<Gpa> float

Range: 0 to 90
Increment: 0.01
*RST: 0

Example: see example "Generating a GBAS signal containing message type 4" on page 112

Manual operation: See "Plan View/Profile View Parameters" on page 36

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:GSADesignator <Gsad>

Sets the ground station accuracy designator.

Parameters:

<Gsad> GADA | GADB | GADC

*RST: GADA

Example: see example "Generating a GBAS signal for message format detection" on page 111

Manual operation: See "Ground Station Accuracy Designator" on page 32

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:GSRReceivers <Gsrr>

Sets the number of ground station reference receivers.

Parameters:

<Gsrr> GW3R | GW4R | GW2R

*RST: GW2R

Example: see example "Generating a GBAS signal for message format detection" on page 111

Manual operation: See "Ground Station Reference Receivers" on page 32

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:LFLocation:COORdinates:DECimal <Longitude>, <Latitude>

Defines the coordinates of the LTP/FTP in decimal format.

Parameters:

<Longitude> float

Range: -180 to 180
Increment: 1E-6
*RST: 0

<Latitude> float

Range: -90 to 90
Increment: 1E-6
*RST: 0

Example: see example "Generating a GBAS signal containing message type 4" on page 112

Manual operation: See "LTP/FTP Location Configuration" on page 37

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:LFLocation:COORdinates:DMS
<LongitudeDeg>, <LongitudeMin>, <LongitudeSec>, <LongitudeDir>, <LatitudeDeg>, <LatitudeMin>, <LatitudeSec>, <LatitudeDir>

Defines the coordinates of the LTP/FTP in degrees, minutes and seconds.

Parameters:

<LongitudeDeg> integer

Range: 0 to 180
*RST: 0

<LongitudeMin> integer

Defines the longitude minutes.

Range: 0 to 59
*RST: 0

<LongitudeSec> float

Defines the longitude seconds.

Range: 0 to 59.999
Increment: 0.001
*RST: 0

<LongitudeDir> EAST | WEST

Defines the longitude direction.

*RST: EAST

<LatitudeDeg> integer

Defines the latitude degrees.

Range: 0 to 90
*RST: 0

<LatitudeMin> integer

Defines the latitude minutes.

Range: 0 to 59
*RST: 0

<LatitudeSec> float

Defines the latitude seconds.

Range: 0 to 59.999
Increment: 0.001
*RST: 0

<LatitudeDir> NORTh | SOUTh

Defines the latitude direction.

*RST: NORT

Example: see example "Generating a GBAS signal containing message type 4" on page 112

Manual operation: See "LTP/FTP Location Configuration" on page 37

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:LFLocation:HEIGht <LfHeight>

Sets the LTP/FTP height.

Parameters:

<LfHeight> float

Range: -512 to 6041.5
Increment: 0.1
*RST: 0

Example: see example "Generating a GBAS signal containing message type 4" on page 112

Manual operation: See "Plan View/Profile View Parameters" on page 36

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:LMVariation <Lmv>

Sets the local magnetic variation.

Parameters:

<Lmv> float

A positive value represents an east variation (clockwise from true north)

Range: -180 to 180
Increment: 0.01
*RST: 0
Default unit: deg

Example: see example "Generating a GBAS signal for message format detection" on page 111

Manual operation: See "Local Magnetic Variation" on page 32

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:LOCation:COORdinates:DECimal
<Longitude>, <Latitude>, <Altitude>

Defines the coordinates of the ground station reference location in decimal format.

Parameters:

<Longitude> float

Range: -180 to 180
Increment: 1E-6
*RST: 0

<Latitude> float

Range: -90 to 90
Increment: 1E-6
*RST: 0

<Altitude> float

Range: -83886.07 to 83886.07
Increment: 0.01
*RST: 0

Example: see example "Generating a GBAS signal for message format detection" on page 111

Manual operation: See "Reference Location Configuration" on page 33

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:LOCation:COORdinates:DMS
<LongitudeDeg>, <LongitudeMin>, <LongitudeSec>, <LongitudeDir>, <LatitudeDeg>, <LatitudeMin>, <LatitudeSec>, <LatitudeDir>, <Altitude>

Defines the coordinates of the ground station reference location in degrees, minutes and seconds.

Parameters:

<LongitudeDeg> integer

Range: 0 to 180
*RST: 0

<LongitudeMin> integer

Defines the longitude minutes.

Range: 0 to 59
*RST: 0

<LongitudeSec> float

Defines the longitude seconds.

Range: 0 to 59.999
Increment: 0.001
*RST: 0

<LongitudeDir> EAST | WEST
Defines the longitude direction.
*RST: EAST

<LatitudeDeg> integer
Defines the latitude degrees.
Range: 0 to 90
*RST: 0

<LatitudeMin> integer
Defines the latitude minutes.
Range: 0 to 59
*RST: 0

<LatitudeSec> float
Defines the latitude seconds.
Range: 0 to 59.999
Increment: 0.001
*RST: 0

<LatitudeDir> NORTh | SOUTh
Defines the latitude direction.
*RST: NORT

<Altitude> float
Defines the height above the ellipsoid (HAE) altitude.
Range: -83886.07 to 83886.07
Increment: 0.01
*RST: 0

Example: see example "Generating a GBAS signal for message format detection" on page 111

Manual operation: See "Reference Location Configuration" on page 33

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:MT2State <Mt2State>

Enables the message type 2 configuration.

Parameters:
<Mt2State> 0 | 1 | OFF | ON
*RST: 0

Example: see example "Generating a GBAS signal for message format detection" on page 111

Manual operation: See "Message Type 2" on page 31

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:MT4State <Mt4State>

Enables the configuration of message type 4.

Parameters:
<Mt4State> 0 | 1 | OFF | ON
*RST: 0

Example: see example "Generating a GBAS signal containing message type 4" on page 112

Manual operation: See "Message Type 4" on page 34

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:NOPPoint <Nofp>

Queries the number of path points - N.

Parameters:
<Nofp> integer
Range: 2 to 11
*RST: 2

Example: see example "Generating a GBAS signal containing message type 4" on page 112

Manual operation: See "Number of Path Points - N" on page 40

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:RFINdex <RefIdx>

Sets the refractivity index.

Parameters:
<RefIdx> integer
Range: 16 to 781
*RST: 16

Example: see example "Generating a GBAS signal for message format detection" on page 111

Manual operation: See "Refractivity Index" on page 32

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:RLETter <Rlet>

Sets the runway letter.

Parameters:
<Rlet> NLETter | LETR | LETL | LETC
*RST: NLETter

Example: see example "Generating a GBAS signal containing message type 4" on page 112

Manual operation: See "Runway Letter" on page 37

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:RNUMber <Rnum>

Sets the runway number.

Parameters:

<Rnum> integer

Range: 1 to 36
*RST: 1

Example: see example "Generating a GBAS signal containing message type 4" on page 112

Manual operation: See "Runway Number" on page 37

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:RPDF <Rpdf>

Sets the reference path data selector for FAS.

Parameters:

<Rpdf> integer

Range: 0 to 48
*RST: 1

Example: see example "Generating a GBAS signal containing message type 4" on page 112

Manual operation: See "Reference Path Data Selector" on page 37

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:RPDT <Rpdt>

Sets the reference path data selector.

Parameters:

<Rpdt> integer

Range: 0 to 254
*RST: 1

Example: see example "Generating a GBAS signal containing message type 4" on page 112

Manual operation: See "Reference Path Data Selector" on page 40

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:RPIF <Rpif>

Sets the reference path identifier for FAS.

Parameters:

<Rpif> string

three or four alphanumeric character

Example: see example "Generating a GBAS signal containing message type 4" on page 112

Manual operation: See "Reference Path ID" on page 37

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:RPIT <Rpit>

Sets the reference path identifier for TAP.

Parameters:

<Rpit> string

three or four alphanumeric characters

Example: see example "Generating a GBAS signal containing message type 4" on page 112

Manual operation: See "Reference Path ID" on page 40

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:RUINdicator <Ruin>

Sets the route indicator.

Parameters:

<Ruin> a single upper case alphabetic character

Allowed are letters, excluding “I” and “O”, or the “space” character.

Example: see example "Generating a GBAS signal containing message type 4" on page 112

Manual operation: See "Route Indicator" on page 37

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:RUNCertainty <Runc>

Set the refractivity uncertainty.

Parameters:

<Runc> integer

Range: 0 to 255
*RST: 0

Example: see example "Generating a GBAS signal for message format detection" on page 111

Manual operation: See "Refractivity Uncertainty" on page 32

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:SHEight <SHeight>

Sets the scale height.

Parameters:

<SHeight> float

Range: 0 to 25500
Increment: 100
*RST: 0
Default unit: m

Example: see example "Generating a GBAS signal for message format detection" on page 111

Manual operation: See "Scale Height" on page 32

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:SVIGradient <Svig>

Sets the Sigma_vert_iono_gradient.

Parameters:

<Svig> float

Range: 0 to 2.54999999356187e-05
Increment: 0.1e-6
*RST: 0

Example: see example "Generating a GBAS signal for message format detection" on page 111

Manual operation: See "Sigma_vert_iono_gradient" on page 32

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:TDSState <Tdss>

Enables the configuration of the Terminal Area Path (TAP) data set.

Parameters:

<Tdss> 0 | 1 | OFF | ON

*RST: 1

Example: see example "Generating a GBAS signal containing message type 4" on page 112

Manual operation: See "TAP Data Set" on page 39

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:TLAS <Tlas>

Sets the value of the broadcast lateral alert limit.

Parameters:

<Tlas> float

Range: 0 to 2.54
Increment: 0.01
*RST: 0

Example: see example "Generating a GBAS signal containing message type 4" on page 112

Manual operation: See "TAP Lateral Alert Limit / Status" on page 41

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:TVAS <Tvas>

Sets the value of the broadcast vertical alert limit.

Parameters:

<Tvas> float

Range: 0 to 127
Increment: 0.5
*RST: 0

Example: see example "Generating a GBAS signal containing message type 4" on page 112

Manual operation: See "TAP Vertical Alert Limit / Status" on page 41

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:WAYPoint:PREDefined:CATalog?
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:WAYPoint:USER:CATalog?

Queries the names of the existing user defined/predefined waypoint files.

Per default, the instrument stores user defined files in the `/var/user/` directory. Use the command `MMEM:CDIRectory` to change the default directory to the currently used one.

Only files with extension `*.txt` are listed.

Example: see example "Generating a GBAS signal containing message type 4" on page 112

Usage: Query only

Manual operation: See "Waypoint File" on page 40

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:WAYPoint:PREDefined:FILE <WpFile>

Loads the selected predeifned file (extension `*.txt`).

Setting parameters:

<WpFile> string

Only the file name is required

Example: see example "Generating a GBAS signal containing message type 4" on page 112

Usage: Setting only

Manual operation: See "Waypoint File" on page 40

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:WAYPoint:USER:FILE <Filename>

Loads the selected user-defined file (extension `*.txt`).

Per default, the instrument stores user defined files in the `/var/user/` directory. Use the command `MMEM:CDIRectory` to change the default directory to the currently used one.

Setting parameters:

<Filename> string

For files stored in the default directory, only the file name is required.

Example: see example "Generating a GBAS signal containing message type 4" on page 112

Usage: Setting only

Manual operation: See "Waypoint File" on page 40

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:WAYPoint:FILE?

Queries the currently selected waypoint file.

Return values:

<Filename> string

filename with file extension (`*.txt`)

Example: see example "Generating a GBAS signal containing message type 4" on page 112

Usage: Query only

Manual operation: See "Waypoint File" on page 40

10.2.6 Filter, Clipping, Modulation Settings

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

The command selects the filter type.

Parameters:

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

*RST: COSine

Example: see example "Quering the default filter, clipping and modulation settings" on page 114

Manual operation: See "Filter" on page 43

[:SOURce<hw>]:BB:GBAS:FILTer:PARameter:APCO25 <Apco25>
[:SOURce<hw>]:BB:GBAS:FILTer:PARameter:COSine <Cosine>
[:SOURce<hw>]:BB:GBAS:FILTer:PARameter:COSine:COFS <CoFs>
[:SOURce<hw>]:BB:GBAS:FILTer:PARameter:GAUSs <Gauss>
[:SOURce<hw>]:BB:GBAS:FILTer:PARameter:LPASs <LPass>
[:SOURce<hw>]:BB:GBAS:FILTer:PARameter:LPASSEVM <LPassevm>
[:SOURce<hw>]:BB:GBAS:FILTer:PARameter:PGAuss <PGauss>

[:SOURce<hw>]:BB:GBAS:FILTer:PARameter:RCOSine <RCosine>
[:SOURce<hw>]:BB:GBAS:FILTer:PARameter:SPHase <SPhase>

Sets the corresponding filter parameter.

Filter Type	Parameter	Parameter Name	min	max	increment	default
APCO25	roll-off factor	<Apco25>	0.05	0.99	0.01	0.2
COSine	roll-off factor	<Cosine>	0.05	1.00	0.01	0.35
COSine	cut off frequency shift	<CoFs>	-1	1	0.01	0
GAUSs	roll-off factor	<Gauss>	0.15	2.5	0.01	0.3
LPASs	cut off frequency	<LPass>	0.05	2	0.01	0.5
LPASSEVM	cut off frequency	<LPassEvm>	0.05	2	0.01	0.5
PGAuss	roll-off factor	<PGauss>	0.15	2.5	0.01	0.3
RCOSine	roll-off factor	<RCosine>	0.05	1.00	0.01	0.35
SPHase	B x T	<SPhase>	0.15	2.5	0.01	2

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

Example: see example "Quering the default filter, clipping and modulation settings" on page 114

Manual operation: See "Roll Off Factor or BxT" on page 43

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

Enables/disable clipping.

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

Example: see example "Quering the default filter, clipping and modulation settings" on page 114

Manual operation: See "Clipping State" on page 45

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

Sets the limit for clipping.

Parameters:
<Level> integer
Range: 1 to 100
*RST: 100

Example: see example "Quering the default filter, clipping and modulation settings" on page 114

Manual operation: See "Clipping Level" on page 46

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

Sets the clipping mode.

Parameters:

<Mode> VECTor | SCALar

*RST: VECTor

Example: see example "Quering the default filter, clipping and modulation settings" on page 114

Manual operation: See "Clipping Mode" on page 46

[:SOURce<hw>]:BB:GBAS:MSET:MTYPe?

Queries the used modulation.

Return values:

<MType> string

*RST: D8PSK

Example: see example "Quering the default filter, clipping and modulation settings" on page 114

Usage: Query only

Manual operation: See "Modulation Type" on page 45

[:SOURce<hw>]:BB:GBAS:MSET:SRATe?

Queries the used sample rate.

Return values:

<SRate> float

Range: 10.49E3 to 10.51E3
Increment: 1E-3
*RST: 10.5E3

Example: see example "Quering the default filter, clipping and modulation settings" on page 114

Usage: Query only

Manual operation: See "Sample Rate Variation/Sample Rate Info" on page 26

10.3 ILS Settings

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

See also chapter 10.6, "Trigger Settings ", on page 181 and chapter 10.9, "Clock Settings", on page 191 for a description of the trigger and clock settings.

10.3.1 General Settings

[:SOURce<hw>]:BB:ILS:PRESet 139
[:SOURce<hw>]:BB:ILS:STATe 139
[:SOURce<hw>]:BB:ILS:TYPE 139

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

Sets the ILS default settings.

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

Activates/deactivates the ILS modulation.

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

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

Selects the ILS modulation type.

Parameters:
<Type> GS | LOCalize | GSLope | MBEacon
*RST: GS

Manual operation: See "ILS Component" on page 48

10.3.2 ILS Glide Slope Settings

[:SOURce<hw>]:BB:ILS[:GS|GSLope]:DDM:COUPling 140
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:DDM:CURRent 140
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:DDM:DIRection 140
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:DDM:LOGarithmic 141
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:DDM:PCT 141
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:DDM:POLarity 141
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:DDM:STEP 141
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:DDM:DEPTh 142
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:FREQuency 142
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:FREQuency:MODE 142
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:ICAO:CHANnel 142

[:SOURce<hw>]:BB:ILS[:GS|GSLope]:LLOBe[:FREQuency] 143
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:MODE 143
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:PHASe 143
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:SDM 144
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:ULOBe[:FREQuency] 144

[: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 144).

Parameters:

<Coupling> FIXed | SDM

*RST: FIXed

Manual operation: See "DDM - SDM Coupling" on page 53

[: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 uA = DDM × 857,1 uA

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

Manual operation: See "DDM Current" on page 52

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

Sets the simulation mode for the ILS-GS 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

Manual operation: See "Fly" on page 52

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

Sets the depth of modulation value for the ILS-GS in dB.

See also `[:SOURce<hw>]:BB:ILS[:GS|GSLope]:DDM:DEPTh` on page 142.

Parameters:

<Logarithmic> float

Range: -999.9 to 999.9
Increment: 1E-4
*RST: 0

Manual operation: See "DDM Logarithmic" on page 53

[: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 142.

Parameters:

<Pct> float

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

Manual operation: See "DDM Percent" on page 53

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

Sets the polarity for DDM calculation (see `[:SOURce<hw>]:BB:ILS[:GS|GSLope]: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

Manual operation: See "DDM Polarity" on page 50

[: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

[: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

Manual operation: See "DDM Depth" on page 52

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

Sets the carrier frequency if `[:SOURce<hw>]:BB:ILS[:GS|GSLope]:FREQuency:MODE` is set to *USER*.

Parameters:
<CarrierFreq> float
Range: 100E3 to 6E9
Increment: 0.01
*RST: 334.7e6

Manual operation: See "Carrier Frequency" on page 50

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

Sets the carrier frequency mode for the ILS-GS modulation signal.

Parameters:
<Mode> USER | ICAO
*RST: USER

Manual operation: See "Carrier Frequency Mode" on page 49

[:SOURce<hw>]:BB:ILS[:GS|GSLope]:ICAO:CHANnel <Channel>

Selects the ICAO channel i.e., the ILS-GS transmitting frequency. The RF frequency is set to the value selected here. The ICAO channel settings for ILS-GS and ILS-LOC are coupled.

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

Manual operation: See "ICAO Channel" on page 50

[: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-GS modulation signal.

Parameters:

<Frequency> float

Range: 100 to 200
Increment: 0.05
*RST: 150

Manual operation: See "Down Frequency" on page 51

[:SOURce<hw>]:BB:ILS[:GS|GSLope]:MODE <Mode>

Sets the operating mode for the ILS-GS modulation signal.

Parameters:

<Mode> NORM | ULOBe | LLOBe

NORM
ILS-GS modulation is active.

ULOBe
Amplitude modulation of the output signal with the upper lobe (90Hz) signal component of the ILS-GS signal is active.

LLOBe
Amplitude modulation of the output signal with the lower lobe (150Hz) signal component of the ILS-GS signal is active.

*RST: NORM

Manual operation: See "Mode" on page 50

[: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-GS signal. The zero crossing of the lower lobe (150Hz) 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

Manual operation: See "Up/Down Phase" on page 51

[:SOURce<hw>]:BB:ILS[:GS|GSLope]:SDM <Sdm>

Sets the arithmetic sum of the modulation depths of the upper lobe (90Hz) and lower lobe (150Hz) for the ILS-GS 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

Manual operation: See "Sum of Depth (SDM)" on page 52

[: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 (up frequency).

Parameters:

<Frequency> float

Range: 60 to 120
Increment: 0.03
*RST: 90

Manual operation: See "Up Frequency" on page 51

10.3.3 ILS Localizer Settings

[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:CODE 145
[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:DASH 145
[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:DEPTh 145
[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:DOT 146
[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:FREQuency 146
[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:LETTer 146
[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:PERiod 146
[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:SYMBol 147
[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:TSCHema 147
[:SOURce<hw>]:BB:ILS:LOCalizer:COMid[:STATe] 147
[:SOURce<hw>]:BB:ILS:LOCalizer:DDM:COUPling 147
[:SOURce<hw>]:BB:ILS:LOCalizer:DDM:CURRent 148
[:SOURce<hw>]:BB:ILS:LOCalizer:DDM:DIRection 148

[:SOURce<hw>]:BB:ILS:LOCalizer:DDM:LOGarithmic 148
[:SOURce<hw>]:BB:ILS:LOCalizer:DDM:PCT 149
[:SOURce<hw>]:BB:ILS:LOCalizer:DDM:POLarity 149
[:SOURce<hw>]:BB:ILS:LOCalizer:DDM:DEPTh 149
[:SOURce<hw>]:BB:ILS:LOCalizer:FREQuency 150
[:SOURce<hw>]:BB:ILS:LOCalizer:FREQuency:MODE 150
[:SOURce<hw>]:BB:ILS:LOCalizer:ICAO:CHANnel 150
[:SOURce<hw>]:BB:ILS:LOCalizer:LLOBe[:FREQuency] 150
[:SOURce<hw>]:BB:ILS:LOCalizer:MODE 151
[:SOURce<hw>]:BB:ILS:LOCalizer:PHASe 151
[:SOURce<hw>]:BB:ILS:LOCalizer:RLOBe[:FREQuency] 151
[:SOURce<hw>]:BB:ILS:LOCalizer:SDM 152

[: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).

Available only if `[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:TSCHema` is set to *USER*.

Parameters:

<Code> string

Manual operation: See "Code" on page 58

[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:DASH <Dash>

Sets the length of a morse dash in seconds.

Available only if `[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:TSCHema` is set to *USER*.

Parameters:

<Dash> float

Range: 0.05 to 1
Increment: 1E-4
*RST: 0.3

Manual operation: See "Dash Length" on page 59

[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:DEPTh <Depth>

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

Parameters:

<Depth> float

Range: 0 to 100
Increment: 0.1
*RST: 10

Manual operation: See "Depth" on page 59

[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:DOT <Dot>

Sets the length of a morse dot in seconds. If the time schema is set to *STD* the length of the dash (3xdot), symbol space (=dot) and letter space (=3xdot) is also determined by this entry.

Parameters:

<Dot> float

Range: 0.05 to 1
Increment: 1E-4
*RST: 0.1

Manual operation: See "Dot Length" on page 59

[: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

Manual operation: See "Frequency" on page 58

[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:LETTer <Letter>

Sets the length of a letter space in seconds.

Available only if `[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:TSCHema` is set to *USER*.

Parameters:

<Letter> float

Range: 0.05 to 1
Increment: 1E-4
*RST: 0.3

Manual operation: See "Letter Space" on page 59

[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:PERiod <Period>

Sets the period of the COM/ID signal in seconds.

Parameters:

<Period> float

Range: 0 to 120
Increment: 1E-3
*RST: 9

Manual operation: See "Period" on page 59

[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:SYMBol <Symbol>

Sets the length of the symbol space in seconds.

Available only if `[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:TSCHema` is set to *USER*.

Parameters:

<Symbol> float

Range: 0.05 to 1
Increment: 1E-4
*RST: 0.1

Manual operation: See "Symbol Space" on page 59

[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:TSCHema <TSchema>

Sets the time schema for the COM/ID signal.

In the standard time schema (STD) the set dot length determines the dash length (= three times the dot length) whereas in the user time schema (USER) all length parameters can be set independently.

Parameters:

<TSchema> STD | USER

*RST: STD

Manual operation: See "Time Schema" on page 59

[:SOURce<hw>]:BB:ILS:LOCalizer:COMid[:STATe] <State>

Switches on/ off the addittional COM/ID signal.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Manual operation: See "State" on page 58

[: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 152).

Parameters:

<Coupling> FIXed | SDM

*RST: FIXed

Manual operation: See "DDM - SDM Coupling" on page 57

[: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 uA = DDM × 857,1 uA

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

Manual operation: See "DDM Current" on page 56

[: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

Manual operation: See "Fly" on page 56

[:SOURce<hw>]:BB:ILS:LOCalizer:DDM:LOGarithmic <Logarithmic>

Sets the depth of modulation value for the ILS-LOC in dB.

See also `[:SOURce<hw>]:BB:ILS:LOCalizer:DDM:DEPTh` on page 149.

Parameters:

<Logarithmic> float

Range: -999.9 to 999.9
Increment: 1E-4
*RST: 0

Manual operation: See "DDM Logarithmic" on page 57

[: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 149.

Parameters:

<Pct> float

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

Manual operation: See "DDM Percent" on page 57

[:SOURce<hw>]:BB:ILS:LOCalizer:DDM:POLarity <Polarity>

Sets the polarity for DDM calculation (see `[:SOURce<hw>]:BB:ILS:LOCalizer:DDM:DEPTh` on page 149).

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

Manual operation: See "DDM polarity" on page 54

[: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

Manual operation: See "DDM Depth" on page 57

[:SOURce<hw>]:BB:ILS:LOCalizer:FREQuency <CarrierFreq>

Sets the carrier frequency if `[:SOURce<hw>]:BB:ILS:LOCalizer:FREQuency:MODE` is set to *USER*.

Parameters:

<CarrierFreq> float

Range: 100E3 to 6E9
Increment: 0.01
*RST: 108.1e6

Manual operation: See "Carrier Frequency" on page 54

[:SOURce<hw>]:BB:ILS:LOCalizer:FREQuency:MODE <Mode>

Sets the carrier frequency mode for the ILS-LOC modulation signal.

Parameters:

<Mode> USER | ICAO

*RST: USER

Manual operation: See "Carrier Frequency Mode" on page 49

[:SOURce<hw>]:BB:ILS:LOCalizer:ICAO:CHANnel <Channel>

Selects the ICAO channel i.e., the ILS-LOC transmitting frequency. The RF frequency is set to the value selected here. The ICAO channel settings for ILS-GS and ILS-LOC are coupled.

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

Manual operation: See "ICAO Channel" on page 50

[:SOURce<hw>]:BB:ILS:LOCalizer:LLOBe[:FREQuency] <Frequency>

Sets the modulation frequency of the antenna lobe arranged at the bottom viewed from the air plane for the ILS-LOC modulation signal.

Parameters:

<Frequency> float

Range: 60 to 120
Increment: 0.03
*RST: 90

Manual operation: See "Left Frequency" on page 55

[:SOURce<hw>]:BB:ILS:LOCalizer:MODE <Mode>

Sets the operating mode for the ILS-LOC modulation signal.

Parameters:

<Mode> NORM | LLOBe | RLOBe

NORM
ILS-LOC modulation is active.

LLOBe
Amplitude modulation of the output signal with the left lobe (90Hz) signal component of the ILS-LOC signal is active.

RLOBe
Amplitude modulation of the output signal with the right lobe (150Hz) signal component of the ILS-LOC signal is active.

*RST: NORM

Manual operation: See "Mode" on page 55

[:SOURce<hw>]:BB:ILS:LOCalizer:PHASe <Phase>

Sets the phase between the modulation signals of the left and right antenna lobe of the ILS-GS signal. The zero crossing of the right lobe (150Hz) 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

Manual operation: See "Left/Right Phase" on page 55

[: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.

Parameters:

<Frequency> float

Range: 100 to 200
Increment: 0.05
*RST: 150

Manual operation: See "Right Frequency" on page 55

[:SOURce<hw>]:BB:ILS:LOCalizer:SDM <Sdm>

Sets the arithmetic sum of the modulation depths of the left lobe (90Hz) and right lobe (150Hz) for the ILS-LOC 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

Manual operation: See "Sum of Depth" on page 56

10.3.4 ILS Marker Beacon Settings

[:SOURce<hw>]:BB:ILS:MBEacon:COMid:CODE....152
[:SOURce<hw>]:BB:ILS:MBEacon:COMid:DASH....152
[:SOURce<hw>]:BB:ILS:MBEacon:COMid:DEPTh....153
[:SOURce<hw>]:BB:ILS:MBEacon:COMid:DOT....153
[:SOURce<hw>]:BB:ILS:MBEacon:COMid:FREQuency....153
[:SOURce<hw>]:BB:ILS:MBEacon:COMid:LETTer....153
[:SOURce<hw>]:BB:ILS:MBEacon:COMid:PERiod....154
[:SOURce<hw>]:BB:ILS:MBEacon:COMid:SYMBol....154
[:SOURce<hw>]:BB:ILS:MBEacon:COMid:TSCHema....154
[:SOURce<hw>]:BB:ILS:MBEacon:COMid[:STATe]....155
[:SOURce<hw>]:BB:ILS:MBEacon:FREQuency....155
[:SOURce<hw>]:BB:ILS:MBEacon:FREQuency:MODE....155
[:SOURce<hw>]:BB:ILS:MBEacon:MARKer:FREQuency....155
[:SOURce<hw>]:BB:ILS:MBEacon[:MARKer]:DEPTh....155

[: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).

Parameters:

<Code> string

Manual operation: See "Code" on page 61

[:SOURce<hw>]:BB:ILS:MBEacon:COMid:DASH <Dash>

Sets the length of a morse dash in seconds.

Available only if `[:SOURce<hw>]:BB:ILS:MBEacon:COMid:TSCHema` is set to *USER*.

Parameters:

<Dash> float

Range: 0.05 to 1
Increment: 1E-4
*RST: 0.3

[:SOURce<hw>]:BB:ILS:MBEacon:COMid:DEPTh <Depth>

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

Parameters:

<Depth> float

Range: 0 to 100
Increment: 0.1
*RST: 5

Manual operation: See "Depth" on page 61

[:SOURce<hw>]:BB:ILS:MBEacon:COMid:DOT <Dot>

Sets the length of a morse dot in seconds. If the time schema is set to *STD* the length of the dash (3xdot), symbol space (=dot) and letter space (=3xdot) is also determined by this entry.

Parameters:

<Dot> float

Range: 0.05 to 1
Increment: 1E-4
*RST: 0.1

Manual operation: See "Dot Length" on page 62

[: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

Manual operation: See "Frequency" on page 61

[:SOURce<hw>]:BB:ILS:MBEacon:COMid:LETTer <Letter>

Sets the length of a letter space in seconds.

Available only if `[:SOURce<hw>]:BB:ILS:MBEacon:COMid:TSCHema` is set to *USER*.

Parameters:

<Letter> float

Range: 0.05 to 1
Increment: 1E-4
*RST: 0.3

Manual operation: See "Letter Space" on page 62

[:SOURce<hw>]:BB:ILS:MBEacon:COMid:PERiod <Period>

Sets the period of the COM/ID signal in seconds.

Parameters:

<Period> float

Range: 0 to 120
Increment: 1E-3
*RST: 9

Manual operation: See "Period" on page 61

[:SOURce<hw>]:BB:ILS:MBEacon:COMid:SYMBol <Symbol>

Sets the length of the symbol space in seconds.

Available only if `[:SOURce<hw>]:BB:ILS:MBEacon:COMid:TSCHema` is set to *USER*.

Parameters:

<Symbol> float

Range: 0.05 to 1
Increment: 1E-4
*RST: 0.1

Manual operation: See "Symbol Space" on page 62

[:SOURce<hw>]:BB:ILS:MBEacon:COMid:TSCHema <Tschema>

Sets the time schema for the COM/ID signal.

In the standard time schema (STD) the set dot length determines the dash length (= three times the dot length) whereas in the user time schema (USER) all length parameters can be set independently.

Parameters:

<Tschema> STD | USER

*RST: STD

Manual operation: See "Time Schema" on page 62

[:SOURce<hw>]:BB:ILS:MBEacon:COMid[:STATe] <State>

Switches on/ off the addittional COM/ID signal.

Parameters:

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

Manual operation: See "State" on page 61

[:SOURce<hw>]:BB:ILS:MBEacon:FREQuency <CarrierFreq>

Sets the carrier frequency for the ILS-MB modulation signal.

Parameters:

<CarrierFreq> float
Range: 100E3 to 6E9
Increment: 0.01
*RST: 75E6

Manual operation: See "Carrier Frequency" on page 60

[:SOURce<hw>]:BB:ILS:MBEacon:FREQuency:MODE <Mode>

Sets the carrier frequency mode of the ILS-MB modulation signal.

Parameters:

<Mode> USER | PREDefined
*RST: USER

Manual operation: See "Carrier Frequency Mode" on page 60

[:SOURce<hw>]:BB:ILS:MBEacon:MARKer:FREQuency <Frequency>

Sets the modulation frequency of the marker signal for the ILS-MB modulation signal.

Parameters:

<Frequency> integer
Range: 400 to 3000
*RST: 0

Manual operation: See "Marker Frequency" on page 60

[:SOURce<hw>]:BB:ILS:MBEacon[:MARKer]:DEPTh <Depth>

Sets the modulation depth of the marker signal for the ILS-MB signal.

Parameters:

<Depth> float

Range: 0 to 100
Increment: 0.1
*RST: 95

Manual operation: See "Marker Depth" on page 60

10.4 VOR Settings

The `BB:VOR` subsystem contains all commands for configuring a VOR signal.

See also chapter 10.6, "Trigger Settings ", on page 181 and chapter 10.9, "Clock Settings", on page 191 for a description of the trigger and clock settings.

10.4.1 VOR General Settings

[:SOURce<hw>]:BB:VOR:MODE 156
[:SOURce<hw>]:BB:VOR:PRESet 157
[:SOURce<hw>]:BB:VOR:STATe 157

[: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 frequencymodulated 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

Manual operation: See "Mode" on page 66

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

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

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

Activates/deactivates the VOR modulation.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

10.4.2 VOR System Configuration Settings

[:SOURce<hw>]:BB:VOR:FREQuency 158
[:SOURce<hw>]:BB:VOR:FREQuency:MODE 158
[:SOURce<hw>]:BB:VOR:ICAO:CHANnel 158
[:SOURce<hw>]:BB:VOR:REFerence[:DEViation] 159
[:SOURce<hw>]:BB:VOR:SUBCarrier:DEPTh 159
[:SOURce<hw>]:BB:VOR:SUBCarrier[:FREQuency] 160
[:SOURce<hw>]:BB:VOR:VAR:FREQuency 160

[:SOURce<hw>]:BB:VOR:VAR:DEPTh 160
[:SOURce<hw>]:BB:VOR:BANGle 160
[:SOURce<hw>]:BB:VOR:BANGle:DIRection 161

[:SOURce<hw>]:BB:VOR:FREQuency <CarrierFreq>

Sets the carrier frequency of the signal if `[:SOURce<hw>]:BB:VOR:FREQuency:MODE` is set to *USER*.

Parameters:

<CarrierFreq> float

Range: 100E3 to 6E9
Increment: 0.01
*RST: 108e6

Manual operation: See "Carrier Frequency" on page 65

[:SOURce<hw>]:BB:VOR:FREQuency:MODE <Mode>

Sets the frequency mode for the VOR modulation signal.

Parameters:

<Mode> USER | ICAO

*RST: USER

Manual operation: See "Carrier Frequency Mode" on page 65

[:SOURce<hw>]:BB:VOR:ICAO:CHANnel <Channel>

Sets the ICAO channel i.e., the VOR transmitting frequency if `[:SOURce<hw>]:BB:VOR:FREQuency:MODE` is set to *ICAO*. The RF frequency is set to the value selected here.

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

Manual operation: See "ICAO Channel" on page 65

[: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

[: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

Manual operation: See "Subcarrier Depth" on page 66

[: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

Manual operation: See "Subcarrier Frequency" on page 66

[: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

Manual operation: See "VAR/REF Frequency" on page 66

[:SOURce<hw>]:BB:VOR:VAR:DEPTh <Depth>

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

Parameters:

<Depth> float

Range: 0 to 100
Increment: 0.1
*RST: 30

Manual operation: See "VAR Depth" on page 66

[: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

Manual operation: See "Bearing Angle" on page 67

[: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

Manual operation: See "Direction" on page 67

10.4.3 VOR COM/ID Settings

[:SOURce<hw>]:BB:VOR:COMid:CODE 161
[:SOURce<hw>]:BB:VOR:COMid:DASH 161
[:SOURce<hw>]:BB:VOR:COMid:DEPTh 162
[:SOURce<hw>]:BB:VOR:COMid:DOT 162
[:SOURce<hw>]:BB:VOR:COMid:FREQuency 162
[:SOURce<hw>]:BB:VOR:COMid:LETTer 162
[:SOURce<hw>]:BB:VOR:COMid:PERiod 163
[:SOURce<hw>]:BB:VOR:COMid:SYMBol 163
[:SOURce<hw>]:BB:VOR:COMid:TSCHema 163
[:SOURce<hw>]:BB:VOR:COMid[:STATe] 163

[: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).

Parameters:

<Code> string

Manual operation: See "Code" on page 68

[:SOURce<hw>]:BB:VOR:COMid:DASH <Dash>

Sets the length of a morse dash in seconds.

Available only if `[:SOURce<hw>]:BB:VOR:COMid:TSCHema` is set to *USER*.

Parameters:

<Dash> float

Range: 0.05 to 1
Increment: 1E-4
*RST: 0.3

[:SOURce<hw>]:BB:VOR:COMid:DEPTh <Depth>

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

Parameters:

<Depth> float

Range: 0 to 100
Increment: 0.1
*RST: 10

Manual operation: See "Depth" on page 68

[:SOURce<hw>]:BB:VOR:COMid:DOT <Dot>

Sets the length of a morse dot in seconds. If the time schema is set to *STD* the length of the dash (3xdot), symbol space (=dot) and letter space (=3xdot) is also determined by this entry.

Parameters:

<Dot> float

Range: 0.05 to 1
Increment: 1E-4
*RST: 0.1

Manual operation: See "Dot Length" on page 68

[: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

Manual operation: See "Frequency" on page 68

[:SOURce<hw>]:BB:VOR:COMid:LETTer <Letter>

Sets the length of a letter space in seconds.

Available only if `[:SOURce<hw>]:BB:VOR:COMid:TSCHema` is set to *USER*.

Parameters:

<Letter> float

Range: 0.05 to 1
Increment: 1E-4
*RST: 0.3

Manual operation: See "Letter Space" on page 69

[:SOURce<hw>]:BB:VOR:COMid:PERiod <Period>

Sets the period of the COM/ID signal in seconds.

Parameters:

<Period> float

Range: 0 to 120
Increment: 1E-3
*RST: 9

Manual operation: See "Period" on page 68

[:SOURce<hw>]:BB:VOR:COMid:SYMBol <Symbol>

Sets the length of the symbol space in seconds.

Available only if `[:SOURce<hw>]:BB:VOR:COMid:TSCHema` is set to *USER*.

Parameters:

<Symbol> float

Range: 0.05 to 1
Increment: 1E-4
*RST: 0.1

Manual operation: See "Symbol Space" on page 69

[:SOURce<hw>]:BB:VOR:COMid:TSCHema <Tschema>

Sets the time schema for the COM/ID signal.

In the standard time schema (STD) the set dot length determines the dash length (= three times the dot length) whereas in the user time schema (USER) all length parameters can be set independently.

Parameters:

<Tschema> STD | USER

*RST: STD

Manual operation: See "Time Schema" on page 68

[:SOURce<hw>]:BB:VOR:COMid[:STATe] <State>

Switches on/ off the addittional COM/ID signal.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Manual operation: See "State" on page 67

10.5 DME Settings

The BB:DME subsystem contains all commands for configuring a DME signal.

See also chapter 10.6, "Trigger Settings ", on page 181 and chapter 10.9, "Clock Settings", on page 191 for a description of the trigger and clock settings.

10.5.1 DME General Settings

[:SOURce<hw>]:BB:DME:STATe....164
[:SOURce<hw>]:BB:DME:PRESet....164
[:SOURce<hw>]:BB:DME:MODE....164

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

Activate/deactivate DME modulation.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

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

Sets the DME default settings.

[: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

Manual operation: See "DME Mode" on page 71

10.5.2 DME System Configuration Settings

[:SOURce<hw>]:BB:DME:CSUFfix....165
[:SOURce<hw>]:BB:DME:EFFiciency....165
[:SOURce<hw>]:BB:DME:FALL....165
[:SOURce<hw>]:BB:DME:FREQuency....166
[:SOURce<hw>]:BB:DME:ICAO:CHANnel....166
[:SOURce<hw>]:BB:DME:PPS....167
[:SOURce<hw>]:BB:DME:PPST....168
[:SOURce<hw>]:BB:DME:RATE....168
[:SOURce<hw>]:BB:DME:RDIStance....168
[:SOURce<hw>]:BB:DME:RDIStance:UNIT....169
[:SOURce<hw>]:BB:DME:RISE....169
[:SOURce<hw>]:BB:DME:SHAPe....169
[:SOURce<hw>]:BB:DME:SINGle....170
[:SOURce<hw>]:BB:DME:SQUitter....170
[:SOURce<hw>]:BB:DME:PINPut:SOURce....170
[:SOURce<hw>]:BB:DME:PINPut:DELay....171
[:SOURce<hw>]:BB:DME:PINPut:TRIGger:LEVel?....171
[:SOURce<hw>]:BB:DME:PINPut:TRIGger:SEARch?....172
[:SOURce<hw>]:BB:DME:WIDTh....172

[: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

Manual operation: See "Channel Mode" on page 72

[: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

[: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 20E-6
Increment: 10E-9
*RST: 2E-6

Manual operation: See "Pulse Fall" on page 76

[: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

Manual operation: See "Carrier Frequency" on page 73

[:SOURce<hw>]:BB:DME:ICAO:CHANnel <Channel>

Sets the ICAO channel i.e., the DME transmitting frequency. The RFfrequency is set to the value selected here.

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

Manual operation: See "ICAO Channel" on page 73

[: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

Manual operation: See "Pulse Spacing" on page 76

[:SOURce<hw>]:BB:DME:PPST <SpacTolerance>

Sets the pulse pair spacing tolerance.

Parameters:

<SpacTolerance> float

Range: 0 to (200E-6)/2
Increment: 20E-9
*RST: 5E-6

[: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 repetition rate in squitter mode.

Parameters:

<Rate> integer

Range: 10 to 6000
*RST: 48

Manual operation: See "Pulse Repetition Rate" on page 74

[: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 provide 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:

```
SOURce1:BB:DME:RDIS:UNIT NM
```
sets the unit to NM
```
:SOURce1:BB:DME:RDIS 1.5NM
```
sets the range distance to 1.5 NM
```
:SOURce1:BB:DME:RDIS?
Response:1.5
:SOURce1:BB:DME:RDIS 20US
```
sets the range distance to 20 us
```
:SOURce1:BB:DME:RDIS?
Response: 1.618
```

Manual operation: See "Range Distance" on page 73

[: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

Manual operation: See "Range Distance" on page 73

[: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 20E-6
Increment: 10E-9
*RST: 2E-6

Manual operation: See "Pulse Rise" on page 76

[: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

Manual operation: See "Pulse Shape" on page 75

[:SOURce<hw>]:BB:DME:SINGle <Single>

Activates/deactivates generation of a single test pulse.

Parameters:

<Single> 0 | 1 | OFF | ON

*RST: 0

Manual operation: See "Single Pulse" on page 76

[: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> 0 | 1 | OFF | ON

*RST: 0

Manual operation: See "Pulse Squitter" on page 73

[:SOURce<hw>]:BB:DME:PINPut:SOURce <InputSource>

Selects the trigger mode for DME modulation signals.

Parameters:

<InputSource> 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 an external power sensor. This mode is only available if `[:SOURce<hw>]:BB:DME:MODE` on page 164 is set to *INTerrogation*.

*RST: EXTernal

Manual operation: See "Input Source" on page 74

[: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). Available only if `[:SOURce<hw>]:BB:DME:PINPut:SOURce` is set to *EXTernal*.

For DME Reply mode this 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

Manual operation: See "Reply Delay" on page 75

[:SOURce<hw>]:BB:DME:PINPut:TRIGger:LEVel?

Queries the measured trigger treshold.

Return values:

<TriggerLevel> float

Range: -200 to 200
Increment: 0.01
*RST: 0

Usage: Query only

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

Determines the trigger level = 50% voltage point of first pulse of the external DME interrogation signal.

This command determines the trigger point after connecting the R&S NRP-Z81 power sensor to the external interrogation signal source. The search function has to be executed with each change of the level of the external DME signal.

Return values:

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

Usage: Query only

Manual operation: See "Search Trigger Level" on page 75

[: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

Manual operation: See "Pulse Width" on page 76

10.5.3 DME Analysis Settings

[:SOURce<hw>]:BB:DME:ANALysis:EFFiciency? 173
[:SOURce<hw>]:BB:DME:ANALysis:EFFiciency:OK? 173
[:SOURce<hw>]:BB:DME:ANALysis:GATE:COUNt 173
[:SOURce<hw>]:BB:DME:ANALysis:GATE:EDELay 173
[:SOURce<hw>]:BB:DME:ANALysis:GATE[:LENGth] 174
[:SOURce<hw>]:BB:DME:ANALysis:GATE:TIME 174
[:SOURce<hw>]:BB:DME:ANALysis:NORMalize? 174
[:SOURce<hw>]:BB:DME:ANALysis:POWer? 175
[:SOURce<hw>]:BB:DME:ANALysis:POWer:OK? 175
[:SOURce<hw>]:BB:DME:ANALysis:PRRate? 175
[:SOURce<hw>]:BB:DME:ANALysis:PRRate:OK? 176
[:SOURce<hw>]:BB:DME:ANALysis:RDIStance? 176
[:SOURce<hw>]:BB:DME:ANALysis:STATe 176
[:SOURce<hw>]:BB:DME:ANALysis:TIME? 176
[:SOURce<hw>]:BB:DME:ANALysis:TIME:OK? 177
[:SOURce<hw>]:BB:DME:ANALysis:TRIGger:SEARch? 177
[:SOURce<hw>]:BB:DME:ANALysis:IAFactor? 177
[:SOURce<hw>]:BB:DME:ANALysis:PSAFactor? 177
[:SOURce<hw>]:BB:DME:ANALysis:UAFactor 178

[: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

Usage: Query only

Manual operation: See "Reply Efficiency" on page 74

[: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

Usage: Query only

Manual operation: See "Reply Efficiency" on page 79

[:SOURce<hw>]:BB:DME:ANALysis:GATE:COUNt <Count>

Sets the number of pulse pairs which are sent from the R&S SMBV (= 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

Manual operation: See "Measurement Time" on page 78

[: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

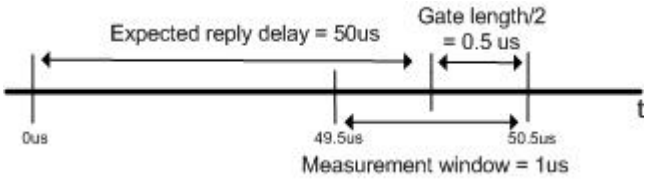
Manual operation: See "Expected Reply Delay" on page 78

[: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

Manual operation: See "Gate Length" on page 78

[: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

[: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> 0 | 1 | OFF | ON

Usage: Query only

Manual operation: See "Normalize Setup" on page 83

[: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

Usage: Query only

Manual operation: See "Peak Level" on page 78

[: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

Usage: Query only

Manual operation: See "Peak Level" on page 78

[: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

Usage: Query only

Manual operation: See "Pulse Repetition Rate" on page 79

[: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

Usage: Query only

Manual operation: See "Pulse Repetition Rate" on page 79

[: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

Usage: Query only

Manual operation: See "Range Distance" on page 78

[:SOURce<hw>]:BB:DME:ANALysis:STATe <State>

Activates/deactivates the DME analysis. The setting is only available after connecting the R&S NRP-Z81 power sensor.

Parameters:

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

Manual operation: See "State" on page 77

[: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

Usage: Query only

Manual operation: See "Reply Delay" on page 79

[: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

Usage: Query only

Manual operation: See "Reply Delay" on page 79

[:SOURce<hw>]:BB:DME:ANALysis:TRIGger:SEARch?

Determines the trigger level = 50% voltage point of first pulse of the external DME interrogation signal.

This command determines the trigger point after connecting the R&S NRP-Z81 power sensor to the external interrogation signal source. The search function has to be executed with each change of the level of the external DME signal.

Return values:
<Search> 0 | 1 | OFF | ON
*RST: 0

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

Usage: Query only

Manual operation: See "Internal Adjustment Factor" on page 84

[: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

Usage: Query only

Manual operation: See "Power Sensor Adjustment Factor" on page 83

[:SOURce<hw>]:BB:DME:ANALysis:UAFactor <UsedFactor>

Sets which internal adjustment factor should be 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 during a normalization setup measured adjustment factor. Query the power sensor adjustment factor with `[:SOURce<hw>]:BB:DME:ANALysis:PSAFactor?`

*RST: INTernal

Manual operation: See "Used Adjustment Factor" on page 84

10.5.4 DME COM/ID Settings

[:SOURce<hw>]:BB:DME:ID:CODE 178
[:SOURce<hw>]:BB:DME:ID:DASH 178
[:SOURce<hw>]:BB:DME:ID:DOT 179
[:SOURce<hw>]:BB:DME:ID:LETTer 179
[:SOURce<hw>]:BB:DME:ID:PPP[:STATe] 179
[:SOURce<hw>]:BB:DME:ID:PPS 180
[:SOURce<hw>]:BB:DME:ID:PERiod 180
[:SOURce<hw>]:BB:DME:ID:PRESet 180
[:SOURce<hw>]:BB:DME:ID:RATE 180
[:SOURce<hw>]:BB:DME:ID:SYMBol 180
[:SOURce<hw>]:BB:DME:ID:TSCHema 181
[:SOURce<hw>]:BB:DME:ID[:STATe] 181

[: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).

Parameters:

<Code> string

Manual operation: See "Code" on page 81

[:SOURce<hw>]:BB:DME:ID:DASH <Dash>

Sets the length of a morse dash in seconds.

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

Manual operation: See "Dash Length" on page 82

[:SOURce<hw>]:BB:DME:ID:DOT <Dot>

Sets the length of a morse dot in seconds. If the time schema is set to *STD* the length of the dash (3xdot), symbol space (=dot) and letter space (=3xdot) is also determined by this entry.

Parameters:

<Dot> float

Range: 0.05 to 1
Increment: 1E-4
*RST: 0.1

Manual operation: See "Dot Length" on page 81

[:SOURce<hw>]:BB:DME:ID:LETTer <Letter>

Sets the length of a letter space in seconds.

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

Manual operation: See "Letter Space" on page 82

[: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> 0 | 1 | OFF | ON

*RST: 0

Manual operation: See "Pair of Pulse Pairs" on page 80

[: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

Manual operation: See "Pulse Pair Spacing" on page 81

[:SOURce<hw>]:BB:DME:ID:PERiod <Period>

Sets the period of the COM/ID signal in seconds.

Parameters:

<Period> integer

Range: 10 to 120
*RST: 40

Manual operation: See "Period" on page 81

[:SOURce<hw>]:BB:DME:ID:PRESet

Sets the default settings for the ID signal.

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

Manual operation: See "Rate" on page 81

[:SOURce<hw>]:BB:DME:ID:SYMBol <Symbol>

Sets the length of the symbol space in seconds.

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

Manual operation: See "Symbol Space" on page 82

[:SOURce<hw>]:BB:DME:ID:TSCHema <TSchema>

Sets the time schema for the COM/ID signal.

In the standard time schema (STD) the set dot length determines the dash length (= three times the dot length) whereas in the user time schema (USER) all length parameters can be set independently.

Parameters:

<TSchema> STD | USER

*RST: STD

Manual operation: See "Time Schema" on page 81

[:SOURce<hw>]:BB:DME:ID[:STATe] <State>

Switches on/ off the addittional COM/ID signal.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Manual operation: See "COM/ID State " on page 80

10.6 Trigger Settings

`EXTernal<ch>`

The numeric suffix to `EXTernal<ch>` distinguishes between the external trigger via the TRIGGER 1 (suffix 1) and TRIGGER 2 (suffix 2) connector.

[:SOURce<hw>]:BB:DME:TRIGger:ARM:EXECute ... 182
[:SOURce<hw>]:BB:GBAS:TRIGger:ARM:EXECute ... 182
[:SOURce<hw>]:BB:ILS:TRIGger:ARM:EXECute ... 182
[:SOURce<hw>]:BB:VOR:TRIGger:ARM:EXECute ... 182
[:SOURce<hw>]:BB:DME:TRIGger:EXECute ... 183
[:SOURce<hw>]:BB:GBAS:TRIGger:EXECute ... 183
[:SOURce<hw>]:BB:ILS:TRIGger:EXECute ... 183
[:SOURce<hw>]:BB:VOR:TRIGger:EXECute ... 183
[:SOURce<hw>]:BB:DME:TRIGger:EXTernal:SYNChronize:OUTPut ... 183
[:SOURce<hw>]:BB:ILS:TRIGger:EXTernal:SYNChronize:OUTPut ... 183
[:SOURce<hw>]:BB:GBAS:TRIGger:EXTernal:SYNChronize:OUTPut ... 183

[:SOURce<hw>]:BB:VOR:TRIGger:EXTernal:SYNChronize:OUTPut 183
[:SOURce<hw>]:BB:DME:TRIGger:OBASeband:DELay 184
[:SOURce<hw>]:BB:GBAS:TRIGger:OBASeband:DELay 184
[:SOURce<hw>]:BB:ILS:TRIGger:OBASeband:DELay 184
[:SOURce<hw>]:BB:VOR:TRIGger:OBASeband:DELay 184
[:SOURce<hw>]:BB:DME:TRIGger:OBASeband:INHibit 184
[:SOURce<hw>]:BB:GBAS:TRIGger:OBASeband:INHibit 184
[:SOURce<hw>]:BB:ILS:TRIGger:OBASeband:INHibit 184
[:SOURce<hw>]:BB:VOR:TRIGger:OBASeband:INHibit 184
[:SOURce<hw>]:BB:DME:TRIGger:RMODe? 184
[:SOURce<hw>]:BB:GBAS:TRIGger:RMODe? 184
[:SOURce<hw>]:BB:ILS:TRIGger:RMODe? 184
[:SOURce<hw>]:BB:VOR:TRIGger:RMODe? 184
[:SOURce<hw>]:BB:DME:TRIGger:SLENgth 184
[:SOURce<hw>]:BB:GBAS:TRIGger:SLENgth 184
[:SOURce<hw>]:BB:ILS:TRIGger:SLENgth 185
[:SOURce<hw>]:BB:VOR:TRIGger:SLENgth 185
[:SOURce<hw>]:BB:GBAS:TRIGger:SLUNit 185
[:SOURce<hw>]:BB:DME:TRIGger:SOURce 185
[:SOURce<hw>]:BB:GBAS:TRIGger:SOURce 185
[:SOURce<hw>]:BB:ILS:TRIGger:SOURce 185
[:SOURce<hw>]:BB:VOR:TRIGger:SOURce 185
[:SOURce<hw>]:BB:DME:TRIGger[:EXTernal<ch>]:DELay 185
[:SOURce<hw>]:BB:GBAS:TRIGger[:EXTernal<ch>]:DELay 185
[:SOURce<hw>]:BB:ILS:TRIGger[:EXTernal<ch>]:DELay 185
[:SOURce<hw>]:BB:VOR:TRIGger[:EXTernal<ch>]:DELay 185
[:SOURce<hw>]:BB:DME:TRIGger[:EXTernal<ch>]:INHibit 186
[:SOURce<hw>]:BB:GBAS:TRIGger[:EXTernal<ch>]:INHibit 186
[:SOURce<hw>]:BB:ILS:TRIGger[:EXTernal<ch>]:INHibit 186
[:SOURce<hw>]:BB:VOR:TRIGger[:EXTernal<ch>]:INHibit 186
[:SOURce<hw>]:BB:DME[:TRIGger]:SEQuence 186
[:SOURce<hw>]:BB:GBAS[:TRIGger]:SEQuence 186
[:SOURce<hw>]:BB:ILS[:TRIGger]:SEQuence 186
[:SOURce<hw>]:BB:VOR[:TRIGger]:SEQuence 186

[:SOURce<hw>]:BB:DME:TRIGger:ARM:EXECute
[:SOURce<hw>]:BB:GBAS:TRIGger:ARM:EXECute
[:SOURce<hw>]:BB:ILS:TRIGger:ARM:EXECute
[:SOURce<hw>]:BB:VOR:TRIGger:ARM:EXECute

Stops signal generation for trigger modes "Armed_Auto" and "Armed_Retrigger". A subsequent internal or external trigger event restart signal generation.

Example: `BB:VOR:TRIG:SOUR INT`
sets internal triggering.
`BB:VOR:TRIG:SEQ ARET`
sets Armed_Retrigger mode, i.e. every trigger event causes signal generation to restart.
`BB:VOR:TRIG:EXEC`
executes a trigger, signal generation is started.
`BB:VOR:TRIG:ARM:EXEC`
signal generation is stopped.
`BB:VOR:TRIG:EXEC`
executes a trigger, signal generation is started again.

Usage: Event

Manual operation: See "Arm" on page 27

[:SOURce<hw>]:BB:DME:TRIGger:EXECute
[:SOURce<hw>]:BB:GBAS:TRIGger:EXECute
[:SOURce<hw>]:BB:ILS:TRIGger:EXECute
[:SOURce<hw>]:BB:VOR:TRIGger:EXECute

Executes a trigger. The internal trigger source must be selected using the command `BB:xxx:TRIG:SOUR INT`(where `xxx` stands for `ILS`, `VOR` or `DME`) and a trigger mode other than AUTO must be selected using the command `BB:xxx:TRIG:SEQ`.

Usage: Event

Manual operation: See "Execute Trigger" on page 26

[:SOURce<hw>]:BB:DME:TRIGger:EXTernal:SYNChronize:OUTPut <Output>
[:SOURce<hw>]:BB:ILS:TRIGger:EXTernal:SYNChronize:OUTPut <Output>
[:SOURce<hw>]:BB:GBAS:TRIGger:EXTernal:SYNChronize:OUTPut <Output>
[:SOURce<hw>]:BB:VOR:TRIGger:EXTernal:SYNChronize:OUTPut <Output>

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

Parameters:

<Output> 0 | 1 | OFF | ON

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

OFF
The signal output begins after elapsing of the processing time and starts with sample 0, i.e. the complete signal is outputted. This mode is recommended for triggering of short signal sequences with signal duration comparable with the processing time of the instrument.

*RST: 1

Manual operation: See "Sync. Output to External Trigger" on page 87

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

Manual operation: See "Trigger Delay" on page 89

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

Manual operation: See "Trigger Inhibit" on page 90

[:SOURce<hw>]:BB:DME:TRIGger:RMODe?
[:SOURce<hw>]:BB:GBAS:TRIGger:RMODe?
[:SOURce<hw>]:BB:ILS:TRIGger:RMODe?
[:SOURce<hw>]:BB:VOR:TRIGger:RMODe?

Queries the current status of signal generation for all trigger modes modulation on.

Return values:

<RunMode> STOP | RUN

*RST: STOP

Usage: Query only

Manual operation: See "Running/Stopped" on page 86

[:SOURce<hw>]:BB:DME:TRIGger:SLENgth <SeqLength>
[:SOURce<hw>]:BB:GBAS:TRIGger:SLENgth <Slength>

[:SOURce<hw>]:BB:ILS:TRIGger:SLENgth <SeqLength>
[:SOURce<hw>]:BB:VOR:TRIGger:SLENgth <SeqLength>

The command defines the length of the signal sequence to be output in the "Single" trigger mode (`SOUR:BB:xxx:SEQ SING`, where `xxx` stands for `ILS`, `VOR` or `DME`). The input is made in terms of samples.

It is possible to output deliberately just part of the frame, an exact sequence of the frame, or a defined number of repetitions of the frame.

Parameters:

<SeqLength> integer

Range: 1 samples to 2^32-1 samples
*RST: 100

Manual operation: See "Trigger Signal Duration" on page 86

[:SOURce<hw>]:BB:GBAS:TRIGger:SLUNit <Slunit>

Sets the units the trigger sequence length is exprecced in.

Parameters:

<Slunit> SEQuence | SAMPle

*RST: SEQuence

Manual operation: See "Signal Duration Unit" on page 86

[:SOURce<hw>]:BB:DME:TRIGger:SOURce <TriggerSource>
[:SOURce<hw>]:BB:GBAS:TRIGger:SOURce <Source>
[:SOURce<hw>]:BB:ILS:TRIGger:SOURce <TriggerSource>
[:SOURce<hw>]:BB:VOR:TRIGger:SOURce <TriggerSource>

Selects the trigger source.

Parameters:

<TriggerSource> INTernal|EXTernal

`INTernal`
manual trigger or `*TRG`.
`EXTernal`
trigger signal on the TRIGGER connector.

*RST: INTernal

Manual operation: See "Trigger Source" on page 87

[:SOURce<hw>]:BB:DME:TRIGger[:EXTernal<ch>]:DELay <Delay>
[:SOURce<hw>]:BB:GBAS: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: `BB:VOR:TRIG:SOUR EXT`
selects an external trigger.
`BB:VOR:TRIG:EXT:DEL 50`
sets a delay of 50 symbols for the trigger.

Manual operation: See "Trigger Delay" on page 89

[:SOURce<hw>]:BB:DME:TRIGger[:EXTernal<ch>]:INHibit <Inhibit>
[:SOURce<hw>]:BB:GBAS: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 number of samples by which a restart is to be inhibited following an external trigger event.

Parameters:

<Inhibit> integer

Range: 0 to 67108863
*RST: 0

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

Manual operation: See "Trigger Inhibit" on page 90

[:SOURce<hw>]:BB:DME[:TRIGger]:SEQuence <TriggerMode>
[:SOURce<hw>]:BB:GBAS[:TRIGger]:SEQuence <Sequence>
[:SOURce<hw>]:BB:ILS[:TRIGger]:SEQuence <TriggerMode>
[:SOURce<hw>]:BB:VOR[:TRIGger]:SEQuence <TriggerMode>

Selects the trigger mode.

Parameters:

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

AUTO
The modulation signal is generated continuously.

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

AAUTo
The modulation signal is generated only when a trigger event occurs. After the trigger event the signal is generated continuously. Signal generation is stopped with command `SOUR:BB:xxx:TRIG:ARM:EXEC`(`xxx` stands for `ILS`, `VOR` or `DME`) and started again when a trigger event occurs.

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

SINGle
The modulation signal is generated only when a trigger event occurs. Then the signal is generated once to the length specified with command `SOUR:BB:xxx:TRIG:SLEN`. Every subsequent trigger event causes a restart.

*RST: AUTO

Manual operation: See "Trigger Mode" on page 85

10.7 Marker Settings DME

[:SOURce<hw>]:BB:DME:MARKer<ch>:DELay....187
[:SOURce<hw>]:BB:DME:MARKer<ch>:MODE....188
[:SOURce<hw>]:BB:DME:MARKer<ch>:PDELay?....188
[:SOURce<hw>]:BB:DME:MARKer<ch>:WIDTh....188

[: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

Manual operation: See "Marker Delay" on page 93

[: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

Manual operation: See "Marker x" on page 92

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

Queries the marker processing delay, internally measured value. This command is avaliable only for "Marker 2 ".

Return values:

<ProcessedDelay> float

Range: 0 to 1
Increment: 10E-9
*RST: 0

Usage: Query only

Manual operation: See "Processing Delay" on page 94

[: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

Manual operation: See "Marker Width" on page 93

10.8 Marker Settings GBAS

Provided are the following commands:

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

Defines the signal for the selected marker output.

Parameters:
<Mode> PULSe | RESTart | PATTern | RATio | TRIGger | PPS
*RST: PPS

Example: see example "Adjusting clock, marker and trigger settings" on page 113

Manual operation: See "Marker Mode" on page 90

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

Defines the bit pattern used to generate the marker signal `PATTern`.

Parameters:
<Pattern> integer

Example:
```
SOURce1:BB:GBAS:TRIGger:OUTPut1:MODE PATTern
SOURce1:BB:GBAS:TRIGger:OUTPut1:PATTern
#H5670,15
```

Manual operation: See "Marker Mode" on page 90

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

Sets the divider for Pulse marker mode (`PULSe`).

Parameters:
<Divider> integer
Range: 2 to 1024
*RST: 2

Example:
```
SOURce1:BB:GBAS:MSET:SRATe?
```
Response: 10500
```
SOURce1:BB:GBAS:TRIGger:OUTPut2:MODE PULSe
SOURce1:BB:GBAS:TRIGger:OUTPut2:PULSe:DIVider 4
SOURce1:BB:GBAS:TRIGger:OUTPut2:PULSe:
FREQuency?
```
Response: 2625
2625 = 10500/4

Manual operation: See "Marker Mode" on page 90

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

Queries the pulse frequency of the pulsed marker signal `PULSe`.

Return values:
<Frequency> float
Range: 2 to 1024
Increment: 1E-3
*RST: 2

Usage: Query only

Manual operation: See "Marker Mode" on page 90

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

Sets the number of symbols in a period (ON time + OFF time) for marker `RATio`

Parameters:

<OffTime> integer

Range: 1 to 16777215
*RST: 1

Example: see example "Adjusting clock, marker and trigger settings" on page 113

Manual operation: See "Marker Mode" on page 90

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

Sets the marker delay.

Parameters:

<Delay> float

Range: 0 to 16777215
Increment: 1E-3
*RST: 0

Example: `SOURce1:BB:GBAS:TRIGger:OUTPut1:DELay?`

Manual operation: See "Marker x Delay" on page 91

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

Queries the minimum/maximum marker delay for fixed marker delay setting.

Return values:

<Maximum> float

Range: 0 to max
Increment: 1E-3
*RST: 2000

Example: `SOURce1:BB:GBAS:TRIGger:OUTPut1:DELay:MAXimum?`

Usage: Query only

Manual operation: See "Marker x Delay" on page 91

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

Restricts the marker delay setting range to the dynamic range.

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

Example: `SOURce1:BB:GBAS:TRIGger:OUTPut1:DELay:FIXed?`

Manual operation: See "Marker x Delay" on page 91

10.9 Clock Settings

[:SOURce<hw>]:BB:DME:CLOCk:MODE ... 191
[:SOURce<hw>]:BB:GBAS:CLOCk:MODE ... 191
[:SOURce<hw>]:BB:ILS:CLOCk:MODE ... 191
[:SOURce<hw>]:BB:VOR:CLOCk:MODE ... 191
[:SOURce<hw>]:BB:DME:CLOCk:MULTiplier ... 191
[:SOURce<hw>]:BB:GBAS:CLOCk:MULTiplier ... 191
[:SOURce<hw>]:BB:ILS:CLOCk:MULTiplier ... 192
[:SOURce<hw>]:BB:VOR:CLOCk:MULTiplier ... 192
[:SOURce<hw>]:BB:DME:CLOCk:SOURce ... 192
[:SOURce<hw>]:BB:GBAS:CLOCk:SOURce ... 192
[:SOURce<hw>]:BB:ILS:CLOCk:SOURce ... 192
[:SOURce<hw>]:BB:VOR:CLOCk:SOURce ... 192
[:SOURce<hw>]:BB:DME:CLOCk:SYNChronization:EXECute ... 192
[:SOURce<hw>]:BB:GBAS:CLOCk:SYNChronization:EXECute ... 192
[:SOURce<hw>]:BB:ILS:CLOCk:SYNChronization:EXECute ... 192
[:SOURce<hw>]:BB:VOR:CLOCk:SYNChronization:EXECute ... 192
[:SOURce<hw>]:BB:DME:CLOCk:SYNChronization:MODE ... 193
[:SOURce<hw>]:BB:GBAS:CLOCk:SYNChronization:MODE ... 193
[:SOURce<hw>]:BB:ILS:CLOCk:SYNChronization:MODE ... 193
[:SOURce<hw>]:BB:VOR:CLOCk:SYNChronization:MODE ... 193

[:SOURce<hw>]:BB:DME:CLOCk:MODE <MOde>
[:SOURce<hw>]:BB:GBAS:CLOCk:MODE <Mode>
[:SOURce<hw>]:BB:ILS:CLOCk:MODE <MOde>
[:SOURce<hw>]:BB:VOR:CLOCk:MODE <MOde>

Sets the type of externally supplied clock.

Parameters:
<MOde> CHIP | MCHip
*RST: CHIP

Manual operation: See "Clock Mode" on page 95

[:SOURce<hw>]:BB:DME:CLOCk:MULTiplier <Multiplier>
[:SOURce<hw>]:BB:GBAS:CLOCk:MULTiplier <Multiplier>

[:SOURce<hw>]:BB:ILS:CLOCk:MULTiplier <Multiplier>
[:SOURce<hw>]:BB:VOR:CLOCk:MULTiplier <Multiplier>

Note: This command is available for clock source "External" and in clock mode "Multiple Sample" only.

The command specifies the multiplier for clock type "Multiplied" (`BB:xxx:CLOCk:MODE MSAMple`) in the case of an external clock source, where `xxx` stands for `ILS`, `VOR` or `DME`.

Parameters:

<Multiplier> integer

Range: 1 to 64
*RST: 4

Example: `BB:xxx:CLOCk:SOURce EXTernal`
selects the external clock source.
`BB:xxx:CLOCk:MODE MSAMple`
selects clock type "Multiplied", i.e. the supplied clock has a rate which is a multiple of the sample rate.
`BB:xxx:CLOCk:MULTiplier 12`
the multiplier for the external clock rate is 12.

Manual operation: See "Clock Multiplier" on page 95

[:SOURce<hw>]:BB:DME:CLOCk:SOURce <Source>
[:SOURce<hw>]:BB:GBAS:CLOCk:SOURce <Source>
[:SOURce<hw>]:BB:ILS:CLOCk:SOURce <Source>
[:SOURce<hw>]:BB:VOR:CLOCk:SOURce <Source>

Parameters:

<Source> INTernal | EXTernal

INTernal
The internal clock reference is used.

EXTernal
The external clock reference is supplied to the CLOCK connector.

*RST: INTernal

Manual operation: See "Clock Source" on page 95

[:SOURce<hw>]:BB:DME:CLOCk:SYNChronization:EXECute
[:SOURce<hw>]:BB:GBAS:CLOCk:SYNChronization:EXECute
[:SOURce<hw>]:BB:ILS:CLOCk:SYNChronization:EXECute
[:SOURce<hw>]:BB:VOR:CLOCk:SYNChronization:EXECute

Performs automatically adjustment of the instrument's settings required for the synchronization mode, set with the command `BB:xxx:CLOC:SYNC:MODE`, where `xxx` stands for `ILS`, `VOR` or `DME`.

Example: `BB:xxx:CLOC:SYNC:MODE MAST`
the instrument is configured to work as a master one.
`BB:xxx:CLOC:SYNC:EXEC`
all synchronization's settings are adjusted accordingly.

Usage: Event

Manual operation: See "Set Synchronization Settings" on page 95

[:SOURce<hw>]:BB:DME:CLOCk:SYNChronization:MODE <Mode>
[:SOURce<hw>]:BB:GBAS:CLOCk:SYNChronization:MODE <Mode>
[:SOURce<hw>]:BB:ILS:CLOCk:SYNChronization:MODE <Mode>
[:SOURce<hw>]:BB:VOR:CLOCk:SYNChronization:MODE <Mode>

Selects the synchronization mode.

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

Note: If several instruments are connected, the connecting cables from the master instrument to the slave one and between each two consecutive slave instruments must have the same length and type.Avoid unnecessary cable length and branching points.

Parameters:

<Mode> NONE | MASTer | SLAVe

NONE
The instrument is working in stand-alone mode.

MASTer
The instrument provides all connected instrument with its synchronization (including the trigger signal) and reference clock signal.

SLAVe
The instrument receives the synchronization and reference clock signal from another instrument working in a master mode.

*RST: NONE

Manual operation: See "Sync. Mode" on page 94

A Annex

A.1 Morse Code Settings

The COM/ID tone is sent according to the selected code (see table 1-1). 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/minute. As 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 1-1: 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	- - . .

A.2 ICAO Channel Frequencies

In the following chapter the standardized transmitting frequencies for the ILS, DME and VOR standards are listed.

A.2.1 ILS Channel Frequencies

The individual values in the table are:

- **Ch. No.** = ICAO channel number
- **LOC Freq.** = ILS Localizer transmitting frequency (MHz)
- **GS Freq.** = ILS GS frequency (MHz)

Table 1-2: Standardized ILS-GS and ILS-LOC transmitting frequencies (MHz) and the associated ICAO channels

Ch. No.	LOC Freq.	GS Freq.		Ch. No.	LOC Freq.	GS Freq.		Ch. No.	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
22X	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				

A.2.2 VOR Channel Frequencies

The individual values in the table cells are:

- **Ch. No.** = ICAO channel number
- **VOR Freq.** = VOR Interrogation frequency (MHz)

Table 1-3: Standardized VOR transmitting frequencies (MHz) and the associated ICAO channels

Ch. No.	VOR Freq.	Ch. No.	VOR Freq.	Ch. No.	VOR Freq.	Ch. No.	VOR Freq.	Ch. No.	VOR Freq.	Ch. No.	VOR Freq.
17X	108.00	45X	110.80	75X	112.80	89X	114.20	103X	115.60	117X	117.00
17Y	108.05	45Y	110.85	75Y	112.85	89Y	114.25	103Y	115.65	117Y	117.05
19X	108.20	47X	111.00	76X	112.90	90X	114.30	104X	115.70	118X	117.10
19Y	108.25	47Y	111.05	76Y	112.95	90Y	114.35	104Y	115.75	118Y	117.15
21X	108.40	49X	111.20	77X	113.00	91X	114.40	105X	115.80	119X	117.20
21Y	108.45	49Y	111.25	77Y	113.05	91Y	114.45	105Y	115.85	119Y	117.25
23X	108.60	51X	111.40	78X	113.10	92X	114.50	106X	115.90	120X	117.30
23Y	108.65	51Y	111.45	78Y	113.15	92Y	114.55	106Y	115.95	120Y	117.35
25X	108.80	53X	111.60	79X	113.20	93X	114.60	107X	116.00	121X	117.40
25Y	108.85	53Y	111.65	79Y	113.25	93Y	114.65	107Y	116.05	121Y	117.45
27X	109.00	55X	111.80	80X	113.30	94X	114.70	108X	116.10	122X	117.50
27Y	109.05	55Y	111.85	80Y	113.35	94Y	114.75	108Y	116.15	122Y	117.55
29X	109.20	57X	112.00	81X	113.40	95X	114.80	109X	116.20	123X	117.60
29Y	109.25	57Y	112.05	81Y	113.45	95Y	114.85	109Y	116.25	123Y	117.65
31X	109.40	58X	112.10	82X	113.50	96X	114.90	110X	116.30	124X	117.70
31Y	109.45	58Y	112.15	82Y	113.55	96Y	114.95	110Y	116.35	124Y	117.75
33X	109.60	59X	112.20	83X	113.60	97X	115.00	111X	116.40	125X	117.80
33Y	109.65	59Y	112.25	83Y	113.65	97Y	115.05	111Y	116.45	125Y	117.85
35X	109.80	70X	112.30	84X	113.70	98X	115.10	112X	116.50	126X	117.90
35Y	109.85	70Y	112.35	84Y	113.75	98Y	115.15	112Y	116.55	126Y	117.95
37X	110.00	71X	112.40	85X	113.80	99X	115.20	113X	116.60		
37Y	110.05	71Y	112.45	85Y	113.85	99Y	115.25	113Y	116.65		
39X	110.20	72X	112.50	86X	113.90	100X	115.30	114X	116.75		
39Y	110.25	72Y	112.55	86Y	113.95	100Y	115.35	114Y	116.75		
41X	110.40	73X	112.60	87Y	114.00	101X	115.40	115X	116.80		
41Y	110.45	73Y	112.65	87Y	114.05	101Y	115.45	115Y	116.85		
43X	110.60	74X	112.70	88X	114.10	102X	115.50	116X	116.90		
43Y	110.65	74Y	112.75	88Y	114.15	102Y	115.55	116Y	116.95		

A.2.3 DME Channel Frequencies

The individual values in the table are:

- **Ch. No.** = ICAO channel number
- **VOR Freq.** = VOR interrogation frequency
- **DME Interrog. Freq.** = DME interrogation frequency (MHz)
- **DME Reply Freq.** = DME reply frequency (MHz)

Table 1-4: Standardized DME transmitting frequencies (MHz) and the associated ICAO channels for interrogation and reply

Ch. No.	VOR Freq.	DME Interrog. Freq.	DME Reply Freq.	Ch. No.	VOR Freq.	DME Interrog.. Freq.	DME Reply Freq.	Ch. No.	VOR Freq.	DME Interrog. Freq.	DME Reply Freq.
1X		1025	962	43X	110.60	1067	1004	85X	113.80	1109	1172
1Y		1025	1088	43Y	110.65	1067	1130	85Y	113.85	1109	1046
2X		1026	963	44X	110.70	1068	1005	86X	113.90	1110	1173
2Y		1026	1089	44Y	110.75	1068	1131	86Y	113.95	1110	1047
3X		1027	964	45X	110.80	1069	1106	87X	114.00	1111	1174
3Y		1027	1090	45Y	110.85	1069	1132	87Y	114.05	1111	1048
4X		1028	965	46X	110.90	1070	1007	88X	114.10	1112	1175
4Y		1028	1091	46Y	110.95	1070	1133	88Y	114.15	1112	1049
5X		1029	966	47X	111.00	1071	1008	89X	114.20	1113	1176
5Y		1029	1092	47Y	111.05	1071	1134	89Y	114.25	1113	1050
6X		1030	967	48X	111.10	1072	1009	90X	114.30	1114	1177
6Y		1030	1093	48Y	111.15	1072	1135	90Y	114.35	1114	1051
7X		1031	968	49X	111.20	1073	1010	91X	114.40	1115	1178
7Y		1031	1094	49Y	111.25	1073	1136	91Y	114.45	1115	1052
8X		1032	969	50X	111.30	1074	1011	92X	114.50	1116	1179
8Y		1032	1095	50Y	111.35	1074	1137	92Y	114.55	1116	1053
9X		1033	970	51X	111.40	1075	1012	93X	114.60	1117	1180
9Y		1033	1096	51Y	111.45	1075	1138	93Y	114.65	1117	1054
10X		1034	971	52X	111.50	1076	1013	94X	114.70	1118	1181
10Y		1034	1097	52Y	111.55	1076	1139	94Y	114.75	1118	1055
11X		1035	972	53X	111.60	1077	1014	95X	114.80	1119	1182
11Y		1035	1098	53Y	111.65	1077	1140	95Y	114.85	1119	1056
12X		1036	973	54X	111.70	1078	1015	96X	114.90	1120	1183
12Y		1036	1099	54Y	111.75	1078	1141	96Y	114.95	1120	1057
13X		1037	974	55X	111.80	1079	1016	97X	115.00	1121	1184
13Y		1037	1100	55Y	111.85	1079	1142	97Y	115.05	1121	1058
14X		1038	975	56X	111.90	1080	1017	98X	115.10	1122	1185
14Y		1038	1101	56Y	111.95	1080	1143	98Y	115.15	1122	1059
15X		1039	976	57X	112.00	1081	1018	99X	115.20	1123	1186
15Y		1039	1102	57Y	112.05	1081	1144	99Y	115.25	1123	1060
16X		1040	977	58X	112.10	1082	1019	100X	115.30	1124	1187
16Y		1040	1103	58Y	112.15	1082	1145	100Y	115.35	1124	1061
17X	108.00	1041	978	59X	112.20	1083	1020	101X	115.40	1125	1188
17Y	108.05	1041	1104	59Y	112.25	1083	1146	101Y	115.45	1125	1062
18X	108.10	1042	979	60X		1084	1021	102X	115.50	1126	1189
18Y	108.15	1042	1105	60Y		1084	1147	102Y	115.55	1126	1063

Ch. No.	VOR Freq.	DME Interrog. Freq.	DME Reply Freq.	Ch. No.	VOR Freq.	DME Interrog.. Freq.	DME Reply Freq.	Ch. No.	VOR Freq.	DME Interrog. Freq.	DME Reply Freq.
19X	108.20	1043	980	61X		1085	1022	103X	115.60	1127	1190
19Y	108.25	1043	1106	61Y		1085	1148	103Y	115.65	1127	1064
20X	108.30	1044	981	62X		1086	1023	104X	115.70	1128	1191
20Y	108.35	1044	1107	62Y		1086	1149	104Y	115.75	1128	1065
21X	108.40	1045	982	63X		1087	1024	105X	115.80	1129	1192
21Y	108.45	1045	1108	63Y		1087	1150	105Y	115.85	1129	1066
22X	108.50	1046	983	64X		1088	1151	106X	115.90	1130	1193
22Y	108.55	1046	1109	64Y		1088	1025	106Y	115.95	1130	1067
23X	108.60	1047	984	65X		1089	1152	107X	116.00	1131	1194
23Y	108.65	1047	1110	65Y		1089	1026	107Y	116.05	1131	1068
24X	108.70	1048	985	66X		1090	1153	108X	116.10	1132	1195
24Y	108.75	1048	1111	66Y		1090	1027	108Y	116.15	1132	1069
25X	108.80	1049	986	67X		1091	1154	109X	116.20	1133	1196
25Y	108.85	1049	1112	67Y		1091	1028	109Y	116.25	1133	1070
26X	108.90	1050	987	68X		1092	1155	110X	116.30	1134	1197
26Y	108.95	1050	1113	68Y		1092	1029	110Y	116.35	1134	1071
27X	109.00	1051	988	69X		1093	1156	111X	116.40	1135	1198
27Y	109.05	1051	1114	69Y		1093	1030	111Y	116.45	1135	1072
28X	109.10	1052	989	70X	112.30	1094	1157	112X	116.50	1136	1199
28Y	109.15	1052	1115	70Y	112.35	1094	1031	112Y	116.55	1136	1073
29X	109.20	1053	990	71X	112.40	1095	1158	113X	116.60	1137	1200
29Y	109.25	1053	1116	71Y	112.45	1095	1032	113Y	116.65	1137	1074
30X	109.30	1054	991	72X	112.50	1096	1159	114X	116.70	1138	1201
30Y	109.35	1054	1117	72Y	112.55	1096	1033	114Y	116.75	1138	1075
31X	109.40	1055	992	73X	112.60	1097	1160	115X	116.80	1139	1202
31Y	109.45	1055	1118	73Y	112.65	1097	1034	115Y	116.85	1139	1076
32X	109.50	1056	993	74X	112.70	1098	1161	116X	116.90	1140	1203
32Y	109.55	1056	1119	74Y	112.75	1098	1035	116Y	116.95	1140	1077
33X	109.60	1057	994	75X	112.80	1099	1162	117X	117.00	1141	1204
33Y	109.65	1057	1120	75Y	112.85	1099	1036	117Y	117.05	1141	1078
34X	109.70	1058	995	76X	112.90	1100	1163	118X	117.10	1142	1205
34Y	109.75	1058	1121	76Y	112.95	1100	1037	118Y	117.15	1142	1079
35X	109.80	1059	996	77X	113.00	1101	1164	119X	117.20	1143	1206
35Y	109.85	1059	1122	77Y	113.05	1101	1038	119Y	117.25	1143	1080
36X	109.90	1060	997	78X	113.10	1102	1165	120X	117.30	1144	1207
36Y	109.95	1060	1123	78Y	113.15	1102	1039	120Y	117.35	1144	1081

Ch. No.	VOR Freq.	DME Interrog. Freq.	DME Reply Freq.	Ch. No.	VOR Freq.	DME Interrog.. Freq.	DME Reply Freq.	Ch. No.	VOR Freq.	DME Interrog. Freq.	DME Reply Freq.
37X	110.00	1061	998	79X	113.20	1103	1166	121X	117.40	1145	1208
37Y	110.05	1061	1124	79Y	113.25	1103	1040	121Y	117.45	1145	1082
38X	110.10	1062	999	80X	113.30	1104	1167	122X	117.50	1146	1209
38Y	110.15	1062	1125	80Y	113.35	1104	1041	122Y	117.55	1146	1083
39X	110.20	1063	1000	81X	113.40	1105	1168	123X	117.60	1147	1210
39Y	110.25	1063	1126	81Y	113.45	1105	1042	123Y	117.65	1147	1084
40X	110.30	1064	1001	82X	113.50	1106	1169	124X	117.70	1148	1211
40Y	110.35	1064	1127	82Y	113.55	1106	1043	124Y	117.75	1148	1085
41X	110.40	1065	1002	83X	113.60	1107	1170	125X	117.80	1149	1212
41Y	110.45	1065	1128	83Y	113.65	1107	1044	125Y	117.85	1149	1086
42X	110.50	1066	1003	84X	113.70	1108	1171	126X	117.90	1150	1213
42Y	110.55	1066	1129	84Y	113.75	1108	1045	126Y	117.95	1150	1087

A.3 Default Settings

In the following chapter the standard default settings for the Avionic standards are listed. The preset value of each parameter is specified also in the description of the corresponding remote command.

A.3.1 GBAS

The default settings for the GBAS standard are:

Parameter	Value
State	Not affected by "Set to Default"
Filter, Clipping	Cosine, Clipping Off
Trigger	Internal, Auto
Clock	Internal
Multiple Frequency Channels	Off
Sample Rate	10.5 KHz

A.3.2 ILS

The default settings for the ILS standard are:

Table 1-5: Glide slope default settings

Parameter	Value
State	Not affected by Set to default
Sum of Depth	80 Percent
Fly	Up
DDM	0
Mode	Norm
Up Frequency	90 Hz
Down Frequency	150 Hz
Up/Down Phase	0 deg
COM/ID State	Off
COM/ID Frequency	1020 kHz
COM/ID Depth	10 percent

Table 1-6: Localizer default settings

Parameter	Value
State	Not affected by Set to default
Sum of Depth	40 Percent
Fly	Up
DDM	0
Mode	Norm
Left frequency	90 Hz
Right Frequency	150 Hz
Left/Right Phase	0 deg
COM/ID State	Off
COM/ID Frequency	1020 kHz
COM/ID Period	9 s
COM/ID Depth	10 percent

Table 1-7: Marker Beacon default settings

Parameter	Value
State	Not affected by Set to default
Marker frequency	400 Hz
Marker Depth	95 %
COM/ID State	Off
COM/ID Frequency	1020 kHz

Parameter	Value
COM/ID Period	9 s
COM/ID Depth	10 percent
Rf frequency	75 MHz

A.3.3 DME

The default settings for the DME standard are:

Table 1-8: Default settings for the DME standard

Parameter	Value
General Parameters	
State	Not affected by Set to default
DME Mode	Interrogation
Signal Settings	
Channel Mode	X Channel
Carrier Frequency	1.025 000 000 000 GHz
Pulse Squitter	Off
Pulse Repetition Rate	48 Hz
Pulse Settings	
Pulse Shape	Cos^2
Pulse Rise	2.00 µs
Pulse Width	3.50 µs
Pulse Fall	2.00 µs
Pulse Spacing	12.00 µs
Single Pulse	Off
Receive Settings	
Pulse Pair Spacing Tolerance	1.00 µs

A.3.4 VOR

The default settings for the VOR standard are:

Table 1-9: VOR default settings

Parameter	Value
State	Not affected by Set to default
Carrier Frequency Mode	User Defined

Parameter	Value
Carrier Frequency	108.000 000 000 MHz
Mode	Norm
VAR/REF Frequency	30.0 Hz
VAR Depth	30.0 %
Subcarrier Frequency	9.960 0 kHz
Subcarrier Depth	30. 0%
REF Deviation	480 Hz
Bearing Angle	0.00 deg
Direction	From
COM/ID State	Off

A.4 Supported File Formats

The R&S SMBV supports the following file formats:

- waypoint files, see chapter A.4.1, "Waypoint File Format", on page 202.
- files with GBAS differential data, see chapter A.4.2, "GBAS Differential File Format", on page 203.

These files use predefined file extensions and file structure.

A.4.1 Waypoint File Format

The waypoint files use the file extension `*.txt`. The file format is a list of coordinates (longitude, latitude, altitude) and a respective resolution in milliseconds (see example "Contents of the predefined waypoint file Braunschweig.txt" on page 202).

Example: Contents of the predefined waypoint file Braunschweig.txt

The resolution command at the beginning of the format specifies the sampling interval to be used for the WGS84 geodetic coordinates list. The resolution gives the time (in ms) between two consecutive waypoints.

```
RESOLUTION: 10000
10.48270840370976,52.32054084253119,1200
10.48782531447518,52.32057768227161,1100
10.49064540739393,52.32038679250167,1000
10.49541991083499,52.32019512664971,900
10.50027587576012,52.32000536916035,800
10.50535314978533,52.3200431506525,700
10.50926768002483,52.32002989881414,600
10.51213496693413,52.31984142364868,500
10.51596247360969,52.31963813345246,400
```

```
10.52023872584375,52.31964325051492,300
10.52435479286515,52.31930292486343,200
10.52746875803649,52.31913528562811,100
```

A.4.2 GBAS Differential File Format

The GBAS differential files are proprietary files with file extension `*.rs_gbas`. The file contains the required information for message type 1, as defined in the GBAS specification RTCA DO-246D.

See example "Contents of the predefined GBAS differential file Correction1.rs_gbas" on page 204 for an example of the file format.

Example: Contents of the predefined GBAS differential file Correction1.rs_gbas

```
<reference1>
    <general>
            <property refcoord="11.5833,48.15,110"/>
    </general>
    <dgnssrecord>
        <property modifiedzcount="215.1"/>
        <property measurementtype="0"/>
        <property ephemeriscrc="0xECF0"/>
        <dgnssvector data="G1,4,311.49,-1.20"/>
        <dgnssvector data="G3,16,81.6,3.41"/>
        <dgnssvector data="G4,110,65,-1.1"/>
        <dgnssvector data="G10,21,6.31,-0.51"/>
        <dgnssvector data="R6,61,5.85,-0.41"/>
        <dgnssvector data="S125,126,212.15,9.41"/>
    </dgnssrecord>
    <dgnssrecord>
        <property modifiedzcount="225.1"/>
        <property measurementtype="0"/>
        <property ephemeriscrc="0xEFF0"/>
        <dgnssvector data="G1,4,311.49,-1.20"/>
        <dgnssvector data="G3,16,81.6,3.41"/>
        <dgnssvector data="G4,110,65,-1.1"/>
        <dgnssvector data="G10,21,6.31,-0.51"/>
        <dgnssvector data="R6,61,5.85,-0.41"/>
        <dgnssvector data="S125,126,212.15,9.41"/>
    </dgnssrecord>
    <dgnssrecord>
        <property modifiedzcount="235.1"/>
        <property measurementtype="0"/>
        <property ephemeriscrc="0xBCF0"/>
        <dgnssvector data="G1,4,311.49,-1.20"/>
        <dgnssvector data="G3,16,81.6,3.41"/>
        <dgnssvector data="G4,110,65,-1.1"/>
        <dgnssvector data="G10,21,6.31,-0.51"/>
        <dgnssvector data="R6,61,5.85,-0.41"/>
        <dgnssvector data="S125,126,212.15,9.41"/>
    </dgnssrecord>
</reference1>
```

The table 1-10 describes the used tags and parameters.

Table 1-10: Format of *.rs_gbas file

Container	Tag name	Parameter	Description
<reference1>			
<general>			
	<property>	<refcoord>	longitude, latitude and altitude of the reference point
<dgnssrecord>			one <dgnssrecord> per measurements

Container	Tag name	Parameter	Description
	<property>	<modifiedzcount>	modified z-count for the record (s)
		<measurementtype>	measurement type
		<ephemeriscrc>	ephemeris CRC
	<dgnssvector>	<data>	One <dgnssvector> per each of the N measurement blocks: <GNSS _Standard><SVID>,<Issue of Data (IOD)>,<Pseudorange Correction (PRC) in (m)>,<Range Rate Correction (RRC) in (m/s)> GNSS _Standard=G for GPS, R for Glonass and S for SBAS

Glossary: Specifications and References

Symbols

1MA193: 1MA193_0e Application Note, "Aeronautical radio navigation measurement solutions"

R

RTCA DO-246D: "GNSS-Based Precision Approach Local Area Augmentation System (LAAS) Signal-in-Space Interface Control Document (ICD)"

List of Commands

[:SOURce<hw>]:BB:DME:ANALysis:EFFiciency:OK?....173
[:SOURce<hw>]:BB:DME:ANALysis:EFFiciency?....173
[:SOURce<hw>]:BB:DME:ANALysis:GATE:COUNt....173
[:SOURce<hw>]:BB:DME:ANALysis:GATE:EDELay....173
[:SOURce<hw>]:BB:DME:ANALysis:GATE:TIME....174
[:SOURce<hw>]:BB:DME:ANALysis:GATE[:LENGth]....174
[:SOURce<hw>]:BB:DME:ANALysis:IAFactor?....177
[:SOURce<hw>]:BB:DME:ANALysis:NORMalize?....174
[:SOURce<hw>]:BB:DME:ANALysis:POWer:OK?....175
[:SOURce<hw>]:BB:DME:ANALysis:POWer?....175
[:SOURce<hw>]:BB:DME:ANALysis:PRRate:OK?....176
[:SOURce<hw>]:BB:DME:ANALysis:PRRate?....175
[:SOURce<hw>]:BB:DME:ANALysis:PSAFactor?....177
[:SOURce<hw>]:BB:DME:ANALysis:RDIStance?....176
[:SOURce<hw>]:BB:DME:ANALysis:STATe....176
[:SOURce<hw>]:BB:DME:ANALysis:TIME:OK?....177
[:SOURce<hw>]:BB:DME:ANALysis:TIME?....176
[:SOURce<hw>]:BB:DME:ANALysis:TRIGger:SEARch?....177
[:SOURce<hw>]:BB:DME:ANALysis:UAFactor....178
[:SOURce<hw>]:BB:DME:CLOCk:MODE....191
[:SOURce<hw>]:BB:DME:CLOCk:MULTiplier....191
[:SOURce<hw>]:BB:DME:CLOCk:SOURce....192
[:SOURce<hw>]:BB:DME:CLOCk:SYNChronization:EXECute....192
[:SOURce<hw>]:BB:DME:CLOCk:SYNChronization:MODE....193
[:SOURce<hw>]:BB:DME:CSUFfix....165
[:SOURce<hw>]:BB:DME:EFFiciency....165
[:SOURce<hw>]:BB:DME:FALL....165
[:SOURce<hw>]:BB:DME:FREQuency....166
[:SOURce<hw>]:BB:DME:ICAO:CHANnel....166
[:SOURce<hw>]:BB:DME:ID:CODE....178
[:SOURce<hw>]:BB:DME:ID:DASH....178
[:SOURce<hw>]:BB:DME:ID:DOT....179
[:SOURce<hw>]:BB:DME:ID:LETTer....179
[:SOURce<hw>]:BB:DME:ID:PERiod....180
[:SOURce<hw>]:BB:DME:ID:PPP[:STATe]....179
[:SOURce<hw>]:BB:DME:ID:PPS....180
[:SOURce<hw>]:BB:DME:ID:PRESet....180
[:SOURce<hw>]:BB:DME:ID:RATE....180
[:SOURce<hw>]:BB:DME:ID:SYMBol....180
[:SOURce<hw>]:BB:DME:ID:TSCHema....181
[:SOURce<hw>]:BB:DME:ID[:STATe]....181
[:SOURce<hw>]:BB:DME:MARKer<ch>:DELay....187
[:SOURce<hw>]:BB:DME:MARKer<ch>:MODE....188
[:SOURce<hw>]:BB:DME:MARKer<ch>:PDELay?....188
[:SOURce<hw>]:BB:DME:MARKer<ch>:WIDTh....188
[:SOURce<hw>]:BB:DME:MODE....164
[:SOURce<hw>]:BB:DME:PINPut:DELay....171

[:SOURce<hw>]:BB:DME:PINPut:SOURce....170
[:SOURce<hw>]:BB:DME:PINPut:TRIGger:LEVel?....171
[:SOURce<hw>]:BB:DME:PINPut:TRIGger:SEARch?....172
[:SOURce<hw>]:BB:DME:PPS....167
[:SOURce<hw>]:BB:DME:PPST....168
[:SOURce<hw>]:BB:DME:PRESet....108
[:SOURce<hw>]:BB:DME:PRESet....164
[:SOURce<hw>]:BB:DME:RATE....168
[:SOURce<hw>]:BB:DME:RDIStance....168
[:SOURce<hw>]:BB:DME:RDIStance:UNIT....169
[:SOURce<hw>]:BB:DME:RISE....169
[:SOURce<hw>]:BB:DME:SETTing:CATalog?....108
[:SOURce<hw>]:BB:DME:SETTing:DELete....108
[:SOURce<hw>]:BB:DME:SETTing:LOAD....109
[:SOURce<hw>]:BB:DME:SETTing:STORe....109
[:SOURce<hw>]:BB:DME:SETTing:STORe:FAST....109
[:SOURce<hw>]:BB:DME:SHAPe....169
[:SOURce<hw>]:BB:DME:SINGle....170
[:SOURce<hw>]:BB:DME:SQUitter....170
[:SOURce<hw>]:BB:DME:STATe....108
[:SOURce<hw>]:BB:DME:STATe....164
[:SOURce<hw>]:BB:DME:TRIGger:ARM:EXECute....182
[:SOURce<hw>]:BB:DME:TRIGger:EXECute....183
[:SOURce<hw>]:BB:DME:TRIGger:EXTernal:SYNChronize:OUTPut....183
[:SOURce<hw>]:BB:DME:TRIGger:OBASeband:DELay....184
[:SOURce<hw>]:BB:DME:TRIGger:OBASeband:INHibit....184
[:SOURce<hw>]:BB:DME:TRIGger:RMODe?....184
[:SOURce<hw>]:BB:DME:TRIGger:SLENgth....184
[:SOURce<hw>]:BB:DME:TRIGger:SOURce....185
[:SOURce<hw>]:BB:DME:TRIGger[:EXTernal<ch>]:DELay....185
[:SOURce<hw>]:BB:DME:TRIGger[:EXTernal<ch>]:INHibit....186
[:SOURce<hw>]:BB:DME:WIDTh....172
[:SOURce<hw>]:BB:DME[:TRIGger]:SEQuence....186
[:SOURce<hw>]:BB:GBAS:CLIPping:LEVel....137
[:SOURce<hw>]:BB:GBAS:CLIPping:MODE....138
[:SOURce<hw>]:BB:GBAS:CLIPping:STATe....137
[:SOURce<hw>]:BB:GBAS:CLOCk:MODE....191
[:SOURce<hw>]:BB:GBAS:CLOCk:MULTiplier....191
[:SOURce<hw>]:BB:GBAS:CLOCk:SOURce....192
[:SOURce<hw>]:BB:GBAS:CLOCk:SYNChronization:EXECute....192
[:SOURce<hw>]:BB:GBAS:CLOCk:SYNChronization:MODE....193
[:SOURce<hw>]:BB:GBAS:FILTer:PARameter:APCO25....136
[:SOURce<hw>]:BB:GBAS:FILTer:PARameter:COSine....136
[:SOURce<hw>]:BB:GBAS:FILTer:PARameter:COSine:COFS....136
[:SOURce<hw>]:BB:GBAS:FILTer:PARameter:GAUSs....136
[:SOURce<hw>]:BB:GBAS:FILTer:PARameter:LPASs....136
[:SOURce<hw>]:BB:GBAS:FILTer:PARameter:LPASSEVM....136
[:SOURce<hw>]:BB:GBAS:FILTer:PARameter:PGAuss....136
[:SOURce<hw>]:BB:GBAS:FILTer:PARameter:RCOSine....137
[:SOURce<hw>]:BB:GBAS:FILTer:PARameter:SPHase....137

[:SOURce<hw>]:BB:GBAS:FILTer:TYPE 136
[:SOURce<hw>]:BB:GBAS:GPOW 116
[:SOURce<hw>]:BB:GBAS:MFCHannels 115
[:SOURce<hw>]:BB:GBAS:MSET:MTYPe? 138
[:SOURce<hw>]:BB:GBAS:MSET:SRATe? 138
[:SOURce<hw>]:BB:GBAS:NOFRames? 119
[:SOURce<hw>]:BB:GBAS:PRESet 108
[:SOURce<hw>]:BB:GBAS:SCATi 115
[:SOURce<hw>]:BB:GBAS:SETTing:CATalog? 108
[:SOURce<hw>]:BB:GBAS:SETTing:DELete 109
[:SOURce<hw>]:BB:GBAS:SETTing:LOAD 109
[:SOURce<hw>]:BB:GBAS:SETTing:STORe 109
[:SOURce<hw>]:BB:GBAS:SETTing:STORe:FAST 109
[:SOURce<hw>]:BB:GBAS:SRINfo? 116
[:SOURce<hw>]:BB:GBAS:STATe 108
[:SOURce<hw>]:BB:GBAS:TRIGger:ARM:EXECute 182
[:SOURce<hw>]:BB:GBAS:TRIGger:EXECute 183
[:SOURce<hw>]:BB:GBAS:TRIGger:EXTernal:SYNChronize:OUTPut 183
[:SOURce<hw>]:BB:GBAS:TRIGger:OBASeband:DELay 184
[:SOURce<hw>]:BB:GBAS:TRIGger:OBASeband:INHibit 184
[:SOURce<hw>]:BB:GBAS:TRIGger:OUTPut:DELay:FIXed 190
[:SOURce<hw>]:BB:GBAS:TRIGger:OUTPut<ch>:DELay 190
[:SOURce<hw>]:BB:GBAS:TRIGger:OUTPut<ch>:DELay:MAXimum? 190
[:SOURce<hw>]:BB:GBAS:TRIGger:OUTPut<ch>:DELay:MINimum? 190
[:SOURce<hw>]:BB:GBAS:TRIGger:OUTPut<ch>:MODE 188
[:SOURce<hw>]:BB:GBAS:TRIGger:OUTPut<ch>:OFFTime 190
[:SOURce<hw>]:BB:GBAS:TRIGger:OUTPut<ch>:ONTime 190
[:SOURce<hw>]:BB:GBAS:TRIGger:OUTPut<ch>:PATTern 189
[:SOURce<hw>]:BB:GBAS:TRIGger:OUTPut<ch>:PULSe:DIVider 189
[:SOURce<hw>]:BB:GBAS:TRIGger:OUTPut<ch>:PULSe:FREQuency? 189
[:SOURce<hw>]:BB:GBAS:TRIGger:RMODe? 184
[:SOURce<hw>]:BB:GBAS:TRIGger:SLENgth 184
[:SOURce<hw>]:BB:GBAS:TRIGger:SLUNit 185
[:SOURce<hw>]:BB:GBAS:TRIGger:SOURce 185
[:SOURce<hw>]:BB:GBAS:TRIGger[:EXTernal<ch>]:DELay 185
[:SOURce<hw>]:BB:GBAS:TRIGger[:EXTernal<ch>]:INHibit 186
[:SOURce<hw>]:BB:GBAS:VDB:APPend 116
[:SOURce<hw>]:BB:GBAS:VDB<ch>:DATA 118
[:SOURce<hw>]:BB:GBAS:VDB<ch>:DATA:DSELection 118
[:SOURce<hw>]:BB:GBAS:VDB<ch>:DATA:PATTern 119
[:SOURce<hw>]:BB:GBAS:VDB<ch>:DELete 117
[:SOURce<hw>]:BB:GBAS:VDB<ch>:DLENgth 118
[:SOURce<hw>]:BB:GBAS:VDB<ch>:FNUMber 118
[:SOURce<hw>]:BB:GBAS:VDB<ch>:GID 117
[:SOURce<hw>]:BB:GBAS:VDB<ch>:INSert 116
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:AID 120
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:APDesignator 120
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:ATCHeight 120
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:ATUSelector 120
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:CWAThreshold 121

[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:DFLocation:COORdinates:DECimal....121
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:DFLocation:COORdinates:DMS....121
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:DG:FILE?....124
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:DG:PREDefined:CATalog?....123
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:DG:PREDefined:FILE....123
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:DG:STATe....122
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:DG:USER:CATalog?....123
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:DG:USER:FILE....123
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:DLOFfset....124
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:FDSState....124
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:FLAA....124
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:FRCLink....125
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:FVAA....125
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:GCID....125
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:GPANgle....126
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:GSADesignator....126
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:GSRReceivers....126
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:LFLocation:COORdinates:DECimal....126
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:LFLocation:COORdinates:DMS....127
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:LFLocation:HEIGht....128
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:LMVariation....128
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:LOCation:COORdinates:DECimal....129
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:LOCation:COORdinates:DMS....129
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:MT2State....130
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:MT4State....130
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:NOPPoint....131
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:RFINdex....131
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:RLETter....131
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:RNUMber....132
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:RPDF....132
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:RPDT....132
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:RPIF....132
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:RPIT....133
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:RUINdicator....133
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:RUNCertainty....133
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:SHEight....133
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:SVIGradient....134
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:TDSState....134
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:TLAS....134
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:TVAS....134
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:WAYPoint:FILE?....136
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:WAYPoint:PREDefined:CATalog?....135
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:WAYPoint:PREDefined:FILE....135
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:WAYPoint:USER:CATalog?....135
[:SOURce<hw>]:BB:GBAS:VDB<ch>:MCONfig:WAYPoint:USER:FILE....135
[:SOURce<hw>]:BB:GBAS:VDB<ch>:SCH:TS<st>:POWer....119
[:SOURce<hw>]:BB:GBAS:VDB<ch>:SCH:TS<st>:STATe....119
[:SOURce<hw>]:BB:GBAS:VDB<ch>:SSID....117
[:SOURce<hw>]:BB:GBAS:VDB<ch>:STATe....117
[:SOURce<hw>]:BB:GBAS:VERSion?....115

[:SOURce<hw>]:BB:GBAS:WAVeform:CREate ... 115
[:SOURce<hw>]:BB:GBAS[:TRIGger]:SEQuence ... 186
[:SOURce<hw>]:BB:ILS:CLOCk:MODE ... 191
[:SOURce<hw>]:BB:ILS:CLOCk:MULTiplier ... 192
[:SOURce<hw>]:BB:ILS:CLOCk:SOURce ... 192
[:SOURce<hw>]:BB:ILS:CLOCk:SYNChronization:EXECute ... 192
[:SOURce<hw>]:BB:ILS:CLOCk:SYNChronization:MODE ... 193
[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:CODE ... 145
[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:DASH ... 145
[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:DEPTh ... 145
[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:DOT ... 146
[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:FREQuency ... 146
[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:LETTer ... 146
[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:PERiod ... 146
[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:SYMBol ... 147
[:SOURce<hw>]:BB:ILS:LOCalizer:COMid:TSCHema ... 147
[:SOURce<hw>]:BB:ILS:LOCalizer:COMid[:STATe] ... 147
[:SOURce<hw>]:BB:ILS:LOCalizer:DDM:COUPling ... 147
[:SOURce<hw>]:BB:ILS:LOCalizer:DDM:CURRent ... 148
[:SOURce<hw>]:BB:ILS:LOCalizer:DDM:DEPTh ... 149
[:SOURce<hw>]:BB:ILS:LOCalizer:DDM:DIRection ... 148
[:SOURce<hw>]:BB:ILS:LOCalizer:DDM:LOGarithmic ... 148
[:SOURce<hw>]:BB:ILS:LOCalizer:DDM:PCT ... 149
[:SOURce<hw>]:BB:ILS:LOCalizer:DDM:POLarity ... 149
[:SOURce<hw>]:BB:ILS:LOCalizer:FREQuency ... 150
[:SOURce<hw>]:BB:ILS:LOCalizer:FREQuency:MODE ... 150
[:SOURce<hw>]:BB:ILS:LOCalizer:ICAO:CHANnel ... 150
[:SOURce<hw>]:BB:ILS:LOCalizer:LLOBe[:FREQuency] ... 150
[:SOURce<hw>]:BB:ILS:LOCalizer:MODE ... 151
[:SOURce<hw>]:BB:ILS:LOCalizer:PHASe ... 151
[:SOURce<hw>]:BB:ILS:LOCalizer:RLOBe[:FREQuency] ... 151
[:SOURce<hw>]:BB:ILS:LOCalizer:SDM ... 152
[:SOURce<hw>]:BB:ILS:MBEacon:COMid:CODE ... 152
[:SOURce<hw>]:BB:ILS:MBEacon:COMid:DASH ... 152
[:SOURce<hw>]:BB:ILS:MBEacon:COMid:DEPTh ... 153
[:SOURce<hw>]:BB:ILS:MBEacon:COMid:DOT ... 153
[:SOURce<hw>]:BB:ILS:MBEacon:COMid:FREQuency ... 153
[:SOURce<hw>]:BB:ILS:MBEacon:COMid:LETTer ... 153
[:SOURce<hw>]:BB:ILS:MBEacon:COMid:PERiod ... 154
[:SOURce<hw>]:BB:ILS:MBEacon:COMid:SYMBol ... 154
[:SOURce<hw>]:BB:ILS:MBEacon:COMid:TSCHema ... 154
[:SOURce<hw>]:BB:ILS:MBEacon:COMid[:STATe] ... 155
[:SOURce<hw>]:BB:ILS:MBEacon:FREQuency ... 155
[:SOURce<hw>]:BB:ILS:MBEacon:FREQuency:MODE ... 155
[:SOURce<hw>]:BB:ILS:MBEacon:MARKer:FREQuency ... 155
[:SOURce<hw>]:BB:ILS:MBEacon[:MARKer]:DEPTh ... 155
[:SOURce<hw>]:BB:ILS:PRESet ... 108
[:SOURce<hw>]:BB:ILS:PRESet ... 139
[:SOURce<hw>]:BB:ILS:SETTing:CATalog? ... 108
[:SOURce<hw>]:BB:ILS:SETTing:DELete ... 109

[:SOURce<hw>]:BB:ILS:SETTing:LOAD....109
[:SOURce<hw>]:BB:ILS:SETTing:STORe....109
[:SOURce<hw>]:BB:ILS:SETTing:STORe:FAST....110
[:SOURce<hw>]:BB:ILS:STATe....108
[:SOURce<hw>]:BB:ILS:STATe....139
[:SOURce<hw>]:BB:ILS:TRIGger:ARM:EXECute....182
[:SOURce<hw>]:BB:ILS:TRIGger:EXECute....183
[:SOURce<hw>]:BB:ILS:TRIGger:EXTernal:SYNChronize:OUTPut....183
[:SOURce<hw>]:BB:ILS:TRIGger:OBASeband:DELay....184
[:SOURce<hw>]:BB:ILS:TRIGger:OBASeband:INHibit....184
[:SOURce<hw>]:BB:ILS:TRIGger:RMODe?....184
[:SOURce<hw>]:BB:ILS:TRIGger:SLENgth....185
[:SOURce<hw>]:BB:ILS:TRIGger:SOURce....185
[:SOURce<hw>]:BB:ILS:TRIGger[:EXTernal<ch>]:DELay....185
[:SOURce<hw>]:BB:ILS:TRIGger[:EXTernal<ch>]:INHibit....186
[:SOURce<hw>]:BB:ILS:TYPE....139
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:DDM:COUPling....140
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:DDM:CURRent....140
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:DDM:DEPTh....142
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:DDM:DIRection....140
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:DDM:LOGarithmic....141
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:DDM:PCT....141
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:DDM:POLarity....141
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:DDM:STEP....141
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:FREQuency....142
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:FREQuency:MODE....142
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:ICAO:CHANnel....142
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:LLOBe[:FREQuency]....143
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:MODE....143
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:PHASe....143
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:SDM....144
[:SOURce<hw>]:BB:ILS[:GS|GSLope]:ULOBe[:FREQuency]....144
[:SOURce<hw>]:BB:ILS[:TRIGger]:SEQuence....186
[:SOURce<hw>]:BB:VOR:BANGle....160
[:SOURce<hw>]:BB:VOR:BANGle:DIRection....161
[:SOURce<hw>]:BB:VOR:CLOCk:MODE....191
[:SOURce<hw>]:BB:VOR:CLOCk:MULTiplier....192
[:SOURce<hw>]:BB:VOR:CLOCk:SOURce....192
[:SOURce<hw>]:BB:VOR:CLOCk:SYNChronization:EXECute....192
[:SOURce<hw>]:BB:VOR:CLOCk:SYNChronization:MODE....193
[:SOURce<hw>]:BB:VOR:COMid:CODE....161
[:SOURce<hw>]:BB:VOR:COMid:DASH....161
[:SOURce<hw>]:BB:VOR:COMid:DEPTh....162
[:SOURce<hw>]:BB:VOR:COMid:DOT....162
[:SOURce<hw>]:BB:VOR:COMid:FREQuency....162
[:SOURce<hw>]:BB:VOR:COMid:LETTer....162
[:SOURce<hw>]:BB:VOR:COMid:PERiod....163
[:SOURce<hw>]:BB:VOR:COMid:SYMBol....163
[:SOURce<hw>]:BB:VOR:COMid:TSCHema....163
[:SOURce<hw>]:BB:VOR:COMid[:STATe]....163

[:SOURce<hw>]:BB:VOR:FREQuency....158
[:SOURce<hw>]:BB:VOR:FREQuency:MODE....158
[:SOURce<hw>]:BB:VOR:ICAO:CHANnel....158
[:SOURce<hw>]:BB:VOR:MODE....156
[:SOURce<hw>]:BB:VOR:PRESet....108
[:SOURce<hw>]:BB:VOR:PRESet....157
[:SOURce<hw>]:BB:VOR:REFerence[:DEViation]....159
[:SOURce<hw>]:BB:VOR:SETTing:CATalog?....108
[:SOURce<hw>]:BB:VOR:SETTing:DELete....109
[:SOURce<hw>]:BB:VOR:SETTing:LOAD....109
[:SOURce<hw>]:BB:VOR:SETTing:STORe....109
[:SOURce<hw>]:BB:VOR:SETTing:STORe:FAST....110
[:SOURce<hw>]:BB:VOR:STATe....108
[:SOURce<hw>]:BB:VOR:STATe....157
[:SOURce<hw>]:BB:VOR:SUBCarrier:DEPTh....159
[:SOURce<hw>]:BB:VOR:SUBCarrier[:FREQuency]....160
[:SOURce<hw>]:BB:VOR:TRIGger:ARM:EXECute....182
[:SOURce<hw>]:BB:VOR:TRIGger:EXECute....183
[:SOURce<hw>]:BB:VOR:TRIGger:EXTernal:SYNChronize:OUTPut....183
[:SOURce<hw>]:BB:VOR:TRIGger:OBASeband:DELay....184
[:SOURce<hw>]:BB:VOR:TRIGger:OBASeband:INHibit....184
[:SOURce<hw>]:BB:VOR:TRIGger:RMODe?....184
[:SOURce<hw>]:BB:VOR:TRIGger:SLENgth....185
[:SOURce<hw>]:BB:VOR:TRIGger:SOURce....185
[:SOURce<hw>]:BB:VOR:TRIGger[:EXTernal<ch>]:DELay....185
[:SOURce<hw>]:BB:VOR:TRIGger[:EXTernal<ch>]:INHibit....186
[:SOURce<hw>]:BB:VOR:VAR:DEPTh....160
[:SOURce<hw>]:BB:VOR:VAR:FREQuency....160
[:SOURce<hw>]:BB:VOR[:TRIGger]:SEQuence....186
<subsystem>:PRESet....108
<subsystem>:SETTing:CATalog....108
<subsystem>:SETTing:DELete....108
<subsystem>:SETTing:LOAD....109
<subsystem>:SETTing:STORe....109
<subsystem>:SETTing:STORe:FAST....109
<subsystem>:STATe....108

Index

A

Add new VDB transmitter 29
Airport ID 37
Airport identification 37
Allocating the VDB to the time domain
  Principle 16
  Settings 30
Altitude
  Delta FPAP 38
  LTP/FTP 37
  Reference location 33
App. Data Length/bytes 29
Append VDB transmitter 29
Approach performance designator 37
Arm
  Trigger 27, 49, 64, 72, 86
Assigning a VDB to time slot
  Settings 30
Avionics standards
  Overview 13

B

B x T 43
Baseband clipping 45
Baseband filter 43
Bearing angle
  VOR 67

C

Carrier frequency
  DME 73
  ILS Glide slope 50
  ILS Localizer 54
  ILS Marker Beacons 60
  VOR 65
Carrier frequency mode
  ILS Glide slope 49, 54
  ILS Localizer 49, 54
  ILS Marker Beacons 60
  VOR 65
Channel mode
  DME 72
Clipping
  Level 46
  Mode 46
  State 45
Clock
  DME 49, 64, 72
  ILS 49, 64, 72
  Multiplier 95
  Source 95
  VOR 49, 64, 72
Clock mode
  DME 95
  ILS 95
  VOR 95
Clock parameters 27
Code
  ILS Localizer 58
  ILS Marker Beacons 61
  VOR 68
COM/ID Letter Length
  Marker Beacon modulation 62, 69
COM/ID Symbol Space
  Marker Beacon modulation 62, 69
Continuation Link 41
Conventions
  SCPI commands 106
Course width at threshold 39
Crest factor 45
Current Range without Recalculation 91
Cut Off Frequency Factor 44
Cut Off Frequency Shift 44

D

Dash length
  DME modulation 82
  ILS Localizer 59
Data list management 25
Data source 28
DDM - SDM coupling
  ILS Glide slope 53
  ILS Localizer 57
DDM current
  ILS Glide slope 52
  ILS Localizer 56
DDM depth
  ILS Glide slope 52
  ILS Localizer 57
DDM logarithmic
  ILS Glide slope 53
  ILS Localizer 57
DDM percent
  ILS Glide slope 53
  ILS Localizer 57
DDM polarity
  ILS Localizer 54
DDM step
  ILS Glide slope 52
  ILS Localizer 56
Default settings 24, 47, 63, 70
Delay
  Marker 91
Delay, external trigger
  DME modulation 75
Delete a VDB transmitter 29
Delta_FPAP location configuration 38
Delta_Length offset 39
Depth
  ILS Localizer 59
  ILS Marker Beacons 61
  VOR 68
Depth of modulation polarity
  ILS Glide slope 50
Differential GNSS
  Enabling 30
  State 42
Direction
  VOR 67

DME
Pulse fall ... 76
Pulse Pair Spacing Tolerance ... 76
Pulse rise ... 76
Pulse shape ... 75
Pulse spacing ... 76
Pulse width ... 76
Single pulse ... 76
DME analysis
DME interrogation ... 76
Expected reply delay ... 78
Gate length ... 78
Measurement count ... 78
Normalize setup ... 83
Peak level ... 78
Pulse repetition frequency ... 79
Range distance ... 78
Reply delay ... 79
Reply efficiency ... 79
State ... 77
DME interrogation
Expected reply delay, analysis ... 78
Gate length, analysis ... 78
Measurement count, analysis ... 78
Normalize setup, analysis ... 83
Peak level, analysis ... 78
Pulse repetition frequency, analysis ... 79
Pulse repetition rate ... 74
Pulse repetition rate trigger ... 74
Range distance ... 78
Repetition rate ... 74
Repetition rate trigger ... 74
Reply delay ... 79
Reply efficiency, analysis ... 79
State, analysis ... 77
DME mode ... 71
DME modulation
Dash length ... 82
Delay, external trigger ... 75
Dot length ... 81
ICAO Channel ... 73
ID frequency ... 81
ID period ... 81
ID symbol space ... 82
ID time schema ... 81
Input source ... 74
Letter space ... 82
Search trigger level ... 75
Squitter ... 73
DME reply
ID code ... 81
ID state ... 80
Range distance ... 73
Reply efficiency ... 74
DME reply mode
ID code ... 81
ID dash length ... 82
ID dot length ... 81
ID frequency ... 81
ID letter space ... 82
ID period ... 81
ID state ... 80
ID symbol space ... 82
ID time schema ... 81
Documentation overview ... 7
Dot length
DME modulation ... 81
ILS Localizer ... 59
ILS Marker Beacons ... 62
VOR ... 68
Down frequency
ILS Glide slope ... 51

E

Execute Trigger
DME ... 26, 48, 64, 71, 87
GBAS ... 26, 48, 64, 71, 87
ILS ... 26, 48, 64, 71, 87
VOR ... 26, 48, 64, 71, 87
Expected reply delay
DME analysis ... 78
Expected Reply delay, analysis
DME interrogation ... 78

F

FAS data set ... 35
FAS lateral alert limit / approach status ... 39
FAS RPDS or continuation link ... 41
FAS vertical alert limit/approach status ... 39
FASLAL ... 39
FASVAL ... 39
Filter Parameter ... 43
Filter Type ... 43
Filtering, Clipping Settings ... 42
Final approach segment (FAS) ... 35
Fix marker delay to current range ... 91
Flight Path Alignment Point (FPAP) ... 38
Fly
ILS Glide slope ... 52
ILS Localizer ... 56
Frequency
ILS Localizer ... 58
ILS Marker Beacons ... 61
VOR ... 68
Frequency number ... 28
Frequency, single/multiple
Advantages ... 15

G

Gate length
DME analysis ... 78
Gate length, analysis
DME interrogation ... 78
GBAS differential file ... 42
Settings ... 30
GBAS ID ... 28
GCID ... 32
Generate
Waveform file ... 25
Glide path angle ... 36
Global Trigger/Clock Settings ... 46, 96
GNSS reference receivers, number ... 32
GPA ... 36
Ground station
Accuracy designator ... 32
Continuity/integrity designator ... 32
Reference receivers ... 32
Ground station accuracy designator ... 32
Ground station continuity/integrity designator ... 32

Ground station reference receivers 32
GSAD 32
GSRR 32

H

h0 32
Header byte
LAAS (GBAS) 25
SCAT-I 25

I

ICAO channel
ILS 50
ILS Localizer 54
VOR 65
ICAO Channel
DME modulation 73
ID code
DME reply 81
DME reply mode 81
ID dash length
DME reply mode 82
ID frequency
DME modulation 81
DME reply mode 81
ID letter space
DME reply mode 82
ID period
DME modulation 81
DME reply mode 81
ID state
DME reply 80
DME reply mode 80
ID symbol space
DME modulation 82
DME reply mode 82
ID time schema
DME modulation 81
DME reply mode 81
ILS Component 48
Inhibit
Trigger 90
Input source
DME modulation 74
Insert new VDB transmitter 29
Installation 11
IOD 204

L

Landing systems
Overview 13
Landing Threshold Point/Fictitious Threshold Point 37
Latitude
Delta FPAP 38
LTP/FTP 37
Reference location 33
Left frequency
ILS Localizer 55
Left/Right phase
ILS Localizer 55
Letter length
ILS Localizer 59
Letter space
DME modulation 82
Local magnetic variation 32
Longitude
Delta FPAP 38
LTP/FTP 37
Reference location 33
LTP/FTP height 36
LTP/FTP location configuration 37

M

Marker
Delay 91
Mode 90
Marker delay
DME 93, 94
Marker depth
ILS Marker Beacons 60
Marker frequency
ILS Marker Beacons 60
Marker mode
DME 92
Marker width
DME 93
Master-slave mode 102
Measured external clock 95
Measurement count
DME analysis 78
Measurement count, analysis
DME interrogation 78
Message configuration
Settings 30
Message Type 1 204
Message type 2 state 31
Message type 2, 4
Settings 30
Message type 4
State 34
Minimum signal-in-space accuracy 32
Mode
ILS Glide slope 50
ILS Localizer 55
VOR 66
Modulation type 45
Multiple frequnecy
Advantages 15
Multiplier 95

N

N_R 32
Normalize setup
DME analysis 83
Normalize setup, analysis
DME interrogation 83
Number of frames 29
Number of pathpoints - N 40
Nyquist filter 43

P

Pair of pulse pairs
DME 80
Peak level
DME analysis 78
Peak level, analysis
DME interrogation 78

Period
ILS Localizer ... 59
ILS Marker Beacons ... 61
VOR ... 68
Position Format
Delta FPAP ... 38
LTP/FTP ... 37
Reference location ... 33
PRC ... 204
Pulse fall
DME ... 76
Pulse pair spacing tolerance
DME ... 76
Pulse repetition frequency
DME analysis ... 79
Pulse Repetition Frequency - DME Modulation ... 79
Pulse repetition frequency, analysis
DME interrogation ... 79
Pulse repetition rate
DME interrogation ... 74
Pulse repetition rate trigger
DME interrogation ... 74
Pulse rise
DME ... 76
Pulse shape
DME ... 75
Pulse spacing
DME ... 76
Pulse squitter
DME interrogation ... 73
Pulse width
DME ... 76

R

Radar systems
Overview ... 13
Radio navigation systems
Overview ... 13
Range distance
DME analysis ... 78
DME interrogation ... 78
DME reply ... 73
Real Data
Configuration ... 28
Reference location configuration ... 33
Reference path data selector
FAS ... 37
TAP ... 40
Reference path ID
TAP ... 40
Reference path identifier
FAS ... 37
Refractivity index ... 32
Refractivity uncertainty ... 32
Repetition rate
DME interrogation ... 74
Repetition rate trigger
DME interrogation ... 74
Reply delay
DME analysis ... 79
DME interrogation ... 79
Reply efficiency
DME analysis ... 79
DME reply ... 74
Reply efficiency, analysis
DME interrogation ... 79
Right frequency
ILS Localizer ... 55
Roll Off ... 43
Route indicator ... 37
RPDS
FAS ... 37
TAP ... 40
RRC ... 204
Runway letter ... 37
Runway number ... 37

S

Sample rate ... 26, 45
Save/Recall
DME ... 25, 48, 63, 70
GBAS ... 25, 48, 63, 70
ILS ... 25, 48, 63, 70
VOR ... 25, 48, 63, 70
Scale height ... 32
Scheduling ... 29
Search trigger level
DME modulation ... 75
Set synchronization ... 95
Set to default ... 24, 47, 63, 70
Show/Hide details
DME ... 80
ILS Localizer ... 58
ILS Marker Beacons ... 61
VOR ... 67
Sigma N ... 32
Sigma vertical ionospheric gradient ... 32
Signal duration unit ... 86
Signal generation status ... 86
Single pulse
DME ... 76
SIS accuracy, minimum ... 32
Speed vs. interference suppression ... 15
Squitter
DME interrogation ... 73
SSID ... 28
Standard deviation of a normal distribution ... 32
Standard settings ... 24, 47, 63, 70
State
DME ... 24, 47, 63, 70
DME analysis ... 77
GBAS ... 24, 47, 63, 70
ILS ... 24, 47, 63, 70
ILS Localizer ... 58
ILS Marker Beacons ... 61
VDB, settings ... 28
VOR ... 24, 47, 63, 67, 70
State, analysis
DME interrogation ... 77
Station Slot Identifier ... 28
Subcarrier depth
VOR modulation ... 66
Subcarrier frequency
VOR ... 66
Sum of depth
ILS Glide slope ... 52
ILS Localizer ... 56
Symbol space
ILS Localizer ... 59
Sync. output to external trigger ... 87
Synchronization mode ... 94
Synchronous signal generation ... 102

System configuration
DME ... 71
ILS ... 48
VOR ... 64

T

TAP data set
State ... 39
TAP lateral alert limit / status ... 41
TAP vertical alert limit / status ... 41
TAPLAL ... 41
TAPVAL ... 41
TCH ... 36
TDMA timing
Principle ... 16
Settings ... 30
Threshold crossing height ... 36
Time domain allocation
Principle ... 16
Settings ... 30
Time schema
ILS Localizer ... 59
ILS Marker Beacons ... 62
VOR ... 68
Time slot ... 30
Trigger
Inhibit ... 90
Mode ... 85
Signal duration ... 86
Source ... 87
Trigger delay
DME ... 89
ILS ... 89
VOR ... 89
Trigger parameters ... 26
Trigger/Marker
DME ... 48, 64, 71
ILS ... 48, 64, 71
VOR ... 48, 64, 71

U

Up frequency
ILS Glide slope ... 51
Up/Down phase
ILS Glide slope ... 51

V

VAR depth
VOR ... 66
VAR/REF frequency
VOR ... 66
VDB
State, settings ... 28
VDB power per TS ... 30
VHF Data Broadcast transmitter
State, settings ... 28

W

Waveform file
Create ... 25
Waypoint file ... 40
WGS84 coordinates
Delta FPAP ... 38
LTP/FTP ... 37
Reference location ... 33