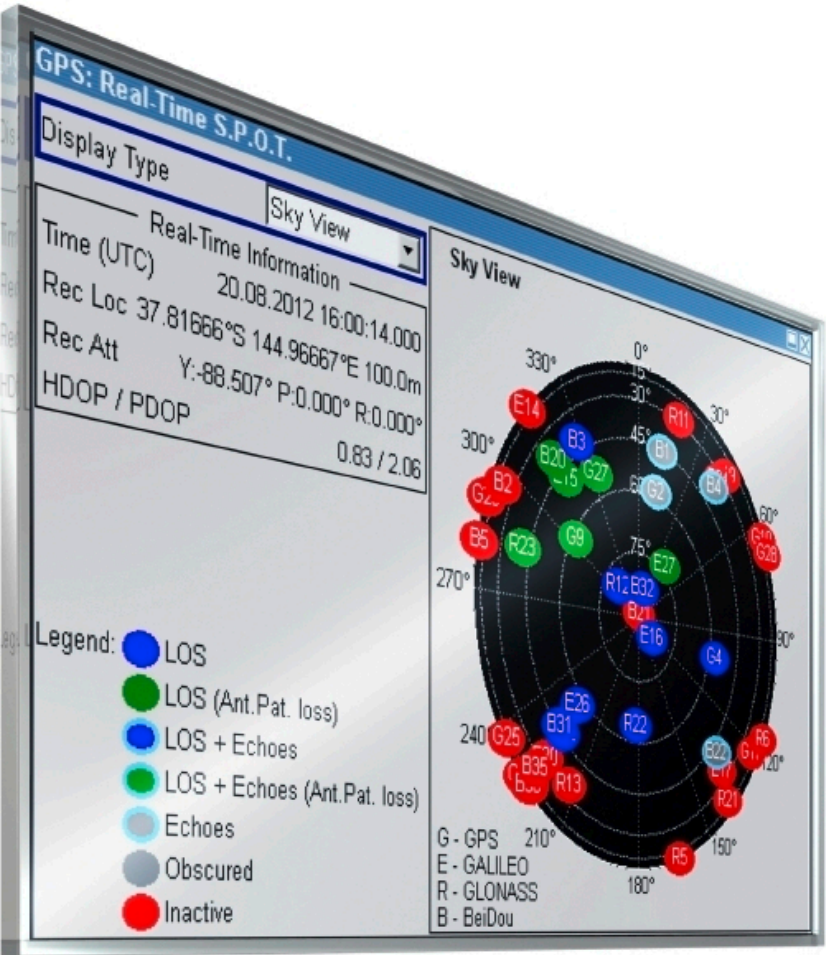


# Satellite Navigation Digital Standards for R&S®SMBV100A Operating Manual



1173.1427.12 – 10

This document describes the software options for satellite navigation: GPS, Assisted GPS, GPS P-Code, Galileo, Assisted Galileo, GLONASS, Assisted GLONASS, COMPASS/BeiDou, QZSS L1 C/A, SBAS, Enh. GNSS and GNSS Extensions, incl. Extension to 12 and 24 Satellites, Obscuration Simulation and Automatic Multipath, Antenna Pattern, Spinning and Attitude Simulation

Described are the following software options:

- R&S®SMBV-K44/-K65/-K66/-K67/-K91/-K92/-K93/-K94/-K95/-K96/-K101/-K102/-K103/-K105/-K107/-K110  
1415.8060.xx, 1415.8560.xx, 1415.8683.xx, 1419.2509.xx, 1415.8577.xx, 1415.8583.xx,  
1415.8660.xx, 1415.8677.xx, 1419.2521.xx, 1415.8790.xx, 1415.8802.xx, 1415.8819.xx,  
1415.8825.xx, 1419.2350.02, 1419.2709.xx, 1419.2273.xx

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

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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

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# 1 Preface

## 1.1 About this Manual

This operating manual provides all the information **specific to the GNSS 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 GNSS options R&S SMBV-K44/-K66/-K94/-K105/-K107/-K110**  
Introduction to and getting familiar with the options
- **About the GNSS options**  
Background information on basic terms and principles in the context of the signal generation
- **GNSS Configuration and Settings**  
A concise description of all functions and settings available to configure signal generation with their corresponding remote control command
- **How to Perform Typical Signal Generation Tasks with the GNSS Options**  
The basic procedure to perform signal generation tasks and step-by-step instructions for more complex tasks or alternative methods  
As well as detailed examples to guide you through typical signal generation scenarios and allow you to try out the application immediately
- **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 ordered 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/apnotes>.

## 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.
<i>Input</i>	Input to be entered by the user is displayed in italics.
<a href="#">Links</a>	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 GNSS Satellite Navigation Standards

The R&S SMBV-K44/-K65/-K66/-K67/-K91/-K92/-K93/-K94/-K95/-K96/-K101/-K102/-K103/-K105/-K107/-K110 are firmware applications that add functionality to generate signals in accordance with GPS, Galileo, GLONASS, QZSS, COMPASS/BeiDou and SBAS.

The global navigation satellite system (GNSS) solution for the R&S SMBV is suitable for R&D lab tests or production tests. Supported are all possible scenarios, from simple setups with individual, static satellites all the way to flexible scenarios generated in realtime with up to 24 dynamic GPS, Glonass, Galileo, QZSS and BeiDou satellites.

The GNSS key features are:

- Support of GPS L1/L2 (C/A and P code), Glonass L1/L2, Galileo E1, BeiDou and QZSS L1, including hybrid constellations
- Realtime simulation of realistic constellations with up to 24 satellites and unlimited simulation time
- Flexible scenario generation including moving scenarios, dynamic power control and atmospheric modeling
- Configuration of realistic user environments, including obscuration and multipath, antenna characteristics and vehicle attitude
- Static mode for basic receiver testing using signals with zero, constant or varying Doppler profiles
- Enabling / disabling particular signal components individually.
- Support of Assisted GNSS (A-GNSS) test scenarios, including generation of assistance data for GPS, Glonass, Galileo and BeiDou
- Realtime external trajectory feed for hardware in the loop (HIL) applications
- High signal dynamics<sup>1)</sup>, simulation of spinning vehicles and precision code (P code) simulations to support aerospace and defense applications
- Enhanced simulation capabilities for aerospace applications by supporting ground-based augmentation system (GBAS)  
see the description "Avionics Standards Digital Standards" for R&S®SMBV operating manual.

<sup>1)</sup> May be subject to export restrictions.

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 GNSS Dialog

### To open the dialog with GNSS settings

- ▶ In the block diagram of the R&S SMBV, select "Baseband > Satellite Navigation".  
A dialog box opens that displays the provided general settings.

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

## 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 GNSS Options

Global navigation satellite system (GNSS) employs the radio signals of several navigation standards, like GPS, Galileo, GLONASS, BeiDou etc. For several years, GPS used to be the only standard available for civilian navigation through its C/A civilian code. Nowadays, the GNSS signals and systems are undergoing fast development, some systems are getting modernized and some are completely new. In the foreseeable future, several more GNSS satellites utilizing more signals and new frequencies will be available.

The GNSS implementation in the R&S SMBV enables you to generate the signal of up to 6, 12 or 24 GNSS satellites, depending on the installed options. Signal generation is done in real-time and thus it is not limited to a certain time period.

### Brief introduction to the global navigation satellite systems (GNSS)

- **GPS**

The Global Positioning System (GPS) consists of several satellites circling the earth in low orbits. The satellites transmit permanently information that can be used by the receivers to calculate their current position (ephemeris) and about the orbits of all satellites (almanac). The 3D position of a receiver on the earth can be determined by carrying out delay measurements of at least four signals emitted by different satellites.

Being transmitted on a single carrier frequency, the signals of the individual satellites can be distinguished by means of correlation (Gold) codes. These ranging codes are used as spreading code for the navigation message which is transmitted at a rate of 50 baud.

- **Galileo**

Galileo is the European global navigation satellite system that provides global positioning service under civilian control. It is planned to be inter-operable with GPS and GLONASS and other global satellite navigation systems.

The fully deployed Galileo system consists of 30 satellites (27 operational and 3 spares). Three independent CDMA signals, named E5, E6 and E1, are permanently transmitted by all Galileo satellites. The E5 signal is further sub-divided into two signals denoted E5a and E5b (see [figure 3-1](#)).

- **GLONASS**

Glomass is the Russian global navigation satellite system that uses 24 Modernized Glonass Satellites touring the globe. Together with GPS, up to 54 GNSS Satellites are provided, which will improve the availability and consequently the navigation performance in high urban areas.

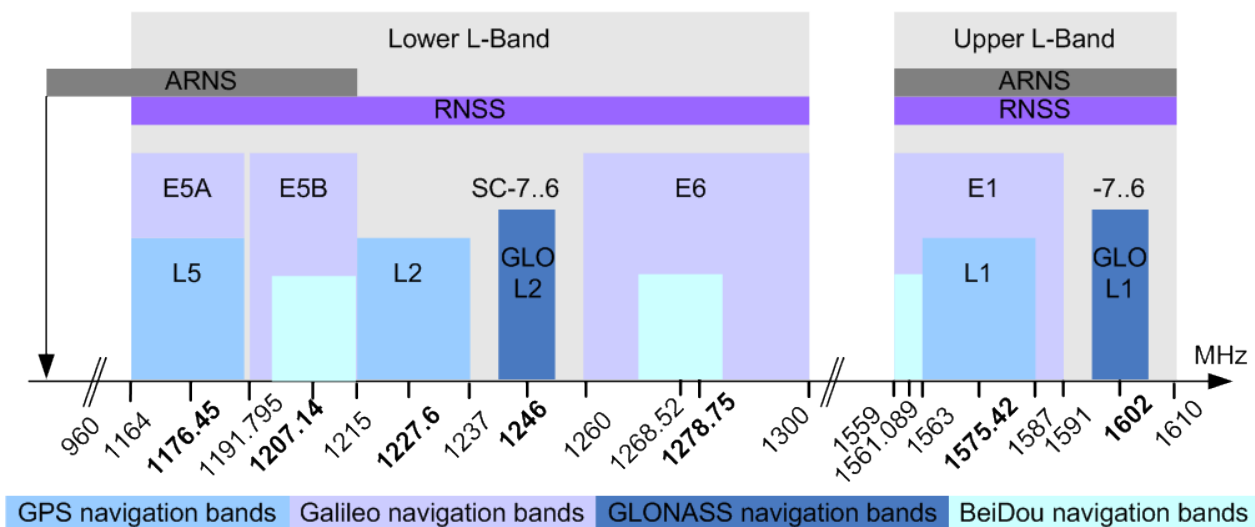


Fig. 3-1: GNSS frequency bands

- **COMPASS/BeiDou**

The fully deployed BeiDou Navigation Satellite System (BDS) is a Chinese satellite navigation system. This navigation system is also known as BeiDou-2 and is expected in 2020. The BDS is a global satellite navigation system that uses a constellation of 35 satellites to cover the globe. This constellation includes 5 geostationary orbit satellites (GEO) and 30 non-geostationary satellites; 27 in medium earth orbit (MEO) and 3 in inclined geosynchronous orbit (IGSO).

The BDS uses frequency allocated in the E1, E2, E5B, and E6 bands.

- **Quasi-Zenith Satellite System (QZSS)**

The Quasi-Zenith Satellite System is a regional space-based positioning system. The system is expected to be deployed in 2013 and the satellites would be visible in Japan.

In its fully deployment stage, the QZSS will use a total number of three regional non-geostationary and highly-inclined satellites. The QZSS does not aim to cover the globe but to increase the availability of GPS in Japan, especially in the larger towns.

The QZSS uses signals that are very similar to the GPS public signals.

- **Assisted GNSS (A-GNSS)**

Assisted GNSS (A-GNSS) was introduced to different mobile communication standards to significantly reduce the Time To First Fix (TTFF) of a user equipment (UE) containing a GNSS receiver. This is achieved by transmitting information (assistance data) mainly about the satellites directly from a base station to the UE. For example, a stand-alone GPS receiver needs about 30-60 seconds for a first fix and up to 12.5 minutes to get all information (almanac).

In A-GNSS "UE based mode", the base station assists the UE by providing the complete navigation message along with a list of visible satellites and ephemeris data. In addition to this information, the UE gets the location and the current time at the Base Station and that speeds up both acquisition and navigation processes of the GPS receiver and hence reduces TTFF to a few seconds.

In A-GNSS "UE assisted mode", the base station is even responsible for the calculation of the UE's exact location, i.e. the base station performs the navigation based on the raw measurements provided by the UE. Since the Acquisition Assis-



tance Data provided by the Base Station already serves speeding up the acquisition process, the UE only has to track the code and carrier phase.

### **Brief introduction to the Satellite-based Augmentation Systems (SBAS)**

The Satellite-based Augmentation System uses geostationary satellites (GEO) to broadcast GNSS coarse integrity and wide area correction data (error estimations), as well as ranging signal to augment the GNSS.

The SBAS broadcasts augmentation data in the GPS frequency band L1 (carrier frequency of 1575.42 MHz), uses the BPSK modulation, and the C/A PRN code of GPS.

The SBAS provides data for a maximum of 51 satellites. In the SBAS, the term pseudo random number (PRN) is used instead of the term space vehicle (SV); there are 90 PRN numbers reserved for SBAS, where the numbering starts at 120.

Several SBAS systems are still in their development phase, like for example the SDCM in Russia Federation, GAGAN in India, etc.

SBAS systems that are currently in operation augment the US GPS satellite navigation system, so that they are suitable for example for civil aviation navigation safety needs. The following SBAS systems are in operation and supported by R&S SMBV:

- **EGNOS**  
EGNOS (European Geostationary Navigation Overlay Service) EGNOS is the European SBAS system
- **WAAS**  
WAAS (Wide Area Augmentation System) is the SBAS system in United States
- **MSAS**  
MSAS (Multi-functional Satellite Augmentation System ) is the SBAS system working in Japan. It uses the Multi functional Transport Satellites (MTSAT) and supports differential GPS.

See also [chapter 3.9.2, "SBAS Configuration"](#), on page 38.

## **3.1 Functional Overview of the Basic Realtime GNSS Options GPS, Galileo, GLONASS, BeiDou and QZSS**

This section gives an overview of the options:

- GPS (R&S SMBV-K44)
- Galileo (R&S SMBV-K66)
- GLONASS (R&S SMBV-K94)
- QZSS (R&S SMBV-K105)
- BeiDou (R&S SMBV-K107)

Throughout this description, these options are denoted as basic GNSS options.

### 3.1.1 Real-time generation

- With the option R&S SMBV-K44, up to six GPS satellites transmitting L1 or L2 signals with C/A-code can be simulated.
- With the option R&S SMBV-K66, up to six Galileo satellites transmitting E1 signal can be simulated.
- With the option R&S SMBV-K94, up to six GLONASS satellites transmitting L1 or L2 signal can be simulated.
- With the option R&S SMBV-K107, up to six BeiDou satellites transmitting L1 or L2 signal can be simulated.

The simulation of the QZSS satellite requires the option R&S SMBV-K105 additionally to any of the options listed above.

### 3.1.2 Multi-satellite GNSS signal

The instrument calculates a multi-satellite GNSS signal in three different simulation modes, the static mode, the auto localization mode and the user localization mode.

In "Static mode", static satellites with constant Doppler shifts are provided for simple receiver test, like receiver sensitivity, acquisition and tracking test, or production tests etc. The selection and configuration of any localization data, such as receiver location for instance are not enabled.

See [chapter 5.1, "Generating a GNSS Signal for Simple Receiver Tests \(Static Mode\)"](#), on page 202.

The superposition signal of up to 6 dynamic satellites at a specific receiver location is generated in one of the localization modes. The major difference to the static mode implies the possibility to specify the receiver's location. Although, both the localization modes are provided for the [generation of a realistic GNSS signal](#), there are some differences between them.

- The "Auto Localization" mode is provided for the generation of a GNSS signal with automatic exchange of satellite whenever needed to improve the position dilution of precision and to ensure satellite visibility at the simulated receiver location. This mode ensures an optimal satellite constellation, automatic dynamic calculation of the satellite power at any moment and ephemeris projection from the selected *almanac*.  
In this simulation mode, the connected GNSS receiver can be forced to obtain a 3D fix at a predefined or user-defined static geographical location. Instrument equipped with the option GNSS enhanced R&S SMBV-K92 can also simulate moving receivers (see [chapter 3.5.1, "Moving Scenarios"](#), on page 27).
- The "User Localization" mode provides flexible configuration of the satellite constellation, the power settings and the individual satellites parameters. For instruments equipped with assistance option R&S SMBV-K65, this mode also enables the extraction of the navigation message from [RINEX](#) files. Dynamic exchange of satellites can be performed by means of deactivation and activation of the individual satellites. The power settings are enabled for configuration but the automatic dynamic calculation function of the instrument may also be utilized.

This mode is required for the generation of user defined assisted GPS test scenarios.

The [table 3-1](#) gives an overview of the supported functionality per simulation mode. Some functionality require additional options.

**Table 3-1: Cross-reference between the simulation mode, supported functionality and the required options**

Simulation Mode / Function	Static	Auto Localization	User Localization	Required Options
Configuration of static receiver location	no	yes	yes	R&S SMBV-K44/K66/K94/K105/K107
GNSS System Configuration	yes	yes	yes	R&S SMBV-K44 and R&S SMBV-K66 and R&S SMBV-K94 and R&S SMBV-K105 and R&S SMBV-K107
Almanac/RINEX	almanac	almanac	Almanac and RINEX file supported	R&S SMBV-K44/K66/K94/K105/K107 R&S SMBV-K65/K67/K95/K105/K107 for RINEX files
Projection of Navigation Message	no	yes	yes	R&S SMBV-K44/K66/K94/K105/K107
S.P.O.T. Display	no	yes	yes	R&S SMBV-K44/K66/K94/K105/K107
Assistance GNSS Data Generation	no	no	yes	R&S SMBV-K44/K66/K94/K105/K107 and R&S SMBV-K65/K67/K95
Configuration of Satellite Constellation	yes	no	yes	R&S SMBV-K44/K66/K94/K105/K107
Power Mode	User	Auto	Auto and User	R&S SMBV-K44/K66/K94/K105/K107
Exchange of Satellites	no	automatic	manual	R&S SMBV-K44/K66/K94/K105/K107
Maximum Number of Satellites	up to 12/24	up to 12/24	up to 12/24	R&S SMBV-K911-K96
Motion Files Motion Smoothing Extract attitude from motion file	no	yes	yes	R&S SMBV-K92
Time Conversion Configuration	yes	no	yes	R&S SMBV-K92
Navigation Message Configuration	configurable	read-only	configurable	R&S SMBV-K92
Atmospheric Configuration	yes	yes	yes	R&S SMBV-K92
Static Multipath Configuration	no	no	yes	R&S SMBV-K92
Automatic Multipath&Osculation scenarios	no	yes	yes	R&S SMBV-K92 and R&S SMBV-K102
Antenna Pattern/Body mask	no	yes	yes	R&S SMBV-K102

Simulation Mode / Function	Static	Auto Localization	User Localization	Required Options
Attitude/Body rotation angle files User defined vehicle spinning	no	yes	yes	R&S SMBV-K92 and R&S SMBV-K103
Hardware in the loop (HIL)	no	yes	yes	R&S SMBV-K92 (motion only) and R&S SMBV-K103 (motion and attitude)
File Conversion Tool SBAS Configuration	no	-	yes	R&S SMBV-K44 and R&S SMBV-K110
Modulation Control Signal Dynamics	yes	no	no	R&S SMBV-K44/K66/K94/ K105/K107

### 3.1.3 GNSS System Configurations

Instrument equipped with the GNSS basic options GPS, Galileo, GLONASS, BeiDou and QZSS can generate the signal of hybrid GNSS satellite constellation with radio signals of all navigation standards. Mixed configurations are enabled only in the common or close-range frequency bands, e.g. L1/E1.

GNSS system configurations can be also used to configure general purpose global parameters for the simulation.

### 3.1.4 Signal Dynamics

For basic receiver testing, the R&S SMBV generates signals with varying Doppler effects in static mode. Thus you can define Doppler profiles with configurable maximum dynamics (velocity, acceleration and jerk).

### 3.1.5 Modulation Control

In static mode, the instrument allows you to disable modulation components individually, like data source, spreading code, time sequence, meandering, navigation message, etc.

### 3.1.6 Multiple almanacs

The instrument supports the configuration of the almanac files used. One almanac file per GNSS navigation standard can be selected.

The Galileo and BeiDou satellite constellation are not yet fully in orbit. Hence, no almanac files for Galileo and BeiDou are available. In this implementation, predicted Galileo and BeiDou almanac files are provided for test purposes. The almanac files for GPS and Galileo use the same format.

Current GNSS almanac data can be downloaded via the Internet and stored on the hard disk of the instrument:

- U.S.Coast Guard Navigation Center GPS Homepage <http://www.navcen.uscg.gov/?pageName=gpsAlmanacs>  
The almanac files are named `xxx.alm` (for YUMA files) or `xxx.al3` (for SEM files),  
where `xxx` denotes the day of a year
- <http://www.celestrak.com/GPS/almanac/>  
The naming convention of the almanac file is: `almanac.sem/`  
`yuma.weekXXXX.YYYYYY.txt`,  
where `xxxx` denotes the GPS week and `yyyyyy` the time of almanac (TOA).
- <ftp://ftp.glonass-iac.ru/MCC/ALMANAC/>  
The file extension of the Glonass almanac file is: `xxx.agl`
- Japanese Space Agency homepage <http://qz-vision.jaxa.jp/USE/en/almanac>  
Available are QZSS almanacs or QZSS+GPS almanac data files.  
The almanac files are named `zzyyyyxxx.alm` (for YUMA files) or `zzyyyyxxx.alm.xml` (for xml files),  
where `zz=q` for QZSS almanacs and `zz=qg` for QZSS+GPS almanacs;  
`yyyy` denotes the year and `xxx` denotes the day of a year.

For detailed information on the content and frame structure of navigation data, refer to the specifications.

### 3.1.7 On-the-fly configuration of the satellites constellation

The simulation mode "User Localization" makes the satellite constellation user-definable. Not only the individual satellite parameters and the navigation message parameters are enabled for configuration, but active satellites can be turned off or the satellite constellation can be extended with new satellites at any time and **on-the-fly**, without causing an interruption of the currently running signal calculation. Changes in ephemeris of an active satellite and the power settings are performed without signal calculation restart, too. Hence, satellites ephemeris adjustment can be performed during the time the satellite is disabled and the updated parameters will be used from the moment this satellite is active again. This functionality can be used to perform manual exchange of satellite's at user defined moment of time.

This on-the-fly re-configuration during signal generation is especially beneficial by time consuming measurements or test.

### 3.1.8 Signal generation with projection of the ephemeris navigation data

The instrument employs a special algorithm for projecting the ephemeris navigation data that allows the generation of a navigation message without limitation in the simulation time. The ephemeris are updated and there is no limitation problem of maximum allowed time span of two hours (GPS) or half an hour (Glonass) between the simulation time and the reference time of the current satellite ephemeris page.

### 3.1.9 Dynamic exchange of satellites

In this implementation, the exchange of satellites can be performed automatically or be configured and triggered by the user.

- To enable the instrument to perform automatic exchange of satellites, select the "Auto Localization" mode.

In this mode, the instrument constantly monitors and updates the simulated satellite's constellation based on two criteria, the optimal satellite constellation with minimum PDOP and the satellite's visibility respecting the [Elevation Mask](#). While the PDOP is a constellation parameter that is calculated by the instrument and displayed in real-time, the satellite's visibility is a satellite parameter which indicates that the satellite elevation at a specific user location is above a configurable elevation mask.

Depending on the current satellite's conditions and the used number of satellites, a sophisticated algorithm decides how often the PDOP and the satellite's visibility have to be proved and at which moment of time the satellite's constellation has to be changed. Satellites that do not fulfill the criteria for minimum PDOP and sufficient visibility are exchanged **dynamically and on-the-fly**. Information about the expected time of the next upcoming exchange is provided by the parameter [Next Constellation Change](#).

See [chapter 5.2, "Generating a GNSS Signal with Automatic Dynamic Exchange of the Satellites \(Auto Localization Mode\)"](#), on page 202.

- In "User Localization" mode the exchange of the satellites is not performed automatically, but the satellite's constellation is fully configurable. Satellites can be turned off, reconfigured and turned on again, the existing satellite constellation can be extended with new satellites. Hence, an exchange of the satellites can be configured and performed at any moment of time, as defined by the user.

See [chapter 5.3, "Generating a GNSS Signal with Manual Exchange of the Satellites \(User Localization Mode\)"](#), on page 203.

### 3.1.10 Flexible power configuration and automatic dynamic power control

The instrument employs a dynamic power control concept. To provide better flexibility, two power modes are provided, the "Auto" and the "User" power modes.

- "User" power mode is intended for dynamical configuration of the power of each satellite separately and manually.
- "Auto" power mode enables an internal dynamical automatic power control. The power is calculated automatically based on the satellite-to-receiver distance which varies with the time.

For examples and information about the power calculation, see:

- [chapter 4.10.1, "Power Configuration"](#), on page 115
- [chapter 5.12, "Adjusting the Power Settings"](#), on page 213.

### 3.1.11 Simulation of uninterrupted location fix

The simulation of uninterrupted location fix requires a GNSS signal that fulfills the following conditions:

- An optimal satellite's constellation is selected and monitored constantly, i.e. the exchange of the satellites is performed automatically
- The power of the satellites is monitored and updated constantly depending on the satellite-to-receiver distance and some channel parameters, e.g. atmospheric effects.
- The age of the ephemeris (t - toe) is respected, for example the simulation time is always within the allowed time span of 2h around the GPS reference time of the current ephemeris page. For GLONASS, this time is usually 30 minutes.

The [table 3-2](#) gives an overview how these criteria are fulfilled by the provided localization modes.

*Table 3-2: Criteria for the generation of GNSS signal for simulation of uninterrupted location fix*

Criteria Simulation Mode	Optimal Satellite's Constellation	Power Monitoring and Update	Age of Ephemeris
"Auto Localization"	selected and updated automatically automatic dynamic exchange of the satellites	performed automatically	projection of the ephemeris from the almanac
"User Localization"	initial optimal satellite's constellation manual user-defined exchange of the satellites	performed automatically	projection of the ephemeris or many ephemeris pages are made available

Hence, both localization modes provide a realistic signal; the decision which localization mode will be used is a trade-off between the much better accuracy of the ephemeris retrieved from a RINEX file or a manual ephemeris configuration and the automatic selection of the optimal satellite's constellation with automatic exchange of the satellites.

See:

- [chapter 5.2, "Generating a GNSS Signal with Automatic Dynamic Exchange of the Satellites \(Auto Localization Mode\)"](#), on page 202
- [chapter 5.3, "Generating a GNSS Signal with Manual Exchange of the Satellites \(User Localization Mode\)"](#), on page 203

### 3.1.12 Real-Time S.P.O.T. display

The real-world situation of disappearance and re-appearance of satellites, as well as the dynamic display of several parameters like HDOP, PDOP, receiver's location, elapsed time and the trajectory of a moving receiver can be observed in real-time in the special "Real-Time S.P.O.T." (Satellites and Position Online Tracker) display.

The [Real-Time S.P.O.T. Settings](#) display is enabled for "Auto Localization" and "User Localization" modes.

## 3.2 GPS P-Code (R&S SMBV-K93)

The option GPS P-Code (R&S SMBV-K93) is only available for instruments equipped with option GPS (R&S SMBV-K44). It enhances the option GPS with the functionality to generate a position accuracy (P-Code) signal and allows the configuration of P or C/A+P satellite signals in addition to the civilian C/A signal enabled by the basic GPS option (R&S SMBV-K44).

P-Codes are one week long codes with a high chip rate 10.23 MHz. The higher chip rate significantly increases the performance compared to the civilian C/A codes used by commercial receivers, i.e. P-Code signal provide better Carrier to Noise sensitivity. Another difference compared to the C/A signals is that P-Code signals are only sensible to less than 30 m multipath delay whereas C/A signals are sensible to 300 m.

See [chapter 5.10, "Generating a GPS Signal Modulated with P Code"](#), on page 211.

## 3.3 Enhancements of Assisted GNSS Options GPS, Galileo and GLONASS

This section gives an overview of the options Assisted GPS (R&S SMBV-K65), Assisted Galileo (R&S SMBV-K67) and Assisted GLONASS (R&S SMBV-K95).

- The option Assisted GPS (R&S SMBV-K65) is only available for instruments equipped with option GPS (R&S SMBV-K44). It enhances the basic option with functionality required for A-GPS/A-GNSS test scenarios for 3GPP FDD, GSM and EUTRA/LTE.
- The option Assisted Galileo (R&S SMBV-K67) is only available for instruments equipped with option Galileo (R&S SMBV-K66). It enhances the basic option with functionality to generate user defined test scenarios.
- The option Assisted GLONASS (R&S SMBV-K95) is only available for instruments equipped with option GLONASS (R&S SMBV-K94). It enhances the basic option with functionality required for A-GLONASS/A-GNSS test scenarios for 3GPP FDD and EUTRA/LTE.

### 3.3.1 Support of RINEX Files

Additionally to the almanac files, a Receiver Independent Exchange Format RINEX files are supported. RINEX files are standard formats generated by Control Stations (CS) and many commercial receivers. RINEX Navigation Files usually comprise the ephemeris sets for several satellites with different TOE and TOC. One RINEX File is enough to describe satellite orbits for a period longer than 2 hours and sometimes up to 1 day.



You can download RINEX files for the Internet and store them on the hard disk of the instrument, e.g. :

- [http://cddis.gsfc.nasa.gov/gnss\\_datasum.html#brdc](http://cddis.gsfc.nasa.gov/gnss_datasum.html#brdc)
- <ftp://ftp.glonass-iac.ru/MCC/BRDC>
- <http://qz-vision.jaxa.jp/USE/en/ephemeris>

### 3.3.2 Full Set of Pre-defined Test Scenarios as Basis for A-GPS/A-GLO-NASS/A-GNSS Protocol and Conformance Test Cases

An instrument equipped with the assisted options supports test scenarios as basis for A-GPS/A-GLONASS/A-GNSS Protocol and Conformance Test cases. Some of the test cases may require additional options.



#### Test scenario vs. test case

An instrument equipped with the required options provides predefined test scenarios, not the standard conform test cases!

The provided test scenarios are suitable basis for the test cases. However, to perform a particular test case as specified by the 3GPP test specification, you have to subsequently configure several settings. You may have to adjust the receiver location, the simulation time, active satellites in the pre-selected satellite constellation, power setting, etc.

Refer to the corresponding 3GPP test specification for the required values.

See also [chapter 5.7, "Generating an A-GNSS Test Signal"](#), on page 206.

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For an overview of the supported test scenarios, see [chapter A.7, "List of the Supported Predefined Test Scenarios"](#), on page 439.

### 3.3.3 Custom Build Scenarios

The assisted options (R&S SMBV-K65/-K67/-K95) and are not limited to be used for A-GNSS testing exclusively. Despite the predefined scenarios, it is also possible to define any user-specific test scenario.

For testing of stand-alone GNSS receivers, the assisted options offer full flexibility on the simulated satellites including definition of the complete navigation message. The simulation mode "User Localization" can be used to get an optimal satellite's constellation and to adjust the navigation message to the exact requirements.

The basic BeiDou option (R&S SMBV-K107) is sufficient for this kind of tests. Additional assisted option is not required.

See [chapter 5.5, "Generating A-GPS Custom Build Scenarios \(User Localization Mode\)"](#), on page 204.

### 3.3.4 Generation of Assistance Data

Besides generating the satellite signals for predefined test scenario, the assisted options (R&S SMBV-K65/-K67/-K95) are also able to provide all kinds of assistance data in line with the simulated scenario which can be provided to the UE by a protocol tester.

Certainly, this also applies to user-defined test scenarios.

For the generation of A-QZSS and A-BeiDou user-defined test signals, the basic QZSS/BeiDou option (R&S SMBV-K105/-K107) is sufficient. Additional assisted option is not required.

See:

- [figure 5-2](#)
- [chapter 5.8, "Generating an GNSS Assistance Data"](#), on page 206

## 3.4 Extension to 12 / 24 Satellites (R&S SMBV-K91/-K96)

These options extend the maximum number of simulated satellites.

- Instrument equipped with the option R&S SMBV-K91 is enabled to generate the signal of up to 12 configurable satellites.  
Any hybrid 12-satellite configuration is possible, for example a combination like 10 C/A GPS + 1 Galileo E1 + 1 GLONASS R-C/A. The available satellites depend on the availability of the basic options, respectively on the enabled standards in the "GNSS System Configurations" and the selected "RF Band"
- The R&S SMBV-K96 requires the option R&S SMBV-K91 and further extends the maximum number of simulated satellites.  
Instruments equipped with this combination are enabled to generate the signal of up to 24 GPS C/A, Galileo E1, Glonass R-C/A and BeiDou B1-C/A satellites if the respectively GNSS basic option or a combination there of is available.  
The option R&S SMBV-K96 does not enhance the number of P-code satellites/taps.

See [chapter 5.21, "Generating GNSS Signal with Several Instruments"](#), on page 242.

There is a limitation of the maximum number of simulated satellites, depending on whether P code signal and BeiDou satellites are enabled in the GNSS system configuration or not. For details, see [chapter A.5, "Channel Budget"](#), on page 436.

## 3.5 Functional Overview of Option GNSS Enhanced (R&S SMBV-K92)

This option enhances the basic options R&S SMBV-K44/-K66/-K94/-K105/-K107 with the following functionality:

- support of motion files

- smoothing of the used defined trajectories
- real time motion vectors or hardware in the loop (HIL)
- modeling static multipath profiles
- configuration of atmospheric effects
- system time conversion
- leap second simulation parameters.

For detailed description see:

• <a href="#">Moving Scenarios</a> .....	27
• <a href="#">Static Multipath Signal Generation</a> .....	28
• <a href="#">Configuration of the Atmospheric Parameters</a> .....	28
• <a href="#">Time Conversion Configuration</a> .....	28
• <a href="#">Leap Second Simulation</a> .....	29
• <a href="#">Internal Waypoint Resampling</a> .....	29
• <a href="#">Motion Smoothing Using Vehicle Description File</a> .....	29
• <a href="#">Hardware in the Loop (HIL)</a> .....	30

### 3.5.1 Moving Scenarios

The option GNSS enhanced (R&S SMBV-K92) enhances the basic GNSS options by user-definable moving scenarios.

The following test scenario require moving scenario:

- A-GPS test scenarios for 3GPP FDD and GSM (Performance Test Scenario#3)
- CDMA test case "3GPP2 Moving Test Scenario"
- A-GNSS Scenario 5 for EUTRA/LTE

Another application field of the moving scenarios is the testing of stand-alone GNSS receivers.

In the R&S SMBV, a movement, i.e. a moving receiver is defined in one of the following ways:

- by a waypoint file that simulates a "moving" of the connected GNSS receiver  
A waypoint can be defined with:
  - the WGS 84 geodetic coordinates, see [chapter A.1.1.1, "Waypoint File Format"](#), on page 413
  - the East-North-Up (ENU) 2D vector trajectory parameters (line, arc), see [chapter A.1.1.2, "Vector Trajectory File Format"](#), on page 414
- by extracting of the location data from the NMEA files, see [chapter A.3, "NMEA Scenarios"](#), on page 429
- by configurable locations in Cartesian or geodetic coordinates with potentially defined velocity vector or velocity magnitude parameters in the \*.xtd file, see [chapter A.1.1.4, "Trajectory Description Files"](#), on page 416
- by the provided predefined waypoint files for the land, ship, aircraft and spacecraft vehicles
- by the KML file format of third-party software, like the Google Earth, Google Maps etc. For description of the file format, refer to the Google Earth documentation.



### Moving vs. motion

All these file formats describe a moving receiver and are suitable for the simulation of a movement from one waypoint to the next.

However, only the more extensive file format \*.xtd is suitable to describe a motion including high dynamics e.g. velocity and attitude. In instruments equipped with the R&S SMBV-K103 option, this file format simulates additionally a body rotation and attitude profile of the receiver's vehicle.

See also [chapter 3.8, "GNSS Extension for Spinning and Attitude Simulation \(R&S SMBV-K103\)"](#), on page 35.

For further information, see Application Note [1GP86 "GPS, Glonass, Galileo, BeiDou Receiver Testing Using a GNSS Signal Simulator"](#).

## 3.5.2 Static Multipath Signal Generation

The instrument provides the possibility to simulate the GNSS signal of one or more satellites that undergoes static multipath propagation effects. The static multipath propagation is implemented as a tapped delay model.

See:

- [chapter 5.9, "Creating Multipath Scenarios"](#), on page 207
- [chapter 4.4.6, "Land Mobile Multipath"](#), on page 76.

## 3.5.3 Configuration of the Atmospheric Parameters

In instruments equipped with the option GNSS enhanced (R&S SMBV-K92), the ionospheric navigation parameters and both ionospheric and tropospheric models of the installed GNSS standards are enabled for configuration.

A possible application of the activation and deactivation of the ionospheric and tropospheric models is to simulate the variation in the pseudorange of the corresponding GNSS satellites. The ionospheric navigation parameters only define what the satellites are transmitting as ionospheric correction parameters whereas the model configuration describes the actual ionospheric and tropospheric models used in the satellite-receiver channel simulation.

## 3.5.4 Time Conversion Configuration

The instrument supports an advanced function for transformation of the GNSS time to the universal time coordinate basis (UTC) and vice versa. The provided GNSS system time conversion parameters are zero-order and first order system clock drift parameters in addition to the current leap second (see [chapter 3.5.5, "Leap Second Simulation"](#), on page 29). The leap second describes the difference between the GPS, Galileo, GLONASS or BeiDou system time and UTC system time. It is for example possible to simulate a system time drift between GPS and Galileo by configuring different time conversion sets for both UTC-GPS and UTC-Galileo conversion parameters.

The time conversion parameters can be either manually configured or fetched from the RINEX header. It is recommended to use the default configurations without system time offset and/or drift.

### 3.5.5 Leap Second Simulation

The instrument enables the simulation of leap second in a straightforward way. The simulation requires only the date and sign of the next leap second, further calculations are performed automatically.

### 3.5.6 Internal Waypoint Resampling

For the simulation of motion and body rotation, the R&S SMBV uses a 100 Hz internal clock. The motion files you load into the instrument may contain waypoints or a combination of waypoints and attitude coordinates with a resolution that is either not constant or different than the internally used one. The R&S SMBV interpolates (resamples) the motion files and transforms the used resolution to the internal resolution of 10 ms.

The internal resampling algorithm is based on the great circle approximation. The instrument resamples the vehicle attitude (yaw/heading, pitch/elevation, roll/bank) parameters linearly in a common reference basis. Depending on the content of the motion file, in particular on the way the velocity is defined, the resampling is performed accordingly.

For more information, see:

- [chapter A.1.1.5, "Resampling Principle"](#), on page 420
- [chapter A.1.1.6, "Calculating the Maximum Time Duration of a Movement File"](#), on page 421.

### 3.5.7 Motion Smoothing Using Vehicle Description File

The selected motion file (e.g. waypoint file) may contain a set of random waypoints, without knowledge about the realistic dynamic. Smoothing is a function that regenerates the motion file based on the specified maximum dynamics (speed, acceleration and jerk) and sampling rate, as they are defined in the vehicle description file \*.xvd.

This approach ensures smoothing of the abrupt changes in the direction or in the velocity of a moving object.

Main characteristics of the smoothing algorithm:

- modified version of linear segment parabolic blend algorithm (LSPB)
- guaranteed continuity in acceleration (limited Jerk) between the waypoints

The smoothing algorithm uses a user-defined proximity parameter to determine:

- the maximum deviation from the user's input waypoints
- the number of inserted waypoints along the great circle

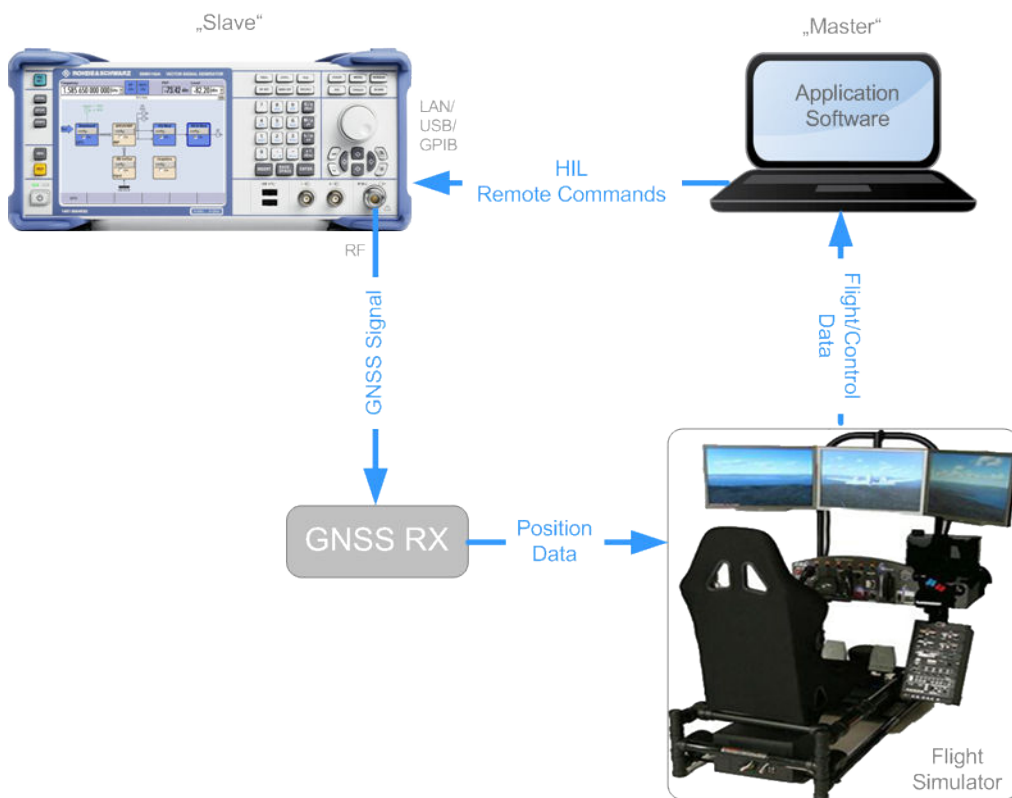
With a proximity value of zero, the motion is formed entirely of straight segments. At any of the specified waypoints, each direction change causes a motion stop.

For description of the file formats, see:

- [chapter A.1.1, "Movement or Motion Files"](#), on page 413
- [chapter A.1.2, "Vehicle Description Files \(Used for Smoothing\)"](#), on page 421.

### 3.5.8 Hardware in the Loop (HIL)

The term Hardware in the Loop (HIL) describes the mode in which the R&S SMBV acts as a slave and is remotely controlled by master application software (see [figure 3-2](#)). The application software sends remote control commands in real time, possibly from a flight simulator. The R&S SMBV processes the received position, motion and attitude information and generates the required signal. The output GNSS signal is provided back to the application or to the flight simulator.



**Fig. 3-2: Example of HIL test setup**

To compensate for system latency, the R&S SMBV applies a prediction algorithm. The instrument uses the high order dynamics of the master application software and predicts the user’s position at the subsequent GNSS signal update time.

The R&S SMBV accepts the real time HIL commands with a varying time resolution up to 100 Hz. If you enable the R&S SMBV to generate a 1PPS marker signal and synchronize the flight simulator to it, the flight simulator sends the real time commands right after 1PPS. This ensures a prediction latency of 10 ms.

For more information, see:

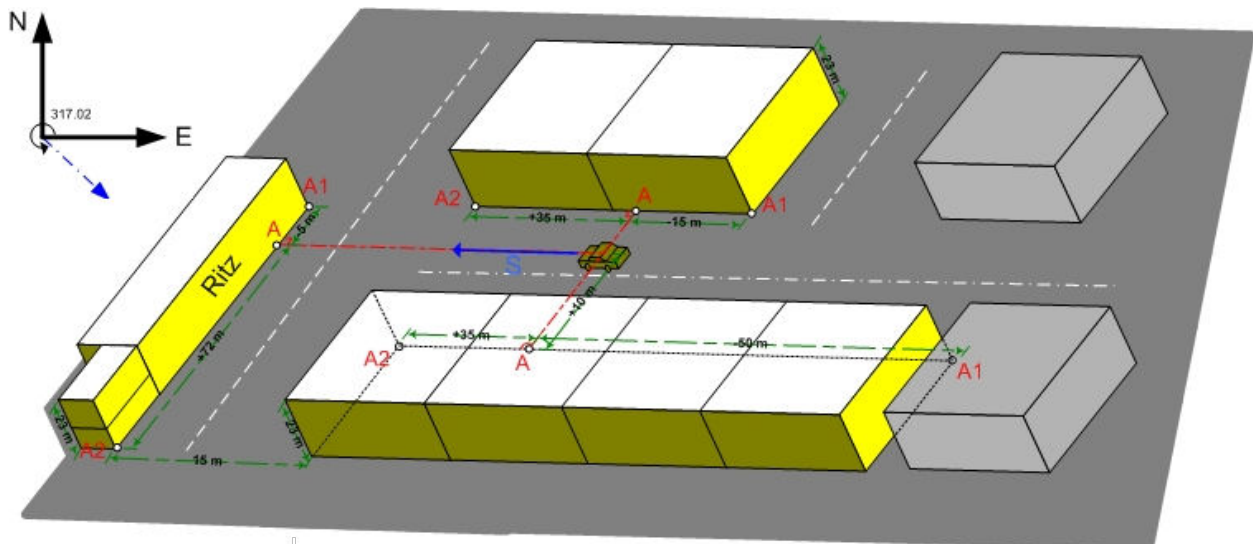
- [chapter 6.8, "Hardware in the Loop \(HIL\)"](#), on page 281
- Application Note [1GP102 "Hardware in the Loop \(HIL\) Testing with a GNSS Simulator"](#).

### 3.6 GNSS Extension for Obscuration Simulation and Automatic Multipath (R&S SMBV-K101)

This option requires one of the basic realtime GNSS options R&S SMBV-K44, R&S SMBV-K66, R&S SMBV-K94 or R&S SMBV-K107. The automatic multipath functionality additionally requires the option R&S SMBV-K92.

In a real-world scenario, a static or a moving receiver may not always receive the signal of all theoretically visible satellites for its current position. In rural or suburban areas, in tunnels or in car parking places, some or more satellites may be partly or completely obscured by a wall or other vertical plane. Receivers experience additionally effects of signal reflection caused by a water surfaces (e.g. the sea) or the ground. This option enhances the basic GNSS options to automatically simulate different obscuration and multipath effects caused for example from surrounding buildings in static or moving scenarios, e.g. urban canyon.

The [figure 3-3](#) is an example of a receiver placed in a car driving on a street. The combination option R&S SMBV-K101/-K92, allows you to define any test scenario, including the particular moving behavior and surrounding buildings with their height and the distance to the receiver, as well as the material they are built from.



**Fig. 3-3: Example: Vertical obstacles for simulation of obscuration and multipath from surrounding buildings**

### Approaches in the different simulation modes

In "User Localization" mode, the simulated user's environment conditions and effects are applied on the user defined subset of satellites.

In "Auto Localization" mode, the optimal satellites constellation is selected based on the enabled "Maximum Number of Satellites" and configured "Evaluation Mask". A line-of-sight propagation (LOS view) is assumed in the first stage and the satellites constellation is selected to minimize the HDOP/PDOP. Only now, the selected constellation is filtered by simulating the "user environment" model's obscuration and multipath effects on the satellite constellation. The satellite constellation is constantly proved and a satellite handover is performed automatically, whenever a new satellite appears or because of the receiver's movement profile, a satellite is not any more obscured.



To simulate a real-life scenario, it is recommended that you enable a hybrid GNSS simulation with 24 satellites. Refer to the corresponding description for an overview of all required options.

See [chapter 5.15, "Creating GNSS Scenarios in a User Environment"](#), on page 216.

### Internal sampling rate

The R&S SMBV samples the user's environment different, depending whether only obscuration or the combination of obscuration and automatic multipath is simulated. For example, the sampling rate of the model "Urban canyon" is 10 Hz if only obscuration is enabled and 5 Hz in the other case.



### Error Message: Cut in the scenario dynamics

If a multipath scenario requires more than the maximum available channel budget, the instrument cuts the scenario dynamics.

See also [chapter A.5, "Channel Budget"](#), on page 436.

For more information, see Application Note [1GP101 "Simulating Automatic Obscuration and Multipath for Realistic GNSS Receiver Testing"](#).

## 3.7 GNSS Extension for Antenna Pattern (R&S SMBV-K102)

This option requires one of the basic realtime GNSS options R&S SMBV-K44, R&S SMBV-K66, R&S SMBV-K94 or R&S SMBV-K107.

This option enhances the basic options with the definition of different antenna patterns, body masks and the simulation of real-life scenarios, like a GNSS antenna placed in a car (see [table 3-3](#)). The instrument provides an interface for loading and creating user-defined antenna patterns. The antenna patterns have to be defined in files with predefined file format and file extension \*.ant\_pat (see [chapter A.1.3, "Antenna Pattern / Body Mask Files"](#), on page 423).

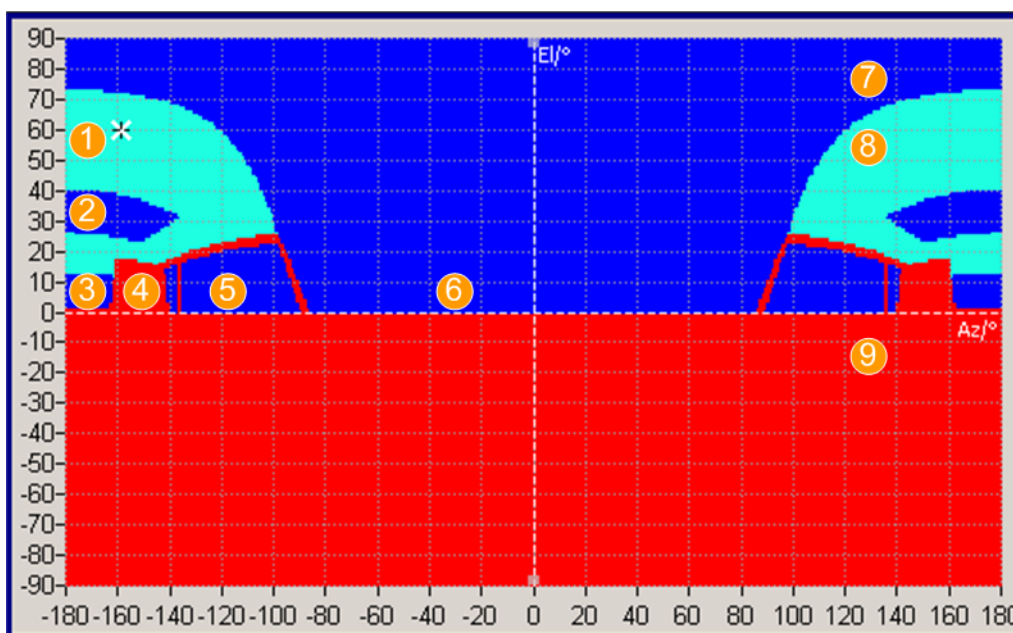


### Antenna pattern and body mask model

When the required options are installed, you will find a subset of predefined antenna pattern files of some generic vehicular models. The body mask models are simplified general model based on the following assumptions:

- All surfaces of the vehicle body are considered as planes
- Ground reflection are not considered for land vehicles; described is only the top body of a car, the part from the window to the roof
- The receiver is placed at the central vertical plane

A body mask is basically a table with rows of elevation angles from  $+90^\circ$  to  $-90^\circ$  and columns of azimuth from  $-180^\circ$  to  $+180^\circ$ . Each table element gives the signal power attenuation in dB of the incident signal. The predefined body masks have up to three regions: pass, attenuated pass and non-pass (see [figure 3-4](#)).



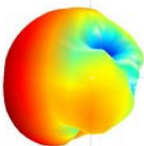
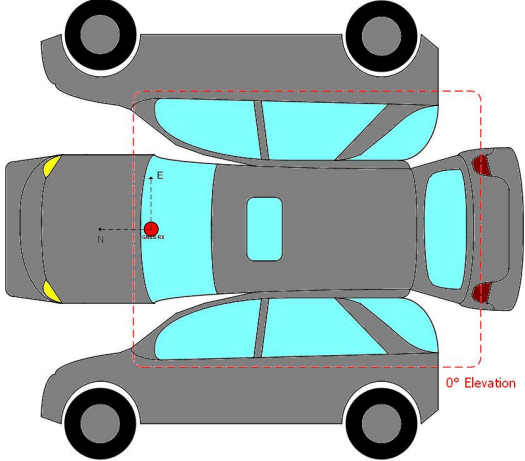
**Fig. 3-4: Antenna mask for medium sized car with roof-top (Azimuth  $-180^\circ$  to  $+180^\circ$ )**

- 1 = Roof
- 2 = Roof window
- 3 = Back window
- 4 = Seat
- 5 = Side window
- 6 = Front window
- 7 = Pass region (dark blue color): the incident signal is not attenuated and the table elements are set to 0 dB
- 8 = Attenuated pass region (light blue color): the incident signal is attenuated but not fully blocked; the table elements are set to 15 dB.
- 9 = Non-pass region (red color): the incident signal is heavily blocked and the table elements are set to 40 dB

The predefined body masks can be changed subsequently, see:

- [chapter 5.17, "Creating and Modifying Antenna Patterns and Body Masks"](#), on page 224
- [chapter 4.5, "Antenna Pattern/Body Mask Settings"](#), on page 80

Table 3-3: Example: Power response matrix due to a car's body mask (Antenna mask for medium sized car with roof-top)

Power and phase profile of an antenna	Car body mask	Power response matrix of the antenna (* .ant_pat file)
		<p>see <a href="#">figure 3-4</a></p>

**Possible application fields**

This option enables you to automatically simulate satellite power and carrier phase depending on the antenna pattern and the attitude parameters.

- Automotive applications  
The provided attitude parameters can forced to the motion direction, i.e. they are automatically extracted from the user-defined motion vector.
- Body mask applications  
Two files describe an antenna, the antenna pattern `*.ant_pat` file and the phase response `*.phase` file.  
Both files must have the same file name and must be stored in the same directory. The `*.ant_pat` file describes the power response matrix of each antenna. The instrument retrieves the phase response matrix from the `*.phase` file.  
If the required `*.phase` file does not exist, the instrument sets the carrier phase matrix to zero.
- Outdoor scenarios  
If the instrument is equipped with both options R&S SMBV-K101/-K102, the antenna pattern is applied on reflections from the defined user environment, e.g roadside plane.
- Indoor absorption scenarios  
The provided antenna pattern can be used to simulate the signal absorption as well as the carrier phase bias from every angle around a GNSS receiver.

The provided `*.ant_pat` file format enables you to define up to four antennas per vehicle and to perform antenna switching trough real time scheduling (see `<subsystem>:APATtern:ANTenna:ID`).

The resolution of the antenna pattern power response and carrier phase offsets is up to 1° for both, the elevation and azimuth.



You can also load antenna patterns measured by some over-the-air (OTA) measurements, e.g the R&S®DST200 RF Diagnostic Chamber.

See also:

- [chapter 5.16, "Visualizing the Effect of an Antenna Pattern"](#), on page 221

### 3.8 GNSS Extension for Spinning and Attitude Simulation (R&S SMBV-K103)

This option requires the GNSS option R&S SMBV-K102.

This option allows you to configure a vehicle attitude or the body rotation parameters yaw, pitch, and roll. The R&S SMBV calculates the power and the carrier phase response of a specific satellite or a multipath reflection at a specific angle of arrival (AoA). The calculation is based on the defined attitude profile and the selected antenna pattern. The firmware updates the powers and carrier phase offsets of all satellite signals in real time and with an update rate of 800 Hz.

In a real-world scenario, a receiver placed in an airplane may not always receive the signal of all theoretically visible satellites at its current position. Depending on the orientation of the vehicle, several satellites may be partly or completely obscured. The orientation of the vehicle is described with the three flight dynamics parameters, the yaw (heading), pitch (elevation) and roll (bank), see [figure 3-5](#). With enabled spinning, the instrument additionally simulates a constant rate of change of the roll.

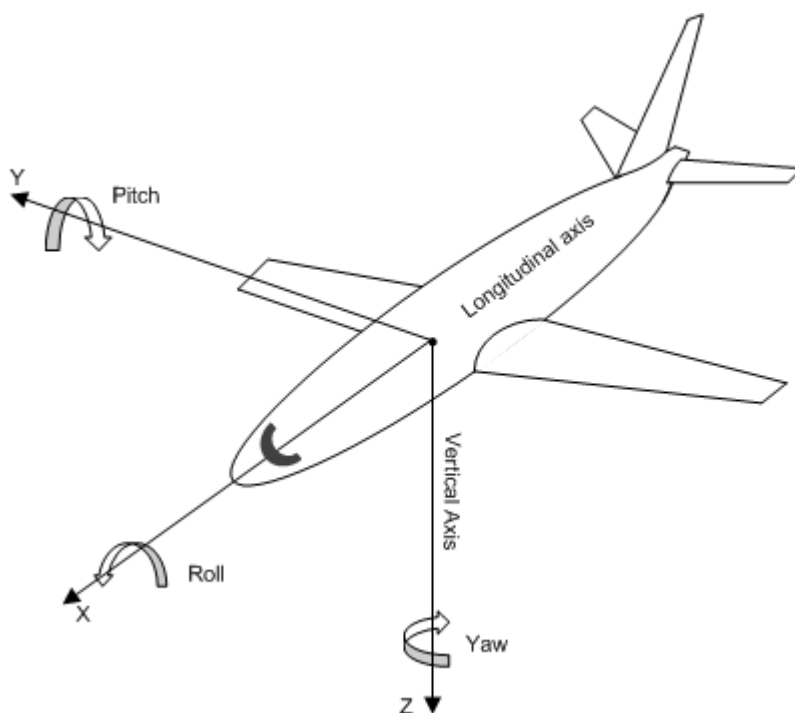


Fig. 3-5: Flight dynamics parameters: yaw/heading, pitch/elevation and roll/bank

See:

- [chapter 5.16, "Visualizing the Effect of an Antenna Pattern"](#), on page 221
- [chapter 4.3, "Localization Data Settings"](#), on page 57

### 3.9 Functional Overview of Option Differential GPS (R&S SMBV-K110)

This option enhances the basic options R&S SMBV-K44 with the following functionality:

- file conversion tool to:
  - load and convert \*.ems or \*.nstrb files and extract SBAS message files
  - extract GPS almanac and RINEX file out of them
  - merge RINEX and Ionospheric files

See:

- [chapter 3.9.1, "File Conversion Tool"](#), on page 37
- [chapter 4.8, "File Conversion Tool Settings"](#), on page 88
- Configuration and generation of SBAS message files, as specified in [RTCA MOPS DO-229](#).
 

See:

  - [chapter 3.9.2, "SBAS Configuration"](#), on page 38
  - [chapter 4.9, "SBAS Configuration Settings"](#), on page 90

- Functions for simulation accuracy improvement and SV perturbations and errors simulation  
See:
  - [chapter 3.9.3, "Improving the Simulation Accuracy and Simulation of SV Perturbation and Errors"](#), on page 40
  - ["Simulation Accuracy"](#) on page 56
  - [chapter 5.20, "Simulating SV Perturbations and Errors"](#), on page 236

### 3.9.1 File Conversion Tool

The file conversion tool is an interface, that helps you convert `*.nstb` or `*.ems` files into SBAS message files in the Rohde & Schwarz proprietary XML format. SBAS message files created in this way can be subsequently loaded and used in the "SBAS Configuration" dialog, see ["SBAS message files"](#) on page 38.

You can also load the downloaded `*.nstb` or `*.ems` files raw format, i.e. without having converted them, in the R&S SMBV. See [chapter 4.9.14, "EGNOS and WAAS Navigation Data as Raw Files"](#), on page 112.

#### EMS files

The `*.ems` files are files with augmentation messages broadcast by EGNOS.

You can find files in this format at the EGNOS Message Server (EMS):

<http://www.egnosc-pro.esa.int/ems/index.html>.

The provided files are hierarchy grouped per PRN (PRN#), per year (y#), per day (d#) and per hour (h#); that is each EMS file contains information on one PRN for the time span of 1 hour.

Correction data is extracted from one of the loaded files; the exact PRN is configurable.

#### NSTB files

The `*.nstb` files are files with augmentation messages broadcast by WAAS.

You can find files in this format at the Federal Aviation Administration page:

<http://www.nstb.tc.faa.gov/DisplayNSTBDataDownload.htm>.

Provided are files from different control stations. The files are grouped per day, where each file contains information on several PRNs for the time span of 24 hours.

The downloaded files do not have an extension; the extension `*.nstb` should be added manually.

See:

- [chapter 4.8, "File Conversion Tool Settings"](#), on page 88
- [chapter 5.18, "Using the File Conversion Tool"](#), on page 228

### 3.9.2 SBAS Configuration

A short introduction to the Satellite-based Augmentation System (SBAS) is provided in "[Brief introduction to the global navigation satellite systems \(GNSS\)](#)" on page 15. This section gives an overview of the provided features.

The SBAS uses three types of services to improve augmentation:

- transmission of ranging information for improved *visibility*
- broadcast of correction data (error estimations) for improved *accuracy*
- broadcast of coarse integrity information for improved *reliability*

The SBAS specification [RTCA MOPS DO-229](#) defines different message types, that carry these coarse integrity or both integrity and wide area correction data information. The correction data itself can be fast, long-term and ionospheric, where:

- the fast corrections eliminate pseudorange errors
- the long-term corrections overcome errors in the satellites position or slow changing clock and ephemeris errors
- the ionospheric corrections are based on the user location

In this implementation, there are two ways to define the content of the generated SBAS signal:

- by defining the content of the SBAS message files  
see "[SBAS message files](#)" on page 38
- by loading of raw `*.nstb` or `*.ems` files  
see
  - [chapter 4.9.14, "EGNOS and WAAS Navigation Data as Raw Files"](#), on page 112
  - [chapter 3.9.1, "File Conversion Tool"](#), on page 37

#### SBAS message files

In this implementation, there are eight SBAS message files, an Almanac and a Rinex file per SBAS regional system.

A subset of predefined SBAS message files is delivered with the firmware. You can create suitable SBAS files manually, by editing the XML files in any text editor, or you can load `*.nstb` or `*.ems` files and convert them into the required SBAS message file format.

See:

- [chapter A.4, "SBAS Message Files Format"](#), on page 430
- [chapter 3.9.1, "File Conversion Tool"](#), on page 37

When using the SBAS message files mode, the SBAS information is not defined on a message by message basis but grouped according to the SBAS service and correction data type. The [table 3-4](#) list the SBAS message type with brief information on their content and information on the section, describing the related settings.

**Table 3-4: SBAS message types (MT)**

MT	Content	Related settings
1	PRN Masks assailments	<a href="#">chapter 4.9.7, "Fast Correction File Configuration", on page 102</a> <a href="#">chapter 4.9.8, "Long Term Correction File Configuration", on page 104</a> <a href="#">chapter 4.9.6, "PRN Mask File Configuration", on page 101</a>
2 to 5	Fast corrections	<a href="#">chapter 4.9.7, "Fast Correction File Configuration", on page 102</a>
6	Integrity information	not supported
7	Fast correction degradation factor	<a href="#">chapter 4.9.9, "Fast Correction Degradation Factor Configuration", on page 105</a>
9	GEO navigation message	<a href="#">chapter 4.9.4, "Rinex File Configuration", on page 98</a>
10	Degradation parameters	<a href="#">chapter 4.9.12, "Degradation Factors Configuration", on page 109</a>
12	SBAS network time, UTC offset parameters	<a href="#">chapter 4.9.4, "Rinex File Configuration", on page 98</a> <a href="#">chapter 4.6, "Time Conversion Configuration Settings", on page 83</a>
17	GEO satellites almanacs	<a href="#">chapter 4.9.4, "Rinex File Configuration", on page 98</a>
18	Ionospheric grid point mask	<a href="#">chapter 4.9.5, "Ionospheric Grid File Configuration", on page 99</a>
24	Mixed fast and log-term correction data	not supported
25	Long-term satellite error correction data	<a href="#">chapter 4.9.8, "Long Term Correction File Configuration", on page 104</a>
26	Ionospheric delay corrections	<a href="#">chapter 4.9.5, "Ionospheric Grid File Configuration", on page 99</a>
27	SBAS service message	<a href="#">chapter 4.9.11, "Service Configuration", on page 107</a>
28	Clock-Ephemeris Covariance Matrix Message	<a href="#">chapter 4.9.10, "Clock-Ephemeris Covariance Matrix Configuration", on page 107</a>
8 11 13 to 16 19 to 23 29 to 61	reserved	- (not simulated)
0 62 63	for SBAS testing only initial test message Null message	- (In this simulation, this message is filled in with empty time slots depending on the transmit period values selected for the other message types)

The SBAS messages are scheduled according to a user-defined period (see "[SBAS message files table](#)" on page 92). The default values reflect the time outs specified in the specification RTCA MOPS DO-229.

See:

- [chapter 4.9, "SBAS Configuration Settings"](#), on page 90
- [chapter 5.19, "Using the SBAS Settings"](#), on page 232

### 3.9.3 Improving the Simulation Accuracy and Simulation of SV Perturbation and Errors

In this implementation, you can use the following functions to improve the simulation accuracy:

- Synchronizes the IODE and URA parameters of the navigation message to the values retrieved from the SBAS fast and long term correction files
- Synchronizes the atmospheric delays to the values retrieved from the SBAS ionospheric correction data
- Synchronizes the satellite biases (pseudorange biases, clock biases and satellite position errors) of each PRN to the values retrieved from the SBAS fast correction data.

#### Biases and corrections

If the functions for improved accuracy are used, the following corrections are applied automatically:

- $\Delta I_{iono_{SV}}$   
vertical delay values, depending on the used "Ionospheric Model" (e.g. none, Klobuchar, NeQuick, MOPS-DO-229D)
- $\Delta T_{tropo_{SV}}$   
corrections, depending on the used "Tropospheric Model" (e.g. none, STANAG, MOPS-DO-229D)
- $\Delta \rho_{SV} = \Delta \rho_{Fast\_corrections}$   
pseudorange bias corrections are the pseudorange corrections retrieved from the SBAS fast correction data ("PRC")
- $\Delta t_{SV} = \Delta t_{clk} + \Delta t_{LT\_corrections}$   
clock corrections calculated as the sum of the clock bias broadcasted by the SV itself ( $\Delta t_{clk}$ ) and the corrections  $\Delta t_{LT\_corrections}$  retrieved from the SBAS long term correction data ("δaf0", "δaf1")
- $\Delta x_{LT\_corrections}$ ,  $\Delta y_{LT\_corrections}$ ,  $\Delta z_{LT\_corrections}$   
i.e. correction information on the GEO satellite location retrieved from the SBAS long term correction data ("δx/δy/δz")

These corrections are used for the pseudorange and range calculations.

#### Pseudorange calculation

The pseudorange  $\tau_{SV}$  is a function of the range  $\rho_{SV}$  and the corrections:



$$T_{SV} = \rho_{SV} + \Delta\rho_{SV} + \Delta Iono_{SV} + \Delta Tropo_{SV} - \Delta t_{SV}$$

Where the range  $\rho_{SV}$  is:

$$\rho_{SV} = \sqrt{[(x_{RX} - x_{SV})^2 + (y_{RX} - y_{SV})^2 + (z_{RX} - z_{SV})^2]}$$

The SV position ( $x_{SV}$ ,  $y_{SV}$ ,  $z_{SV}$ ) is the sum of the ephemeris position ( $x_{eph}$ ,  $y_{eph}$ ,  $z_{eph}$ ) and the long term corrections ( $\Delta x_{LT\_corrections}$ ,  $\Delta y_{LT\_corrections}$ ,  $\Delta z_{LT\_corrections}$ ), for example

$$x_{SV} = x_{eph} + \Delta x_{LT\_corrections}$$



### Impact of enabled simulation accuracy features on the logged data

With enabled [Simulation Accuracy](#) functions, the pseudorange, satellites and receiver position values are automatically corrected.

If data logging is used, the logged values include the corrections. The logged data may deviate from the expected not corrected parameters.

Related settings:

- ["Simulation Accuracy"](#) on page 56
- [chapter 4.9.7, "Fast Correction File Configuration"](#), on page 102
- [chapter 4.9.8, "Long Term Correction File Configuration"](#), on page 104
- [chapter 4.11, "Atmospheric Configuration Settings"](#), on page 154
- [chapter 4.13, "Data Logging Settings"](#), on page 170

### Perturbations and errors simulation

The simulation accuracy functions, together with some additional settings, can also be used to simulate perturbation and errors in the channel between the GNSS receiver and the satellite.

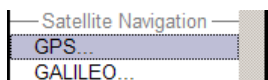
For more information, see [chapter 5.20, "Simulating SV Perturbations and Errors"](#), on page 236.

## 4 GNSS Configuration and Settings



- The instrument may be equipped with different satellite navigation options. To access the available satellite standards, select "Baseband block > Satellite Navigation" and select the desired satellite standard, e.g. GPS. To simplify the description, the selected satellite standard is referred as an "entry standard".
- Since most of the parameters provided for configuration are similar and do not depend on the entry standard, this description uses the SW option GPS/A-GPS (R&S SMBV-K44/-K65) and the GNSS global options R&S SMBV-K91/-K92/-K96 (Extension to 12 and 24 Satellites/GNSS Enhancements) as a reference. Satellite standard dependent settings are described separately or the differences are explicitly stated.

### 4.1 GNSS Main Dialog

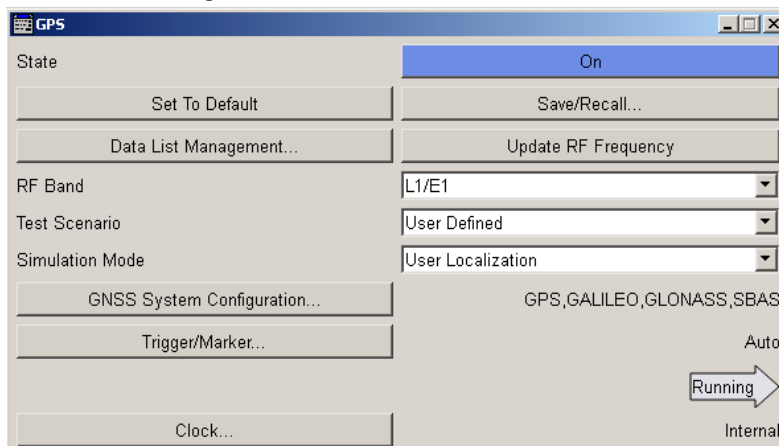


To access the available satellite standards:

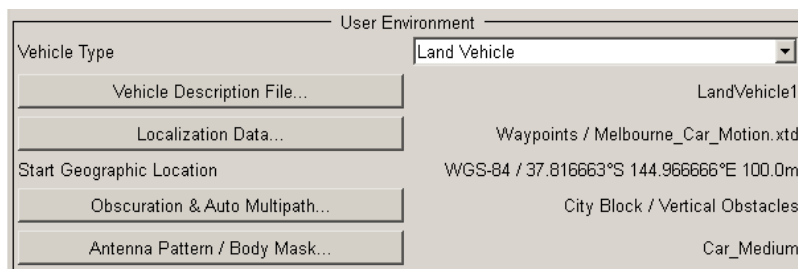
- ▶ Select "Baseband > Satellite Navigation" and select the desired satellite standard, e.g. "GPS".

The dialog is split into several sections.

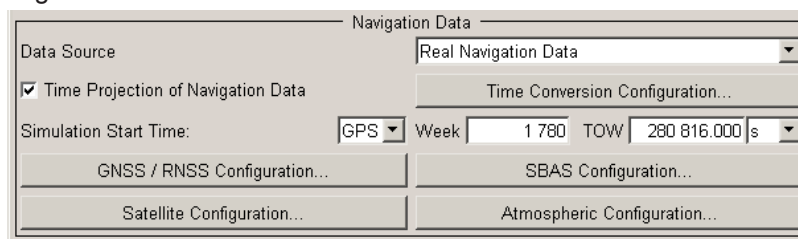
- The upper section of the dialog is where you enable the GNSS digital standard, call the default settings and select the simulation mode.



- In the real-time solution, the "User Environment" section comprises the settings of the satellite signals, the vehicle type and the obscuration and enabled antenna.



- The "Navigation Data" section comprises the navigation data source settings, the settings for configuring the satellite signals and the atmospheric configuration settings.



- Additionally, you can access the settings for generating assistance data and displaying the "Real-Time S.P.O.T." and configuring the "Data Logging".



The remote commands required to define these settings are described in [chapter 6, "Remote-Control Commands"](#), on page 245.

- [General Settings for GNSS Simulation](#)..... 43
- [User Environment](#)..... 48
- [Navigation Data](#)..... 50
- [Advanced Configuration](#)..... 54

### 4.1.1 General Settings for GNSS Simulation

To access these settings:

- ▶ Select "Baseband > Satellite Navigation > GPS".

The provided settings enable you to perform general configurations, like to set the default settings or access further dialogs.

#### State

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

A continuous GNSS signal is generated for up to 24 satellites in real time mode. The maximum number is determined by the parameter [Maximum Number of Satellites](#) and the maximum value depends on the installed SW options.

**Note:** Enabling the standard sets automatically the "Frequency" and "Level" displayed in the header of the instrument according to the selected settings, e.g. "RF Band" and "Total Power" at the simulation start time!

Remote command:

`<subsystem>:STATe` on page 249

### Set to default

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

**Note:** Use [Update RF Frequency](#) function to preset the RF Frequency and level.

Parameter	Value
State	Not affected by "Set to default"
RF Band	L1/E1
Simulation Mode	Static
Almanac	GPS_SEM678.txt/GAL_Yuma678.txt/GLO_678.agl/Beidou_Yuma678.txt
Data Source	PRBS9
System Time	Time basis of the entry standard
GNSS System Configuration	GPS only, Galileo only, GLONASS only or BeiDou only (depending on the entry standard)
<b>Satellite configuration</b>	
Maximum Number of Satellites	1
State satellite 1	On
Standard	GPS, Galileo, GLONASS or BeiDou (depending on the entry standard)
Signal	C/A, E1-DEF, R-C/A or B1-C/A (depending on the entry standard)

Remote command:

`<subsystem>:PRESet` on page 248

### 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.

The following file extension are used: \*.gps, \*.galileo, \*.glonass respectively.

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.

Remote command:

[ :SOURce<hw> ] :BB:GPS:SETTing:CATalog? on page 252  
 [ :SOURce<hw> ] :BB:GALileo:SETTing:CATalog? on page 252  
 <subsystem>:SETTing:STORe on page 252  
 <subsystem>:SETTing:STORe:FAST on page 252  
 <subsystem>:SETTing:LOAD on page 253  
 <subsystem>:SETTing:DELeTe on page 253

### Data List Management

Accesses the "Data List Management" dialog used to create and edit data lists.

All data lists are stored as files with the predefined file extension \*.dm\_iqd. The file name and the directory they are stored in are user-definable.

**Note:** All data lists are generated and edited by means of the SOURCE:BB:DM subsystem commands. Files containing data lists usually end with \*.dm\_iqd. The data lists are selected as a data source for a specific function in the individual subsystems of the digital standard.

### Update RF Frequency

Sets the "Status Bar > Frequency" display to the resulting frequency. The RF Frequency is calculated automatically depending on the selected RF Band, on the entry standard and on the enabled navigation standards.

**Note:** RF Frequency vs RF Band.

- For navigation standards with overlapping carrier frequencies, e.g. GPS and Galileo in the L1/E1 upper RNSS band, the RF frequency is the carrier frequency L1 = E1 = 1.57542 GHz.  
See also [figure 3-1](#)
- For navigation standards with different RF Frequencies, e.g. GPS and GLONASS in the L1/E1 upper RNSS band, the resulting RF frequency is located between the GPS L1 and the GLONASS L1 frequency.

Remote command:

<subsystem>:PRFFrequency on page 249

### RF Band

Determines the RF band, i.e. the upper or lower RNSS band.

The different satellites will be modulated on their corresponding standard carrier frequencies.

See [table 4-1](#)).

**Table 4-1: Carrier frequencies**

Navigation Standard	"RF Band"	Carrier Frequency, GHz	Required SW Option
GPS	L1	1.57542	R&S SMBV-K44
	L2	1.2276	
GALILEO	E1	1.57542	R&S SMBV-K66

Navigation Standard	"RF Band"	Carrier Frequency, GHz	Required SW Option
GLONASS	L1	1.602	R&S SMBV-K94
	L2	1.246	
BeiDou	L1	1.561098	R&S SMBV-K107

Remote command:

`<subsystem>:RFBand` on page 249

### Test Scenario

Selects a predefined A-GPS/A-GLONASS/A-GNSS test scenario (see [chapter 3.3.2, "Full Set of Pre-defined Test Scenarios as Basis for A-GPS/A-GLONASS/A-GNSS Protocol and Conformance Test Cases"](#), on page 25 for an overview).

The available test scenarios depend on the installed SW options. The A-GNSS test cases require hybrid GNSS configuration (see ["Activate Systems"](#) on page 55).

All parameters (simulated position, satellite configuration, Almanac, navigation data, etc.) will be set according to the selected test scenario.

The selection "User Defined" enables the configuration of all parameters.

Remote command:

`[ :SOURCE<hw> ] :BB:GPS:ATSCenario` on page 250

`[ :SOURCE<hw> ] :BB:GLONass:ATSCenario` on page 251

### Simulation Mode

Sets the simulation mode.

**Note:** Refer to [table 3-1](#) for an overview of the supported functionality per simulation mode. Some functionality require additional options.

"Static"            The satellite signals are configured by the user.  
See also [chapter 5.1, "Generating a GNSS Signal for Simple Receiver Tests \(Static Mode\)"](#), on page 202

### "Auto Localization"

The satellite signals are configured corresponding to a 'real' user defined location.

Four satellites will be selected depending on the selected almanac. For instruments equipped with option R&S SMBV-K91/-K96, the number of configurable satellites is extended to 12 resp. 24. The number of configurable satellites is adjusted with the parameter [Maximum Number of Satellites](#).

In this localization mode, a new satellite will be exchanged in real-time with a current one as soon as the elevation of the latter is less than the selected [Elevation Mask](#) or a new satellite constellation with better PDOP is found.

The ephemeris are extracted from the almanac and displayed in the [Navigation Message Configuration](#) dialog. The ephemeris data of all satellites are updated automatically and projected automatically to ensure that the age of the ephemeris is within the allowed time span. Whenever a new almanac is selected, the start time of the simulation will be set to the almanac's TOA (Time of Application).

See also [chapter 5.2, "Generating a GNSS Signal with Automatic Dynamic Exchange of the Satellites \(Auto Localization Mode\)"](#), on page 202.

### "User Localization"

User localization mode enables the configuration of the satellites constellation at the beginning of the simulation and editing it in real-time, i.e. satellites can be enabled or disabled in real-time and without interruption of the signal generation.

For instruments equipped with assistance option (e.g. R&S SMBV-K65/-K95/-K67), this mode additionally enables the configuration of all parameter of the [Navigation Message](#), the generation of assistance data and the loading of RINEX files.

This mode is useful for the generation of A-GNSS test signals different than the standardized ones.

See also [chapter 5.5, "Generating A-GPS Custom Build Scenarios \(User Localization Mode\)"](#), on page 204.

Remote command:

`<subsystem>:SMODE` on page 250

### GNSS System Configuration

Opens the [GNSS System Configuration Settings](#) dialog for defining the GNSS system configuration and selecting the almanac/RINEX files per navigation standards. If a hybrid GNSS configuration is enabled, the name of the selected GNSS navigation standard is displayed next to the button.

### Trigger/Marker, Marker

Accesses the dialog for selecting the trigger source, for setting the time delay of an external trigger signal and for configuring the marker signals (see [chapter 4.15, "Trigger/Marker/Clock Settings"](#), on page 191).

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

Remote command:  
n . a .

**Arm**

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

Remote command:  
<subsystem>:TRIGger:ARM:EXECute on page 404

**Execute Trigger**

For internal trigger source, executes trigger manually.

Remote command:  
<subsystem>:TRIGger:EXECute on page 405

**Clock**

Accesses the dialog for selecting the clock source and for setting a delay (see [chapter 4.15, "Trigger/Marker/Clock Settings"](#), on page 191).

Remote command:  
n . a .

**4.1.2 User Environment**

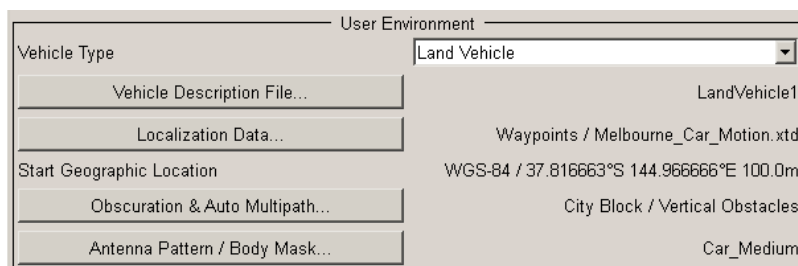
The propagation channel between a GNSS satellite and an user is split into three environment characteristics:

- Satellite Configuration (orbit and satellite clock errors)
- Atmospheric Configuration (Ionosphere, troposphere)
- User Environment or near user environment (Environment model e.g. Urban canyon, vehicle type, vehicle’s aerodynamics, vehicle’s motion and attitude as well as antenna pattern)

With the "User Environment" parameters you can configure the near field parameters.

To access this settings:

1. Select "Baseband > Satellite Navigation > GPS".
2. Select "Simulation Mode > Auto Localization/User Localization".
3. Navigate to "User Environment".





**Vehicle Type**

Sets the vehicle type, e.g. "Pedestrian", "Land Vehicle", "Ship", "Aircraft", "Spacecraft", "HIL (Hardware in the Loop)".

The selected vehicle type determines:

- the GNSS application e.g. automotive with "Pedestrian" and "Land Vehicle"
- the main elements of the vehicle as vehicle description file, localization data, Obscuration and Multipath models and antenna pattern/body mask.

When changing the selected vehicle type, a corresponding predefined vehicle description files as well as motion files (if necessary) are selected in order to ensure that the simulated receiver motion maps to the vehicle type and the particular application, e.g. aeronautics with "Aircraft".

**"Aircraft/Spacecraft"**

A vehicle motion profile is pre-selected. Simulation with a static location simulation is not possible.

**"HIL (Hardware in the Loop)"**

There are no predefined files available.

The instrument expects the vehicle's motion and attitude coordinates in real time from for example an external application software (see [figure 3-2](#)).

Smoothing is not possible.

Remote command:

`<subsystem>:VEHicle:TYPE` on page 257

**Vehicle Description File**

Provides an access to the standard "File Select" dialog to select a user defined vehicle description file. The vehicle description files are files with extension `*.xvd` and predefined file format, see [chapter A.1.2, "Vehicle Description Files \(Used for Smoothing\)"](#), on page 421. The `*.xvd` files include the limits on the vehicle's dynamics.

The firmware provides some predefined vehicle description files. These files are stored at a predefined system directory.

If a file is selected, the name of the selected file is displayed.

Remote command:

`<subsystem>:VEHicle:CATalog:USER?` on page 257

`<subsystem>:VEHicle:CATalog:PREDefined?` on page 256

`<subsystem>:VEHicle:FILE` on page 257

**Localization Data**

Access to the dialog with setting to configure a 'real' static or moving geographic location, see [chapter 4.3, "Localization Data Settings"](#), on page 57.

A summary information on the selected location is displayed.

**(Start) Geographic Location**

Displays the coordinates of the static geographic location or the coordinates of the start geographic location as defined in the selected waypoint/attitude file.

See also ["Location Coordinates"](#) on page 60 and ["Waypoint/Attitude File ..."](#) on page 59.

**Obscuration and Auto Multipath**

Available in instruments equipped with option R&S SMBV-K101 and enabled "Auto Localization" or "User Localization" mode.

Accesses the dialog to define the near environmental model, see [chapter 4.4, "Obscuration and Auto Multipath Settings"](#), on page 62.

A summary information on the enabled settings is displayed.

**Antenna Pattern/Body Mask**

For instruments equipped with R&S SMBV-K102, accesses the "Antenna Pattern/Body Mask" dialog.

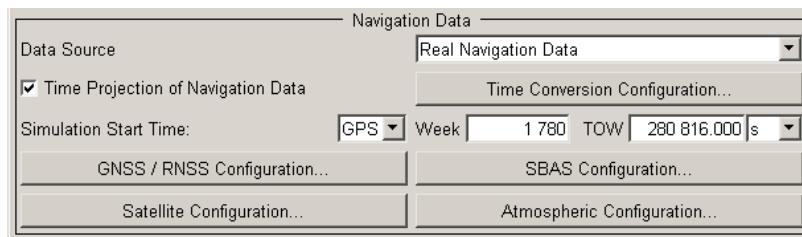
See [chapter 4.5, "Antenna Pattern/Body Mask Settings"](#), on page 80.

The name of the current antenna pattern file is displayed.

**4.1.3 Navigation Data**

- ▶ To access these settings, select "GNSS Main Dialog > Navigation Data"

With the provided settings you can define the data source for navigation information.



[Data Source](#)..... 50

[Time Projection of Navigation Data](#).....52

[Time Conversion Configuration](#).....52

[Simulation Start Time](#).....52

[GNSS/RNSS Configuration](#).....53

[SBAS Configuration](#).....53

[Satellite Configuration](#).....53

[Atmospheric Configuration](#).....53

**Data Source**

Selects data source for the navigation information.

Navigation data is essential for calculating the positions of the satellites. It also contains the information about the currently valid space vehicle IDs.

**"Real Navigation Data"**

This value is pre-selected in "Auto Localization" and "User Localization" mode and no other data source can be selected.

You can download Almanac files ("Real Navigation Data") from the internet and store them on the hard disk of your instrument. If required, re-configure manually these downloaded files.

If you work in "User Localization" mode, you can also use RINEX files.

Neither almanac nor RINEX files for Galileo and BeiDou are available. To simulate the movement of Galileo and BeiDou satellites on their designed orbits, you will find predicted almanacs and RINEX files provided with this software.

Use the [Almanac Configuration](#) parameter to select the almanac file per navigation standard.

**"PRBSxx/Data List/Pattern"**

Arbitrary data is available in "Static" mode and suitable for basic tests on the GNSS signals.

Signals generated in this way can be recognized by a GPS receiver. However, since there is no real navigation data modulated with the GNSS spreading code, only the signal level of the simulated satellite(s) as carrier to noise ratio can be measured and displayed by the receiver (sensitivity test).

A signal of this type is sufficient for performing simple function tests.

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".

**Remote command:**

`<subsystem>:NAVigation:DATA` on page 266

`<subsystem>:NAVigation:DATA:DSElect` on page 267

`<subsystem>:NAVigation:DATA:PATtern` on page 267

### Time Projection of Navigation Data

Forces ephemeris and almanac projection for all satellites.

Enable this parameter to simulate any past or future simulation dates with the same almanac file. That is, if the simulation date and time are outside the time span of the selected almanac file, the almanac data is projected.

If this parameter is enabled:

- the parameter "Sat# > Navigation Message Configuration > [Real-Time Projection](#)" is enabled automatically for all satellites;
- the software ignores the date entry in the SBAS files and repeats the SBAS data daily, i.e. it uses the same SV and ionospheric corrections for each simulated day. You recognize that this mode is activated if there is no date indication in the SBAS message dialogs.

It is recommended that the used files contain a time span of 24 hours.

See also:

- [chapter 4.9.2, "Timing Setting"](#), on page 94
- ["To load and convert EMS files"](#) on page 228

**Note:** If assistance data will be generated, select "Time Projection of Navigation Data > Off".

Remote command:

`<subsystem>:SATellite:GRTProjection` on page 316

### Time Conversion Configuration

Opens the [Time Conversion Configuration Settings](#) dialog.

### Simulation Start Time

Sets the simulation start time in the format of the selected "Time Basis".

"Time Basis" Per default, the time basis of the entry standard is used but the user may choose or switch to a different time basis at any time. The time is then automatically recalculated and displayed in the selected time format.

**Note:** Use the [Time Conversion Configuration Settings](#) dialog to configure the parameters, necessary for time conversion between the navigation's standard proprietary time and the UTC.

Remote command:

`<subsystem>:NAVigation:SIMulation:TBASis` on page 267

"Date [dd.mm.yyyy], Time [hh:mm:ss:xxx]"

(enabled for "Data Source > Real Navigation Data" and "Time Basis > UTC/GLO")

Enters the date for the simulation in DD.MM.YYYY format of the Gregorian calendar and the exact simulation start time in UTC time format. The simulation time is not limited to the almanac week.

In "Auto Localization" mode, these parameters are retrieved from the selected almanac file; they correspond to the TOA of the entry standard.

Remote command:

`<subsystem>:NAVigation:SIMulation:DATE` on page 267

`<subsystem>:NAVigation:SIMulation:TIME` on page 268

**"Week Number, Time of Week (TOW)"**

(enabled for "Time Basis > GPS/GST/BDT/QZSST" and "Data Source > Real Navigation Data")

The satellite clocks in the GPS and Galileo navigation systems are not synchronized to the UTC one but use a proprietary time, e.g. the GPS/Galileo System Time. The format used for these system time basis is week number (WN) and Time of Week (TOW), that is the simulation start time within this week.

The Time of Week (TOW) is expressed in number of seconds and covers an entire week. The value is reset to zero at the end of each week.

The weeks are numbered starting from a reference point of time (WN\_REF=0), that depends on the navigation standard:

- GPS reference point: January 6, 1980 (00:00:00 UTC)
- GALILEO reference point: August 22, 1999
- BeiDou reference point: January 01, 2006

The default value of this parameter is equal to the [Week](#) of the almanac that corresponds to the navigation standard used as an entry standard.

Remote command:

`<subsystem>:NAVigation:SIMulation:WNUMber` on page 268

`<subsystem>:NAVigation:SIMulation:TOWeek` on page 269

**GNSS/RNSS Configuration**

Accesses the [Almanac Configuration](#) dialog.

You can select one almanac file and one RINEX file per navigation standard, where the available navigation standards depend on the installed options.

Using RINEX files is enabled for "User Localization" mode and requires installed assistance option of the navigation standard used as an entry standard. For description of the RINEX file format, see [chapter A.2, "RINEX Files"](#), on page 427.

**SBAS Configuration**

In instruments equipped with option R&S SMBV-K110, accesses the [SBAS Configuration Settings](#) dialog.

**Satellite Configuration...**

Accesses the dialog for configuring the satellite data (see [chapter 4.10, "Satellite Configuration Settings"](#), on page 114).

**Atmospheric Configuration**

Access the [Atmospheric Configuration Settings](#) dialog for configuring:

- the ionospheric tropospheric models used for the satellite channel's simulation
- the atmospheric parameters as transmitted in the corresponding GNSS navigation message.

#### 4.1.4 Advanced Configuration

##### Real-Time S.P.O.T.

(enabled for "Auto/User Localization" mode)

Access the dialog for real-time display of the current PDOP and HDOP values, display of the satellites states and position, display of the receiver position and display of the received satellite power (see [chapter 4.12, "Real-Time S.P.O.T. Settings"](#), on page 163).

##### Data Logging

Access the dialog for configuring the data logging, see [chapter 4.13, "Data Logging Settings"](#), on page 170.

##### Assistance Data Generation

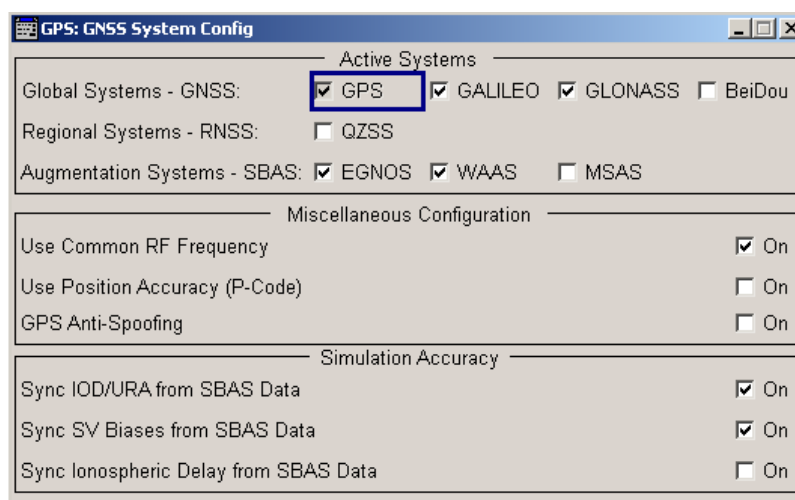
(enabled for "User Localization" mode; requires the basic BeiDou option R&S SMBV-K107 or installed assisted option, e.g. Assisted GPS R&S SMBV-K65.

Access the dialog [Assistance Data Generation Settings](#) for generation of assistance data corresponding to the selected "Assistance Mode".

## 4.2 GNSS System Configuration Settings

To access this dialog:

1. Select "GNSS > General > Simulation Mode > User Localization"
2. Select "GNSS System Configuration"



In this dialog, you select which global, regional and augmentation GNSS systems will be simulated and enable settings for improved simulation accuracy.

Activate Systems.....	55
Use Common RF Frequency.....	55
Use Position Accuracy (P-Code) GPS.....	55
GPS Anti-Spoofing.....	56
Simulation Accuracy.....	56
L Sync IOD/URA from SBAS Data.....	56
L Sync Ionospheric Delay form SBAS Data.....	56
L Sync SV Biases from SBAS Data.....	56

### Activate Systems

Defines the navigation standards that will be part of the GNSS system configuration.

A GNSS system has to be enabled in order that its satellites are configurable in the [Satellite Configuration Settings](#) dialog and in the [SBAS Configuration Settings](#) dialog.

The navigation standard of the entry point is always enabled. The further available global, regional and augmentation GNSS systems depend on the installed options.

**Note:** Throughout this description, the term hybrid configuration denotes a GNSS system configuration comprising the satellites of two or more navigation standards.

Remote command:

`<subsystem>:HYBRid:<GNSS>[:STATE]` on page 254

`<subsystem>:NAVigation:SBAS:<RegSystem>[:STATE]` on page 303

### Use Common RF Frequency

Enable this parameter if several R&S SMBV instruments are connected to generate GNSS signal in the same GNSS band (see [figure 3-1](#)) and phase coherent signal is required, e.g. two instruments generating respectively up to 24 GPS, 24 GLONASS and 24 BeiDou satellites in the L1/E1 RF band.

This feature triggers the instruments to shift the baseband signal in the frequency domain so that both instruments can use the same RF frequency. The effect is comparable with enabled hybrid GNSS configuration. With correct configured settings, instruments equipped with hardware option R&S SMBV-B90 generate phase coherent RF signals.

For more information on the required options, connection and configuration steps, refer to [chapter 5.21, "Generating GNSS Signal with Several Instruments"](#), on page 242.

Remote command:

`<subsystem>:UCRF` on page 254

### Use Position Accuracy (P-Code) GPS

The generation of GPS signal modulated by P-code requires the additional software option R&S SMBV-K93.

This parameter is enabled only if GPS standard is activated in the GNSS system configuration. Activate "Use Position Accuracy" to enable the selection of P and C/A+P signals in the [Satellite Configuration Settings](#) dialog.

Remote command:

`<subsystem>:UMGPs` on page 254

**GPS Anti-Spoofing**

Enables Anti Spoofing flag in the GPS navigation message.

Remote command:

`<subsystem>:SATellite:ASpoofing` on page 254

**Simulation Accuracy**

Combines functions that improve the simulation accuracy, see [chapter 3.9.3, "Improving the Simulation Accuracy and Simulation of SV Perturbation and Errors"](#), on page 40.

The settings are active, if at least one SBAS augmentation system is enabled.

If more than one SBAS augmentation systems are enabled, the following applies:

- used are the correction files of the SBAS augmentation system, by that the SV is monitored
- if a SV is motored by more than one SBAS augmentation systems, the SBAS systems are evaluated in the order EGNOS, WAAS, MSAS
- ionospheric information is mixed, an ionospheric file is created and loaded automatically, and the ionospheric model is set to "MOPS-DO-229D". (see ["MOPS-DO-229D Parameters"](#) on page 157).

**Sync IOD/URA from SBAS Data ← Simulation Accuracy**

Synchronizes the IODE and URA parameters of the navigation message to the values retrieved form the SBAS fast and long term correction files.

See:

- [table 4-6](#)
- ["Long Term Correction Data Parameters"](#) on page 105

The IOD/URA values are updated in real time, the displayed values are however not updated.

Remote command:

`<subsystem>:SIOD` on page 255

**Sync Ionospheric Delay form SBAS Data ← Simulation Accuracy**

Sets the [Ionospheric Model](#) to "MOPS-DO-229D" and retrieves the atmospheric delays form the SBAS ionospheric correction data. These values are considered in the calculation of the ionospheric navigation parameters.

Remote command:

`<subsystem>:SIDelay` on page 255

**Sync SV Biases from SBAS Data ← Simulation Accuracy**

If enabled, the satellite biases (pseudorange corrections PRC, clock biases and satellite position errors) of each PRN are retrieved form the SBAS fast correction data. The PRCs are used to estimate the pseudorange bias corrections.

These corrections are added to the [Pseudorange](#) of the satellites with the same PRN.

Remote command:

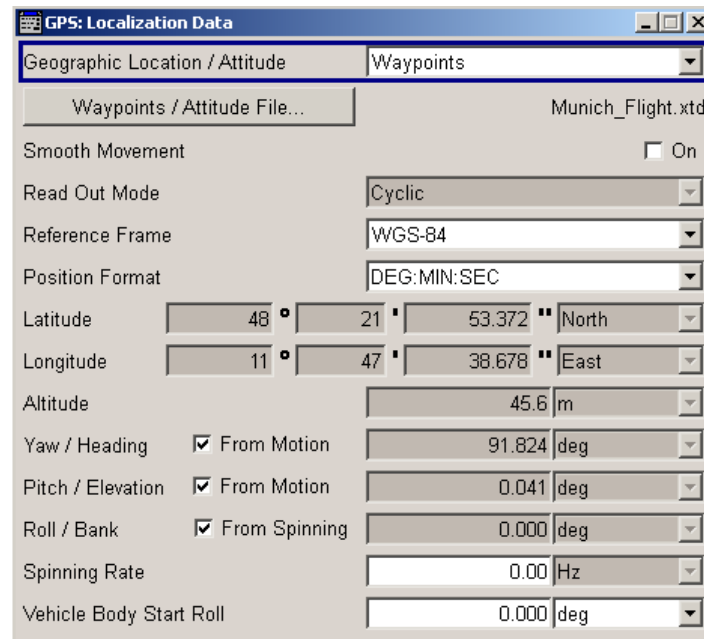
`<subsystem>:SSVBias` on page 255



## 4.3 Localization Data Settings

To access this settings:

1. Select "Baseband > Satellite Navigation > GPS".
2. Select "Simulation Mode > Auto Localization/User Localization".
3. Select "User Environment > Localization Data".



In the "Localization Data" dialog you can configure the satellites signal corresponding to a 'real' static or moving geographic location.

Geographic Location/Attitude.....	57
Waypoint/Attitude File .....	59
Smooth Movement.....	59
Read Out Mode.....	60
Reference Frame.....	60
Location Coordinates.....	60
Yaw/Heading, Pitch/Elevation, Roll/Bank.....	61
From Motion/From Spinning.....	61
Spinning Rate.....	62
Vehicle Body Start Roll.....	62
Delay for Removal of Command Jitter.....	62

### Geographic Location/Attitude

Selects the geographic location of the GNSS receiver.

- "User Defined" This mode enables the definition of the vehicle's body rotation parameters of the GNSS receiver when a static location in the WGS84 coordinate system is defined:
- "Latitude", "Longitude" and "Altitude"
  - in instrument equipped with R&S SMBV-K103, also the attitude (yaw, pitch and roll)
- The simulated altitude is the height above the ellipsoid (HAE) altitude.
- "Waypoints" (requires option GNSS Enhancements R&S SMBV-K92)  
Enables you to select and load a predefined or user waypoint files to simulate a moving scenario, i.e. to simulate a moving receiver. The parameters "Latitude", "Longitude" and "Altitude" are set according to the first simulated position defined in the file describing the movement, i.e. the raw waypoint, NMEA, KML, \*.xtd or trajectory description file.  
For information about the current position of the receiver, open the [Real-Time S.P.O.T. Settings](#) display and check the parameter "Receiver Location" or the displayed receiver trajectory ("Map View"). The movement files are file with human readable syntax, from those you can retrieve further information, like the speed of the moving receiver, etc (see [chapter A.1, "User Environment Files"](#), on page 413).  
See also [chapter 3.5.1, "Moving Scenarios"](#), on page 27.  
Option R&S SMBV-K103 is required to simulate the attitude information retrieved from the waypoint/attitude file.

"City" Selects one of the predefined fixed geographic locations (see [table 4-2](#)). The parameters "Latitude", "Longitude" and "Altitude" are set according to the selected position.

**Table 4-2: Coordinates of the Simulated Predefined Positions**

Continent	City	Latitude	Longitude	Altitude
America	New York	40.7142	-74.0064	1 m
	San Francisco	37.8194388888	-122.4784944	35 m
Asia	Beijing	39.905555555555	116.391388888888	60 m
	Seoul	37.5515	126.987794444444	265 m
	Singapore	1.3113111111111	103.826852777777	110 m
	Taipei	25.022344444444	121.514758333333	10 m
	Tokyo	35.683861111111	139.745058333333	45 m
Australia	Sydney	-33.8833	151.2167	3 m
Europe	London	51.500625	-0.1246222	22 m
	Moscow	55.752222	37.615556	200 m
	Munich	48,150	11,5833	508 m
	Paris	48.8584	2.2946277777777	66 m

Remote command:

`<subsystem>:LOCation:CATalog?` on page 261

`<subsystem>:LOCation[:SElect]` on page 261

#### Waypoint/Attitude File ...

For selected "Geographic Location > Waypoints", access to the "Select Waypoint/Attitude File" dialog to select predefined waypoint files.

A waypoint file is description of a moving scenario with possibly attitude coordinates that may have different forms, like for example a sequence of positions or vector arc movement. A waypoint file must have the extension `*.txt`, `*.nmea`, `*.kml` or `*.xtd`.

See also [chapter A.1.1, "Movement or Motion Files"](#), on page 413 for detailed description of the file formats.

Remote command:

`<subsystem>:LOCation:WAYPoints:FILE` on page 261

#### Smooth Movement

The location of the waypoints defined in the waypoints file may cause sharp changes in the movement direction. In instruments equipped with R&S SMBV-K92, this parameter uses an internal algorithm to smooth the trajectory to simulate more realistic movement.

Remote command:

`<subsystem>:LOCation:SMOVement` on page 265

**Read Out Mode**

For selected "Geographic Location > Waypoints", defines the way the waypoint/attitude file is to be read.

The receiver trajectory can be observed in the "Map View" on the [Real-Time S.P.O.T. Settings](#) display.

- "Cyclic"            The waypoint file is read out cyclic.  
Using this read out mode is only recommended for waypoint files that describe a circle moving scenario or moving scenario in which the start and the end point are close to each other.
- "One Way"           The file is read out only once.  
By reaching the end of the file, the last described position is assumed to be a static one.
- "Round Trip"        By reaching the end of the file, the file is read out backwards.

Remote command:

[<subsystem>:LOCation:WAYPoints:ROMode](#) on page 262

**Reference Frame**

Select the reference frame used to define the receiver coordinates.

The transformation between the reference frames is performed automatically.

The following applies:

- $X_{WGS84} = (1 - 0.008 \cdot 10^{-6}) \cdot X_{PZ90} - 0.2041 \cdot 10^{-7} \cdot Y_{PZ90} + 0.1716 \cdot 10^{-7} \cdot Z_{PZ90} - 0.013$
- $Y_{WGS84} = (1 - 0.008 \cdot 10^{-6}) \cdot Y_{PZ90} - 0.2041 \cdot 10^{-7} \cdot X_{PZ90} + 0.1115 \cdot 10^{-7} \cdot Z_{PZ90} + 0.106$
- $Z_{WGS84} = (1 - 0.008 \cdot 10^{-6}) \cdot Z_{PZ90} - 0.1716 \cdot 10^{-7} \cdot X_{PZ90} - 0.1115 \cdot 10^{-7} \cdot Y_{PZ90} + 0.022$

Both reference frames are ECEF frames with a set of associated parameters.

- "WGS-84"            The World Geodetic System WGS-84 is the reference frame used by GPS.
- "PZ 90.11 (GLONASS)"  
Parametry Zemli PZ (Parameters of the Earth) is the reference frame used by GLONASS.

Remote command:

[<subsystem>:LOCation:COORDinates:RFFrame](#) on page 262

**Location Coordinates**

In the ECEF coordinate system, a geographic location is identified by three coordinates, the altitude, latitude and longitude. The last two can be displayed in decimal or DMS format. The display format is determined by the parameter "Position Format".

Parameter	Description
"Position Format"	<p>Sets the format in which the Latitude and Longitude are displayed.</p> <ul style="list-style-type: none"> <li>"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.</li> <li>"Decimal Degree" The display format is decimal degree, i.e. +/-XX.XXXXXX°, where "+" indicates North and East and "-" indicates South and West.</li> </ul>
"Altitude"	<p>Sets the geographic altitude of the reference location in meters above sea level.</p> <p>The simulated altitude is the height above the ellipsoid (HAE) altitude.</p>
"Latitude"	Sets the latitude of the reference location.
"Longitude"	Sets the longitude of the reference location.

The altitude, latitude and longitude are only configurable for user defined geographic locations. If a value other than "User Defined" is selected in the "Geographic Location" field, these fields are read only.

Remote command:

to enter the coordinates in Degree:Minute:Second format

`<subsystem>:LOCation:COORDinates:DMS:WGS|PZ` on page 263

to enter the coordinates in decimal degree format

`<subsystem>:LOCation:COORDinates:DECimal:WGS|PZ` on page 262

### Yaw/Heading, Pitch/Elevation, Roll/Bank

For instruments equipped with R&S SMBV-K103, sets the angles of rotation in the corresponding direction, i.e. the rotation around the respective yaw, pitch and roll axes. "Yaw/Heading, Pitch/Elevation, Roll/Bank" are defined relative to the local horizon.

See also [figure 3-5](#).

Remote command:

`<subsystem>:LOCation:YAW` on page 264

`<subsystem>:LOCation:PITCh` on page 264

`<subsystem>:LOCation:ROLL` on page 264

see also `<subsystem>:RT:RATTitude?` on page 392

### From Motion/From Spinning

Enable "From Motion/From Spinning" to extract the attitude parameters from the waypoint file. For scenarios with defined waypoints/attitude file this forces the attitude parameters to motion direction even if the Waypoint / Attitude has attitude information, like for example in a \*.xtd file with `<property waypointformat="position_attitude">`.

For specific applications like automotive, it is realistic to set the yaw and pitch to vehicle's motion direction, because the usual body axes angles of a car are in the direction of the velocity vector. For other applications, however, like for example aeronautics with a landing plane, this parameter is not useful (the nose of the plane is in an upward direction at the time when the plane is moving downwards).

**Tip:**

- Enable the parameter "From Motion" if you simulate an automotive scenario with instrument without the option R&S SMBV-K103.
- Open the [Real-Time S.P.O.T. Settings](#) view and select "Display Type > Attitude View" to visualize the effect.  
See also [chapter 5.16, "Visualizing the Effect of an Antenna Pattern"](#), on page 221.

Remote command:

`<subsystem>:LOCation:YAW:FMOTion` on page 264

`<subsystem>:LOCation:PITCh:FMOTion` on page 264

`<subsystem>:LOCation:ROLL:FSPinning` on page 264

**Spinning Rate**

For instruments equipped with R&S SMBV-K103, simulates a constant rate of change of the roll, defined with [Vehicle Body Start Roll](#).

Remote command:

`<subsystem>:LOCation:SPIN:RATE` on page 265

**Vehicle Body Start Roll**

For instruments equipped with R&S SMBV-K103, defines the start angles of rotation of the vehicle.

Remote command:

`<subsystem>:LOCation:SPIN:SRoll` on page 265

**Delay for Removal of Command Jitter**

For instruments equipped with R&S SMBV-K92, adds an artificial delay (i.e. buffer time) to increase the latency of the R&S SMBV response to the selected value.

The minimum value 20 ms and corresponds to the hardware processing time of the R&S SMBV, see [table 6-7](#).

Remote command:

`<subsystem>:LOCation:DELay` on page 284

## 4.4 Obscuration and Auto Multipath Settings



The "Obscuration and Auto Multipath" dialog is available for instrument equipped with the additional option R&S SMBV-K101.

To access this settings:

1. Select "Baseband > Satellite Navigation > GPS".
2. Select "Simulation Mode > Auto Localization/User Localization".

3. Select "User Environment > Obscuration and Auto Multipath".

The provided settings enables you to select a predefined near environmental model or to customize the model as required. Most of the user defined models are created in table form, where each row corresponds to a object that causes obscuration, reflection of the signal and/or multipath effects. The configured objects are displayed on a graphical view with selectable orientation. Each object is identified on the graphical view with its row index.

To simplify and accelerate the configuration, the instrument provides:

- a subset of predefined but customizable user environment models, like suburban area, urban canyon, tunnel, bridge, highway, etc. that can be used directly or as basis for further configurations.
- an interface for loading of generated files or storing current configurations into files (see "[Obstacles File](#)" on page 68 or "[Planes File](#)" on page 71).
- as well as setting for joint obstacle's configuration, like defining of a subset of obstacles and automatically repeating the configured subset (see "[Repetition Window](#)" on page 71).



#### Visualizing the obscured satellites

The defined user environment model is applied on the current satellite's constellation. For the current receiver's location, some satellites are not simulated, others are simulated but are obscured or not, have echos or with attenuated power due to antenna pattern response. To visualize the satellite's constellation state currently used by the receiver, use the "Sky View" in the [Real-Time S.P.O.T. Settings](#) display.

### 4.4.1 Common Settings

This section describes the parameters that are common for all near environmental models.

Type	Urban Canyon		
Near Environment	Vertical Obstacles	Physical Model	Obscuration & Multipath

<a href="#">Type</a> .....	63
<a href="#">Near Environment</a> .....	64
<a href="#">Physical Model</a> .....	65
<a href="#">Viewport from/to, Zoom Out</a> .....	66

#### Type

Selects a predefined obscuration&auto multipath model or enables the configuration of the near environment and physical model.

- Customizable Type
  - User Defined: the parameters "Near Environment" and "Physical Model" are configurable
- Predefined Types
  - City Block

- The model assumes: average building height 20m
- Urban Canyon  
Correspond to an urban canyons in commercial city places.  
The model assumes: street width 30m, average building height 30m, gap between the buildings along a street 10m, street length 1200m
- Suburban Area  
The model assumes: relatively high distance between the GNSS receiver and the main reflecting obstacles
- Cutting  
The model assumes: obscuration effects from side barriers on the left and right of a vehicle moving on a highway
- Highway  
The model assumes: effects of the barriers as well as cars moving in the opposite lines and subsequently interrupting the GNSS signal for a short time in a periodic way
- Bridge
- Parking  
The model assumes: a full signal obscuration in a parking for 1 min, 10 min or 1 hour.  
This model is useful by measuring the time a GNSS receiver needs to reacquire the GNSS satellites after leaving the obscured area.
- Tunnel

To store a user-defined configuration, use the "Save As" function. User defined obscurations can be loaded at a latter time to repeat test with the same user environment.

Remote command:

`<subsystem>:OBSCuration:TYPE` on page 271

### **Near Environment**

Determines the kind and nature of the obstacles.



**Table 4-3: Available customizable near environment models in depending on the vehicle type and the geographic location**

Near Environment	Vehicle Type	Moving location	Static location	Short Description
Vertical Obstacles	Pedestrian Land Vehicle	x	x	<p>The model simulates the whole fix geometry of many objects (locations) to the left, right, front and back of the user's static location and is suitable for city block simulation</p> <p>The objects are defined relative to the map orientation, i.e to the street orientation. The map is built on the OX and OY axes and any point on the map can be defined as a reference point. Each object is defined with its length and its distance to this reference point.</p> <p>The receiver's position is configurable and defined as an offset to the reference point.</p> <p>See <a href="#">chapter 4.4.2, "Vertical Obstacles Settings"</a>, on page 66.</p>
Roadside Planes	Pedestrian Land Vehicle	x		<p>This model describes an environment where the user defined obstacles representing roadside planes or surfaces built from different materials are located to the left and/or to the right side of the receiver/vehicle. In this mode the roadside planes are assumed parallel to the motion of the vehicle</p> <p>The model is enabled in instrument equipped with option R&amp;S SMBV-K92.</p> <p>See <a href="#">chapter 4.4.3, "Roadside Planes Settings"</a>, on page 70.</p>
Full Obscuration	Pedestrian Land Vehicle Ship	x		<p>This model defines areas with configurable size in that the satellite signals are completely obscured.</p> <p>The model is enabled in instrument equipped with option R&amp;S SMBV-K92.</p> <p>See <a href="#">chapter 4.4.4, "Full Obscuration Settings"</a>, on page 73</p>
Ground/Sea Reflection	Ship Aircraft Spacecraft	x	x (Ship only)	<p>Simulated is ground/sea reflection as well as obscuration of satellites due to modeled canyon obstacles (left and right) with configurable distance to vehicle, height and surface type with different properties.</p> <p>Use this model to simulate flights over sea/lakes with surrounding canyon or for ships crossing sea straits.</p> <p>See <a href="#">chapter 4.4.5, "Ground/Sea Reflection"</a>, on page 74</p>
Land Mobile Multipath	all	x	x	<p>This model describes the channel conditions observed by a GNSS receiver in a given environment.</p> <p>See <a href="#">chapter 4.4.6, "Land Mobile Multipath"</a>, on page 76</p>
Line of Sight (LOS)	all	x	x	No near field environment is defined

The environment view displays the currently configured model.

Remote command:

`<subsystem>:OBSCuration:ENVIRONMENT` on page 272

### Physical Model

For "Near Environment" different than "LOS", the physical model determines whether the satellite signals are obscured and/or multipath echoes are simulated.

The simulation of multipath effects in "Physical Model > Obscuration&Multipath" requires additionally the option R&S SMBV-K92.

Remote command:

<subsystem>:OBSCuration:PMODEl on page 272

**Viewport from/to, Zoom Out**

Zooms in the displayed model to the selected range. To display the full model again, use the"Zoom Out" function.

**4.4.2 Vertical Obstacles Settings**

This section comprises the parameters, necessary to configure a "near environmental" model for simulation of obscurations and multipath effects expected in a city environment. The vertical obstacles are defined in a static (OX, OY) coordinate system and are either parallel to OX or OY axis following axis direction.

Examples of predefined environment based on the vertical obstacles are "City Block" and "Urban Canyon".

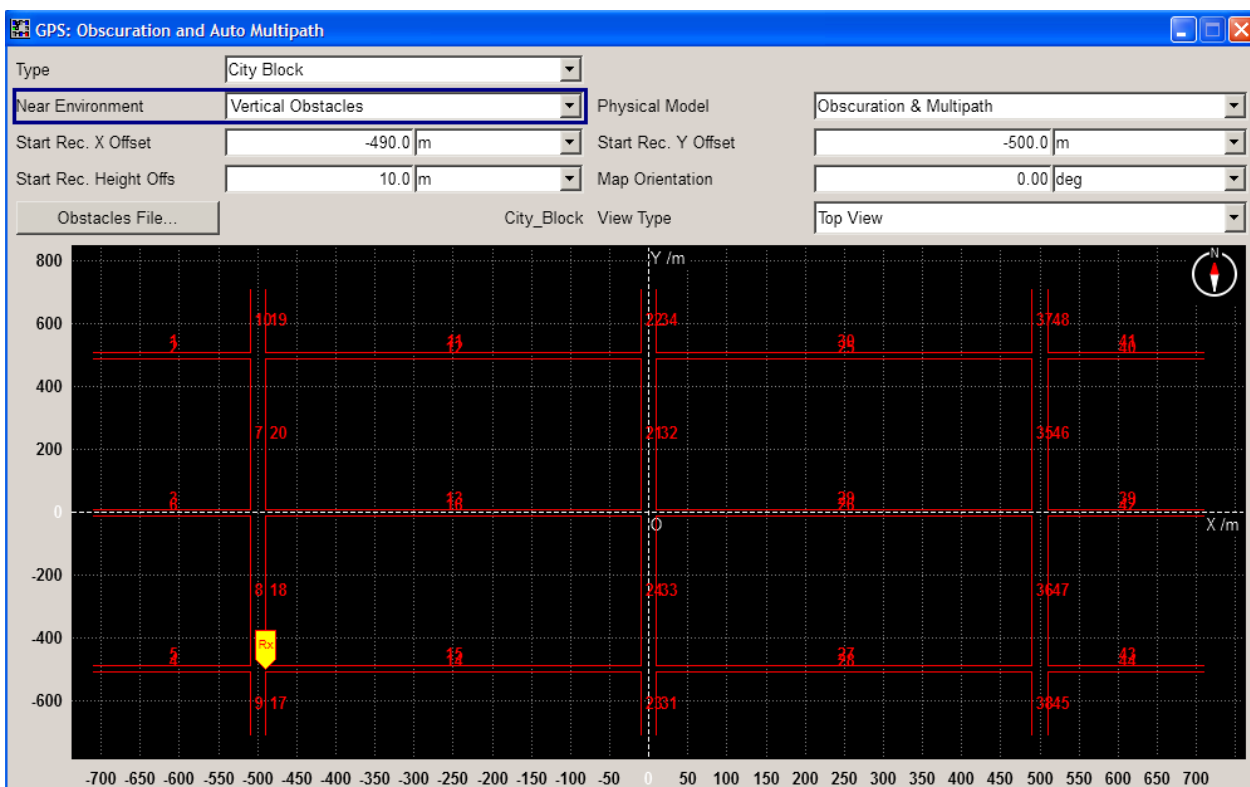


Fig. 4-1: Vertical obstacles settings on the basis of a predefined city block

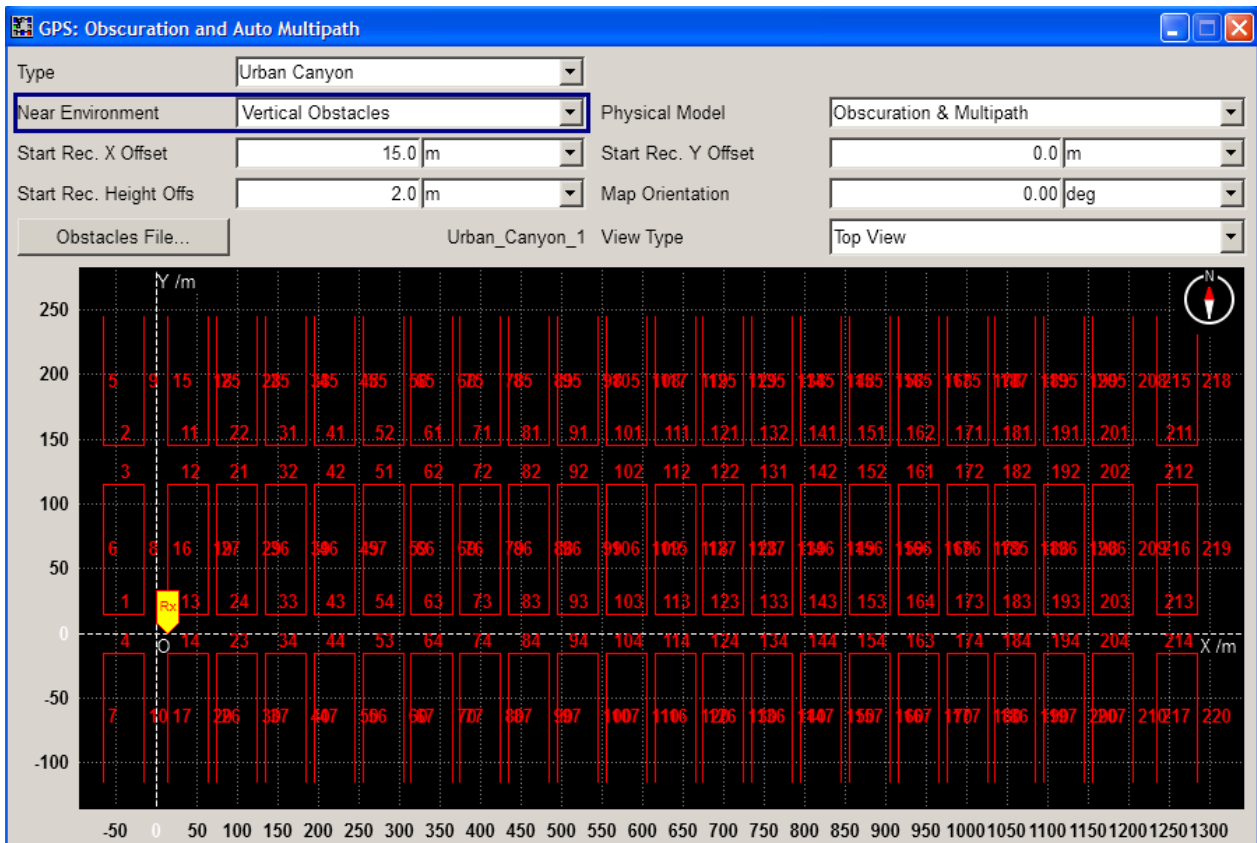


Fig. 4-2: Vertical obstacles settings on the basis of a predefined urban canyon

- Receiver Offset..... 67
- Map Orientation..... 68
- Obstacles File..... 68
- View Type..... 68
- Obstacles Configuration Table..... 69
  - Direction axis..... 69
  - First Edge X/Y Coordinates, m..... 69
  - Length/Height..... 69
  - Material..... 69
  - Permittivity/Power Loss..... 69
  - Alignment Filter..... 69
  - Material Property..... 70
  - Insert Left/Right, Delete, Undo All, Save..... 70

**Receiver Offset**

Determines the start position of a receiver/vehicle in terms of height and left/front offset relative to the reference point (i.e. the (0,0,0) coordinate). The reference point is the reference for the definition of the vertical obstacles.

**Tip:** Use this parameters to redefine the receiver's start location relative to the configured obstacles geometry without changing the obstacles definition in the table ([Obstacles Configuration Table](#)).

**Note:** Simulation of vehicle. If a vehicle is simulated, the position describes a vehicle geometric reference. The offset between antenna and the vehicle's reference is described in the antenna pattern (\*.ant\_pat). The simulated GNSS signal refers to the antenna and not the vehicle geometric reference.

"Start Receiver X Offset"

X offset of the first simulated receiver location in the (OX, OY) coordinate system

"Start Receiver Y Offset"

Y offset of the first simulated receiver location in the (OX, OY) coordinate system

"Start Receiver Height Offset"

Height offset

Remote command:

[<subsystem>:OBSCuration:VOBS:ROFFset:X](#) on page 273

[<subsystem>:OBSCuration:VOBS:ROFFset:Y](#) on page 273

[<subsystem>:OBSCuration:VOBS:ROFFset:HEIGHt](#) on page 273

### Map Orientation

The map is aligned to the points of the compass. The value represents the angle between East direction and OX axis. A value of 0° means that OX axis is to the east and OY to North; a value of 90° corresponds to OX orientation to the north and OY to West.

A compass sign shows the current direction to the north.

Remote command:

[<subsystem>:OBSCuration:VOBS:ROFFset:MOrientation](#) on page 273

### Obstacles File

Accesses the standard "File Select" dialog to select a user defined obstacles description file (\*.rs\_obst).

Remote command:

[<subsystem>:OBSCuration:VOBS:CATalog:PREDeFined?](#) on page 274

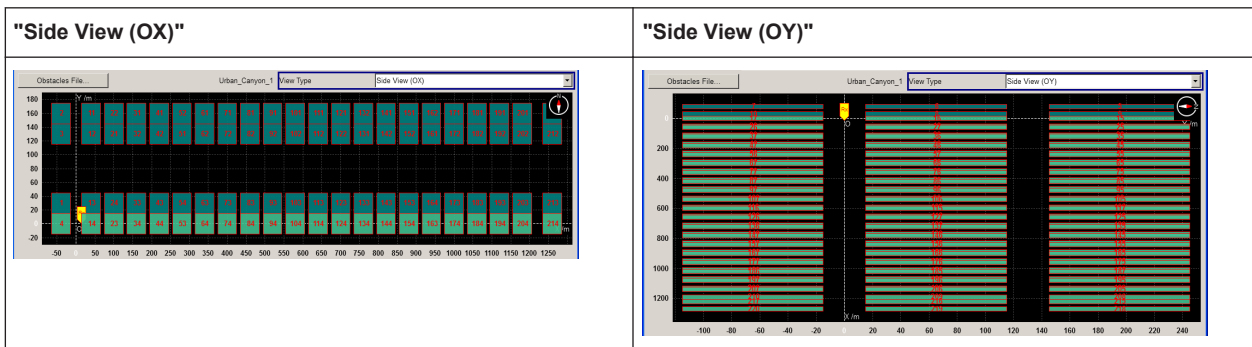
[<subsystem>:OBSCuration:VOBS:CATalog:USER?](#) on page 274

[<subsystem>:OBSCuration:VOBS:FILE](#) on page 274

### View Type

Change the display orientation of the model. The available view types depend on the current near environmental model.

Table 4-4: Graphical representation of the urban canyon



**Obstacles Configuration Table**

Each vertical obstacle is defined in one table row. The row index indicates the obstacle on the display view.

	Direction	1st Edge X-Coord /m	1st Edge Y-Coord /m	Length /m	Height /m	Material	Permittivity
1	OX	-710.0	510.0	200.0	20.0	User Def.	7.0
2	OX	-710.0	490.0	200.0	20.0	User Def.	7.0
3	OX	-710.0	10.0	200.0	20.0	User Def.	7.0
4	OX	-710.0	-510.0	200.0	20.0	User Def.	7.0
5	OX	-710.0	-490.0	200.0	20.0	User Def.	7.0
6	OX	-710.0	-10.0	200.0	20.0	User Def.	7.0
7	OY	-510.0	10.0	480.0	20.0	User Def.	7.0

**Direction axis ← Obstacles Configuration Table**

Determines the alignment of the vertical obstacle, parallel to OX or to the OY axis.

**First Edge X/Y Coordinates, m ← Obstacles Configuration Table**

For vertical obstacles, sets the coordinate of the start point (first edge) of the obstacle in meters. First edge has the lowest coordinate value on its direction axis. The coordinate is interpreted on the OX or OY axis.

**Length/Height ← Obstacles Configuration Table**

Defines the obstacles' length and height in meters. The obstacle is parallel to the [Direction axis](#)

**Material ← Obstacles Configuration Table**

Defines the material the obstacle is build from. Available are "Glass", "Concrete", "Wood", "Gypsum", "Formica", "Marble", "Dry Wall", "Brick".

**Permittivity/Power Loss ← Obstacles Configuration Table**

Displays/defines the material property, permittivity or power loss, for the selected material. This value is a measure for the reflection caused by the obstacle.

**Alignment Filter ← Obstacles Configuration Table**

Filters the display of all obstacles for that the selected criteria is fulfilled.

**Material Property ← Obstacles Configuration Table**

Define whether the material is defined by its permittivity/conductivity or power loss characteristic.

**Insert Left/Right, Delete, Undo All, Save ← Obstacles Configuration Table**

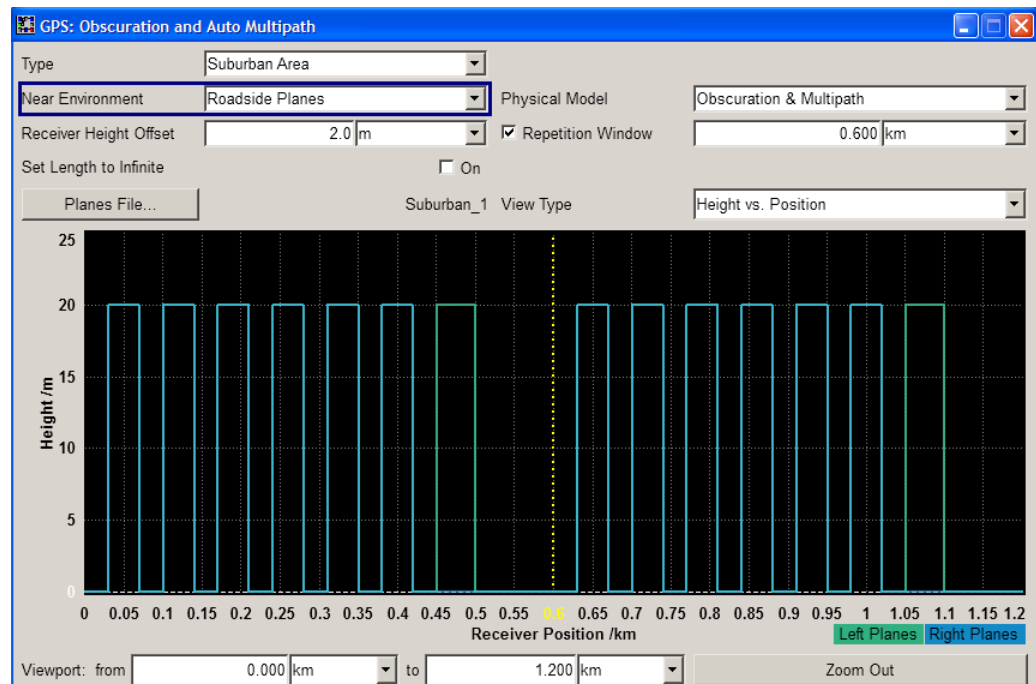
Standard functions for adding/appendng and removing table rows, undo and save changes.

**4.4.3 Roadside Planes Settings**

This model is enabled in instrument equipped with option R&S SMBV-K92.

This section comprises the parameters, necessary to configure a near environmental model for simulation of obscurations and multipath effects that a moving receiver experiences while moving on a road surrounded by buildings or other objects.

The vertical roadside planes are defined alongside the road and parallel to the motion direction of the moving receiver. A maximum of two vertical planes at max (left and right) are considered based on current user mileage. Examples of predefined environment based on roadside planes are "Suburban Area", "Highway" and "Cutting".



**Fig. 4-3: Roadside planes settings on the basis of a predefined suburban area**

Receiver Height Offset..... 71

Repetition Window..... 71

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Planes File..... 71

View Type..... 71

Obstacles Configuration Table..... 72

    L Alignment..... 72

- L [Reference Receiver Position](#)..... 72
- L [Distance](#)..... 72
- L [Height](#)..... 72
- L [Material](#)..... 72
- L [Permittivity/Power Loss](#)..... 73
- L [Material Property](#)..... 73
- L [Alignment Filter](#)..... 73
- L [Insert Left/Right, Delete, Undo All, Save](#)..... 73

**Receiver Height Offset**

Determines the start position of a receiver in terms of height offset relative to the reference point used to define the roadside planes.

**Tip:** Use this parameters to redefine the vehicle's height relative to the configured obstacles geometry without changing the obstacles definition in the table ([Obstacles Configuration Table](#)).

Remote command:

`<subsystem>:OBSCuration:RPL:ROFFset:HEIGHt` on page 275

**Repetition Window**

Enables the repetition of the defined objects and determines the repeating period (in km).

Remote command:

`<subsystem>:OBSCuration:RPL:RWINDow:STATe` on page 275

`<subsystem>:OBSCuration:RPL:RWINDow` on page 275

**Set Length to Infinite**

If enabled, assumes planes with infinite width. Enable this parameter if a cutting scenario is simulated.

Remote command:

`<subsystem>:OBSCuration:RPL:ILENght` on page 276

**Planes File**

Accesses the standard "File Select" dialog to select a user defined description file (\*.rs\_buil).

Remote command:

`<subsystem>:OBSCuration:RPL:CATalog:PREDeFined?` on page 274

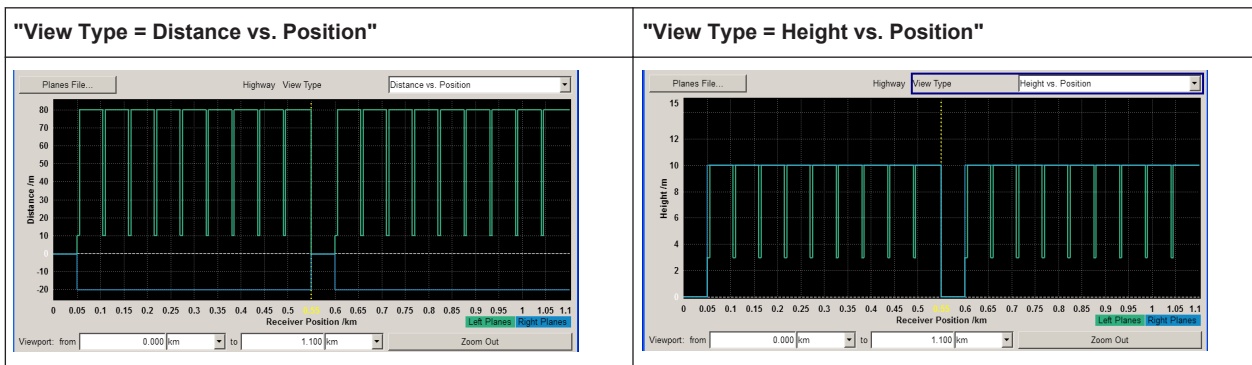
`<subsystem>:OBSCuration:RPL:CATalog:USER?` on page 274

`<subsystem>:OBSCuration:RPL:FILE` on page 274

**View Type**

Change the display orientation of the model. The available view types depend on the current near environmental model.

Table 4-5: Graphical representation of a highway model



**Obstacles Configuration Table**

Each roadside plane is defined in one table row. The row index indicates the obstacle on the display view. The left and right planes are color-coded.

	Alignment	Ref. Receiver Position /km	Distance /m	Height /m	Material	Permittivity
1 >	Left	0.050	10.0	3.0	User Def.	5.0
2	Right	0.050	20.0	10.0	User Def.	5.0
3	Left	0.055	80.0	10.0	User Def.	5.0
4	Left	0.105	10.0	3.0	User Def.	5.0
5	Left	0.110	80.0	10.0	User Def.	5.0
6	Left	0.160	10.0	3.0	User Def.	5.0
7	Left	0.165	80.0	10.0	User Def.	5.0
8	Left	0.215	10.0	3.0	User Def.	5.0
9	Left	0.220	80.0	10.0	User Def.	5.0
10	Left	0.270	10.0	3.0	User Def.	5.0

**Alignment ← Obstacles Configuration Table**

For roadsides planes, determines according to which axis (left or right) the location is aligned. The available values depend on the selected Alignment Filter.

**Reference Receiver Position ← Obstacles Configuration Table**

Distance (mileage) starting from which the corresponding roadside plane is considered for user obscuration and multipath simulation.

**Distance ← Obstacles Configuration Table**

Defines the distance of the vertical obstacle to the OX or OY axis. The distance is expressed in meters.

**Height ← Obstacles Configuration Table**

Defines the obstacles' height in meters.

**Material ← Obstacles Configuration Table**

Defines the material the obstacle is build from. Available are "Glass", "Concrete", "Wood", "Gypsum", "Formica", "Marble", "Dry Wall", "Brick".



**Permittivity/Power Loss ← Obstacles Configuration Table**

Displays/defines the material property, permittivity or power loss, for the selected material. This value is a measure for the reflection caused by the obstacle.

**Material Property ← Obstacles Configuration Table**

Define whether the material is defined by its permittivity/conductivity or power loss characteristic.

**Alignment Filter ← Obstacles Configuration Table**

Filters the display of all obstacles for that the selected criteria is fulfilled.

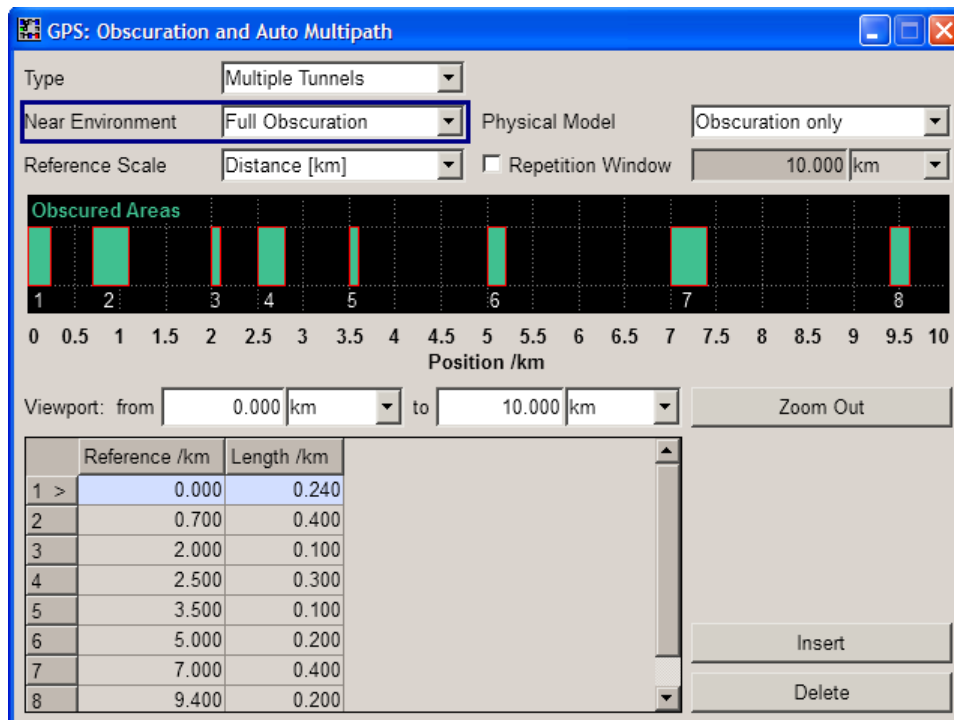
**Insert Left/Right, Delete, Undo All, Save ← Obstacles Configuration Table**

Standard functions for adding/appending and removing table rows, undo and save changes.

**4.4.4 Full Obscuration Settings**

This model is enabled in instrument equipped with option R&S SMBV-K92.

This section comprises the parameters, necessary to configure areas in that the satellite signal is fully obscured, like in tunnels. Examples of predefined environments based on full obscuration are "Bridge", "Parking" and "Tunnel".



Reference Scale.....74  
 Repetition Window.....74  
 Full Obscuration Configuration Table.....74

**Reference Scale**

Defines whether the obstacles' positions are defined as distance (in km) or as time (in s).

**Note:** Changing between the two scale without saving the configuration leads to data loss.

Remote command:

`<subsystem>:OBSCuration:FULL:SCALE` on page 276

**Repetition Window**

Enables the repetition of the defined objects and determines the repetition period (in km).

Remote command:

`<subsystem>:OBSCuration:FULL:RWINDOW:STATE` on page 276

`<subsystem>:OBSCuration:FULL:RWINDOW` on page 276

**Full Obscuration Configuration Table**

Defines the full obscured areas as a sequence of zones at defined position and with defined "Width". Each zone is defined in one table row.

**Tip:** To enable an area pattern, define the subset of areas and enable a "Repetition Window" with suitable repetition period. Adjust the displayed window size ([Viewport from/to, Zoom Out](#)), to visualize all configured full obscuration areas.

"Reference" Defines the reference starting position or time stamp at which a specific obscured zone is applied.

Remote command:

`<subsystem>:OBSCuration:FULL:AREA<ch>:REFerence` on page 277

"Length" Length of the obscured zone, defined in km or sec.

Remote command:

`<subsystem>:OBSCuration:FULL:AREA<ch>:LENGth` on page 278

Remote command:

`<subsystem>:OBSCuration:FULL:AREA:COUNT?` on page 277

`<subsystem>:OBSCuration:FULL:AREA:APPend` on page 277

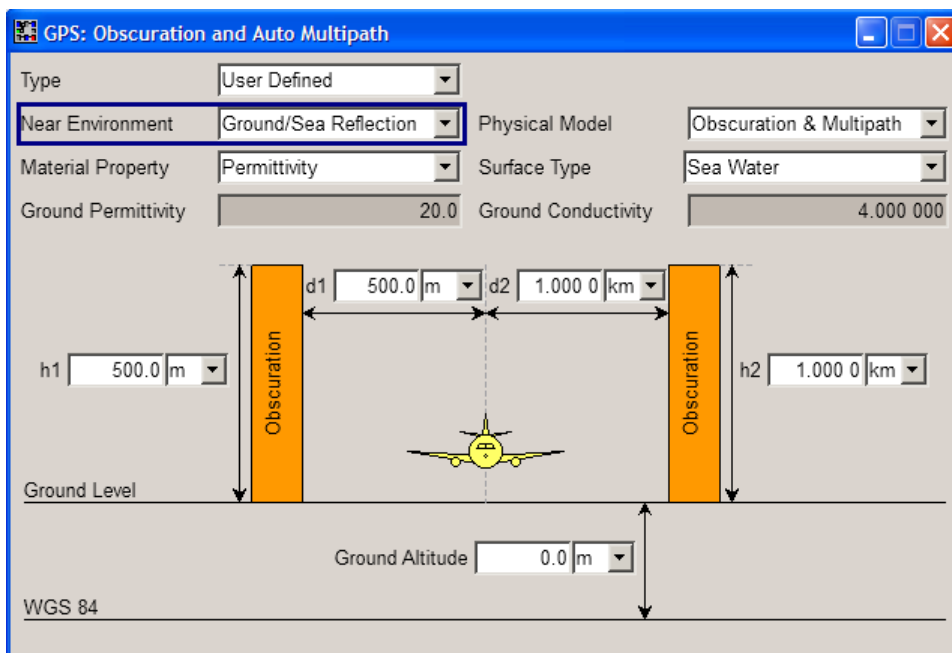
`<subsystem>:OBSCuration:FULL:AREA<ch>:INSert` on page 277

`<subsystem>:OBSCuration:FULL:AREA<ch>:DELeTe` on page 277

**4.4.5 Ground/Sea Reflection**

This section comprises the parameters, necessary to configure a near environmental model for simulation of obscurations and multipath effects caused by ground and sea reflections.

The ground/sea reflections model is available for ship, aircraft and spacecraft vehicles and describes canyon vertical obstacles parallel to the motion direction of the user (direction axis).



Material Property.....75  
 Surface Type.....75  
 Ground Permittivity/Conductivity, Power Loss.....75  
 h1/h2, d1/d2.....76  
 Ground Altitude.....76  
 Obstacle Orientation.....76

**Material Property**

Define whether the material is defined by its permittivity/conductivity or power loss characteristic.

The material properties depend on the selected surface type.

Remote command:

<subsystem>:OBSCuration:GSR:MPRoerty on page 278

**Surface Type**

Describes the surface. Available are "Dry Ground", "Medium Dry Ground", "Wet Ground", "Fresh Water" and "Sea Water". The different surfaces feature different reflection characteristics.

Remote command:

<subsystem>:OBSCuration:GSR:STYPe on page 278

**Ground Permittivity/Conductivity, Power Loss**

Displays/defines the surface property, permittivity, conductivity or power loss, for the selected surface type. This value is a measure for the reflection caused by the surface.

Remote command:

<subsystem>:OBSCuration:GSR:PERMittivity on page 279

<subsystem>:OBSCuration:GSR:CONDuctivity on page 279

<subsystem>:OBSCuration:GSR:PLOSs on page 279

**h1/h2, d1/d2**

Determines the height of the right/left obstacle and the distance between the receiver and the obstacles.

Remote command:

`<subsystem>:OBSCuration:GSR:O1Distance` on page 280

`<subsystem>:OBSCuration:GSR:O2Distance` on page 280

`<subsystem>:OBSCuration:GSR:O1Height` on page 280

`<subsystem>:OBSCuration:GSR:O2Height` on page 280

**Ground Altitude**

Sets the altitude of the ground level relative to the WGS84 ellipsoid, i.e. the terrain ground level is set relative to WGS84 zero level or sea level.

Remote command:

`<subsystem>:OBSCuration:GSR:GALTititude` on page 280

**Obstacle Orientation**

For "Geographic Location/Attitude" different than waypoint and "Vehicle Type = Aircraft/Ship/Spacecraft", defines the direction of the obstacles. If the vehicle is moving, the obstacles are assumed to be parallel to the motion.

The value zero means that the obstacles are parallel to the east direction.

Remote command:

`<subsystem>:OBSCuration:GSR:OORientation` on page 281

## 4.4.6 Land Mobile Multipath

**Land Mobile Multipath (LMM) model**

The Land Mobile Multipath (LMM) model can be used to simulate different receiver environments. This model assumes that the channel state of a satellite-to-receiver link only depends on the azimuth and elevation angles of the corresponding satellite. In this implementation, the sky (i.e. the possible satellite positions) is divided into segments, specified with their azimuth and elevation angles. The 3D dome-like sky shape is unfolded and displayed on a 2D plane.

See [figure 4-4](#).

Each segment is then assigned one of the possible *channel states*:

- Line of Sight (LOS) Only: the received signal is a Line of Sight (LOS) signal
- LOS + Echo: the received signal consists of a LOS signal and a maximum of four echo signals
- Echoes Only: the received signal consists only of a maximum of four echo signals
- Obscuration: the signal is obscured, i.e. no signal is available

### LMM files

The R&S SMBV provides an interface for loading and creating user-defined LMM file. The LMM patterns have to be defined in files with predefined file format and file extension \*.lmm.

A LMM file is a list of 6 tables:

- a category table, that defines the channel states
- a number of echo taps table
- four taps tables, that define the echos in terms of "Range Offset", "Power", "Doppler Shift" and "Carrier Phase"

All tables have rows of elevation angles from 0 to +90° and columns of azimuth from -180° to +180°.

See [chapter A.1.4, "Land Mobile Multipath \(LMM\) Files"](#), on page 425

### Difference between the static multipath tapped delay model and the LMM model

In R&S SMBV you can define static multipath effects per satellite, see [chapter 4.10.10, "Static Multipath Configuration"](#), on page 152. The multipath model describing the static multipath propagation is implemented as a tapped delay model. The multipath parameters in the LMM model are however not satellite specific; the number of taps and the taps parameters are function of the azimuth and elevation angles of the simulated satellite.

### Land Mobile Multipath settings

To access these settings:

1. Select "Baseband > Satellite Navigation > GPS".
2. Select "Simulation Mode > Auto Localization/User Localization".
3. Select "User Environment > Obscuration and Auto Multipath".
4. Select "Near Environment > Land Mobile Multipath".
5. Select a file describing the land mobile multipath, e.g. select "Land Mobile Multipath File > Select Predefined LMM > Offenburg\_Suburban".
6. The dialog shows the LMM model as a grid of segments, each described with its azimuth and elevation angle, number of multipath taps and its channel state.

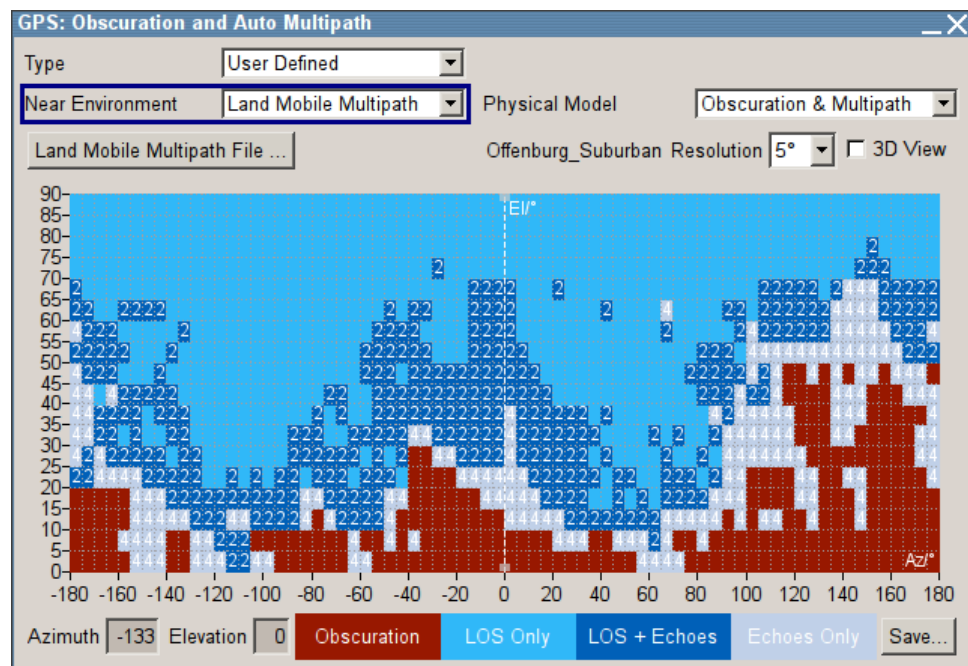
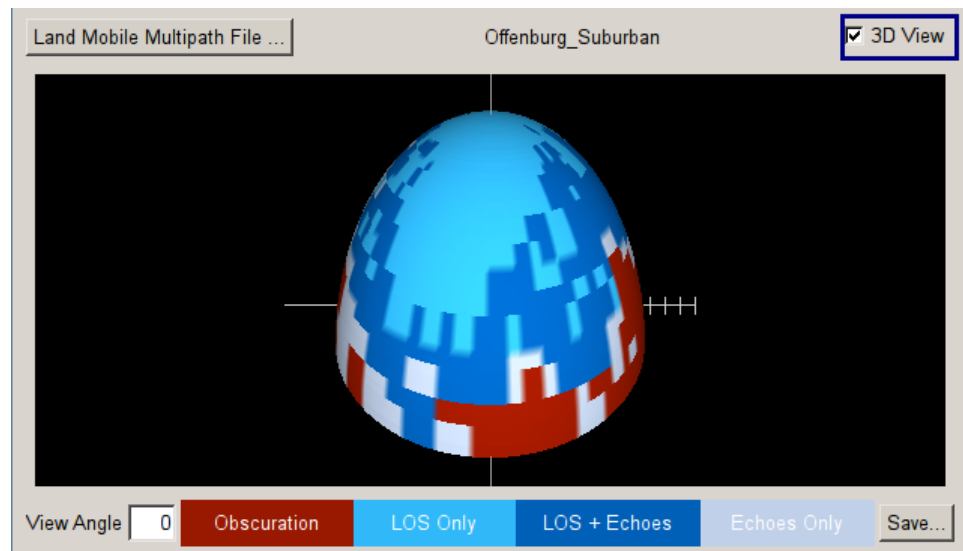


Fig. 4-4: Land Mobile Model (Example)

The display is color coded, where the different channel states are indicated with different colors.

7. Enable "3D View > On"



The 3D view is interactive. To turn the display on the y axis, use a connected mouse or change the parameter "View Angle".

For more information, see:

- ["To simulate a multipath based on the LMM \(Land Mobile Multipath\) model"](#) on page 208

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Land Mobile Multipath.....	79
Azimuth, Elevation.....	80
View Angle.....	80
Save.....	80

### Land Mobile Multipath File

Accesses the standard "File Select" dialog to select a user defined or a predefined LMM file (\*.lmm) or to create a new one.

If a file is selected, the file name is displayed.

See also:

- "LMM files" on page 77
- [chapter A.1.4, "Land Mobile Multipath \(LMM\) Files"](#), on page 425

Remote command:

`<subsystem>:OBSCuration:LMM:FILE` on page 274

`<subsystem>:OBSCuration:LMM:CATalog:PREDefined?` on page 274

`<subsystem>:OBSCuration:LMM:CATalog:USER?` on page 274

### Resolution

Sets the used resolution.

Using a rough resolution may be useful to adjust values with larger steps width or larger value changes, whereas a high resolution is suitable for fine adjustment. Each time you change the resolution, you have to define whether it is only the scale that changes or the values should be interpolated. The latter may lead to data lost.

### 3D View

Displays an interactive 3D representation of the LMM model.

### LMM Graph

Displays the channel states and number of multipath taps distribution per sky segment. The graph is interactive; you can select an area and change the channel state, number of multipath taps, zoom in, etc.

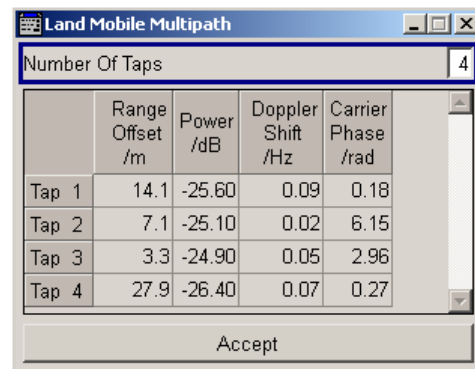
See "[To simulate a multipath based on the LMM \(Land Mobile Multipath\) model](#)" on page 208 for example on how to work with the provided settings.

### Land Mobile Multipath

In the "Land Mobile Multipath" you configure the multipath tap parameters.

To access the dialog:

- On the LMM graph, select a segment with channel state "LOS + Echo" or "Echoes Only"
- Left mouse click to open the context menu and select "Multipath"



The following parameters can be configured for each multipath tap to simulate multipath conditions:

"Number of Taps"

Number of multipath taps, i.e. number of rows available for configuration.

"Range Offset" Additional delay of the segment in meters

"Power" Additional power of the segment in dB.

"Doppler Shift" Additional Doppler shift of the simulated signal of the segment in Hz

"Carrier Phase" Additional carrier phase in radians

"Accept" Confirms the configuration and applies the settings.

#### Azimuth, Elevation

Displays the corresponding values of the selected sky segment on the LMM graph.

#### View Angle

Changes the view angle of the [3D View](#).

#### Save

Accesses the standard "File Select" dialog to store the channel states as a file. The predefined files can not be overwritten. If a predefined file have been changed, it have to be stored under new file name.

Remote command:

see "[Land Mobile Multipath File](#)" on page 79

## 4.5 Antenna Pattern/Body Mask Settings

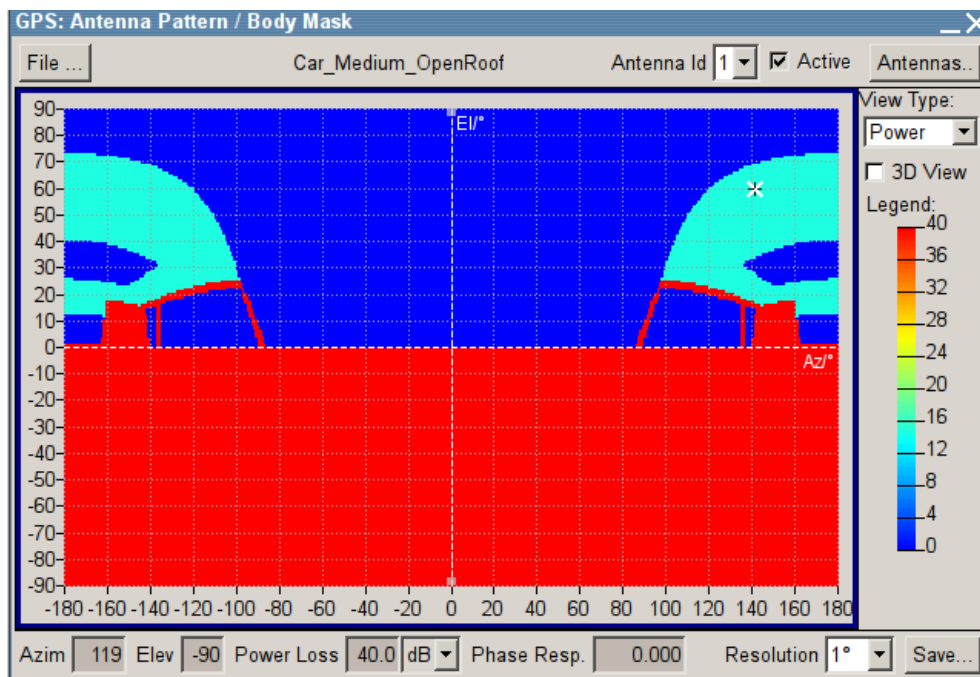
To access this settings:

1. Select "GNSS Main Dialog > Simulation Mode > Auto Localization/User Localization".
2. Select "User Environment > Antenna Pattern/Body Mask".



3. Select "File > Select Predefined Antenna Pattern" and select one of the provided files.

Per default the "View Type > Power" is used and the dialog displays the power response of the antenna for the current body mask.



The display is color coded, where the different power levels are indicated with different colors (see "Legend").

See also [figure 3-4](#).

Two files describe an antenna, the antenna pattern \*.ant\_pat file and the phase response \*.phase file. Both files must have the same file name and must be stored in the same directory. The \*.ant\_pat file describes the power response matrix of each antenna.

With a selected antenna pattern, the instrument simulates the satellite power and carrier phase depending on the antenna pattern and attitude parameters.

For automotive applications, set "GNSS Main Dialog > User Environment > Localization Data > From Motion" to extract the attitude parameters from the waypoint file.

Try out also the following:

- Enable "3D View > On"
- Select "View Type > Phase" to visualize the phase response
- Select "View Type > Position" to visualize the antenna's orientation and location compared to the center of body mass.

For more information, see:

- [chapter 3.7, "GNSS Extension for Antenna Pattern \(R&S SMBV-K102\)"](#), on page 32
- [chapter A.1.3, "Antenna Pattern / Body Mask Files"](#), on page 423

- [chapter 5.17, "Creating and Modifying Antenna Patterns and Body Masks"](#), on page 224
- [chapter 5.16, "Visualizing the Effect of an Antenna Pattern"](#), on page 221

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**File**

Accesses the standard "File Select" dialog to select a file, describing the antenna pattern or the body mask. Several predefined antenna patterns are provided.

If a file is selected, the file name is displayed.

Remote command:

`<subsystem>:APATtern:CATalog:PREDeFined?` on page 257

`<subsystem>:APATtern:CATalog:USER?` on page 258

`<subsystem>:APATtern:FILE` on page 258

see also:

`<subsystem>:RT:UPDate:ANTenna` on page 259

**Antenna ID, Active Antenna**

Selects the ID of the antenna that is currently edited.

To activate an antenna, set its parameter "Active > On". Only one antenna can be activated at the same time.

Remote command:

`<subsystem>:APATtern:ANTenna:LIST?` on page 258

`<subsystem>:APATtern:ANTenna:ID` on page 258

**Antennas**

Accesses a context menu with standard handling functions.

To add an antenna, select "Add Antenna" and enter the "ID of Antenna to Add".

To delete an antenna, select "Delete Antenna X".

**Antenna Pattern Graph**

Depending on the selected [View Type](#), displays the power/phase distribution or the position of the current antenna.

The graph is interactive; you can select an area and change the power loss value, zoom in, etc.

See [chapter 5.17, "Creating and Modifying Antenna Patterns and Body Masks"](#), on page 224 for example on how to work with the provided settings.

**View Type**

Sets whether the graph displays the power/phase distribution of the antenna or the antenna position relative to the center of body mass.

**3D View**

Displays an interactive 3D representation of the power/phase distribution of the antenna.

**Azimuth, Elevation, Power Loss, Phase Response**

Displays the corresponding values of the selected point on the power/phase graph.

To edit the value, select an area on the graph, see [chapter 5.17, "Creating and Modifying Antenna Patterns and Body Masks"](#), on page 224.

 **$\Delta$ Heading,  $\Delta$ Elevation,  $\Delta$ Bank**

Displays the information on the antenna orientation and tilt.

 **$\Delta$ X,  $\Delta$ Y,  $\Delta$ Z**

Sets an offset relative to the center of body mass to place the antenna.

**Resolution**

Sets the used resolution.

Using a rough resolution may be useful to adjust values with larger steps width or larger value changes, whereas a high resolution is suitable for fine adjustment. Each time you change the resolution, you have to define whether it is only the scale that changes or the values should be interpolated. The latter may lead to data lost.

**Save**

Accesses the standard "File Select" dialog to store the antenna pattern as a file. The predefined files can not be overwritten. If a predefined file have been changed, it have to be stored under new file name.

## 4.6 Time Conversion Configuration Settings

To access these settings:

1. Select "Baseband > Satellite Navigation" and select the satellite standard, for example "GPS".
2. Select "Navigation Data > Data Source > Real Navigation Data".
3. Select "Navigation Data > Time Conversion Config...".

This dialog contains the settings required to configure the time conversion from a navigation standard, for example GPS to UTC. The conversion settings are necessary for switching from one time basis to another.

**GPS: Time Conversion Configuration**

Time Conversion Parameters

	GPS-UTC	GALILEO-UTC	GLONAS-(UTC(SU)+3h)	BeiDou-UTC	QZSS-UTC	EGNOS-UTC	WAAS-UTC	MSAS-UTC
A <sub>0</sub>	0	0	0	0	0	0	0	0
Scale Factor	2 <sup>-30</sup>	2 <sup>-30</sup>	2 <sup>-31</sup>	2 <sup>-30</sup>	2 <sup>-30</sup>	2 <sup>-30</sup>	2 <sup>-30</sup>	2 <sup>-30</sup>
Scaled Value	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00
A <sub>1</sub>	0	0		0	0	0	0	0
Scale Factor	2 <sup>-50</sup>	2 <sup>-50</sup>		2 <sup>-50</sup>	2 <sup>-50</sup>	2 <sup>-50</sup>	2 <sup>-50</sup>	2 <sup>-50</sup>
Scaled Value	0.000000e+00	0.000000e+00		0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00
T <sub>ot</sub>	0	0		0	0	0	0	0
Scale Factor	2 <sup>12</sup>	3600		1	2 <sup>12</sup>	2 <sup>12</sup>	2 <sup>12</sup>	2 <sup>12</sup>
Scaled Value	0.000000e+00	0.000000e+00		0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00
WN <sub>ot</sub>	0	0			0	0	0	0

Leap Second Configuration

**Synchronize**

Current Leap Seconds (Ref. 1980)

Simulate Leap Second Transition  On

Next Leap Second Date

Leap Sign

UTC - UTC(SU)

UTC(SU) Reference Date

A<sub>0</sub>  x 2<sup>-10</sup> = 0.002 9 s

A<sub>1</sub>  x 2<sup>-16</sup> = 0.000 153s/msd

The time conversion is performed according to the following formula:

$$t_{UTC} = (t_E - \text{delta\_}t_{UTC}) \text{ modulo } 86400, \text{ where } \text{delta\_}t_{UTC} \text{ and } t_E \text{ are as follows:}$$

$$\text{delta\_}t_{UTC} = \text{delta\_}t_{LS} + A_0 + A_1 (t_E - T_{ot} + 604800(WN - WN_{ot})) \text{ and}$$

$$t_E = t_{GPS} \text{ or } t_{Galileo}$$

[Time Conversion Parameters](#)..... 84

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[UTC-UTC\(SU\)](#)..... 85

**Time Conversion Parameters**

Configuration of the time conversion parameters requires software option R&S SMBV-K92. The time conversion parameters are enabled only in "User Localization" and "Static" modes.

The basis for the time conversion is the UTC. The parameters of each of the navigation standards are set as an offset to the UTC.

To retrieve the time configuration parameters from an imported RINEX file, enable the parameter [Update UTC and Atmospheric Parameters](#).

For better readability, the values of the time correction parameters are input as integer in the same way as they are included in the satellite's navigation message but the corresponding "Scale Factor" and the "Scaled Value" are displayed too.

Parameter	Description	SCPI Command
"A_0"	Constant term of polynomial, $A_0$	<subsystem>:NAVigation:TCONversion:GPS:AZERo on page 295
"A_1"	1 <sup>st</sup> order term of polynomial, $A_1$	<subsystem>:NAVigation:TCONversion:GPS:AONE on page 294
"t_ot"	UTC data reference Time of Week, $t_{ot}$	<subsystem>:NAVigation:TCONversion:GPS:TOT on page 295
"WN_t"	UTC data reference Week Number, $WN_t$	<subsystem>:NAVigation:TCONversion:GPS:WNOT on page 296

### Leap Second Configuration

The GPS time does not consider time corrections that are typical for the UTC, such as the leap second for instance.

The date of the next expected correction is determined by the parameter "Next Leap Second Date".

As of June 30, 2012, the value of the "Current Leap Second", is 16 seconds.

Parameter	Description	SCPI Command
"Synchronize"	Synchronizes the leap second according to the simulation time.	<subsystem>:NAVigation:TCONversion:LEAP:SYNC on page 298
"Current Leap Seconds (Ref. 1980)"	Displays the currently used leap second.	<subsystem>:NAVigation:TCONversion:LEAP:SECONDS on page 297
"Simulate Leap Second Transition"	Enables/disables the simulation of the leap second transition.	<subsystem>:NAVigation:TCONversion:LEAP:SLSTransition[:STATE] on page 297
"Next Leap Second Date"	Determines the date of the next UTC time correction.	<subsystem>:NAVigation:TCONversion:LEAP:DATE on page 297
"Leap Sign"	The time correction is performed in steps of one second. One second may be added to or subtracted from the current leap second value.	<subsystem>:NAVigation:TCONversion:LEAP:SIGN on page 298

### UTC-UTC(SU)

(for GLONASS satellites)

The Universal Time Coordinate (UTC) as used for GPS and Galileo can have a phase shift and a frequency drift compared to the Russian UTC basis (UTC(SU)). These settings are provided for configuration of the UTC differences UTC - UTC(SU) as transmitted by GLONASS satellites.

Parameter	Description	SCPI Command
"UTC(SU) Reference Date"	Indicates the UTC-UTC (SU) time conversion reference date.	<subsystem>:NAVigation:TCONversion:UTCSu:DATE? on page 297
"A_0"	Constant term of polynomial $A_0$ (virtual)	<subsystem>:NAVigation:TCONversion:UTCSu:AZERo on page 296
"A_1"	1 <sup>st</sup> order term of polynomial, $A_1$ (virtual)	<subsystem>:NAVigation:TCONversion:UTCSu:AONE on page 296

The Glonass satellites transmit the offset between GPS and GLONASS system time as part of their navigation message. They assume only a delay and no frequency drift. The time offset is calculated as following:

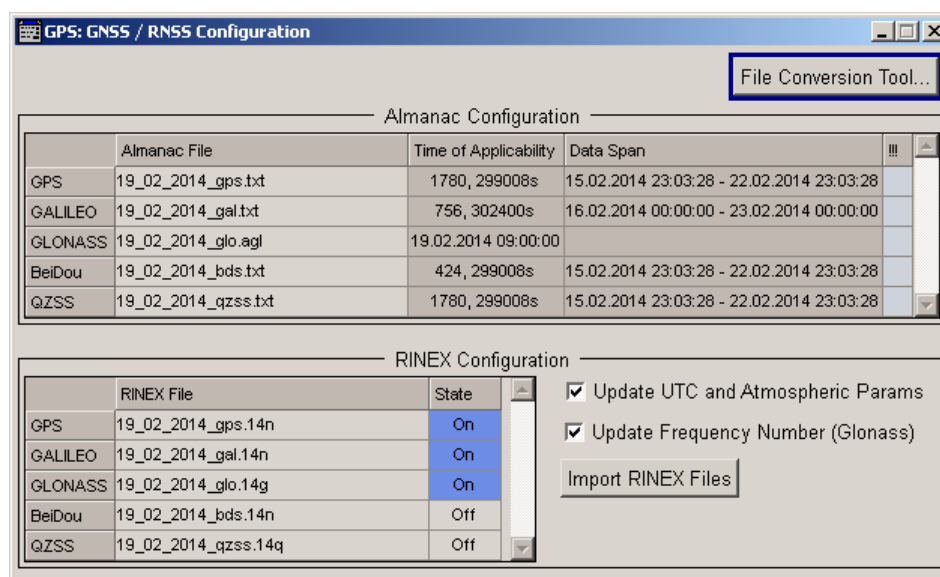
$$\text{GPS} - \text{GLONASS} = \text{"GPS} - \text{UTC"} + \text{"UTC} - \text{UTC(SU)}" - \text{"GLONASS} - (\text{UTC(SU)} + 3\text{h})" - 3\text{h}$$

For hybrid GNSS configuration with activated GLONASS satellites, this GPS – GLO-NASS time offset is maintained constant by automatically adjusting the "GPS-UTC" drift parameters ("A\_1", "T\_ot" and "WN\_ot") while changing the "UTC – UTC(SU)" parameters.

## 4.7 GNSS/RNSS Configuration Settings

To access this dialog:

1. Select "GNSS > Simulation Mode > User Localization"
2. Select "GNSS > Navigation Data"
3. Select "Navigation Data > Data Source > Real Navigation Data"
4. Select "Navigation Data > GNSS/RNSS Configuration"



In this dialog, you select the almanac data and RINEX files.

### File Conversion Tool

In instruments equipped with option R&S SMBV-K110, accesses the [File Conversion Tool Settings](#) dialog.

### Almanac Configuration

Displays the settings of the selected almanac files per navigation standard.

One almanac file can be selected per navigation standard. Predefined or user-defined almanac files can be loaded.

When an almanac file is selected, the time information of the file (Week, SEM and TOA) is indicated in the table. The SEM and TOA are indicated in Greenwich Mean Time.

If RINEX file is not enabled, the satellite specific information (ephemeris) is also retrieved from the almanac.

The software compares the data span of the selected almanac file and the current simulation time (see [Simulation Start Time](#)):

- If [Time Projection of Navigation Data](#) > On, the "Data Span" is automatically updated, based on the current simulation time.
- If [Time Projection of Navigation Data](#) > Off and the selected simulation date is outside the data span of the selected almanac file, a conflict ("!!!") is indicated.

Parameter	SCPI command
"Almanac File"	<a href="#">&lt;subsystem&gt;:NAVigation:ALManac:&lt;GNSS&gt;:FILE on page 287</a> <a href="#">&lt;subsystem&gt;:SVID:&lt;GNSS&gt;:LIST on page 292</a>
"Time of Applicability (TOA)" <sup>1)</sup>	<a href="#">&lt;subsystem&gt;:NAVigation:ALManac:&lt;GNSS&gt;:TOApplicability:TOWeek on page 290</a>
	<a href="#">&lt;subsystem&gt;:NAVigation:ALManac:&lt;GNSS&gt;:TOApplicability:WNUMber on page 290</a>
	<a href="#">&lt;subsystem&gt;:NAVigation:ALManac:GLONass:TOApplicability:DATE? on page 289</a> <a href="#">&lt;subsystem&gt;:NAVigation:ALManac:GLONass:TOApplicability:TIME? on page 289</a>
"Data Span"	<a href="#">&lt;subsystem&gt;:NAVigation:ALManac:&lt;GNSS&gt;:SPAN? on page 287</a>
"Week Number" <sup>2)</sup>	<a href="#">&lt;subsystem&gt;:NAVigation:ALManac:&lt;GNSS&gt;:WNUMber on page 290</a>
"Week Span" <sup>2)</sup>	<a href="#">&lt;subsystem&gt;:NAVigation:ALManac:&lt;GNSS&gt;:DATE:BEGIN on page 288</a>
	<a href="#">&lt;subsystem&gt;:NAVigation:ALManac:&lt;GNSS&gt;:DATE:END on page 288</a>

- <sup>1)</sup> TOA format for GPS: *(WN, TOW) WN\_REF (6 Jan 1980 00:00:00 UTC)*  
TOA format for Galileo: *(WN, TOW) WN\_REF (22 August 1999 00:00:00 UTC)*
- <sup>2)</sup> "Week Number" and "Week Span": no SCPI command for Glonass

For an overview of the supported almanac files, see [chapter 3.1.6, "Multiple almanacs"](#), on page 20.

### RINEX Configuration

Selects and activates one "RINEX File" per navigation standard. Predefined or user RINEX files can be loaded.

- Perform "Import RINEX Files" to upload the selected file. The ephemeris and satellite clock parameters of the SV IDs included in the selected RINEX file are retrieved from this file. However, the parameters of SV IDs that are not included in the RINEX file are retrieved from the almanac of the corresponding GNSS.

- Enable the "Update UTC and Atmospheric Parameters" to synchronize the [time conversion parameters](#) and the atmospheric parameters to the corresponding values retrieved from the RINEX file.
- Enable the "Update Frequency Number (GLONASS)" to extract the frequency number allocations from the RINEX file.

See also:

- [chapter A.2, "RINEX Files"](#), on page 427 for description of the RINEX file format
- [chapter 5.11, "Configuring the Navigation Parameters"](#), on page 212

Remote command:

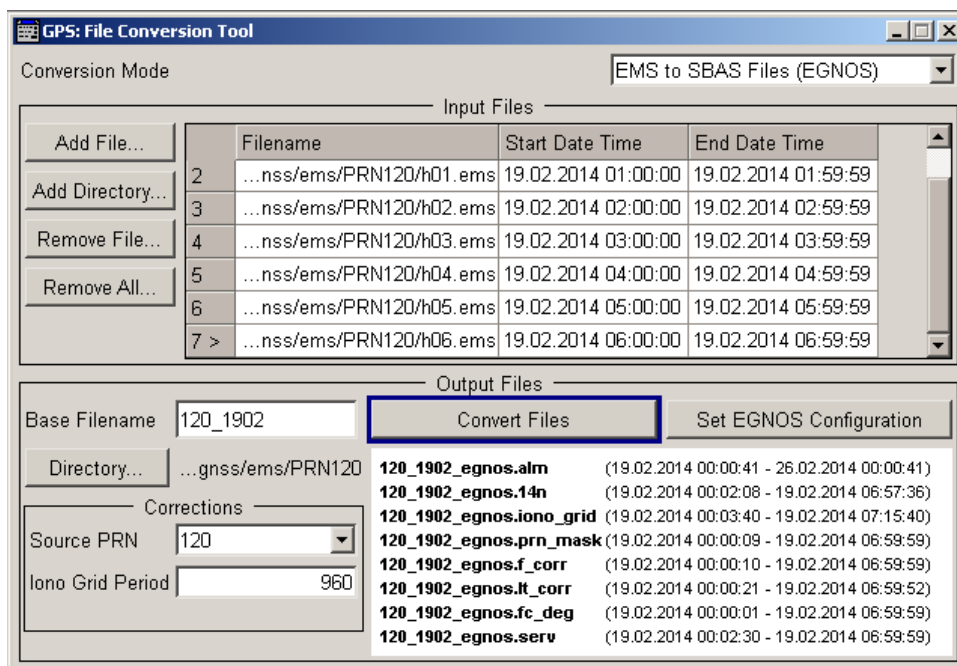
- <subsystem>:NAVigation:RINex:GPS:FILE on page 291
- <subsystem>:NAVigation:RINex:GPS:STATe on page 291
- <subsystem>:NAVigation:RINex:IMPorT on page 291
- <subsystem>:NAVigation:RINex:UUAState on page 292
- <subsystem>:NAVigation:RINex:UFNState on page 292

## 4.8 File Conversion Tool Settings

This dialog is enabled in instruments equipped with option Differential GPS (R&S SMBV-K110).

To access this dialog, perform one of the following:

1. Select "GNSS > Navigation Data > GNSS/RNSS Configuration > File Conversion Tool".
2. Select "GNSS > Navigation Data > SBAS Configuration > File Conversion Tool".





For an overview information on the provided features, refer to [chapter 3.9.1, "File Conversion Tool"](#), on page 37.

See also:

- ["To load and convert EMS files"](#) on page 228
- ["To load and convert NSTB files"](#) on page 230
- ["To load, convert and use the NSTB files to generate GPS almanac and RINEX files"](#) on page 231
- ["To merge multiple ionospheric grid files"](#) on page 231

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**Conversion Mode**

Defines the output format of the converted files.

Available are:

- "EMS to SBAS Files (EGNOS)"  
see ["To load and convert EMS files"](#) on page 228
- "NSTB to SBAS Files (WAAS)"  
see ["To load and convert NSTB files"](#) on page 230
- "NSTB to GPS Almanac and RINEX"  
see ["To load, convert and use the NSTB files to generate GPS almanac and RINEX files"](#) on page 231
- "Merge multiple RINEX files"
- "Merge multiple Ionospheric Grid files"  
see ["To merge multiple ionospheric grid files"](#) on page 231

**Input Files**

Standard file handling functions.

- Use the "Add File" function to select and load a predefined or user specific file of file type as defined with the parameter [Conversion Mode](#).
- Use the "Add Directory" function to load a set of file in one step.
- When a file is loaded, its "File Name" and "Start/End Date and Time" are retrieved and displayed.
- To remove a file or all files, select it and select "Remove" or "Remove All".

See also ["To load and convert EMS files"](#) on page 228.

**Output Files**

Provides settings of the converted file.

- "Base Filename" Add a file prefix in the filename of the converted files.
- "Directory" Sets the directory the converted files are stored in.
- "Source PRN" For \*.ems and \*.nstb files, sets the PRN, i.e. the file, form that the correction data is extracted.  
See also ["To load and convert EMS files"](#) on page 228.

- "Iono Grid Sampling Period, s"  
For \*.ems and \*.nsth files, sets the resolution of the generated ionospheric grid file.  
The "Iono Grid Sampling Period = 1 s" corresponds to the real world data, but the generated \*.ion\_grid file is big in size.  
The default value is a resolution, that is sufficient for test purposes, maintains the size of the output file and is a multiple of the default "Period", see ["SBAS message files table"](#) on page 92.
- "Convert Files" Triggers the instrument to convert the input files.  
A list of the generated files confirms that the operation is completed.
- "Set EGNOS/WAAS Configuration"  
Applies automatically the output files as SBAS messages files in the [SBAS Configuration Settings](#) dialog.  
See also ["To load and convert EMS files"](#) on page 228.
- "Set GPS/RINEX Configuration"  
Applies automatically the generated RINEX files in the "Almanac/RINEX" dialog.  
See also ["To load and convert NSTB files"](#) on page 230.
- "Set Atmospheric Configuration"  
Applies automatically the generated Ionospheric files in the [Atmospheric Configuration Settings](#) dialog.  
See also ["To merge multiple ionospheric grid files"](#) on page 231.

## 4.9 SBAS Configuration Settings

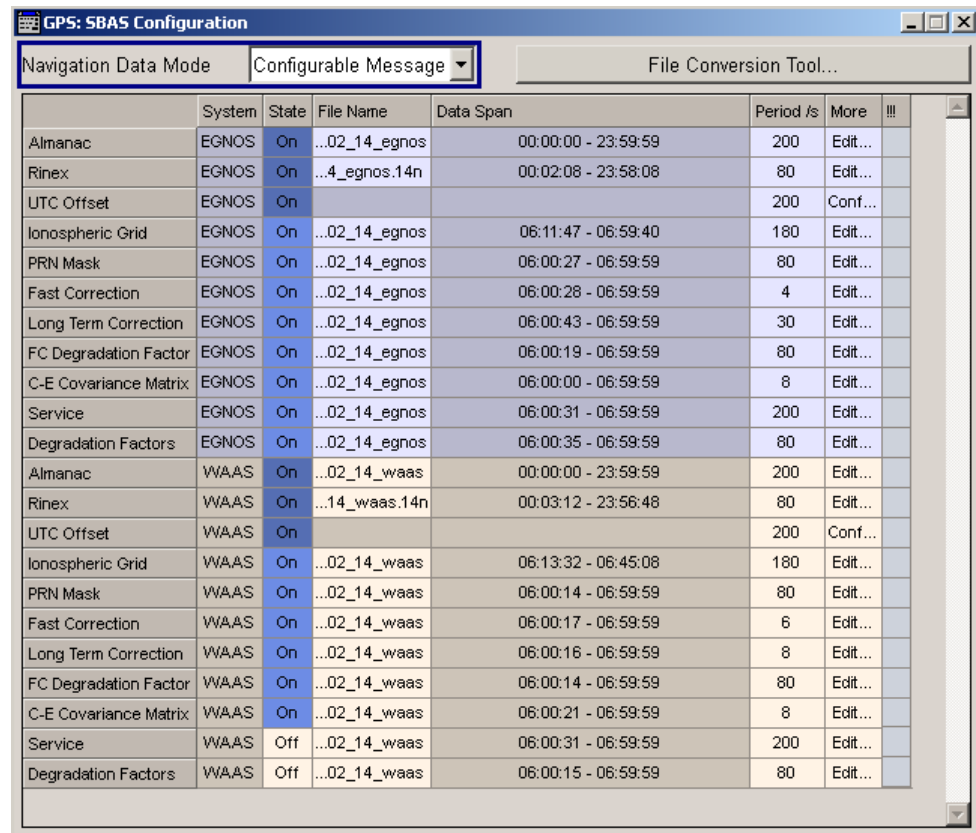
This dialog is enabled in instruments equipped with option Differential GPS (R&S SMBV-K110).

For an overview information on the provided features, refer to [chapter 3.9.2, "SBAS Configuration"](#), on page 38.

### To access the "SBAS Configuration" dialog

1. Select "GNSS > General > GNSS/RNSS Configuration".
2. Enable at least one "Augmentation System".
3. Select "GNSS > General > SBAS Configuration".
4. Select "Navigation Data Mode > Configurable Message"  
For description on the provided settings when using the raw SBAS files, see [chapter 4.9.14, "EGNOS and WAAS Navigation Data as Raw Files"](#), on page 112.

5. To enable the type of correction data to be generated, enable it, e.g. "Ionospheric Correction > State > On".



In this dialog, you select which SBAS messages (see [table 3-4](#)) will be generated and define the content of the messages.

The dialog displays the augmentation system that are enabled in the [GNSS System Configuration](#) dialog. The subset of SBAS message files belonging to one augmentation system are displayed with the same color in the [SBAS message files table](#).

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- [Timing Setting](#).....94
- [Almanac Configuration](#).....97
- [Rinex File Configuration](#).....98
- [Ionospheric Grid File Configuration](#).....99
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- [Fast Correction File Configuration](#).....102
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## 4.9.1 SBAS General Settings

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### Navigation Data Mode

Defines whether the navigation data is defined as SBAS message files or retrieved from the loaded raw files.

See [chapter 4.9.14, "EGNOS and WAAS Navigation Data as Raw Files"](#), on page 112.

Remote command:

`<subsystem>:NAVigation:SBAS:NDMode` on page 303

### File Conversion Tool

In instruments equipped with option R&S SMBV-K110, accesses the [File Conversion Tool Settings](#) dialog.

### SBAS message files table

Lists the SBAS message files that will be generated. Different colors indicate the subset of message files belonging to the same augmentation system.

#### Note:

If the SBAS message files table is empty, enable at least one SBAS augmentation system.

For example, set "GNSS System Configuration > EGNOS > On" (see [Activate Systems](#)).

Each SBAS message file is defined with:

"System"	Indicates the "Augmentation System" the SBAS message files belong to.
"State"	Enables generation of the particular SBAS correction data per enabled "Augmentation System". Almanac and Rinex files are required for the navigation services of SBAS and are always enabled.

Remote command:

`<subsystem>:NAVigation:SBAS:<RegSystem>:<MessageFile>:STATE`  
on page 304

"File name"	Accesses the standard "File Select" dialog to select predefined or user defined files. If a file is selected, displayed is the file name and file path.
-------------	--

Remote command:

`<subsystem>:NAVigation:SBAS:<RegSystem>:<MessageFile>:FILE`  
on page 304

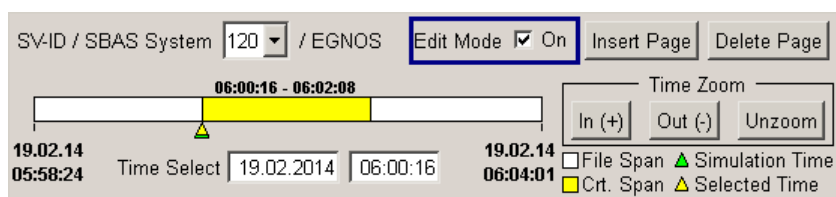
"Span"	Displays information on the time span the file is defined for.
--------	--

Remote command:

`<subsystem>:NAVigation:SBAS:<RegSystem>:<MessageFile>:SPAN`  
on page 305

- "Period" Sets the periodicity of the SBAS message, i.e. the time interval after that a message is retransmitted.  
The selected value must not exceed the time out specified in the specification [RTCA MOPS DO-229](#).  
See also:
- [chapter 4.9.2, "Timing Setting"](#), on page 94
  - [chapter A.4.2, "Interpolation and Correction Data Sampling Principle"](#), on page 435
- Remote command:  
`<subsystem>:NAVigation:SBAS:<RegSystem>:<MessageFile>:PERiod`  
on page 306
- "Edit" Accesses the dialog with further settings to configure the content of the SBAS files.  
See:
- [chapter 4.9.3, "Almanac Configuration"](#), on page 97
  - [chapter 4.9.4, "Rinex File Configuration"](#), on page 98
  - [chapter 4.6, "Time Conversion Configuration Settings"](#), on page 83
  - [chapter 4.9.5, "Ionospheric Grid File Configuration"](#), on page 99
  - [chapter 4.9.6, "PRN Mask File Configuration"](#), on page 101
  - [chapter 4.9.7, "Fast Correction File Configuration"](#), on page 102
  - [chapter 4.9.8, "Long Term Correction File Configuration"](#), on page 104
  - [chapter 4.9.9, "Fast Correction Degradation Factor Configuration"](#), on page 105
  - [chapter 4.9.10, "Clock-Ephemeris Covariance Matrix Configuration"](#), on page 107
  - [chapter 4.9.11, "Service Configuration"](#), on page 107
  - [chapter 4.9.12, "Degradation Factors Configuration"](#), on page 109
- "Conflict" The software compares the time span of the selected file and the current simulation time and indicates a conflict, in one of the following cases:
- if [Time Projection of Navigation Data](#) > Off and the selected simulation date is outside the time span of the selected file
  - if [Time Projection of Navigation Data](#) > On and the time span of selected file is shorter than 24 hours.

## 4.9.2 Timing Setting



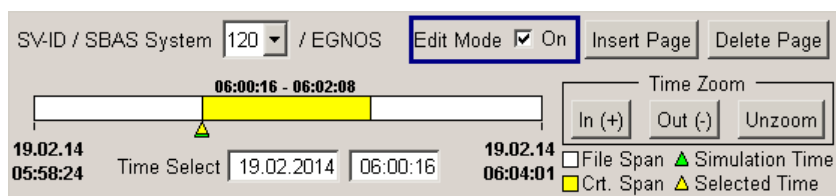
Navigation and correction data are time specific information. While configuring any of the SBAS message files, you have to define the SBAS parameters for a specific time span.

Three parameter types define the content of the SBAS messages:

- the [Time Projection of Navigation Data](#) defines how the timing information in the used SBAS file is interpreted, that is whether it is used or ignored
- the [Time span](#) defines how long the SBAS parameters are valid
- the parameter "Period" defines how often a SBAS message is retransmitted within a [Time span](#).

### Time span

There is a time slider in each SBAS dialog. With this time slider, you can "scroll" over the time so that you can edit for example the navigation data at a particular time. The time span, as retrieved from the used file, is displayed as a white time bar with its start and end date and time; the yellow bar indicates the current time span for that the SBAS parameters apply.



**Fig. 4-5: Timing settings if "Repeat SBAS data daily (ignore date) > Off" (Date and Time indication)**

- If the simulation time reaches the end of the time span, the correction data of the last time page is applied.  
If the select simulation time lays before the defined time span, the correction data of the first time page is applied.
- Logically, if the parameter [Time Projection of Navigation Data](#) is enabled, the instrument ignores the date entry in the files and repeats the SBAS data daily. The 24-hours time span, loaded either from the files or generated with as described above, is repeated infinitely.

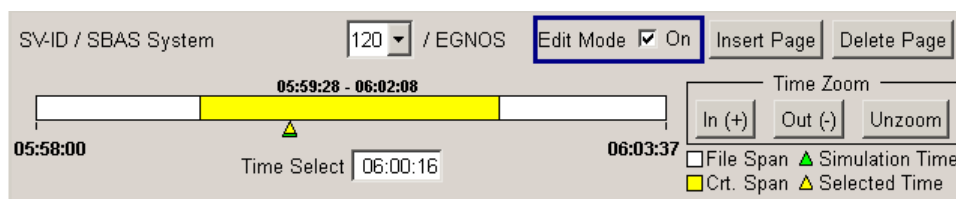


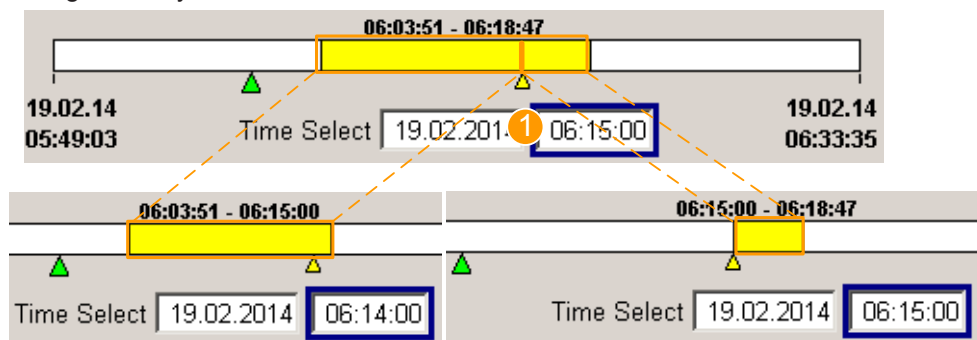
Fig. 4-6: Timing settings if "Repeat SBAS data daily (ignore date) > On" (Time indication only)

Note that the ionospheric data is repeated every 24 hours but the correction data is repeated every two GPS orbit revolutions, i.e. every 23h 56min. Provided that the selected GPS almanac file is for a date within the time span of the SBAS files, this repetition ensures that the same PRNs are monitored even though the date changes.

If the selected almanac does not cover the time span of the SBAS files, it is not necessary to change the almanac file. It is sufficient to set the [Simulation Start Time](#) and enable the parameter [Time Projection of Navigation Data](#). The almanac is projected to the selected simulation date, so that past and future dates can be simulated.

Use the following functions to define the SBAS parameters for a specific time or for a period of time:

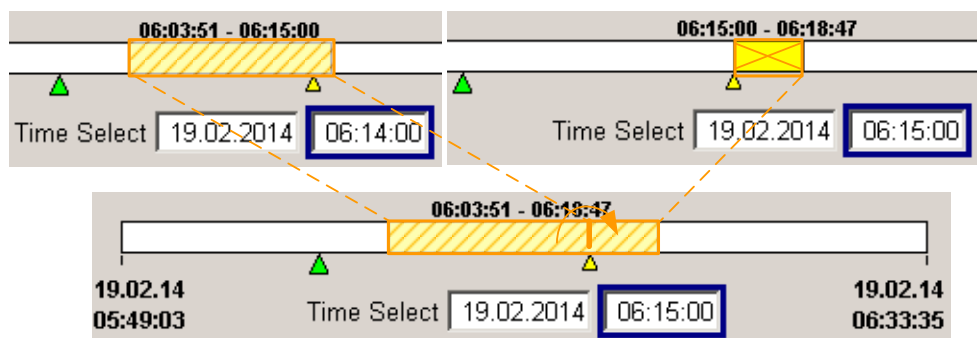
- Set the "Time Select" value to define the start time (and the time span) the SBAS parameters apply for
- Zoom in to display the time scale in greater detail
- Zoom out or unzoom to display the complete time scale and get an overview
- Insert a page to split the time span and define parameter changers at more precise time granularity



1 = "Time Select" defines the page split edge

The minimum split granularity is equal to the selected "Period", see ["SBAS message files table"](#) on page 92.

- Remove pages to merge correction data



Provided settings:

SV-ID / SBAS System, PRN.....	96
Edit Mode.....	96
File Name.....	96
Insert/Delete Page.....	96
Time Scale, Time Select.....	96
Time Zoom.....	96

**SV-ID / SBAS System, PRN**

Displays the SV-ID number or the PRN number and the SBAS Regional System the current PRN belongs to.

**Edit Mode**

Enables the navigation data parameters for editing.

The predefined files are read only. Create a new file to change the parameters.

An asterisk (\*) symbol behind the file name indicates unsaved settings.

**File Name**

Displays the name of the current used file, see "SBAS message files table" on page 92.

An asterisk (\*) symbol behind the file name indicates unsaved settings.

**Insert/Delete Page**

"Insert Page" splits the current page at the current "Time Select" moment.

"Delete Page" removes the current page; the time span of the previous page is extended and the content of the new page corresponds to the content of the previous page.

**Time Scale, Time Select**

Displays a time scale (the white bar) and the current time span (the yellow bar).

The "Time Select" indicates the selected time (yellow pointer), where es the simulation time (the green pointer) is set with the navigation data parameter [Simulation Start Time](#).

If the parameter [Time Projection of Navigation Data](#) is enabled, the date is irrelevant and its indication is suppressed.

**Time Zoom**

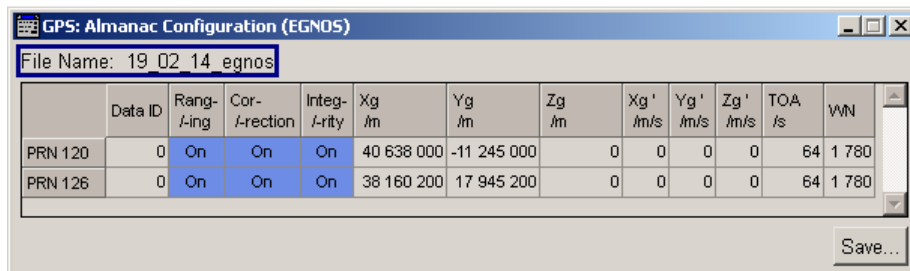
Zooms in and out on the time scale.



### 4.9.3 Almanac Configuration

To access this dialog:

- ▶ In the "SBAS Configuration" dialog, for "System > EGNOS", select "Almanac > Edit".



Almanacs for up three satellites (PRNs) are carried by one message of MT 17. This message provides the user with information on the GEO's location, the services they provide and their health and status. The MT 17 should help the user to decide which satellite provides the best service.

#### Almanac Parameters

Comprises the MT 17 almanac parameters.

See also "[Almanac Configuration](#)" on page 86.

Parameter	Description
PRN	PRN Number
Data ID	The data ID is 00
Ranging, Correction, Integrity	Health and status indication
$X_G/Y_G/Z_G$ , m	ECEF coordinates of the GEO satellite
$X_G/Y_G/Z_G$ ROC (Rate of Change), m/s	Rate of change vector in ECEF (first derivative with respect to time)
TOA, s	Time of Applicability ( $t_0$ )
WN	Week Number

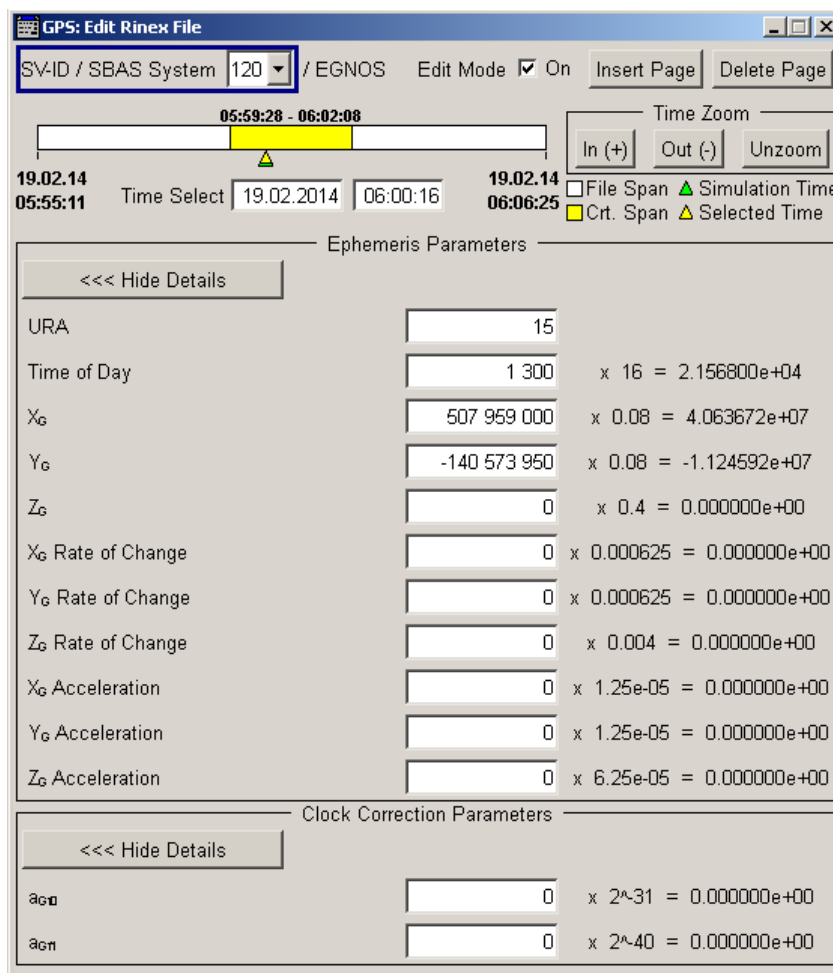
Remote command:

n.a.

### 4.9.4 Rinex File Configuration

To access this dialog:

- In the "SBAS Configuration" dialog, for "System > EGNOS", select "Rinex > Edit".



Provided are the message type 9 (MT 9) GEO navigation message parameters, divided into two groups. The MT 9 carries position, velocity and acceleration information on the GEO satellite in Cartesian ECEF (Earth Centered Earth Fixed) coordinates.

Provided settings:

[Ephemeris Parameters](#)..... 98

[Clock Correction Parameters](#)..... 99

#### Ephemeris Parameters

Comprises the MT 9 ephemeris parameters.

Parameter	Description
URA	User Range Accuracy (accuracy exponent)
Time of Day	time of applicability $t_0$
$X_G/Y_G/Z_G$	ECEF coordinates of the GEO satellite
$X_G/Y_G/Z_G$ Rate of Change	Rate of change vector in ECEF (first derivative with respect to time)
$X_G/Y_G/Z_G$ Acceleration	Acceleration vector in ECEF (the second derivative with respect to time)

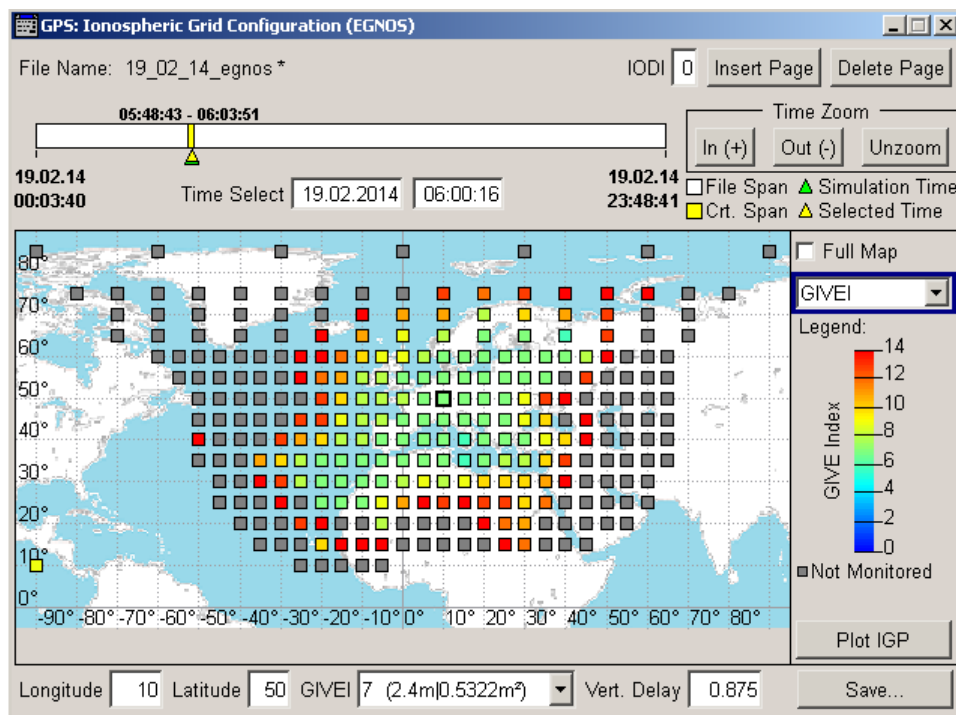
**Clock Correction Parameters**

Sets the parameters  $a_{Gf0}$  and  $a_{Gf1}$ , that is the estimates of the time offset and drift with respect to SBAS network time.

**4.9.5 Ionospheric Grid File Configuration**

To access this dialog:

1. In the "SBAS Configuration" dialog, select "SBAS General Settings > Ionospheric Correction > On".  
See also "To access the "SBAS Configuration" dialog" on page 90
2. For "System > EGNOS", select "Ionospheric Grid > Edit".



The ionospheric grid file is an XML file that contains the ionospheric delay correction parameters of MT 26 and the ionospheric grid mask, that is the grid of all monitored squares, of MT 18.

MT 26 carries information on the vertical delays and their accuracy ( $\sigma^2_{\text{GIVE}}$ ) at geographically defined ionospheric grid points (IGP).

The "GIVEI/Vertical Delay" values are displayed as a color coded grid. Not monitored (NM) IGPs are indicated in grey.

See also ["To change the ionospheric correction data"](#) on page 235.

Provided settings:

IODI.....	100
Longitude, Latitude.....	100
GIVEI, Vertical Delay.....	100
Full Map.....	100
View type of the ionospheric grid.....	100
Save.....	100

#### **IODI**

Sets the *initial* Issue of Data ionospheric mask. The IOD is the incremental identifier of the transmission.

The IODI is internally increased every 240 seconds with the transmission of each page.

#### **Longitude, Latitude**

Displays the geographic coordinated of the current selected IGP.

#### **GIVEI, Vertical Delay**

Sets the Grid Ionospheric Vertical Error Indicator GIVEI and Vertical Delay values of the current IGP.

See also [chapter 4.9.5, "Ionospheric Grid File Configuration"](#), on page 99.

#### **Full Map**

If enabled, the complete word's map is displayed.

#### **View type of the ionospheric grid**

Sets the parameter, Grid Ionospheric Vertical Error Indicator GIVEI or Vertical Delay, which ionospheric grid is displayed.

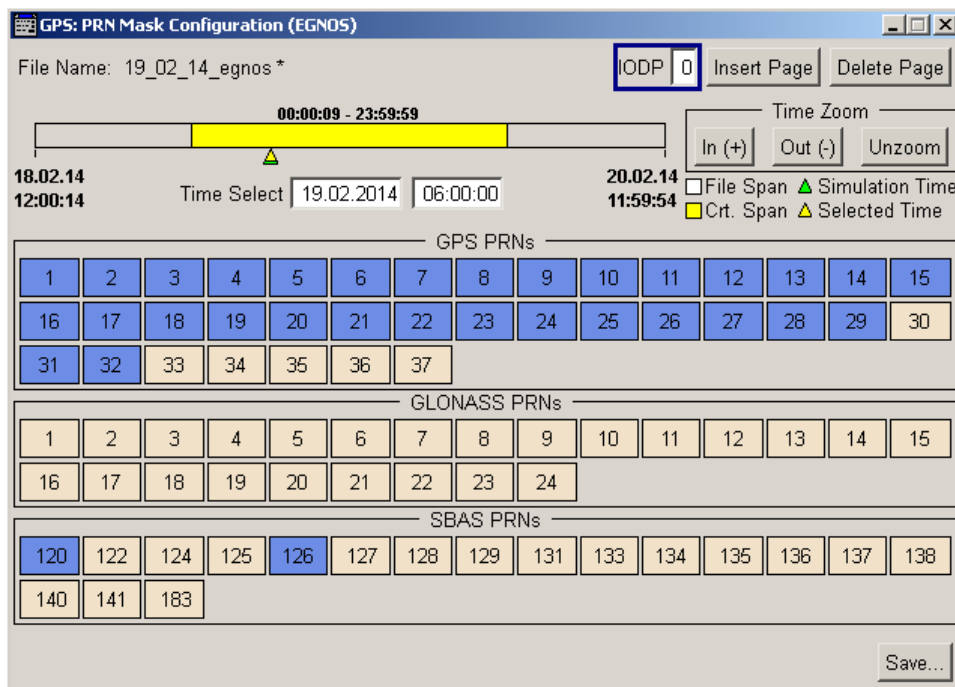
#### **Save**

Accesses the standard "File Select" dialog to store the file.

### 4.9.6 PRN Mask File Configuration

To access this dialog:

1. In the "SBAS Configuration" dialog, select "SBAS General Settings > PRN Mask > On".  
See also "To access the "SBAS Configuration" dialog" on page 90
2. For "System > EGNOS", select "PRN > Edit".



The PRN Mask file is an XML file containing a list of the SVs for which the fast and long term correction data apply.

Provided settings:

GNSS/SBAS PRNs..... 101  
 IODP..... 101

#### GNSS/SBAS PRNs

To enable a SV ID/PRN, select it. Up to 51 satellites can be enabled, where an enabled satellite is indicated with blue color.

It is, however, not necessary to change the PRN mask because currently, only GPS and SBAB satellites are monitored; EGNOS and WAAS do not change the PRN mask. In the future, when more GNSS systems will be augmented, changing the PRN mask would be necessary in order to define the 51 monitored SV ID/PRNs.

#### IODP

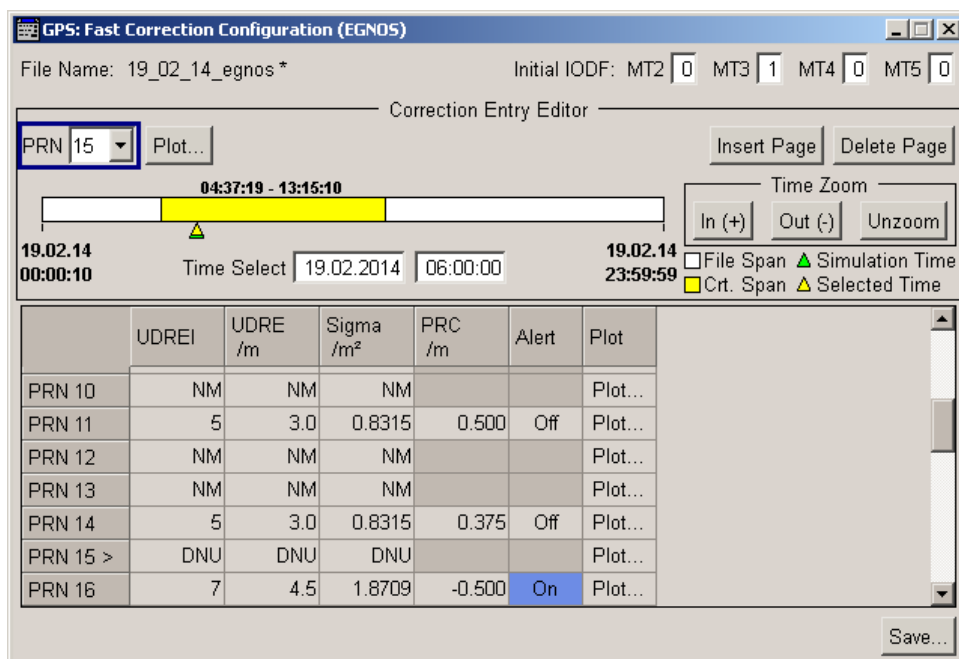
Sets the Issue of Data PRN mask parameter.

To simulate mask handover, select a specific time span and reconfigure the PRN mask.

### 4.9.7 Fast Correction File Configuration

To access this dialog:

1. In the "SBAS Configuration" dialog, select "SBAS General Settings > Fast Corrections > On".  
See also "To access the "SBAS Configuration" dialog" on page 90
2. For "System > EGNOS", select "Fast Corrections > Edit".



The fast correction file is an XML file that contains the fast correction parameters of MT 2, 3, 4 and 5. MT 2, 3, 4 and 5 carry information on the issue of data fast correction (IODF), User Differential Range Error Indicator (UDREI) and the UDRE, the coarse integrity "use/don't use" alarm ("Alert" flag) and the Pseudo Range Correction (PRC) per PRN for a set of up to 13 PRNs.

Table 4-6: UDRE,  $\sigma^2_{UDRE}$  and GPS URA as a function of UDREI

UDREI	UDRE, m	$\sigma^2_{UDRE}$ , m <sup>2</sup>	GPS URA*
0	0.75	0.0520	2
1	1.0	0.0924	2
2	1.25	0.1444	2
3	1.75	0.2830	2
4	2.25	0.4678	2

UDREI	UDRE, m	$\sigma^2_{UDRE}$ , m <sup>2</sup>	GPS URA*
5	3.0	0.8315	3
6	3.75	1.2992	3
7	4.5	1.8709	4
8	5.25	2.5465	5
9	6.0	3.3260	5
10	7.5	5.1968	5
11	15.0	20.7870	15
12	50.0	230.9661	10
13	150	2078.695	11
14	not monitored ("NM")	not monitored ("NM")	5** (average accuracy)
15	Do not use ("DNU")	Do not use ("DNU")	15 Do not use ("DNU")

\*) If [Sync IOD/URA from SBAS Data](#) is enabled, the [GPS URA](#) values are automatically set.

\*\*\*) for UDREI = 14 (not monitored), the GPS URA value is set to an average accuracy, i.e. URA = 5.

See also:

- ["To configure the fast correction data and simulate a short term alarm"](#) on page 233.
- ["To vary and apply pseudorange corrections \(PRC\) that follow a linear ramp function"](#) on page 236.

Provided settings:

[IODF](#)..... 103  
[PRN](#)..... 104  
[Fast Correction Data Parameters](#)..... 104

**IODF**

Sets the *initial* Issue of Data Fast Correction (IODF) parameter per message type (MT).

This parameter is used to prevent erroneous application of  $\sigma^2_{UDRE}$ .

An alarm can be simulated in one of the following ways:

- with the parameter "Alert > On"; the corresponding IODF is internally set to 3, the displayed value is not updated.
- in the \*.f\_corr file, add an ALERT = "ON" tag for the particular PRN, e.g.  

```
<F_CORR_ENTRY DateTime = "14-02-19 11:24:07" PRN = " 2" PRC = " 0.875" UDREI = " 3.00" ALERT = "ON"/>
```

See also ["To configure the fast correction data and simulate a short term alarm"](#) on page 233.

**PRN**

Selects the PRN the fast correction data applies for.

**Fast Correction Data Parameters**

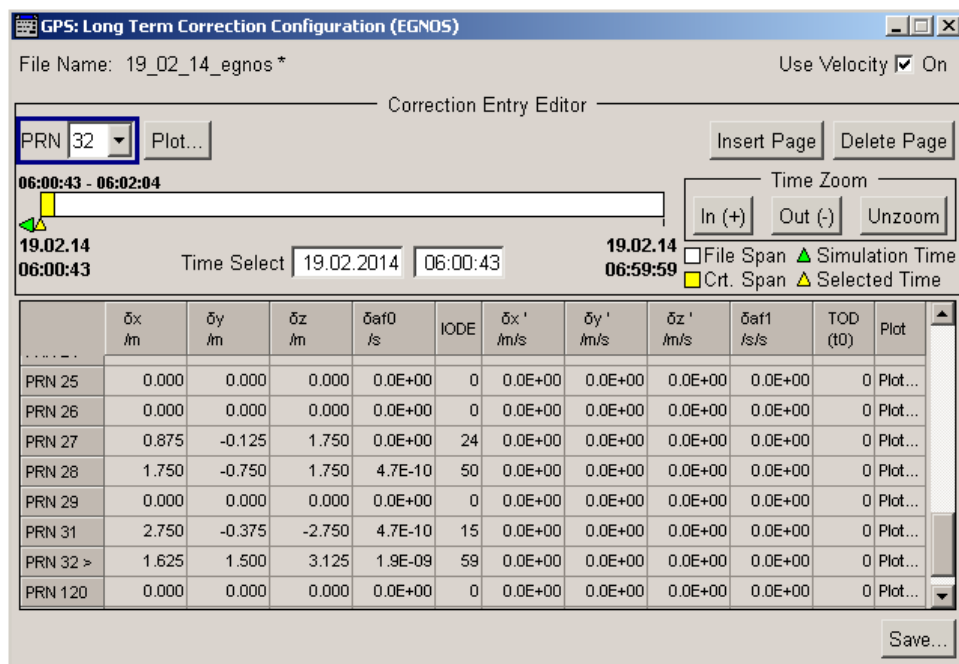
Sets the fast correction data parameters per PRN.

- "UDREI" User Differential Range Error Indicator
- "UDRE" User Differential Range Error value
- "Sigma" UDRE accuracy  $\sigma^2_{UDRE}$ , see [table 4-6](#).
- "PRC" Pseudo Range Corrections  
See ["To vary and apply pseudorange corrections \(PRC\) that follow a linear ramp function"](#) on page 236.
- "Alert" If enabled, simulates a short term alarm, i.e. a coarse integrity "don't use" information.  
See ["To configure the fast correction data and simulate a short term alarm"](#) on page 233.

**4.9.8 Long Term Correction File Configuration**

To access this dialog:

1. In the "SBAS Configuration", select "SBAS General Settings > Long Term Corrections > On".  
See also ["To access the "SBAS Configuration" dialog"](#) on page 90
2. For "System > EGNOS", select "Long Term Correction > Edit".





The long term correction file is an XML file that contains the fast correction parameters of MT 1, 24 and 25.

MT 25 and the long term data set part of MT 24 carry error estimates for slow varying satellite ephemeris (SV location) and clock errors, including velocity and drift errors.

See also:

- ["To configure the long term correction data"](#) on page 233.
- ["To configure clock or satellite position errors"](#) on page 238.

Provided settings:

<a href="#">PRN</a> .....	105
<a href="#">Use Velocity</a> .....	105
<a href="#">Long Term Correction Data Parameters</a> .....	105

#### PRN

Selects the PRN the long term correction data applies for.

#### Use Velocity

Enables signaling of the velocity and clock drift errors.

#### Long Term Correction Data Parameters

Sets the long term correction data parameters per PRN.

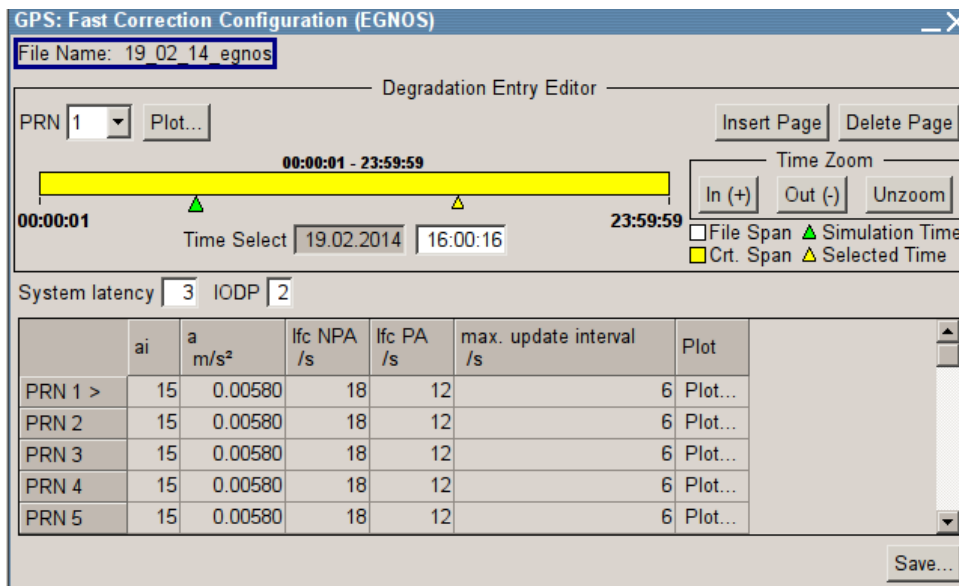
" $\delta x/\delta y/\delta z$ , m"	Correction information on the GEO satellite location in WGS-84 coordinates.
" $\delta af0$ , s"	Clock offset error correction
"IODE"	Issue of Data Ephemeris (IODE) <b>Note:</b> The IOD must match the IODC and IODE in the navigation message of the GPS satellite. To automatically synchronize the required values and ensure integrity, enable the parameter <a href="#">Sync IOD/URA from SBAS Data</a> . See also <a href="#">"To configure the long term correction data"</a> on page 233.
" $\delta x'/\delta y'/\delta z'$ "	Rate of change correction vector If the "Use Velocity > Off", the rate of change vector is set to 0.
" $\delta af1$ "	Clock drift error correction.
"TOD"	Time of Day, i.e. the time span for that the " $\delta x'/\delta y'/\delta z'$ " and " $\delta af1$ " are applied.

### 4.9.9 Fast Correction Degradation Factor Configuration

To access this dialog:

1. In the "SBAS Configuration", select "SBAS General Settings > FC Degradation Factor > On".  
See also ["To access the "SBAS Configuration" dialog"](#) on page 90

2. For "System > EGNOS", select "FC Degradation Factor > Edit".



The fast correction degradation factor ("a"), the applicable IODP and the system latency time ( $t_{lat}$ ) are carried by the MT 7.

Provided settings:

System latency..... 106  
 IODP..... 106  
 Fast Correction Degradation Factor Parameters..... 106

**System latency**

Sets the system latency time  $t_{lat}$ .

**IODP**

Sets the IODP.

**Fast Correction Degradation Factor Parameters**

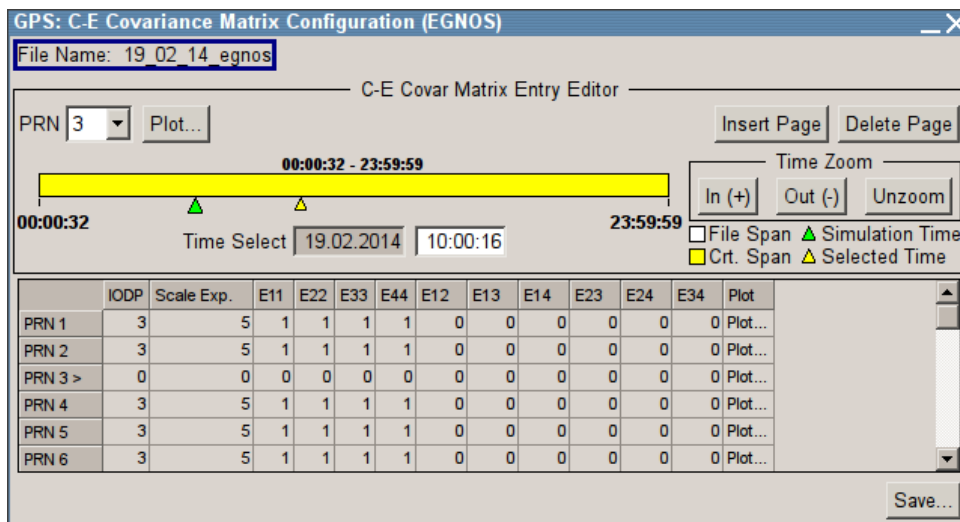
Sets the fast correction degradation factor per PRN.

- " $a_i$ " Fast correction degradation factor indicator  
This value of this parameter determines the values of the other degradation parameters.
- "a, m/s<sup>2</sup>" Fast correction degradation factor.
- " $l_{fc}$  NPA, s" User time-out interval, En Route through LANV Approach.
- " $l_{fc}$  PA, s" User time-out interval, En Route through LANV/VAN, LV, LP Approach.
- "Max. update interval, s"  
Maximum fast correction update interval.

### 4.9.10 Clock-Ephemeris Covariance Matrix Configuration

To access this dialog:

1. In the "SBAS Configuration", select "SBAS General Settings > C-E Covariance Matrix > On".  
See also "To access the "SBAS Configuration" dialog" on page 90
2. For "System > EGNOS", select "C-E Covariance Matrix > Edit".



The relative covariance matrix for clock and ephemeris errors is transmitted by MT 28.

Provided settings:

#### Clock-Ephemeris Covariance Matrix Elements

Sets the C-E covariance matrix elements per PRN.

"IODP" IODP for the corresponding PRN as set in MT 1, see [chapter 4.9.6, "PRN Mask File Configuration"](#), on page 101.

"Scale Exp." Scale exponent

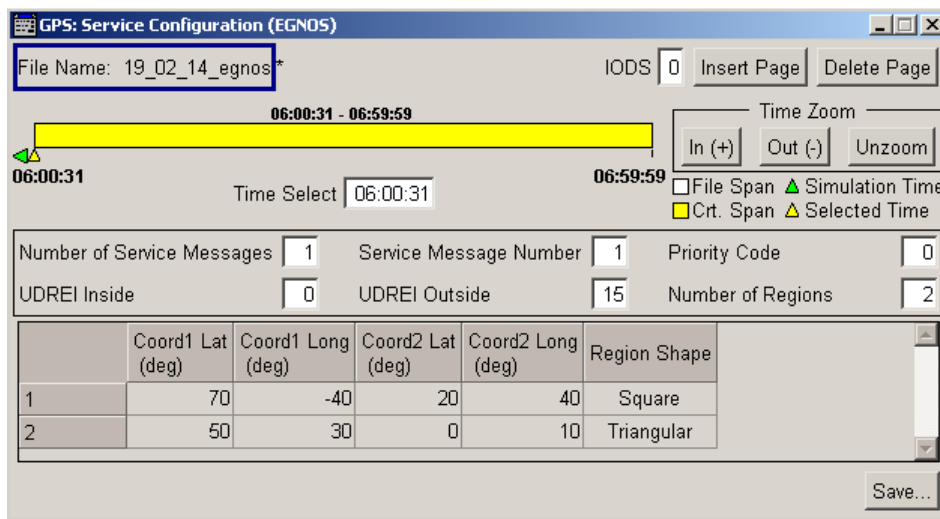
"E11, E22, ... E44" 10 non-zero elements  $E_{1,1}$  to  $E_{4,4}$  of the covariance matrix.

### 4.9.11 Service Configuration

To access this dialog:

1. In the "SBAS Configuration", select "SBAS General Settings > Service > On".  
See also "To access the "SBAS Configuration" dialog" on page 90

2. For "System > EGNOS", select "Service > Edit".



The service information is transmitted by MT 27.

Provided settings:

IODS..... 108

Number of Service Messages..... 108

Service Message Number..... 108

Priority Code..... 108

UDREI Inside/Outside..... 108

Number of Regions..... 109

Coordinates and shape of each of up to 5 regions..... 109

**IODS**

Sets the Issue of Data, Service.

**Number of Service Messages**

Defines the total number of unique Type 27 messages for the selected IODS.

**Service Message Number**

Sequential number that indicates a service message.

**Priority Code**

If the regions defined in more than messages overlap, this parameter indicates the message priority. The UDREI values specified in the service message with higher priority are used.

**UDREI Inside/Outside**

Specifies the δUDREI factors.

The "UDREI Inside" factor applies on users within any of the specified regions; the "UDREI Outside", to the users that are outside.

See [Coordinates and shape of each of up to 5 regions](#).

**Number of Regions**

Sets the number of geographic regions.

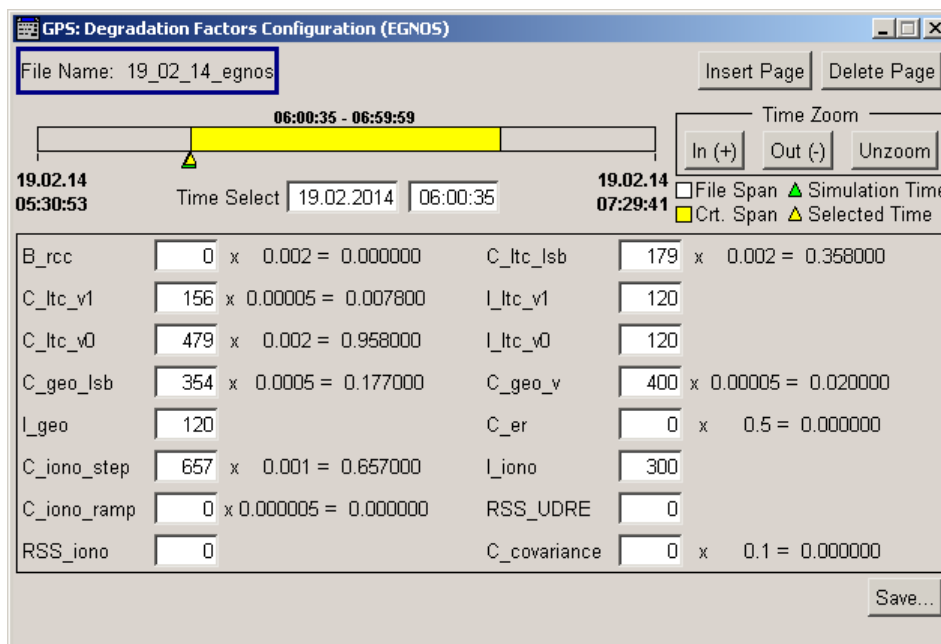
**Coordinates and shape of each of up to 5 regions**

Geographic regions are closed polygons, described with their shape ("Triangular" or "Square") and the coordinates ("Latitude" and "Longitude") of the corners.

**4.9.12 Degradation Factors Configuration**

To access this dialog:

1. In the "SBAS Configuration", select "SBAS General Settings > Degradation Factors > On".  
See also ["To access the "SBAS Configuration" dialog"](#) on page 90
2. For "System > EGNOS", select "Degradation Factors > Edit".



The dialog comprises the optional global degradation factors as specified in [RTCA MOPS DO-229](#). The degradation factors are broadcasted in MT 10.

Provided settings:

B_rrc.....	110
C_ltc_v1, C_ltc_lsb, I_ltc_v1, C_ltc_v0, I_ltc_v0.....	110
I_geo, C_geo_lsb, C_geo_v.....	110
C_er.....	110
RSS_iono, C_iono_step, C_geo_v, I_iono.....	110
RSS_UDRE.....	110
C_covariance.....	110

**B\_rrc**

Sets the range-rate correction degradation parameter  $B_{rrc}$ .

**C\_ltc\_v1, C\_ltc\_lsb, I\_ltc\_v1, C\_ltc\_v0, I\_ltc\_v0**

Set the degradation parameters for long term correction:

"I<sub>ltc\_v1</sub>, C<sub>ltc\_v1</sub>, C<sub>ltc\_lsb</sub>" Apply if both offset and velocity are included in the messages (i.e. MT 24 and MT 25 with [Use Velocity](#) = On).

"I<sub>ltc\_v0</sub>, C<sub>ltc\_v0</sub>" Apply if only offset is included in the messages (i.e. Velocity Code = 0).

**I\_geo, C\_geo\_lsb, C\_geo\_v**

Set the degradation parameters for GEO navigation message data  $I_{geo}$ ,  $C_{geo\_lsb}$  and  $C_{geo\_v}$ .

**C\_er**

Sets the extra "catch-all" degradation parameter  $C_{er}$ .

**RSS\_iono, C\_iono\_step, C\_geo\_v, I\_iono**

Define the degradation of the ionospheric corrections, as a function of:

"RSS<sub>iono</sub>" The root-sum-square flag.

"C<sub>iono\_ramp</sub>, I<sub>iono</sub>" The rate of change and the minimum update interval for ionospheric corrections.

"C<sub>iono\_step</sub>" The bound on difference between successive ionospheric grid delay values.

**RSS\_UDRE**

Sets the root-sum-square flag  $RSS_{UDRE}$ , necessary to calculate the fast and long term correction degradation.

**C\_covariance**

Sets the degradation factor  $C_{covariance}$ , necessary to calculate the additional term  $\epsilon_c$  that is broadcasted in MT 28.

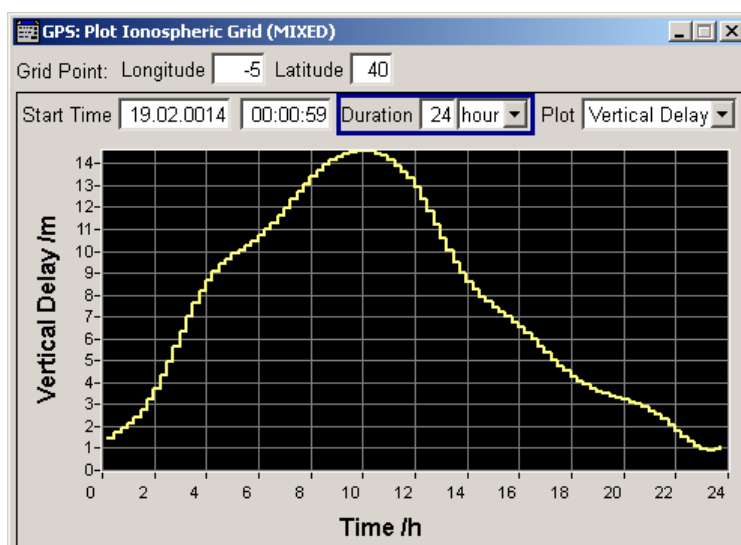
### 4.9.13 Visualizing the Parameters Variation Over Time

Each of the files describing the "Ionospheric Grid", the "Fast Correction", the "Long-term Correction", the "FC Degradation Factor" and the "C-E Covariance Matrix" data carries information on one or more parameters that may vary over time.

For each of this parameters, you can access the dedicated "Plot" graph to visualize the parameter variation over time.

#### To access the plot graphs

1. In the "Ionospheric Grid Configuration" dialog, select "Plot IGP".

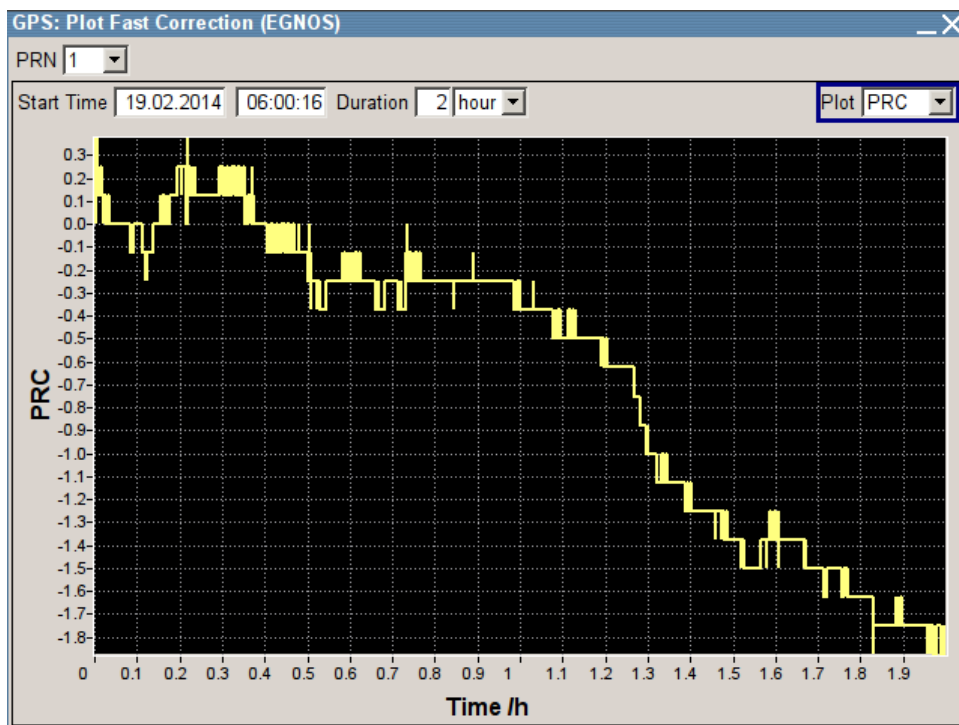


**Fig. 4-7: Example: 24h Vertical Delay distribution for a given position (the curve shows a typical NeQuick distribution)**

See also:

- [NeQuick Parameters](#)
- ["Klobuchar Ionospheric Navigation Parameters"](#) on page 160

2. In the "Fast/Log Term Correction Configuration" dialogs, select a "PRN" or a parameter and select "Plot".



The plot graph visualizes the parameter variation for a particular "Grid Point" or "PRN" but you can change the "Grid Point/PRN" and the visualized parameter subsequently.

Provided settings:

Grid Point, PRN.....	112
Start Data and Time, Duration.....	112
Plot.....	112

**Grid Point, PRN**

Sets the "Longitude" and "Latitude" of the ionospheric grid point or the "PRN" number for that the parameter variation is displayed.

**Start Data and Time, Duration**

Sets the displayed time span, i.e. defines the scale on the X-axis.

**Plot**

Sets the parameter which variation is plotted, i.e. determines the units on the Y-axis.

**4.9.14 EGNOS and WAAS Navigation Data as Raw Files**

For the EGNOS and WAAS SBAS augmentation systems it is possible to download raw files containing the transmitted navigation bits on a specific day, see "EMS files" on page 37 and "NSTB files" on page 37.

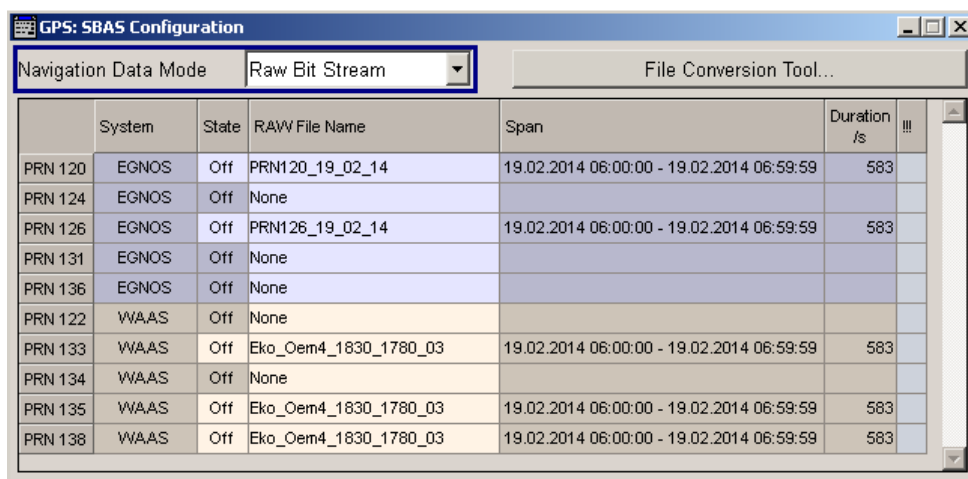
The raw files are files with extension \*.ems and \*.nstb. In this implementation, you can load these raw files and the firmware generates the required SBAS files out of



them. The "Span" information indicates the time span duration the files are valid for. Thus, you can evaluate whether the files are valid for the select GNSS simulation time.

To access the required settings:

1. Select "GNSS > General > GNSS/RNSS Configuration".
2. Enable "Augmentation System > EGNOS or WAAS".
3. Select "GNSS > General > SBAS Configuration".
4. Select "Navigation Data Mode > Raw Bit Stream"



The used raw files are displayed in a table form, where the files belonging to the same regional system use different color. There is one row per PRN.

Provided settings:

[File Conversion Tool](#)..... 113  
[Raw Files Table](#)..... 113

**File Conversion Tool**

In instruments equipped with option R&S SMBV-K110, accesses the [File Conversion Tool Settings](#) dialog.

**Raw Files Table**

Lists the raw files. There is one row per PRN.

Different colors indicate the subset of files belonging to the same regional system.

The following information is displayed per SBAS raw file:

- "PRN" Displays the PRN number the raw file is used for.
- "System" Indicates the "Augmentation System" the to that SBAS message files belong.
- "State" Enables/disables the file.

Remote command:

`<subsystem>:NAVigation:SBAS:<RegSystem>:PRN<ch>:STATe` on page 308

**"Raw File name"**

Accesses the standard "File Select" dialog to select predefined or user defined files.

If a file is selected, displayed is the file name and file path.

## Remote command:

`<subsystem>:NAVigation:SBAS:<RegSystem>:PRN<ch>:FILE` on page 308

**"Span"**

Displays information on the time span the file is valid for.

## Remote command:

`<subsystem>:NAVigation:SBAS:<RegSystem>:PRN<ch>:SPAN` on page 308

**"Duration"**

Duration in seconds

Selected simulation time that is outside of the time span is indicated as "Invalid" duration.

## Remote command:

`<subsystem>:NAVigation:SBAS:<RegSystem>:PRN<ch>:DURation`

on page 307

**"!!!"**

Indicates a conflict.

A conflict occurs, if the selected simulation time is outside the time span covered by the SBAS raw file ("Duration = Invalid") but the "PRN# > State > On".

## 4.10 Satellite Configuration Settings

To access these settings:

1. Select "Baseband > Satellite Navigation" and select the desired satellite standard, e.g. GPS.

2. Select "Satellite Configuration".

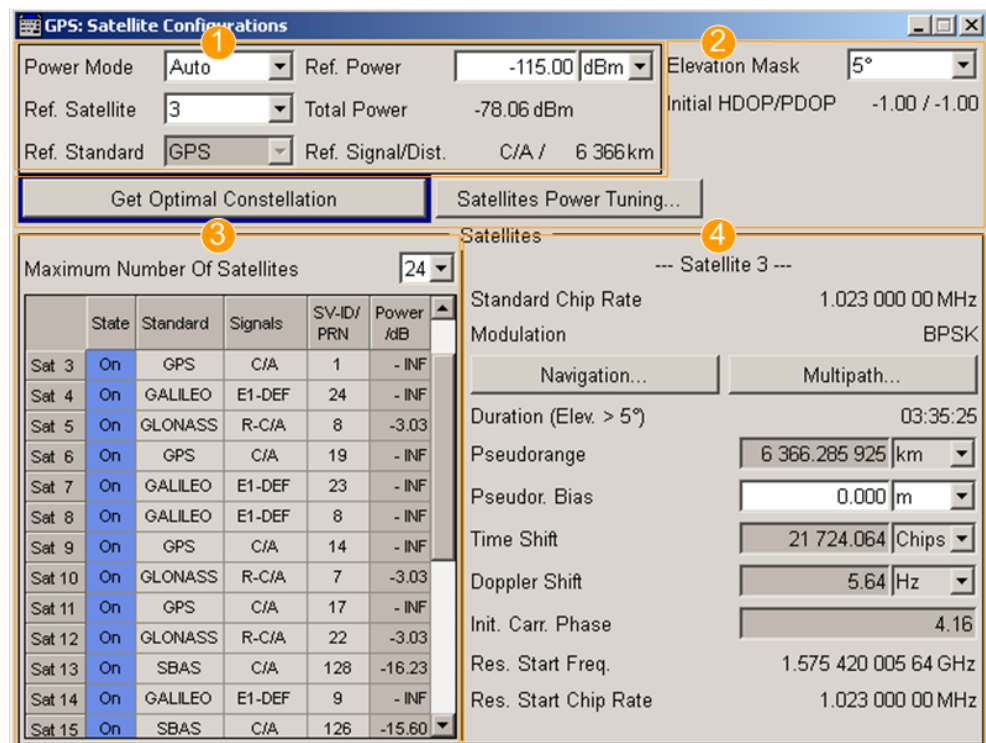


Fig. 4-8: "Satellite Configuration"

- 1 = [chapter 4.10.1, "Power Configuration"](#), on page 115
- 2 = [chapter 4.10.2, "General Satellites Settings"](#), on page 123
- 3 = [chapter 4.10.3, "Configuration of the Satellite Constellation"](#), on page 125
- 4 = [chapter 4.10.4, "Individual Satellite Settings"](#), on page 128

In the "Satellite Configuration" dialog, you can activate and configure the signal simulation of up to 24 satellites. The maximum number of the configurable satellites depends on the installed options.

In static mode, you can configure and enable the additional functions modulation control and signal dynamics, see [chapter 4.10.5, "Modulation Control"](#), on page 132 and [chapter 4.10.6, "Signal Dynamics"](#), on page 133.

### 4.10.1 Power Configuration

This section comprises the power settings. The dynamic power control concept is based on two power modes, the "Auto" and the "User" mode. Use the auto mode if a dynamic automatic power calculation is preferred. For flexible real time configuration of the power settings per satellite, enable the user mode.

The [table 4-7](#) gives an overview of the parameters that are considered by the calculation of the satellites' power levels.

Table 4-7: Overview of the parameters affecting the power level of the GNSS signal

Power Mode	Reference Power	Reference Satellite	Pseudorange	Inter-Standard Tuning	Additional Power per Tap	Relative/Displayed Power of the individual satellites signal component
Auto	yes	yes	yes	yes	yes	displays the power level at the simulation start time
User	yes	-	-	-	yes	yes

The table 4-8 shows how the power levels are calculated depending on the "Simulation Mode", the "Power Mode" and whether a signal component undergoes static multipath or not.

Table 4-8: Calculating the power levels of the satellite as a function of the "Power Mode" and the "Simulation Mode".

Power Mode/ Simulation Mode	Auto	User
"Static"	-	Absolute Power <sub>Sat#_Signal</sub> = Ref. Power + Relative Power <sub>Sat#_Signal</sub>
"Auto Localization"	Absolute Power <sub>Sat#_Signal</sub> = Ref. Power + Power* <sub>Sat#_Signal</sub> <sup>1)</sup>	Absolute Power <sub>Sat#_Signal, Tap#</sub> = Ref. Power + Power <sub>Sat#_Signal</sub> + Additional Power <sub>Tap#</sub>
"User Localization"	Absolute Power <sub>Sat#_Signal, Tap#</sub> = Ref. Power + Power* <sub>Sat#_Signal</sub> <sup>1)</sup> + Additional Power <sub>Tap#</sub>	

1) For a satellite in the satellite list with pseudorange at time t = Pseudorange<sub>t</sub> and "Ref. Standard = Std"

Power\*<sub>Sat#\_Signal\_t</sub> = 20log<sub>10</sub>(Ref. Orbital Dist/ND<sub>Ref.Std</sub>) + 20log<sub>10</sub>(ND<sub>Std</sub>/Pseudorange<sub>t</sub>) + Inter-Standard Power<sub>Sat#\_Ref.Signal</sub>, where ND is the nominal orbital distance (see Reference Signal/ Reference Orbital Distance).

**Example: Calculation of the Power\* if "Ref. Satellite" is different than N.A.**

Power\*<sub>Sat#\_Signal\_t</sub> = 20log<sub>10</sub>(Pseudorange<sub>Ref.Sat\_t0</sub>/Pseudorange<sub>Sat#Signal\_t</sub>) + Inter-Standard Power<sub>Sat#\_Ref.Sat</sub>, where t<sub>0</sub> represents the start moment of the simulation.



If "Ref. Satellite" different than N.A. , the power level displayed in the user interface (Power) represents the power level at the start moment of the simulation (t<sub>0</sub>) and is calculated as follow:

Displayed Power<sub>Sat#\_Signal\_t0</sub> = 20log<sub>10</sub>(Pseudorange<sub>Ref.Sat\_t0</sub>/Pseudorange<sub>Sat#Signal\_t0</sub>) + Inter-Standard Power<sub>Sat#\_Ref.Sat</sub>



The total power of the generated GNSS signal is displayed with the parameter Total Power.

**Example: Power calculation in "User" power mode for GNSS signal undergoing static multipath propagation**

Power calculation for the power settings and satellite constellation as shown on [figure 4-9](#).

Maximum Number Of Satellites					
	State	Standard	Signals	SV-ID	Power /dB
Sat 1	On	GPS	C/A	6	-1.00
Sat 2	On	GPS	C/A	16	0.00
Sat 3	On	GALILEO	E1-DEF	14	-5.00
Sat 4	On	GALILEO	E1-DEF	17	-10.00

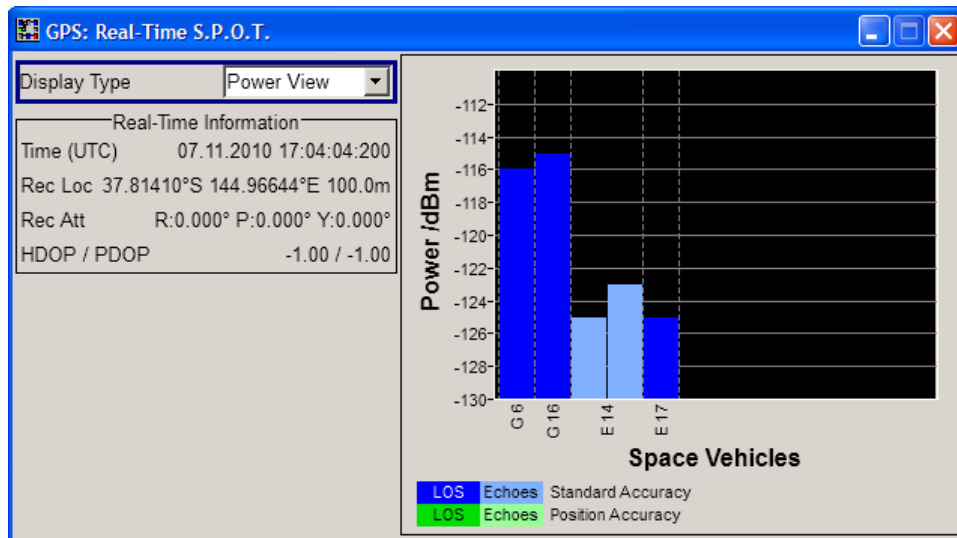
**Fig. 4-9: Example: Power Configuration in User Power Mode**

- Number of Satellites = 4
- Sat#1:  $\text{Power}_{\text{Sat\#1\_C/A}} = -1 \text{ dB}$ ; static Multipath = Off
- Sat#2:  $\text{Power}_{\text{Sat\#2\_C/A}} = 0 \text{ dB}$ ; static Multipath = Off
- Sat#3:  $\text{Power}_{\text{Sat\#3\_E1-DEF}} = -5 \text{ dB}$ ; static Multipath = On (Additional  $\text{Power}_{\text{Tap\#1}} = -5 \text{ dB}$ , Additional  $\text{Power}_{\text{Tap\#2}} = -3 \text{ dB}$ )
- Sat#4:  $\text{Power}_{\text{Sat\#4\_E1-DEF}} = -10 \text{ dB}$ ; static Multipath = Off
- Reference Power = -115 dBm

Calculation of the absolute power levels

- Absolute  $\text{Power}_{\text{Sat\#1\_C/A}} = \text{Ref. Power} + \text{Power}_{\text{Sat\#1\_C/A}} + \text{Additional Power}_{\text{tap\#}} = -115 \text{ dBm} + -1 \text{ dB} = -116 \text{ dBm}$
- Absolute  $\text{Power}_{\text{Sat\#2\_C/A}} = \text{Ref. Power} + \text{Power}_{\text{Sat\#2\_E1-DEF}} + \text{Additional Power}_{\text{tap\#}} = -115 \text{ dBm} + 0 \text{ dB} = -115 \text{ dBm}$
- Absolute  $\text{Power}_{\text{Sat\#3\_E1-DEF, Tap\#1}} = \text{Ref. Power} + \text{Power}_{\text{Sat\#3\_E1-DEF}} + \text{Additional Power}_{\text{Tap\#1}} = -115 \text{ dBm} + -5 \text{ dB} + -5 \text{ dB} = -125 \text{ dBm}$   
 Absolute  $\text{Power}_{\text{Sat\#3\_E1-DEF, Tap\#2}} = \text{Ref. Power} + \text{Power}_{\text{Sat\#3\_E1-DEF}} + \text{Additional Power}_{\text{Tap\#2}} = -115 \text{ dBm} + -5 \text{ dB} + -3 \text{ dB} = -123 \text{ dBm}$
- Absolute  $\text{Power}_{\text{Sat\#4\_E1-DEF}} = \text{Ref. Power} + \text{Power}_{\text{Sat\#4\_C/A}} + \text{Additional Power}_{\text{tap\#}} = -115 \text{ dBm} + -10 \text{ dB} = -125 \text{ dBm}$

Select "GNSS General Settings > Real-Time SPOT" and select "Display Type > Power View" and compare the displayed power levels.



The power level are displayed sorted per navigation standard and in ascending order of the SV-ID.

**Example: Power calculation in "Auto" power mode**

Power calculation for the power settings and satellite constellation at the simulation start time as shown on figure 4-10.

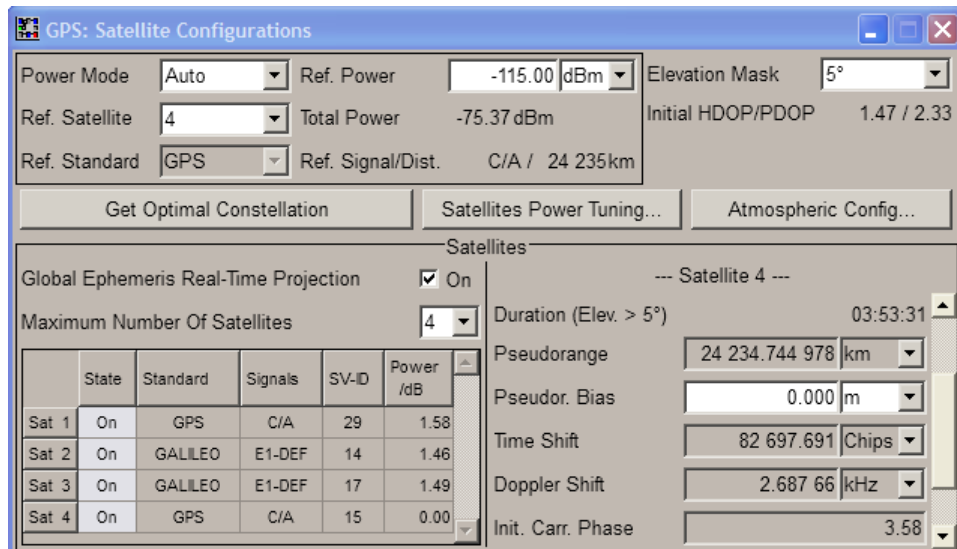


Fig. 4-10: Example: Power Configuration in Auto Power Mode

**Note:** The power values displayed in "Auto" power mode correspond to the start of the simulation ( $t_0$ ). The power levels change automatically as function of the satellite-receiver distance but the display is not updated.

**Tip:** Select "GNSS General Settings > Real-Time SPOT" and select "Display Type > Power View". The displayed power levels are updated in real-time.

Power levels at the beginning of the simulation (t=t0):

- Reference Power = -115 dBm  
The reference power is the nominal power of the reference satellite at the start time and location; the power of all other satellites are simulated as relative power to the power of the reference one.
- Reference Satellite = Sat#4
- Number of Satellites = 4
- for all satellites static Multipath = Off
- Sat#1: Displayed Power<sub>Sat#1\_C/A</sub> = 1.58 dB
- Sat#2: Displayed Power<sub>Sat#2\_E1-DEF</sub> = 1.46 dB
- Sat#3: Displayed Power<sub>Sat#2\_E1-DEF</sub> = 1.49 dB
- Sat#4: Displayed Power<sub>Sat#4\_C/A</sub> = 0 dB
- Inter-Standard Power Tuning<sub>GPS C/A-GAL E1-DEF</sub> = -1.5 dB , i.e. the displayed power levels of the Galileo satellites are internally boosted with 1.5 dB.

Calculation of the absolute power levels at the beginning of the simulation (t=t0):

- Absolute Power<sub>Sat#1\_C/A</sub> = Ref. Power + Displayed Power<sub>Sat#1\_C/A</sub> = -115 dBm + 1.58 dB = -113.42 dBm
- Absolute Power<sub>Sat#2\_E1-DEF</sub> = Ref. Power + Displayed Power<sub>Sat#2\_E1-DEF</sub> = -115 dB + 1.46 dB = -113.54 dB
- Absolute Power<sub>Sat#3\_E1-DEF</sub> = Ref. Power + Displayed Power<sub>Sat#3\_E1-DEF</sub> = -115 dBm + 1.49 dB = -113.51 dB
- Absolute Power<sub>Sat#4\_C/A</sub> = Ref. Power = -115 dBm

Select "GNSS General Settings > Real-Time SPOT" and select "Display Type > Power View" and compare the displayed power levels.

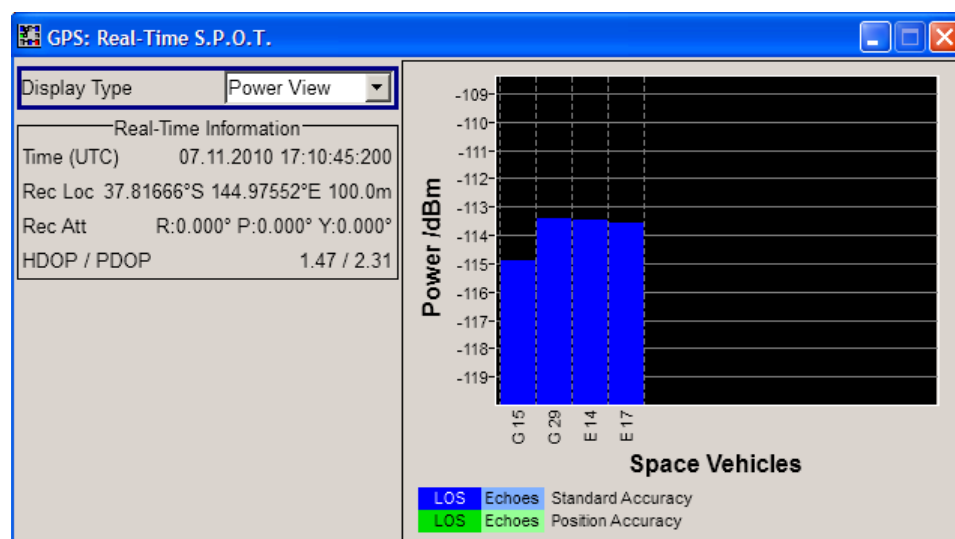


Fig. 4-11: Example: Power levels at the beginning of the simulation

Another way to query the current power levels is by using the corresponding SCPI command, e.g. see `<subsystem>:RT:<GNSS>:SVID<ch>:TAP<us>:POWER:ABSolute` on page 385.



The total power of the generated GNSS signal is displayed with the parameter "Total Power".

### Example: Power calculation for mixed signals

Power calculation for the power settings and satellite constellation at the simulation start time as shown on [figure 4-12](#).

Maximum Number Of Satellites					
	State	Standard	Signals	SV-ID	Power /dB
Sat 1	On	GPS	(C/A+P)Q	28	-1.31
Sat 2	On	GALILEO	E1-DEF	21	0.00
Sat 3	On	GLONASS	R-C/A	1	-5.39
Sat 4	On	GPS	C/A	4	-2.14

**Fig. 4-12: Example: Power Configuration with Mixed Signal**

This example focus only on the power calculation of the mixed signal.

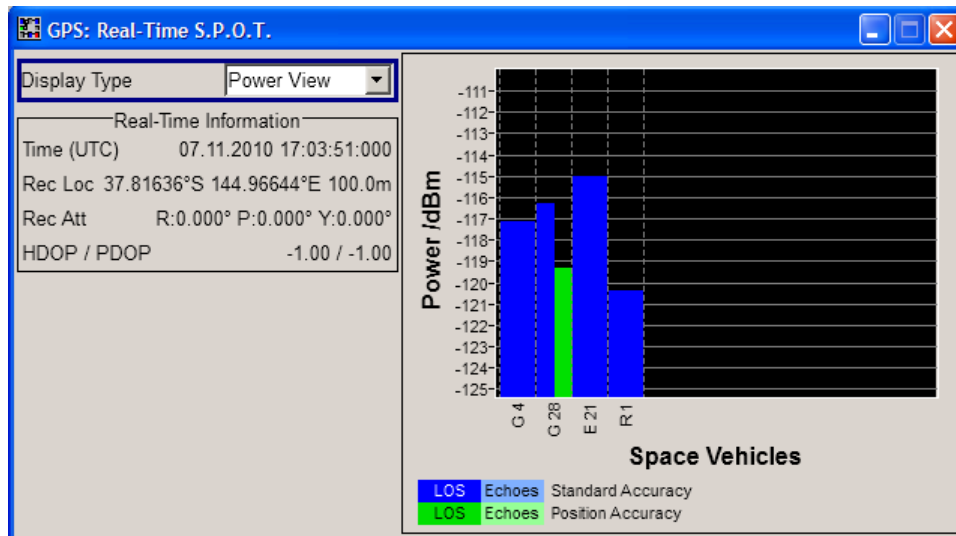
- Power Mode = User  
Number of Satellites = 4  
for all satellites Multipath = Off
- Sat#1:  $\text{Power}_{\text{Sat}\#1\_C/A+P} = -1.31 \text{ dB}$ ; Power Reference = C/A; Intra-Standard  $\text{Power}_{\text{Sat}\#\_\text{PowRef}} = 3 \text{ dB}$ , i.e the C/A signal is boosted with 3 dB compared to the P-code signal.
- Sat#2:  $\text{Power}_{\text{Sat}\#2\_E1-DEF} = 0 \text{ dB}$ ;  $\text{Pseudorange}_{\text{Ref.Sat}\_t0} = 23384433.474 \text{ m}$
- Sat#3:  $\text{Power}_{\text{Sat}\#3\_R-C/A} = -5.39 \text{ dB}$ ;
- Sat#4:  $\text{Power}_{\text{Sat}\#4\_C/A} = -2.14 \text{ dB}$ ;
- Reference Power = -115 dBm

Calculation of the absolute power levels

- Absolute Power  $\text{Power}_{\text{Sat}\#1\_C/A} = \text{Ref. Power} + \text{Power}_{\text{Sat}\#1\_C/A+P} + \text{Additional Power}_{\text{tap}\#} = -115 \text{ dBm} + -1.31 \text{ dB} = -116.31 \text{ dBm}$   
Absolute Power  $\text{Power}_{\text{Sat}\#1\_P} = \text{Ref. Power} + \text{Power}_{\text{Sat}\#1\_C/A+P} + \text{Additional Power}_{\text{tap}\#} + \text{Intra-Standard Power}_{\text{Sat}\#\_\text{PowRef}} = -115 \text{ dBm} + -1.31 \text{ dB} + -3 \text{ dB} = -119.31 \text{ dBm}$
- Absolute Power  $\text{Power}_{\text{Sat}\#2\_E1-DEF} = \text{Ref. Power} + \text{Power}_{\text{Sat}\#2\_E1-DEF} + \text{Additional Power}_{\text{tap}\#} = -115 \text{ dBm} + 0 \text{ dB} = -115 \text{ dBm}$
- Absolute Power  $\text{Power}_{\text{Sat}\#3\_R-C/A} = \text{Ref. Power} + \text{Power}_{\text{Sat}\#3\_R-C/A} + \text{Additional Power}_{\text{tap}\#} = -115 \text{ dBm} + -5.39 \text{ dB} = -120.39 \text{ dBm}$
- Absolute Power  $\text{Power}_{\text{Sat}\#4\_C/A} = \text{Ref. Power} + \text{Power}_{\text{Sat}\#4\_C/A} + \text{Additional Power}_{\text{tap}\#} = -115 \text{ dBm} + -2.14 \text{ dB} = -117.14 \text{ dBm}$



Select "GNSS General Settings > Real-Time SPOT" and select "Display Type > Power View" and compare the displayed power levels.



See also:

- [chapter 5.12, "Adjusting the Power Settings"](#), on page 213
- [chapter 5.13, "Generating a GNSS Signal for Receiver Sensitivity Tests"](#), on page 214

<a href="#">Power Mode</a> .....	121
<a href="#">Reference Power</a> .....	121
<a href="#">Reference Satellite</a> .....	122
<a href="#">Total Power</a> .....	122
<a href="#">Reference Standard</a> .....	122
<a href="#">Reference Signal/ Reference Orbital Distance</a> .....	123

**Power Mode**

Determines whether the power is calculated automatically or is based on user defined settings:

- "User" power mode is intended for dynamical configuration of the power of each satellite separately and manually.
- "Auto" power mode enables an internal dynamical automatic power control. The power of all satellites is calculated automatically based on the satellite-to-receiver distance and relative to the relative power of the reference satellite. The Reference Satellite is simulated as relative 0 dB at the start reference receiver location and at the simulation start time.  
The "Auto" power mode is enabled in "Auto Localization" and "User Localization" modes.

Remote command:

<subsystem>:POWER:MODE on page 330

**Reference Power**

Sets the power level that is used as a reference for the calculation of the power level of the satellites.

- In "Auto" power mode, the "Reference Power" is the power level of the reference signal component [Reference Satellite](#) at the reference orbital distance.

**Example:**

Power Mode	Auto	Ref. Power	-120.00 dBm
Ref. Satellite	N.A.	Total Power	---
Ref. Standard	GPS	Ref. Signal/Dist.	C/A / 20 300 km

"Ref. Orbital Dist" = 20300 km

"Ref. Standard" = GPS

"Ref. Signal" = C/A

The "Inter-Standard Power Tuning" settings are applied automatically. The power levels of all satellites are calculated automatically based on this reference power level for each moment of time depending on the ratio of their dynamic satellite-receiver distance.

- In "User" power mode, the "Reference Power" represents the power level based on which all initial satellite power levels are calculated.

See also:

- [chapter 4.10.1, "Power Configuration"](#), on page 115
- [chapter 5.13, "Generating a GNSS Signal for Receiver Sensitivity Tests"](#), on page 214

Remote command:

`<subsystem>:POWer:REFeRence[:POWer]` on page 330

**Reference Satellite**

Determines the satellite used as a reference for the calculation of the power levels of the satellites in "Power Mode > Auto".

- For "Reference Satellite" different than "N.A."
 

The values of [Reference Standard](#) and [Reference Signal/ Reference Orbital Distance](#) are updated for the selected "Reference Satellite" and the satellite to user distance at the start simulation time.
- For "Reference Satellite = N.A."
 

"Reference Standard" is configurable and "Ref. Distance" is set to the nominal orbital distance ND of the selected "Reference Standard". See also [Reference Signal/ Reference Orbital Distance](#).

Remote command:

`<subsystem>:POWer:REFeRence:SATellite` on page 331

**Total Power**

By enabled signal generation, displays the total power of the generated GNSS signal at a moment of time. The total power is a real time parameter that follows the real time changes in the absolute power levels of all active satellites.

Remote command:

`<subsystem>:POWer:TOTal?` on page 333

**Reference Standard**

In "Power Mode > Auto", determines the reference standard.

**Note:** In a test setup involving two instruments, in both instruments, set the "Reference Satellite > N.A." and enable equal "Reference Power" and the same "Reference Standard".

Remote command:

`<subsystem>:POWER:REFerence:STANdard` on page 331

### Reference Signal/ Reference Orbital Distance

("Power Mode > Auto" only)

- For "Reference Satellite" different than "N.A." displays the signal component of the current reference satellite used as reference for the power calculation and the pseudorange of the reference satellite at the beginning of the simulation ( $t=t_0$ ).
- For "Reference Satellite = N.A.", the following nominal orbit distances (ND) are used:
  - $ND_{GPS} = 20300$  km
  - $ND_{GLONASS} = 19100$  km
  - $ND_{Galileo} = 23222$  km
  - $ND_{BeiDou\_MEO} = 21528$  km and  $ND_{BeiDou\_IGSO/GEO} = 35786$  km
  - $ND_{QZSS} = 35786$  km

Remote command:

`<subsystem>:POWER:REFerence:SIGNal?` on page 331

`<subsystem>:POWER:REFerence:DISTance?` on page 331

## 4.10.2 General Satellites Settings

This section comprises all settings regarding the satellites configuration, constellation, power, as well as signal dynamics and modulation.

See also [figure 4-8](#).

<a href="#">Use Spreading</a> .....	123
<a href="#">Elevation Mask</a> .....	123
<a href="#">Initial HDOP/PDOP</a> .....	124
<a href="#">Get Optimal Constellation</a> .....	124
<a href="#">Satellites Power Tuning</a> .....	125
<a href="#">Global Signal (and Relative Power) Configuration</a> .....	125

### Use Spreading

(enabled in "Static" mode only)

Activates/deactivates spreading. When spreading is deactivated the pure navigation data is modulated onto the RF carrier.

Remote command:

`<subsystem>:SPReading[:STATe]` on page 315

### Elevation Mask

(enabled for "Auto Localization" and "User Localization" mode)

Sets the satellite's elevation mask, i.e. determines the elevation filter applied during the "Get Optimal Constellation" process or, while using the Auto Localization mode, used to filter all low-elevation satellites which are closer to the horizon and may witness in reality more unwanted multipath effects.

When the elevation decreases below the selected elevation mask, the GPS satellite is considered as invisible by the receiver and hence the GPS receiver can not use this satellite for determining its position. The GPS receiver has to search for another satellite with better visibility.

Automatic dynamic exchange of the satellites is performed in "Auto Localization" only. The expected time of the next upcoming satellites handover is displayed in the "Real-Time S.P.O.T." view with the parameter [Next Constellation Change](#).

While analyzing the generated signal, make sure that the "Satellite Elevation Mask" used by the signal generation is set to the elevation mask of the GNSS receiver.

Remote command:

`<subsystem>:SEMAsk` on page 315

### Initial HDOP/PDOP

Displays the HDOP (Horizontal Dilution of Precision) / PDOP (Position Dilution of Precision) of the selected satellite constellation at the beginning of the simulation.

The displayed HDOP/PDOP value is not updated. The dynamic "HDOP" and "PDOP" calculated on the current satellite constellation is displayed in the [Real-Time S.P.O.T. Settings](#) dialog.

The HDOP can be used as an indication of 2D positioning quality; the PDOP is an indication of 3D positioning quality. The general rule here is that the smaller the HDOP/PDOP the better the precision of the position fix will be.

At least four different satellites have to be configured to get a reasonable value; otherwise -1 will be displayed.

This parameter is enabled only for "Auto Localization" and "User Localization" mode.

Remote command:

`<subsystem>:HDOP?` on page 315

`<subsystem>:PDOP?` on page 316

### Get Optimal Constellation

In "User Localization" mode, the satellites are fully configurable. Use this function prior to and as basis for further configurations and retrieve an optimal satellites constellation for the selected Almanac/RINEX file, [Elevation Mask](#) and the selected [Maximum Number of Satellites](#).

**Note:** The retrieved satellite's constellation includes satellites with "State Off", if the number of satellites with elevation higher than the selected "Elevation Mask" is less than the selected "Maximum Number of Satellites".

Remote command:

`<subsystem>:GOConstellation` on page 316

`<subsystem>:RT:OCONstellation?` on page 391

**Satellites Power Tuning**

Opens the [Satellites Power Tuning](#) dialog for setting the power relation between the signals of different GNSS standards.

**Global Signal (and Relative Power) Configuration**

Enabled in "Auto Localization" mode. "Relative Power Configuration" is enabled in "Power Mode > User".

Opens the [Global Signal Configuration](#) dialog to determine:

- the type of signal a SV ID will use in the moment the corresponding satellite becomes visible
- in "Power Mode > User", the relative power per SV ID.

**4.10.3 Configuration of the Satellite Constellation**

This section comprises the setting of the satellites constellation and the individual settings of each enabled satellite.

The satellite constellation is enabled for configuration in "Static" and "User Localization" mode.

See also [figure 4-8](#).

<a href="#">Maximum Number of Satellites</a> .....	125
<a href="#">Constellation Table</a> .....	125
L <a href="#">Satellite State</a> .....	126
L <a href="#">Standard</a> .....	126
L <a href="#">Signal(s)</a> .....	126
L <a href="#">SV-ID/PRN</a> .....	127
L <a href="#">Power</a> .....	127

**Maximum Number of Satellites**

Determines the maximum number of satellites that can be simulated and the number of rows in the [Constellation Table](#).

The minimum allowed values depends on the selected [Simulation Mode](#):

- Configurations with one satellite are allowed only in "Static" mode.
- "Auto Localization" and "User Localization" modes require four satellites or more.

Generating the navigation signal with more than 6 satellites requires options R&S SMBV-K91/-K96. The maximum number of satellites is additionally limited by the available hardware resources of the instrument, especially if P-Code modulated signals are enabled in the GNSS system configuration. Refer to [chapter A.5, "Channel Budget"](#), on page 436 for detailed description.

Remote command:

`<subsystem>:SATellite:COUNT` on page 316

**Constellation Table**

Comprises the setting of the satellites constellation.

These settings are enabled for configuration in "Static" and "User Localization" mode.

**Satellite State ← Constellation Table**

Activates/deactivates the satellite.

**Note:**

In "User Localization" mode, changing the satellites state is performed **on-the-fly** and without interruption of the signal generation, unless:

- "Obscuration & Auto Multipath > Near Environment" is different than LOS or
- "Antenna Pattern / Body Mask File" is different than "Isotropic"

**Note:** Not enough hardware resources

This error message appears and the satellite is disabled if the available hardware resources are not enough to generate the desired signal.

Hybrid GNSS configurations, multipath configurations, signals modulated by P-Code and activated satellites consume hardware resources. Refer to [chapter A.5, "Channel Budget"](#), on page 436 for description on the how the available hardware resources are distributed.

Remote command:

`<subsystem>:SATellite<st>:STATe` on page 321

**Standard ← Constellation Table**

The available GNSS standards depend on the entry standard, the selected [GNSS System Configuration Settings](#) and the installed options.

Remote command:

`<subsystem>:SATellite<st>:STANdard` on page 321

**Signal(s) ← Constellation Table**

Selects the type of signal the corresponding satellite is using.

**Table 4-9: Overview of the supported signals**

Band	Entry Point	Standard	Signal	minimum Required Option
L1/E1	GPS	GPS	C/A <sup>1)</sup>	R&S SMBV-K44
			P	R&S SMBV-K93
			(C/A+P)Q <sup>2)</sup> (C/A+P) <sup>2)</sup>	
	any	QZSS	C/A	R&S SMBV-K105
	any	SBAS	C/A	R&S SMBV-K110
	Galileo	Galileo	E1-DEF	R&S SMBV-K66
GLONASS	GLONASS	R-C/A	R&S SMBV-K94	
BeiDou	BeiDou	B1-C/A	R&S SMBV-K107	

- <sup>1)</sup> C/A code ( $f_{ca} = 1.023$  MHz) is provided for civilian purposes and used as spreading codes for the navigation data.  
The carrier L1 or L2 signal can be modulated by C/A code only, P code only or by both (C/A+P).  
The parameter [Modulation](#) displays the current modulation.
- <sup>2)</sup>

- C/A + P signals require a hybrid GNSS configuration and enabled parameter "GNSS System Configuration > Use Position Accuracy (P-Code) > On"
- (C/A + P)Q is the standard transmitted signal on L1 and P is the standard transmitted signal on L2; old generation IIA satellites did not transmit P on L2. The standard mentions some cases where C/A and P are in-phase on L2 and hence the availability of the configuration (C/A+P)I.

**Note:** Not enough hardware resources

This error message appears and the satellite is disabled if the available hardware resources are not enough to generate the desired signal.

Hybrid GNSS configurations, multipath configurations, signals modulated by P-Code and activated satellites consume hardware resources. Refer to [chapter A.5, "Channel Budget"](#), on page 436 for description on the how the available hardware resources are distributed.

Remote command:

`<subsystem>:SATellite<st>:SIGNal` on page 321

#### **SV-ID/PRN ← Constellation Table**

Enters the Space Vehicle ID (SV-ID) or Pseudo-Random Noise (PRN) of the satellite to be simulated. This value is used to generate the corresponding spreading code.

**Note:** The SV ID of the GLONASS satellites are with 64 smaller than their PRN number, e.g to GLONASS satellite R5 corresponds PRN=69.

If "Real Navigation Data" is used, you can select from the almanac records that are existing in the almanac file as well as healthy satellites; otherwise, any ID can be selected.

SV ID set to "N.A." indicates a not assigned satellite.

The SV-ID field is highlighted in dark blue color if a static multipath is activated.

Remote command:

`<subsystem>:SATellite<st>:SVID` on page 322

#### **Power ← Constellation Table**

Power offset of a satellite.

The meaning of this parameter depends on the selected "Power Mode":

- In "User" power mode, this parameters sets the power offset of the satellite in dB. The offset determines the power ratio of the activated satellites. Configuration of satellites power is performed on-the-fly and without interruption of the signal generation, unless:
  - "Obscuration & Auto Multipath > Near Environment" is different than LOS or
  - "Antenna Pattern / Body Mask File" is different than "Isotropic"
- In "Auto" power mode, the displayed value is the power level of the satellite at the start of the simulation ( $t_0$ ). A configured [Inter-Standard Tuning](#) is automatically applied. The power level changes automatically as function of the satellite-receiver distance ([Pseudorange](#)) but the display is not updated.

See also:

- [chapter 4.10.1, "Power Configuration"](#), on page 115

- [chapter 5.13, "Generating a GNSS Signal for Receiver Sensitivity Tests"](#), on page 214

Remote command:

`<subsystem>:SATellite<st>:POWer` on page 332

`<subsystem>:RT:<GNSS>:SVID<ch>:TAP<us>:POWer:ABSolute` on page 385

#### 4.10.4 Individual Satellite Settings

Comprises the settings of the selected satellite.



The values displayed in this section are the initial values of the parameters at the beginning of the simulation or at the time the specific satellite is activated.

These values will be updated internally to implement moving satellites and receivers. However the displayed values are not updated.

See also [figure 4-8](#).

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##### Standard Chip Rate

Displays the chip rate.

Remote command:

`<subsystem>:SATellite<st>:SCRate?` on page 321

##### Regional System

(for SBAS satellites only)

Displays the regional system an SBAS satellite belongs to.

##### Frequency Number

(enabled for GLONASS satellites only)



Frequency number indicates the sub-carrier used to modulate the GLONASS satellite.

If you use "Data Source > Real Navigation Data", the frequency number is retrieved from the selected almanac file; while using arbitrary data, the frequency number is configurable.

Remote command:

`<subsystem>:SATellite<st>:FNUMber` on page 318

### Orbit Type

(enabled for BeiDou satellites only)

Indicates the orbit type the BeiDou satellite is using. The BeiDou global satellite navigation systems uses a constellation of 35 satellites with following orbits:

"GEO"	5 geostationary orbit satellites with "SV-ID = 1.. 5"
"MEO"	27 middle earth orbits global satellites
"IGSO"	3 Inclined Geosynchronous Satellite Orbit regional satellites, visible only in China and Australia

Remote command:

`<subsystem>:SATellite<st>:ORBit?` on page 320

### Modulation

Displays the modulation used for modulating the carrier signal.

Remote command:

`<subsystem>:SATellite<st>:MODulation?` on page 319

### Power Reference

For mixed [Signal\(s\)](#) like "C/A+P", displays the signal used as a reference by power calculation. The power reference is fixed.

For signals modulated only with the P code, the power reference is "P".

Remote command:

`<subsystem>:SATellite<st>:POWer:RSIGnal?` on page 332

### Navigation...

Accesses the dialog for configuring the parameters of the navigation message.

See [chapter 4.10.9, "Navigation Message Configuration"](#), on page 140

### Multipath...

(requires option R&S SMBV-K92)

Accesses the [Static Multipath Configuration](#) dialog for configuring the static multipath propagation per satellite.

### Duration (Elev. > 2.5/5/7.5/10°)

This parameter is enabled only for "Localization" mode.

Displays the time the satellite's elevation will be higher than 2.5, 5, 7.5 or 10° starting at the first simulation moment of the satellite of interest, as selected with the parameter [Elevation Mask](#). Use this parameter to determine the time the connected GNSS receiver may use a certain satellite for its position fix.

The value is displayed in format hh:mm:ss.

The displayed value is not updated but the elevation of each satellite is constantly monitored. Decreasing the satellite's elevation below the selected elevation mask value is one of the reasons for the automatic dynamic exchange of satellites. Thus, a change of the satellite constellation can occur before the initially calculated time elapses.

In "Auto Localization" mode, the expected time of each upcoming exchange is displayed in the "Real-Time S.P.O.T." view by the parameter [Next Constellation Change](#).

Remote command:

`<subsystem>:SATellite<st>:DURation?` on page 318

### Initial Code Phase

(enabled only in "Static" mode and for arbitrary navigation data source)

Sets the initial code phase.

Remote command:

`<subsystem>:SATellite<st>:CPHase` on page 318

### Pseudorange

Displays the propagation delay from satellite to receiver in meters that is calculated as follows:

$$\text{Pseudorange} = \text{Time Shift} * c / \text{Standard Chip Rate}$$
, where  $c$  is the speed of light.

In "Auto" power mode, this parameter affects the calculation of the displayed power level of the corresponding satellite.

The parameter is enabled for configuration in "Simulation Mode > Static".

Remote command:

`<subsystem>:SATellite<st>:PRANge` on page 320

### Pseudorange Bias

Sets a bias to the [Pseudorange](#). The parameter is updated on-the-fly and can be used to bias the pseudorange of a satellite.

The parameter is enabled for configuration in "Auto/User Localization" modes.

Remote command:

`<subsystem>:SATellite<st>:PRBias` on page 320

### Time Shift/ chips

Displays the propagation delay from satellite to receiver. The time shift is displayed in chips.

The parameter is enabled for configuration in "Static" mode.

In "Localization" mode, this parameter is not configurable and is set automatically depending on the simulated [Geographic Location/Attitude](#) and on the satellite's orbit.

Remote command:

`<subsystem>:SATellite<st>:TSHift` on page 322

### (Initial) Doppler Shift

Queries the initial Doppler shift.

The simulation of Doppler-shifted signals can be used to check the receiver characteristics under more realistic conditions than with zero Doppler.

The parameter is set automatically depending on the simulated "Geographic Location" and on the satellite's orbit.

The instrument calculates automatically the relevant change to the chip rate of the code. The currently valid values for Doppler-shifted carrier frequency and chip rate are displayed as:

- [Resulting Start Frequency](#)
- [Resulting Start Chip Rate](#)
- [Resulting P-Code Chip Rate](#)

Remote command:

`<subsystem>:SATellite<st>:DSHift` on page 317

### Initial Carrier Phase

Sets the initial carrier phase.

The parameter is enabled for configuration in "Simulation Mode > Static".

In "Auto/User Localization" modes, the instrument automatically updates the value.

Remote command:

`<subsystem>:SATellite<st>:ICPHase` on page 319

### Resulting Start Frequency

Indicates the currently valid values for Doppler-shifted carrier frequency.

The resulting frequency is calculated according to the following:

- GPS, Galileo, BeiDou, QZSS  
 $f_{\text{resulting}} = f_{\text{band}} + f_{\text{Doppler}}$   
 where  $f_{\text{band}}$  is set with parameter [RF Band](#).
- Glonass  
 $f_{\text{band\_L1}} = 1602 \text{ MHz}$ ,  $f_{\text{band\_L2}} = 1247 \text{ MHz}$   
 $k = \text{frequency number}$   
 $f_{\text{Glo\_L1\_resulting, MHz}} = 1602 + (k * 0.5625) + f_{\text{Doppler}}$   
 $f_{\text{Glo\_L2\_resulting, MHz}} = 1247 + (k * 0.4375) + f_{\text{Doppler}}$

Remote command:

`<subsystem>:SATellite<st>:FREQuency?` on page 318

### Resulting Start Chip Rate

Indicates the currently valid values for the chip rate. The relevant change to the chip rate is carried out automatically if the Doppler shift is changed.

The resulting chip rate is calculated according to the following:

- GPS, Galileo, BeiDou, QZSS  
 $f_{\text{resulting}} = f_{\text{code}} * \{1 + f_{\text{Doppler}} / f_{\text{band}}\}$ ,  
 where  $f_{\text{band}}$  is set with parameter [RF Band](#),  
 $f_{\text{code\_GPS/Galileo}} = 1.023 \text{ MHz}$  and  $f_{\text{code\_BeiDou}} = 2.046 \text{ MHz}$
- Glonass on L1/E1 band  
 $f_{\text{resulting}} = f_{\text{code}} * \{1 + f_{\text{Doppler}} / [f_{\text{band}} + k * 562500 \text{ (Hz)}]\}$
- Glonass on L2 band

$$f_{\text{resulting}} = f_{\text{code}} * \{1 + f_{\text{Doppler}} / [f_{\text{band}} + k * 437500 \text{ (Hz)}]\},$$

Remote command:

`<subsystem>:SATellite<st>:CACRate?` on page 317

#### Resulting P-Code Chip Rate

Indicates the currently valid values for the chip rate of the P-code. The relevant change to the chip rate of the P-code is carried out automatically if the Doppler shift is changed.

The resulting P-chip rate is calculated according to the following:

$$f_{\text{P-resulting}} = f_{\text{P}} * \{1 + f_{\text{Doppler}} / f_{\text{band}}\}$$

where  $f_{\text{band}}$  is as set with parameter [RF Band](#) and  $f_{\text{P}}$  is fixed to 10.230 MHz.

Remote command:

`<subsystem>:SATellite<st>:PCRate?` on page 319

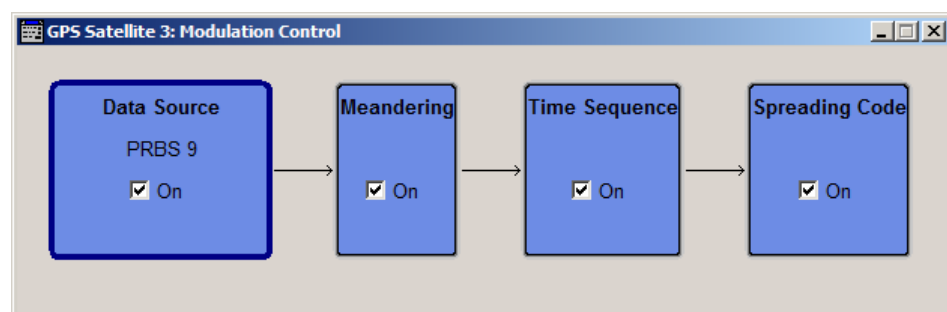
### 4.10.5 Modulation Control

In the "Modulation Control" dialog, you can enable or disable the signal components for the production tests individually. The components are denoted in a block diagram, which varies according to the selected satellite signal.

The R&S SMBV provides this feature for user defined test scenarios in static mode.

To access these settings:

1. Select "Baseband > Satellite Navigation" and select the desired satellite standard, e.g. "GPS".
2. Select "Test Scenario > User Defined" and "Simulation Mode > Static".
3. In the "System Configuration" dialog, configure the required "Active GNSS" standards, "Common Frequency" and "P-code" settings.
4. Select "Satellite Configuration > Satellite Table > e.g. Sat 3 > GLONASS".
5. Select "Modulation Control".



*Fig. 4-13: Example: GLONASS modulation control diagram*

The dialog shows the signal components of the satellite navigation signal as functional blocks, representing the modulation scheme and the channels used.

**Modulation Control**

Enables you to turn off data or modulation signal components of the satellite navigation signals individually.

"Data Source" Signal data component, selected under **"Data Source"** on page 50. When disabled, you can evaluate the pure modulation signal.

Remote command:

`<subsystem>:SATellite<st>:MCONtrol:DATA<ch>[:STATe]` on page 323

"Spreading Code"

Modulation signal component. When disabled the pure navigation data is used.

Remote command:

`<subsystem>:SATellite<st>:MCONtrol:SPReading<ch>[:STATe]`  
on page 323

"Meandering" Doubles the default data rate of 50 Hz of GLONASS signals automatically.

When disabled, you can still select between 50 Hz and 100 Hz manually in the "Data Source" block.

Remote command:

`<subsystem>:SATellite<st>:MCONtrol:MEANdering[:STATe]` on page 323  
`<subsystem>:SATellite<st>:MCONtrol:DRATe` on page 323

"Time Sequence"

Time signal component of GLONASS signals.

Remote command:

`<subsystem>:SATellite<st>:MCONtrol:TSEQuence[:STATe]` on page 324

"Secondary Code"

Data signal component in the pilot channel of Galileo or BeiDou signals.

Remote command:

`<subsystem>:SATellite<st>:MCONtrol:SECondary<ch>[:STATe]`  
on page 323

**4.10.6 Signal Dynamics**

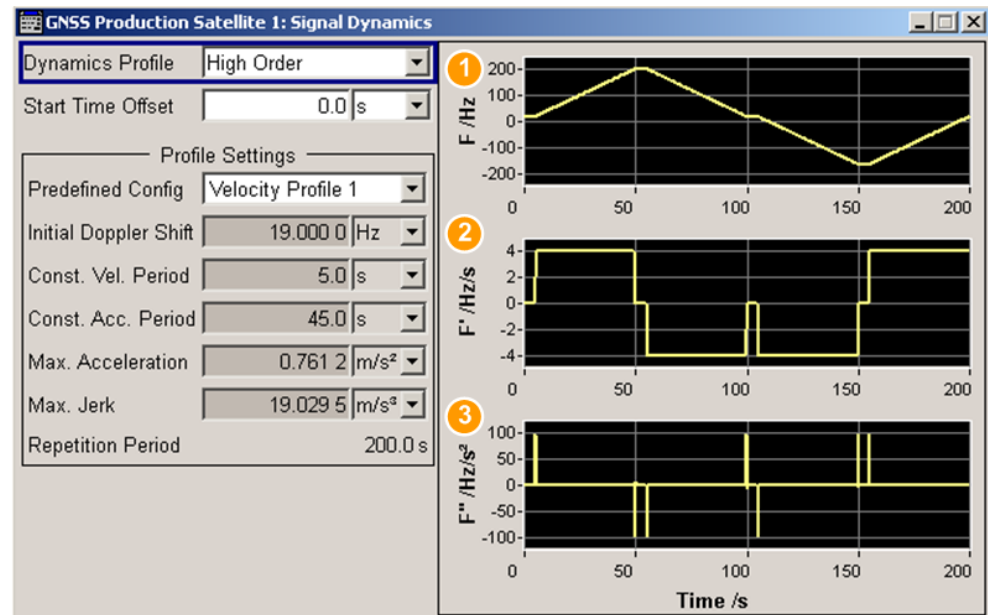
Signal dynamics enables you to configure the signal dynamics. It is especially designed for testing the receiver sensitivity under varying signal dynamics. You can select a predefined or constant Doppler profile, or define a user-specific Doppler profile.

The R&S SMBV provides this feature for user defined test scenarios in static mode.

To access these settings:

1. Select "Baseband > Satellite Navigation" and select the desired satellite standard, e.g. "GPS".
2. Select "Test Scenario > User Defined" and "Simulation Mode > Static".

3. In the "System Configuration" dialog, configure the required "Active GNSS" standards, "Common Frequency" and "P-code" settings.
4. Select "Satellite Configuration > Satellite Table > e.g. Sat 3 > GPS".
5. Select "Signal Dynamics".



- 1 = Velocity (rate of position change over time)  
 2 = Acceleration (rate of velocity change over time)  
 3 = Jerk (rate of acceleration change over time)

The dialog contains the parameters required to define a profile of a Doppler signal, and shows the selected settings graphically.

### Dynamics Profile

Selects a Doppler profile.

- "Constant" Generates a constant signal with definable Doppler shift, see [Constant profile settings](#).
- "High Order" Enables Doppler profiles with higher dynamics. There are two predefined profiles, or you can define a specific profile, see [High order profile settings](#).

Remote command:

`<subsystem>:SATellite<st>:SDYnamics:PROFile` on page 326

### Constant profile settings

The constant Doppler profile is defined with:

#### Doppler Shift Unit ← Constant profile settings

With "Dynamics Profile > Constant", selects the unit of the parameter [Doppler Shift \(Constant\)](#).

Remote command:

`<subsystem>:SATellite<st>:SDYnamics:DSHift:UNIT` on page 326

**Doppler Shift (Constant) ← Constant profile settings**

Sets the Doppler shift for a constant signal profile.

Remote command:

`<subsystem>:SATellite<st>:SDYNamics:DSHift` on page 325

**High order profile settings**

The Doppler profiles with higher dynamics are defined with:

**Start Time Offset ← High order profile settings**

Sets a time delay before the generation of the Doppler signal starts.

This parameter is enabled for "[Dynamics Profile > High Order](#)".

Remote command:

`<subsystem>:SATellite<st>:SDYNamics:TOFFset` on page 327

**Predefined Config. ← High order profile settings**

Selects of of the predefined high order Doppler profiles or an user-defined one.

"Velocity Profile 1, 2"

Generates a Doppler signal using the settings of one of the predefined Doppler profiles.

"User Dynamics"

Generates a Doppler signal with user-defined parameters. The profile parameters are configurable.

Remote command:

`<subsystem>:SATellite<st>:SDYNamics:CONFig` on page 325

**Initial Doppler Shift ← High order profile settings**

Displays the doppler shift set for predefined high order profile.

Select "[Predefined Config. > User Dynamics](#)" to change the value.

Remote command:

`<subsystem>:SATellite<st>:SDYNamics:IDSHift` on page 326

**Const. Vel. Period ← High order profile settings**

Displays the constant velocity duration of a predefined high order velocity profile, that is the period where acceleration is assumed to be 0

Select "[Predefined Config. > User Dynamics](#)" to change the value.

Remote command:

`<subsystem>:SATellite<st>:SDYNamics:RPERiod?` on page 327

**Const. Acc. Period ← High order profile settings**

Displays the constant acceleration duration of a predefined high order velocity profile.

Select "[Predefined Config. > User Dynamics](#)" to change the value.

Remote command:

`<subsystem>:SATellite<st>:SDYNamics:CAPeriod` on page 324

**Max. Acceleration ← High order profile settings**

Displays the maximum acceleration of a predefined high order velocity profile.

Select "[Predefined Config.](#) > User Dynamics" to change the value.

Remote command:

`<subsystem>:SATellite<st>:SDYNamics:ACCel:MAX` on page 324

#### **Max. Jerk ← High order profile settings**

Displays the maximum jerk of a predefined high order velocity profile, with respect to time.

Select "[Predefined Config.](#) > User Dynamics" to change the value.

Remote command:

`<subsystem>:SATellite<st>:SDYNamics:JERK:MAX` on page 326

#### **Repetition Period ← High order profile settings**

Displays the time that elapses until the Doppler signal of a predefined high order velocity profile repeats.

Remote command:

`<subsystem>:SATellite<st>:SDYNamics:RPERiod?` on page 327

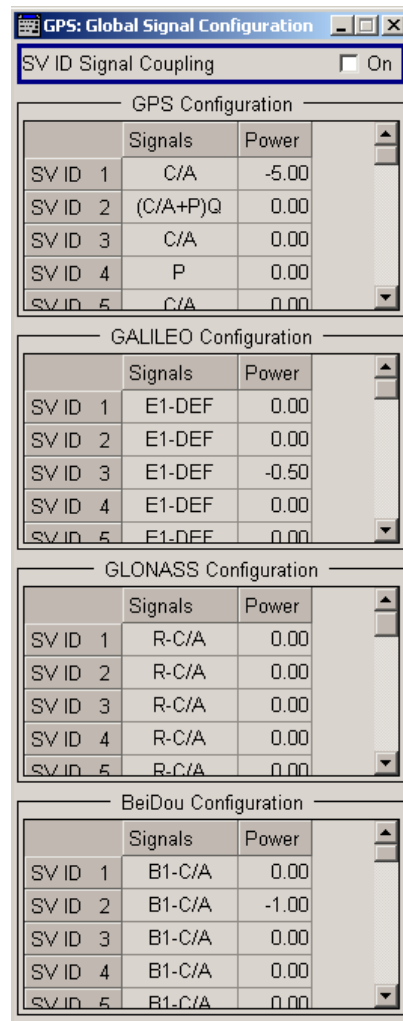
### **4.10.7 Global Signal Configuration**

To access these settings:

1. Select "Baseband > Satellite Navigation" and select the satellite standard, for example "GPS".
2. Select "Simulation Mode > Auto Localization".
3. Select "Satellite Configuration > Global Signal Configuration".

Use the provided settings to determine the type of signal a SV ID will use in the moment the corresponding satellite becomes visible.





The dialog displays all available SV ID of each of the enabled GNSS standards according to the selected almanac. For each available SV ID a signal can be assigned. Refer to [table 4-9](#) for an overview of the supported signals pre GNSS standard.

[SV ID Signal Coupling](#).....137  
[GPS/Galileo/GLONASS/BeiDou Signals and Power](#)..... 138

**SV ID Signal Coupling**

For quick configuration, enables the configuration of all SV IDs simultaneously, i.e. the value set for the first available SV ID is used for all other. Current settings are overwritten.

Remote command:

`<subsystem>:SVID:SIGNal:COUPling` on page 327

**GPS/Galileo/GLONASS/BeiDou Signals and Power**

In "Auto Localization" mode, determine the type of signal and the power a SV ID will use in the moment the corresponding satellite becomes visible.

Remote command:

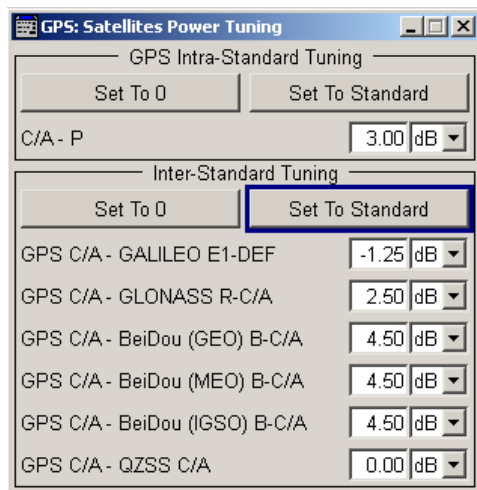
`<subsystem>:SVID<ch>:<GNSS>:SIGNal` on page 328

`<subsystem>:SVID<ch>:<GNSS>:POWer` on page 328

**4.10.8 Satellites Power Tuning**

To access this dialog:

1. Select "Baseband > Satellite Navigation" and select the desired satellite standard, e.g. "GPS".
2. Select "Satellite Configuration > Satellites Power Tuning".



The "Satellite Power Tuning" dialog comprises the setting for inter-standard power relations and the power relation between the signals of a specific GNSS standard. The inter-standard parameters are required for the configuration of the nominal power difference between the different navigation standards. These parameters are considered only in "Auto Power Mode".

See [chapter 4.10.1, "Power Configuration"](#), on page 115 for information about the power calculation.

[Intra-Standard Tuning](#)..... 139

- [L Set to 0](#)..... 139
- [L Set to Standard](#)..... 139
- [L C/A-P](#)..... 139

[Inter-Standard Tuning](#)..... 139

- [L Set to 0](#)..... 139
- [L Set to Standard](#)..... 139
- [L GPS C/A-GALILEO E1-DEF, GPS C/A-GLONASS R-C/A, GPS C/A-BeiDou \(GEO/MEO/IGSO\) B-C/A, GPS C/A-QZSS C/A](#)..... 140

**Intra-Standard Tuning**

Intra-Standard power settings are provided for GPS mixed signals. The C/A signal is always used as "Power Reference".

**Set to 0 ← Intra-Standard Tuning**

Sets the power relations between the signal components to 0 dB.

Remote command:

`<subsystem>:POWer:INTRa:GPS:PZERo` on page 334

**Set to Standard ← Intra-Standard Tuning**

Sets the power relation between the signals belonging to the same navigation standard according to the relation determined in the specifications.

**Table 4-10: Intra-Standard Tuning**

Parameter	Value
C/A - P	3 dB

Remote command:

`<subsystem>:POWer:INTRa:GPS:PSTandard` on page 334

**C/A-P ← Intra-Standard Tuning**

Sets the power relation between the signals belonging to the same navigation standard.

Use the [Set to Standard](#) function to preset the values.

Remote command:

`<subsystem>:POWer:INTRa:GPS:CAP` on page 334

**Inter-Standard Tuning**

The inter-standard calculation is performed based on the GPS standard.

**Set to 0 ← Inter-Standard Tuning**

Sets the Inter-Standard Power relations to 0 dB.

Remote command:

`<subsystem>:POWer:INTer:PZERo` on page 333

**Set to Standard ← Inter-Standard Tuning**

Sets the power relation between the signals belonging to the different navigation standard according to the relation determined in the specifications.

**Table 4-11: Inter-Standard Tuning**

Parameter	Value
GPS C/A - CALILEO E1-DEF	-1.25 dB
GPS C/A - GLONASS R-C/A	3.03 dB
GPS C/A - BeiDou (GEO) B-C/A	4.5 dB
GPS C/A - BeiDou (MEO) B-C/A	4.5 dB

Parameter	Value
GPS C/A - BeiDou (IGSO) B-C/A	4.5 dB
GPS C/A - QZSS C/A	0.0 dB

Remote command:

`<subsystem>:POWer:INTer:PSTandard` on page 333

#### GPS C/A-GALILEO E1-DEF, GPS C/A-GLONASS R-C/A, GPS C/A-BeiDou (GEO/MEO/IGSO) B-C/A, GPS C/A-QZSS C/A ← Inter-Standard Tuning

Sets the power relation between the signals belonging to the different navigation standards. Use the [Set to Standard](#) function to preset the values.

The power level of the GPS signal C/A is used as reference.

Remote command:

`<subsystem>:POWer:INTer:CAE1Def` on page 333

`<subsystem>:POWer:INTer:CARCA` on page 333

`<subsystem>:POWer:INTer:CABCAGeo` on page 333

`<subsystem>:POWer:INTer:CABCAIgsO` on page 333

`<subsystem>:POWer:INTer:CABCAMEo` on page 333

`<subsystem>:POWer:INTer:CAQCA` on page 333

### 4.10.9 Navigation Message Configuration



One of the assisted options, e.g. Assisted GPS (R&S SMBV-K65) is required to configure the parameters of the navigation message.

To access these settings:

1. Select "Baseband > Satellite Navigation" and select the satellite standard, for example "GPS".
2. Select "Simulation Mode > Auto Localization".
3. Select "Satellite Configuration > Satellite Table > e.g. Sat 1 > GPS" and select "Navigation...".

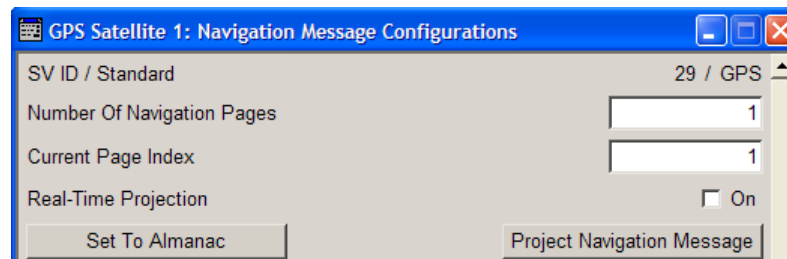
The parameters of the navigation message of each satellite are read only.

4. To enable the parameters for configuration, select "Simulation Mode > User Localization".

The navigation messages are fully configurable. However, it is recommended that you use the almanac's parameter as basis for further configurations.

See ["Set To Almanac"](#) on page 144.

For better readability of the parameters in the "Navigation Message Configurations" dialog, the values are input as integer in the same way as they are included in the satellite's navigation message. The scaled values and the scaling factors are also displayed. Different scaling factors may apply for the same parameters in the different GNSS standards.



Ephemeris Parameters

<<< Hide Details

Code On L2	<input type="text" value="P Code ON"/>	
L2 P Data Flag	<input type="checkbox"/>	On
Fit Interval Flag	<input type="checkbox"/>	On
SV Accuracy / URA Index	<input type="text" value="0"/>	
SV Health	<input type="text" value="0"/>	
IODC	<input type="text" value="0"/>	
IODE	<input type="text" value="0"/>	
TOE	<input type="text" value="0"/>	$\times 2^4 = 0.000000e+00$
M_0	<input type="text" value="0"/>	$\times 2^{-31} = 0.000000e+00$
Delta_N	<input type="text" value="0"/>	$\times 2^{-43} = 0.000000e+00$
e	<input type="text" value="0"/>	$\times 2^{-33} = 0.000000e+00$
SQRT(A)	<input type="text" value="100 000"/>	$\times 2^{-19} = 1.907349e-01$
OMEGA_0	<input type="text" value="0"/>	$\times 2^{-31} = 0.000000e+00$
i_0	<input type="text" value="0"/>	$\times 2^{-31} = 0.000000e+00$
omega	<input type="text" value="0"/>	$\times 2^{-31} = 0.000000e+00$
OMEGA_DOT	<input type="text" value="0"/>	$\times 2^{-43} = 0.000000e+00$
IDOT	<input type="text" value="0"/>	$\times 2^{-43} = 0.000000e+00$
C_uc	<input type="text" value="0"/>	$\times 2^{-29} = 0.000000e+00$
C_us	<input type="text" value="0"/>	$\times 2^{-29} = 0.000000e+00$
C_rc	<input type="text" value="0"/>	$\times 2^{-5} = 0.000000e+00$
C_rs	<input type="text" value="0"/>	$\times 2^{-5} = 0.000000e+00$
C_ic	<input type="text" value="0"/>	$\times 2^{-29} = 0.000000e+00$
C_is	<input type="text" value="0"/>	$\times 2^{-29} = 0.000000e+00$
SF1 Reserved 1	<input type="text" value="0"/>	
SF1 Reserved 2	<input type="text" value="0"/>	
SF1 Reserved 3	<input type="text" value="0"/>	
SF1 Reserved 4	<input type="text" value="0"/>	
AODO	<input type="text" value="0"/>	
SV Config	<input type="text" value="0"/>	

Clock Correction Parameters

<<< Hide Details

T_GD	<input type="text" value="0"/>	$\times 2^{-31} = 0.000000e+00$
t_OC	<input type="text" value="31 950"/>	$\times 2^4 = 5.112000e+05$
a_f2	<input type="text" value="0"/>	$\times 2^{-55} = 0.000000e+00$
a_f1	<input type="text" value="0"/>	$\times 2^{-43} = 0.000000e+00$
a_f0	<input type="text" value="0"/>	$\times 2^{-31} = 0.000000e+00$

The provided parameters depend on the GNSS standard the satellite belongs to. The navigation message parameters of the SBAS satellites are described in [chapter 4.9.4, "Rinex File Configuration"](#), on page 98.



The QZSS navigation message structure deviates from the QZSS navigation message scheduling published on the [JAXA](#) web page.

For more information, see [chapter A.6, "QZSS Navigation Message Scheduling"](#), on page 438.

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#### **SV-ID / Standard**

Displays the SV ID and the navigation standard the navigation message is related to.

Remote command:

n.a.

#### **Number of Navigation Pages**

(Requires installed assistance option, e.g. Assistance GPS R&S SMBV-K65)

Several navigation pages are available per satellite.

If RINEX file is used, the value of this parameter is retrieved from the file. A RINEX file may contains ephemeris information for up to 24h. Since the ephemeris are update every two hours, the RINEX file contains a maximum number of 12 navigation pages.

Remote command:

`<subsystem>:SVID<ch>:<GNSS>:NMESsage:PAGE:COUNT` on page 338

#### **Current Page Index**

(Requires installed assistance option, e.g. Assistance GPS R&S SMBV-K65)

Select a specific page from all available navigation pages ([Number of Navigation Pages](#)) and enables the set of ephemeris parameters of this page for configuration.

Remote command:

n.a.

### Real-Time Projection

(enabled in "User Localization" mode and with [Time Projection of Navigation Data](#) > Off)

Enables the instrument to internally perform a projection of the navigation message whenever this message is approaching its validity limit.

When using RINEX file containing information for up to 24 hours, the navigation page to be used is selected in the way, that the simulation start time is within the time span from TOE to TOE+2h, i.e.  $TOE \leq \text{Current Simulation Time} \leq TOE+2h$ .

It may however happen, that the required consecutive navigation page is missing in the RINEX file. The enabled "Real-Time Projection" assures the automatic projection of the navigation message, i.e. the ephemeris set will contain valid data again.

**Note:** "Real-Time Projection" have to be disabled, if assistance data will be generated.

Remote command:

`<subsystem>:SVID<ch>:<GNSS>:NMESsage:RTPRojection` on page 339

### Set To Almanac

(enabled in "User Localization" mode)

The navigation message's parameters will be calculated according to the selected almanac.

Using this option as basis for further reconfiguration is recommended.

Remote command:

`<subsystem>:SVID<ch>:<GNSS>:NMESsage:PRESet` on page 339

### Project Navigation Message

(enabled only in "User Localization" mode)

Triggers the projection of the parameters of the navigation message. The values of the TOE and TOC are calculated according to the selected current simulation time in UTC format, see [Simulation Start Time](#). The updated values of the ephemeris and clock correction are displayed.

**Note:** Use this function prior to the generation of assistance data, if RINEX files are not used.

The projection affects the parameters of the signal at the exact moment the satellite is activated. Thus, if projection is required, trigger the projection at the beginning of the satellite signal generation.

Remote command:

`<subsystem>:SVID<ch>:<GNSS>:NMESsage:PROJect` on page 339

### GPS, Galileo, BeiDou and QZSS Common Ephemeris Parameters

The ephemeris parameters correspond to the SV ID and navigation standard displayed with the parameter [SV-ID / Standard](#) and to the navigation page determined by the [Current Page Index](#).



Table 4-12: Common Ephemeris Parameters

Parameter	Description <sup>(1)</sup>	SCPI command
M_0	Mean Anomaly at Reference Time ( $M_0$ )	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:&lt;GNSS&gt;: NMESsage[:PAGE&lt;us&gt;]:EPHemeris: MZERo on page 346</code>
Delta_N	Mean Motion Difference From Computed Value ( $\Delta n$ )	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:&lt;GNSS&gt;: NMESsage[:PAGE&lt;us&gt;]:EPHemeris: NDELta on page 347</code>
e	Eccentricity	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:&lt;GNSS&gt;: NMESsage[:PAGE&lt;us&gt;]:EPHemeris: ECCentricity on page 343</code>
SQRT(A)	Square Root of the Semi-Major Axis ( $\sqrt{a}$ )	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:&lt;GNSS&gt;: NMESsage[:PAGE&lt;us&gt;]:EPHemeris: SQRA on page 349</code>
OMEGA_0	Longitude of Ascending Node of Orbit Plane at Weekly Epoch ( $\Omega_0$ )	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:&lt;GNSS&gt;: NMESsage[:PAGE&lt;us&gt;]:EPHemeris: OZERo on page 348</code>
i_0	Inclination Angle at Reference Time ( $i_0$ )	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:&lt;GNSS&gt;: NMESsage[:PAGE&lt;us&gt;]:EPHemeris: IZERo on page 346</code>
Omega	Argument of Perigee ( $\Omega$ )	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:&lt;GNSS&gt;: NMESsage[:PAGE&lt;us&gt;]:EPHemeris: OMEGa on page 347</code>
OMEGA_DOT	Rate of Right Ascension	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:&lt;GNSS&gt;: NMESsage[:PAGE&lt;us&gt;]:EPHemeris: ODOT on page 347</code>
IDOT	Rate of Inclination Angle	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:&lt;GNSS&gt;: NMESsage[:PAGE&lt;us&gt;]:EPHemeris: IDOT on page 344</code>
C_uc	Amplitude of the Cosine Harmonic Correction Term to the Argument of Latitude	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:&lt;GNSS&gt;: NMESsage[:PAGE&lt;us&gt;]:EPHemeris: CUC on page 343</code>
C_us	Amplitude of the Sine Harmonic Correction Term to the Argument of Latitude	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:&lt;GNSS&gt;: NMESsage[:PAGE&lt;us&gt;]:EPHemeris: CUS on page 343</code>
C_rc	Amplitude of the Cosine Harmonic Correction Term to the Orbit Radius	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:&lt;GNSS&gt;: NMESsage[:PAGE&lt;us&gt;]:EPHemeris: CRC on page 342</code>
C_rs	Amplitude of the Sine Harmonic Correction Term to the Orbit Radius	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:&lt;GNSS&gt;: NMESsage[:PAGE&lt;us&gt;]:EPHemeris: CRS on page 343</code>
C_ic	Amplitude of the Cosine Harmonic Correction Term to the Angle of Inclination	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:&lt;GNSS&gt;: NMESsage[:PAGE&lt;us&gt;]:EPHemeris: CIC on page 341</code>

Parameter	Description <sup>(1)</sup>	SCPI command
C_is	Amplitude of the Sine Harmonic Correction Term to the Angle of Inclination	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:&lt;GNSS&gt;:NMESsage[:PAGE&lt;us&gt;]:EPHemeris:CIS</code> on page 342
TOE	Time Of Ephemeris $t_{oe}$	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:&lt;GNSS&gt;:NMESsage[:PAGE&lt;us&gt;]:EPHemeris:TOE</code> on page 349

<sup>1</sup>: As these parameter affects the satellite's orbit, the selected values have an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation > 2.5/5/7.5/10°)".

The values are be updated automatically.

### Common Ephemeris Parameters

The ephemeris parameters correspond to the SV ID and navigation standard displayed with the parameter [SV-ID / Standard](#) and to the navigation page determined by the [Current Page Index](#).

**Table 4-13: Common Ephemeris Parameters**

Parameter	Description	SCPI command
SV accuracy / URA Index SISA (Galileo)	Signal In Space Accuracy	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:&lt;GNSS&gt;:NMESsage[:PAGE&lt;us&gt;]:EPHemeris:URA</code> on page 350  <code>&lt;subsystem&gt;:SVID&lt;ch&gt;:GALileo:NMESsage[:PAGE&lt;us&gt;]:EPHemeris:SISA</code> on page 348  <code>&lt;subsystem&gt;:SVID&lt;ch&gt;:GLONass:NMESsage[:PAGE&lt;us&gt;]:EPHemeris:URA</code> on page 350
SV Health	This value does not have an impact on the actual health status of the generated satellite.	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:&lt;GNSS&gt;:NMESsage[:PAGE&lt;us&gt;]:EPHemeris:HEALth</code> on page 344
IODC (GPS/QZSS) AODC (BeiDou)	Issue of Data, Clock Age Of Data, Clock	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:&lt;GNSS&gt;:NMESsage[:PAGE&lt;us&gt;]:EPHemeris:IDOC</code> on page 345
IODE (GPS/QZSS) AODE (BeiDou)	Issue of Data, Ephemeris Age Of Data, Ephemeris	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:&lt;GNSS&gt;:NMESsage[:PAGE&lt;us&gt;]:EPHemeris:IDOE</code> on page 345
IODnav IODa	Issue Of Data, Ephemeris and Clock Issue Of Data, Almanacs	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:GALileo:NMESsage[:PAGE&lt;us&gt;]:EPHemeris:IODNav</code> on page 346  <code>&lt;subsystem&gt;:SVID&lt;ch&gt;:GALileo:NMESsage[:PAGE&lt;us&gt;]:EPHemeris:IODA</code> on page 345

### GPS and QZSS Ephemeris Parameters

The ephemeris parameters correspond to the SV ID and navigation standard displayed with the parameter [SV-ID / Standard](#) and to the navigation page determined by the [Current Page Index](#).

**Table 4-14: GPS Ephemeris Parameters**

Parameter	Description	SCPI command
Code on L2	Type of code for L2; This value does not have any impact on the actual used ranging code of the generated satellite.  The used "Ranging Code" is set in the "Satellite Configuration" menu. <ul style="list-style-type: none"> <li>"Reserved" Reserved for future use.</li> <li>"P Code ON" Carrier L2 (f_L2= 1.2276 GHz) is modulated by P-code (BPSK).</li> <li>"C/A Code ON" Carrier L2 (f_L2= 1.2276 GHz) is modulated by C/A-code (BPSK).</li> </ul>	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:GPS:NMESSage[:PAGE&lt;us&gt;]:EPHemeris:CLTMode</code> on page 342
L2 P Data Flag	Use of carrier L2 P data flag  This value does not have an impact on whether really data is transmitted on the satellite's carrier L2 or not.	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:GPS:NMESSage[:PAGE&lt;us&gt;]:EPHemeris:LTPData</code> on page 346
Fit Interval Flag	Indicates the curve-fit interval used by the CS (Control Segment) in determining the ephemeris parameters	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:GPS:NMESSage[:PAGE&lt;us&gt;]:EPHemeris:FIFlag</code> on page 344
SF1 Reserved 1/2/3/4		<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:GPS:NMESSage[:PAGE&lt;us&gt;]:EPHemeris:SF1Reserved&lt;gr&gt;</code> on page 348
AODO	Age of Data Offset	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:GPS:NMESSage[:PAGE&lt;us&gt;]:EPHemeris:AODO</code> on page 341
SV Configurations		<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:GPS:NMESSage[:PAGE&lt;us&gt;]:EPHemeris:SVConfig</code> on page 349

**GPS, BeiDou and QZSS Clock Correction Parameters**

The ephemeris parameters correspond to the SV ID and navigation standard displayed with the parameter [SV-ID / Standard](#) and to the navigation page determined by the [Current Page Index](#).

**Table 4-15: GPS and BeiDou Clock Correction Parameters**

Parameter	Description <sup>(1)</sup>	SCPI command
T_GD	L1-L2 Correction Term	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:&lt;GNSS&gt;:NMESSage[:PAGE&lt;us&gt;]:CCORrection:TGD</code> on page 340
t_OC a_f2 a_f1 a_f0	Clock Correction Parameter <sup>(1)</sup>	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:&lt;GNSS&gt;:NMESSage[:PAGE&lt;us&gt;]:CCORrection:TOC</code> on page 341  <code>&lt;subsystem&gt;:SVID&lt;ch&gt;:&lt;GNSS&gt;:NMESSage[:PAGE&lt;us&gt;]:CCORrection:AF&lt;gr0&gt;</code> on page 340

<sup>1</sup>: As these parameter affects the satellite's orbit, the selected values have an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation > 2.5/5/7.5/10°)".

The values are be updated automatically.

**GLONASS Ephemeris Parameters**

Comprises the GLONASS specific ephemeris parameters.

**Table 4-16: GLONASS Specific Ephemeris Parameters**

Parameter	Description	SCPI command
Satellite Ephemeris Type (M)	Satellite ephemeris types GLONASS, GLO-NASS-M	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:GLONass:NMESsage[:PAGE&lt;us&gt;]:EPHemeris:SEType</code> on page 355
SV Health (B_n,1_n)	A health value. The user navigation equipment analyzes only the MSB of this word. <ul style="list-style-type: none"> <li>B_n[3] = 1_n = 1 Satellite not healthy</li> <li>B_n[3] = 1_n = 0 Satellite is healthy</li> </ul>	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:GLONass:NMESsage[:PAGE&lt;us&gt;]:EPHemeris:HEALth</code> on page 355
Age of Ephemeris Page (P1)	Time interval between 2 adjacent values of TOE. It defines hence the age of the current Glonass Ephemeris page. This parameter maps to the P1 parameter in the navigation message as follows: <ul style="list-style-type: none"> <li>01 Age of Ephemeris = 30 min</li> <li>10 Age of Ephemeris = 45 min</li> <li>11 Age of Ephemeris = 60 min</li> </ul> <b>Note:</b> Tb-Interval and TOE displays depend on this value.	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:GLONass:NMESsage[:PAGE&lt;us&gt;]:EPHemeris:AOEP</code> on page 354
Tb-Index	Index of the Tb-time interval. Time of Ephemeris (TOE) corresponds to this value multiplied by 15 minutes. This value is actually a scaled TOE value with a unit of 15 minutes. <b>Note:</b> Tb-Interval and TOE displays depend on this value.                     Condition to be always met: <ul style="list-style-type: none"> <li>(Tb-Index – 1) should be an integer multiple of (Age of Ephemeris[<i>min</i>]/15)</li> <li>Case 1: Age of Ephemeris = 30 min Tb-Index = 1, 3, 5... 95</li> <li>Case 2: Age of Ephemeris=45 min Tb-Index = 1, 4, 7... 94</li> <li>Case 3: Age of Ephemeris = 60 min Tb-Index = 1, 5, 9... 93</li> </ul>	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:GLONass:NMESsage[:PAGE&lt;us&gt;]:EPHemeris:TINDEX</code> on page 356

Parameter	Description	SCPI command
Tb-Alignment (P2)	Configures TOE to be aligned to an even or odd scale of 15 min for "Age of Ephemeris" = 30 or 60 min.  Forced to "1", hence odd in case of Age of Ephemeris = 45 min  <b>Note:</b> All Ephemeris pages of an SVID have the same Tb alignment (P2).  The <b>Tb-Interval</b> and <b>TOE</b> parameters depend on this value.	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:GLONass:NMESsage[:PAGE&lt;us&gt;]:EPHemeris:TAlignment</code> on page 356
Tb-Interval	Displays the Tb-Interval in the current day where the Ephemeris set page is valid.  $\text{Tb-Interval} = [((\text{Tb} - 1 + \text{P2}) * 15 * 60) - \text{AgeOfEphemeris} / 2]$ Examples: <ul style="list-style-type: none"> <li>• <math>\text{tb} = 45, \text{P2} = 1</math> and Age of Eph = 30 Tb-Interval = [11:00:00 11:30:00]</li> <li>• <math>\text{tb} = 45, \text{P2} = 1</math> and Age of Eph = 45 Tb-Interval = [10:52:30 11:37:30]</li> <li>• <math>\text{tb} = 45, \text{P2} = 0</math> and Age of Eph = 60 Tb-Interval=[10:30:00 11:30:00]</li> </ul>	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:GLONass:NMESsage[:PAGE&lt;us&gt;]:EPHemeris:TInterval?</code> on page 356
TOE (tb)	Displays the time of Ephemeris in the current day. Also referred to in the standard as the middle of the Tb-Interval or tb. This parameter is equivalent to $\text{DayTime}[(\text{Tb} - 1 + \text{P2}) * 15 * 60 \text{ seconds}]$ and independent of "Age of Ephemeris". Examples: <ul style="list-style-type: none"> <li>• <math>\text{tb} = 45, \text{P2} = 1</math></li> <li>• <math>\text{tb} = 45, \text{P2} = 1</math></li> <li>• <math>\text{tb} = 45, \text{P2} = 0</math> TOE = 11:00:00</li> </ul>	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:GLONass:NMESsage[:PAGE&lt;us&gt;]:EPHemeris:TOE?</code> on page 357
p	Reliability measure of system time conversion parameters. <ul style="list-style-type: none"> <li>• 00 TAU_C and TAU_GPS relayed from control segment.</li> <li>• 01 TAU_C from control segment; TAU_GPS calculated on board GLONASS-M satellite.</li> <li>• 10 TAU_C on board Glonass-M satellite and TAU_GPS relayed from CS.</li> <li>• 11 TAU_C and TAU_GPS calculated on board Glonass-M satellites.</li> </ul>	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:GLONass:NMESsage[:PAGE&lt;us&gt;]:EPHemeris:P</code> on page 355
X_n	The OX <b>position</b> coordinate of the current satellite at TOE(tb), i.e. the middle of the Tb-Interval <sup>(1)</sup> .	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:GLONass:NMESsage[:PAGE&lt;us&gt;]:EPHemeris:XN</code> on page 357
Y_n	The OY <b>position</b> coordinate of the current satellite at TOE(tb), i.e. the middle of Tb-Interval <sup>(1)</sup> .	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:GLONass:NMESsage[:PAGE&lt;us&gt;]:EPHemeris:YN</code> on page 357
Z-n	The OZ <b>position</b> coordinate of the current satellite at TOE(tb), i.e. the middle of Tb-Interval <sup>(1)</sup> .	<code>&lt;subsystem&gt;:SVID&lt;ch&gt;:GLONass:NMESsage[:PAGE&lt;us&gt;]:EPHemeris:ZN</code> on page 357

Parameter	Description	SCPI command
XDOT_n	The OX <b>velocity</b> coordinate of the current satellite at TOE(tb), i.e. the middle of Tb-Interval <sup>(1)</sup> .	<subsystem>:SVID<ch>:GLONass: NMESsage[:PAGE<us>]:EPHemeris: XDN on page 358
YDOT_n	The OY <b>velocity</b> coordinate of the current satellite at TOE(tb), i.e. the middle of Tb-Interval <sup>(1)</sup> .	<subsystem>:SVID<ch>:GLONass: NMESsage[:PAGE<us>]:EPHemeris: YDN on page 358
ZDOT_n	The OZ <b>velocity</b> coordinate of the current satellite at TOE(tb), i.e. the middle of Tb-Interval <sup>(1)</sup> .	<subsystem>:SVID<ch>:GLONass: NMESsage[:PAGE<us>]:EPHemeris: ZDN on page 358
XDDOT_n	The OX <b>acceleration</b> coordinate of the current satellite due to solar and lunar gravitational effects at TOE(tb), i.e. the middle of Tb-Interval <sup>(1)</sup> .	<subsystem>:SVID<ch>:GLONass: NMESsage[:PAGE<us>]:EPHemeris: XDDN on page 357
YDDOT_n	The OY <b>acceleration</b> coordinate of the current satellite due to solar and lunar gravitational effects at TOE(tb), i.e. the middle of Tb-Interval <sup>(1)</sup> .	<subsystem>:SVID<ch>:GLONass: NMESsage[:PAGE<us>]:EPHemeris: YDDN on page 357
ZDDOT_n	The OZ <b>acceleration</b> coordinate of the current satellite due to solar and lunar gravitational effects at TOE(tb), i.e. the middle of Tb-Interval <sup>(1)</sup> .	<subsystem>:SVID<ch>:GLONass: NMESsage[:PAGE<us>]:EPHemeris: ZDDN on page 357

<sup>1</sup>: The coordinates correspond to the PZ-90.11 coordinate system, see also "[Reference Frame](#)" on page 60.

### GLONASS Clock Correction Parameters

Comprises the GLONASS specific parameters for clock correction.

**Table 4-17: GLONASS Clock Correction Parameters**

Parameter	Description	SCPI command
TAU_n (-a_f0)	SV Clock bias correction coefficient	<subsystem>:SVID<ch>:GLONass: NMESsage[:PAGE<us>]: CCORrection:TAUN on page 354
GAMMA_n (a_f1)	SV Clock drift correction coefficient	<subsystem>:SVID<ch>:GLONass: NMESsage[:PAGE<us>]: CCORrection:GAMN on page 354
Delta_TAU_n	Time difference between navigation RF signal transmitted in L2 and navigation RF signal transmitted in L1 band	<subsystem>:SVID<ch>:GLONass: NMESsage[:PAGE<us>]: CCORrection:DTAU on page 353
E_n	Age of operation information	<subsystem>:SVID<ch>:GLONass: NMESsage[:PAGE<us>]: CCORrection:EN on page 353

### Galileo INAV Parameters

Comprises the parameters of the Integrity navigation message I/NAV, provided by E5b and E1-B signals and supporting Safety of Life Service. The I/NAV message carries extended system integrity information.

**Table 4-18: INAV Parameters**

Parameter	Description	SCPI command
B_GD (E1-E5B)	E1-E5b Broadcast Group Delay BGD(E1,E5b)	<subsystem>:SVID<ch>:GALileo: NMESsage[:PAGE<us>]:INAV:BGD on page 352
T_OC (E1-E5B)	Clock correction data reference Time of Week $t_{oc}$ (E1,E5b)	<subsystem>:SVID<ch>:GALileo: NMESsage[:PAGE<us>]:INAV:TOC on page 353
a_f2 (E1-E5B)	SV clock drift rate correction coefficient $a_{f2}$ (E1,E5b)	<subsystem>:SVID<ch>:GALileo: NMESsage[:PAGE<us>]:INAV: AF<gr0> on page 351
a_f1 (E1-E5B)	SV clock drift correction coefficient $a_{f1}$ (E1,E5b)	
a_f0 (E1-E5B)	SV clock bias correction coefficient $a_{f0}$ (E1,E5b)	
E1B_DVS	Data Validity Satellite Status, transmitted on E1-B (E1-B <sub>DVS</sub> )	<subsystem>:SVID<ch>:GALileo: NMESsage[:PAGE<us>]:INAV:E1BDVS on page 352
E5B_DVS	Data Validity Satellite Status, transmitted on E5b (E5b <sub>DVS</sub> )	<subsystem>:SVID<ch>:GALileo: NMESsage[:PAGE<us>]:INAV:E5BDVS on page 352
E1B_HS	Signal Health Status for E1 (E1-B <sub>HS</sub> )	<subsystem>:SVID<ch>:GALileo: NMESsage[:PAGE<us>]:INAV:E1BHS on page 352
E5B_HS	Signal Health Status for E5b (E5b <sub>HS</sub> )	<subsystem>:SVID<ch>:GALileo: NMESsage[:PAGE<us>]:INAV:E5BHS on page 353

**Galileo FNAV Parameters**

Comprises the parameters of the freely accessible navigation message F/NAV, provided by the E5a signal for Open Service.

**Table 4-19: FNAV Parameters**

Parameter	Description	SCPI command
B_GD (E1-E5A)	E1-E5a Broadcast Group Delay BGD(E1,E5a)	<subsystem>:SVID<ch>:GALileo: NMESsage[:PAGE<us>]:FNAV:BGD on page 350
T_OC (E1-E5A)	Clock correction data reference Time of Week $t_{oc}$ (E1,E5a)	<subsystem>:SVID<ch>:GALileo: NMESsage[:PAGE<us>]:FNAV:TOC on page 351
a_f2 .. a_f0 (E1-E5A)	SV clock drift rate correction coefficient $a_{f2}$ , $a_{f1}$ and $a_{f0}$ (E1,E5a)	<subsystem>:SVID<ch>:GALileo: NMESsage[:PAGE<us>]:FNAV: AF<gr0> on page 350
E5A_DVS	Data Validity Satellite Status, transmitted on E5a (E5a <sub>DVS</sub> )	<subsystem>:SVID<ch>:GALileo: NMESsage[:PAGE<us>]:FNAV:E5ADV on page 350

Parameter	Description	SCPI command
E5A_HS	Signal Health Status for E5a (E5a <sub>HS</sub> )	<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:FNAV:E5AHS on page 351
K	F-NAV Almanac Scheduling start index	<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:FNAV:K on page 351

### 4.10.10 Static Multipath Configuration

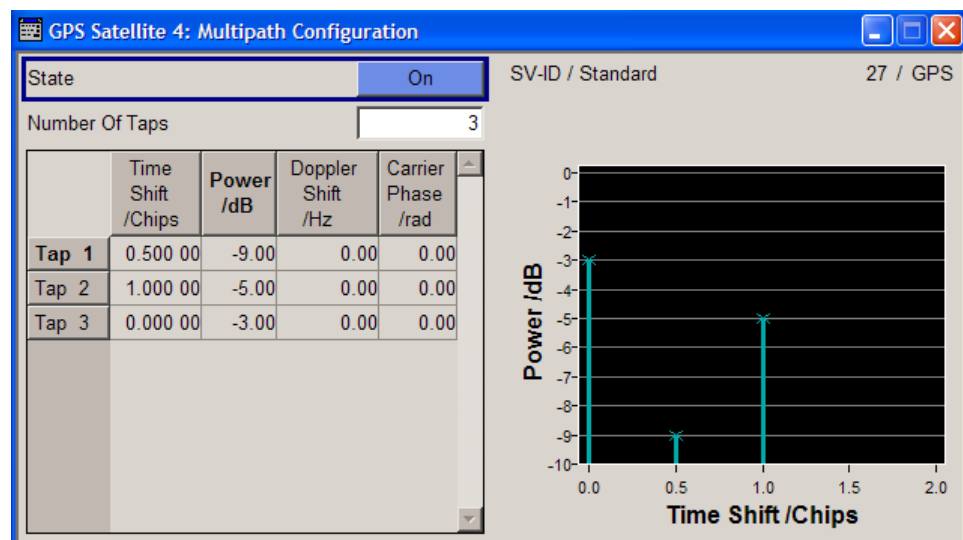


The parameters of the "Multipath Configuration" are only configurable for instruments with equipped assisted option (R&S SMBV-K92).

To access these settings:

1. Select "Baseband > Satellite Navigation > GPS".
2. Select "Simulation Mode > User Localization".
3. Select "Satellite Configuration > Multipath".

The "Multipath Configuration" dialog enables you to configure the signal parameters of the selected satellite, so that a signal undergoing multipath propagation is simulated. The provided settings enable configuration of the number of fading taps and individual configuration of the time and Doppler shift, power and carrier phase per tap. The resulting propagation is displayed in the graph on the right side of the dialog.



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L Time Shift / Chips.....	153
L Power.....	153
L Doppler Shift /Hz.....	153
L Carrier Phase /rad.....	154

**State**

Enables/disables the generation of multipath signal for the satellite with the displayed SV ID belonging to the displayed GNSS standard. Settings made in the dialog are considered only if the multipath configuration is enabled.

Remote command:

`<subsystem>:SVID<ch>:<GNSS>:MPATH:STATE` on page 310

**SV-ID / Standard**

Displays the SV ID and the navigation standard the navigation message is related to.

Remote command:

n.a.

**Number of Taps**

Sets the paths number. The value determines the number of rows available for configuration.

The maximum value for this parameter is calculated dynamically, see [chapter A.5, "Channel Budget"](#), on page 436.

Remote command:

`<subsystem>:SVID<ch>:<GNSS>:MPATH:TAP:COUNT` on page 310

**Multipath Taps Table**

Comprises the settings of the taps. The number of taps, i.e. the table rows is determined by the parameter [Number of Taps](#).

**Time Shift / Chips ← Multipath Taps Table**

Sets an additional delay of the selected satellite, used to simulate multipath conditions.

Remote command:

`<subsystem>:SVID<ch>:<GNSS>:MPATH:TAP<us>:TShift` on page 312

**Power ← Multipath Taps Table**

Sets the additional power of the satellite in dB, used to simulate multipath conditions.

See [chapter 4.10.1, "Power Configuration"](#), on page 115 for information about the power calculation.

Remote command:

`<subsystem>:SVID<ch>:<GNSS>:MPATH:TAP<us>:POWER` on page 312

**Doppler Shift /Hz ← Multipath Taps Table**

Enters the additional Doppler shift of the simulated signal of the satellite, used to simulate multipath conditions.

Remote command:

`<subsystem>:SVID<ch>:<GNSS>:MPATH:TAP<us>:DSHift` on page 311

**Carrier Phase /rad ← Multipath Taps Table**

Sets the carrier phase, used in case of multipath simulation.

Remote command:

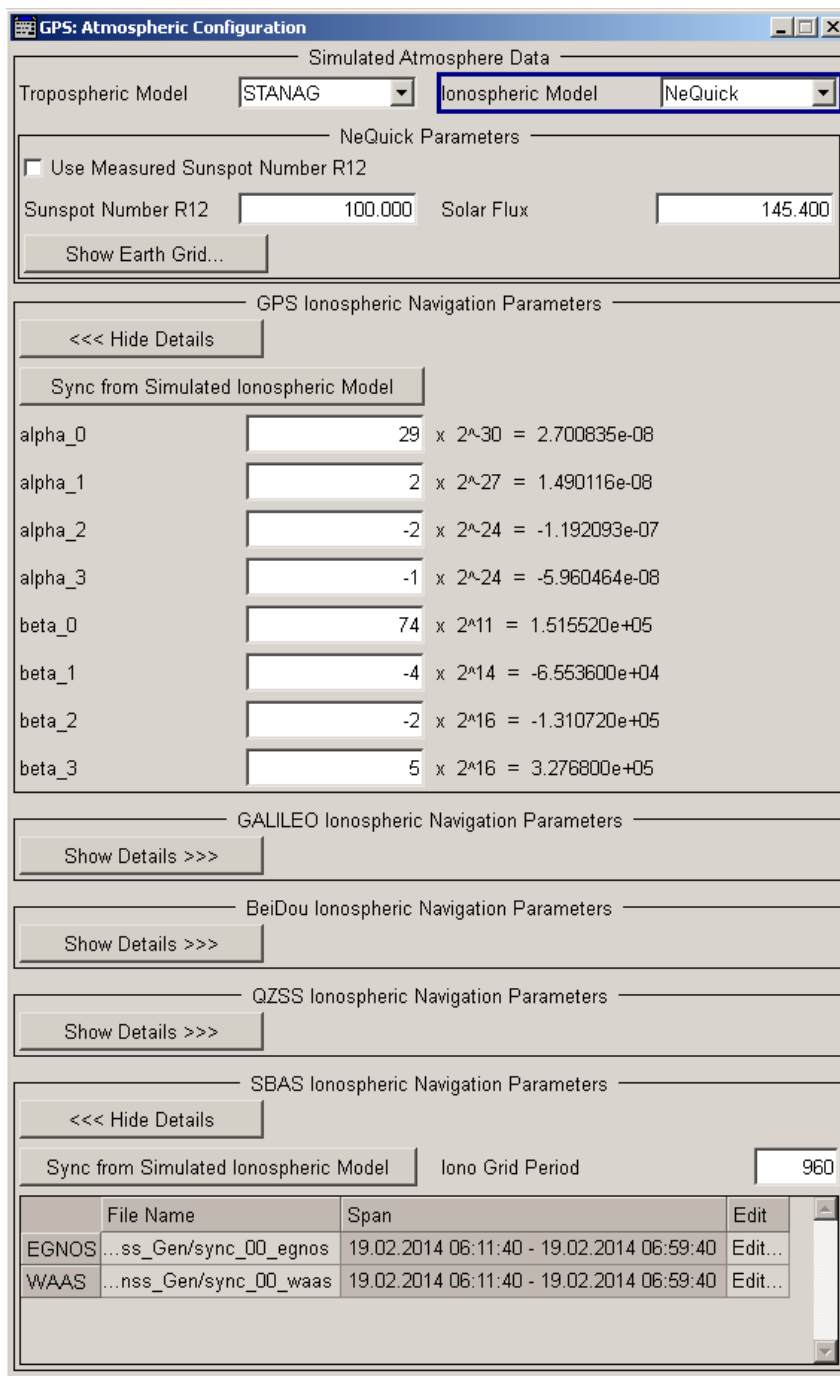
`<subsystem>:SVID<ch>:<GNSS>:MPATH:TAP<us>:CPHase` on page 311

## 4.11 Atmospheric Configuration Settings

To access this dialog:

1. Select "Main Dialog > Atmospheric Configuration".

- Set the tropospheric and ionospheric models, e.g. select "Ionospheric Model > NeQuick".



The atmospheric configuration comprises the parameters for adjusting the ionospheric and tropospheric models of the simulation as well as the atmospheric navigation parameters transmitted by each GNSS if available.

- GPS, Galileo and BeiDou assume specific ionospheric models and hence transmit different atmospheric navigation parameters

- By the time this firmware had been developed, the ionospheric model for GLO-NASS is not yet specified and hence Glonass satellites transmit no data on the atmosphere.

The ionospheric navigation parameters only define what the satellites are transmitting as ionospheric correction parameters whereas the selected model describes the actual ionospheric and tropospheric models used in the satellite-receiver channel simulation.

Option GNSS Enhanced (R&S SMBV-K92) is required to configure the atmospheric parameter.

[Tropospheric Model](#)..... 156  
[Ionospheric Model](#)..... 156  
[MOPS-DO-229D Parameters](#)..... 157  
[NeQuick Parameters](#)..... 159  
[Klobuchar Ionospheric Navigation Parameters](#)..... 160  
[Sync from Simulated Ionospheric Model](#)..... 162  
[GALILEO Ionospheric Navigation Parameters](#)..... 162  
[SBAS Ionospheric Navigation Parameters](#)..... 162

**Tropospheric Model**

Sets the tropospheric model used in the satellite-receiver channel simulation.

The troposphere is the lower atmosphere layer that comprises rain, snow, clouds, etc. and affects the GNSS signals propagation. The GNSS signals experience a variable path delay, caused mainly by the dry atmosphere.

"STANAG"      A tropospheric model described in the NATO Standard Agreement [STANAG 4294 Issue 1](#).

"MOPS-DO-229D"  
 The minimum operational performance standards (MOPS) is a tropospheric model used by the SBAS systems.  
 The model is based on a mapping function or wet and dry troposphere.

Remote command:

`<subsystem>:ATMospheric:TROPospheric:MODe1` on page 359

**Ionospheric Model**

Sets ionospheric model used by the channel simulation.

The selected model applies for all satellites, irrespectively to the navigation standards they belong to.

"Klobuchar"      Klobuchar is the correction model used by GPS.  
 Although the Klobuchar algorithm estimates the ionospheric delay in the GPS L1 frequency signal, it can be also used for delay estimations for any GNSS signal.  
 See "[Klobuchar Ionospheric Navigation Parameters](#)" on page 160.

"NeQuick" Requires option Differential GPS (R&S SMBV-K110)  
 NeQuick is the correction model proposed by Galileo, but the ionospheric corrections computed by the NeQuick can be used for any GNSS signal.  
 NeQuick is a 3D time-dependent ionospheric electron density model. It provides electron density in the ionosphere as a function of the position (longitude, latitude and height), time (UTC or TOW) and the solar activity. [1]  
 See "NeQuick Parameters" on page 159.

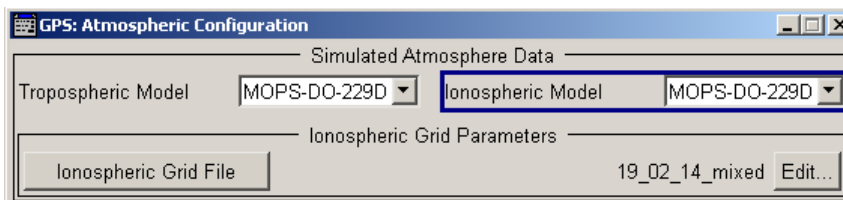
"MOPS-DO-229D" Requires option Differential GPS (R&S SMBV-K110)  
 The minimum operational performance standards (MOPS) is a model used by the SBAS systems and based on a mapping function or wet and dry troposphere.  
 See "MOPS-DO-229D Parameters" on page 157.

Remote command:  
 <subsystem>:ATMospheric:IONospheric:MODe1 on page 359

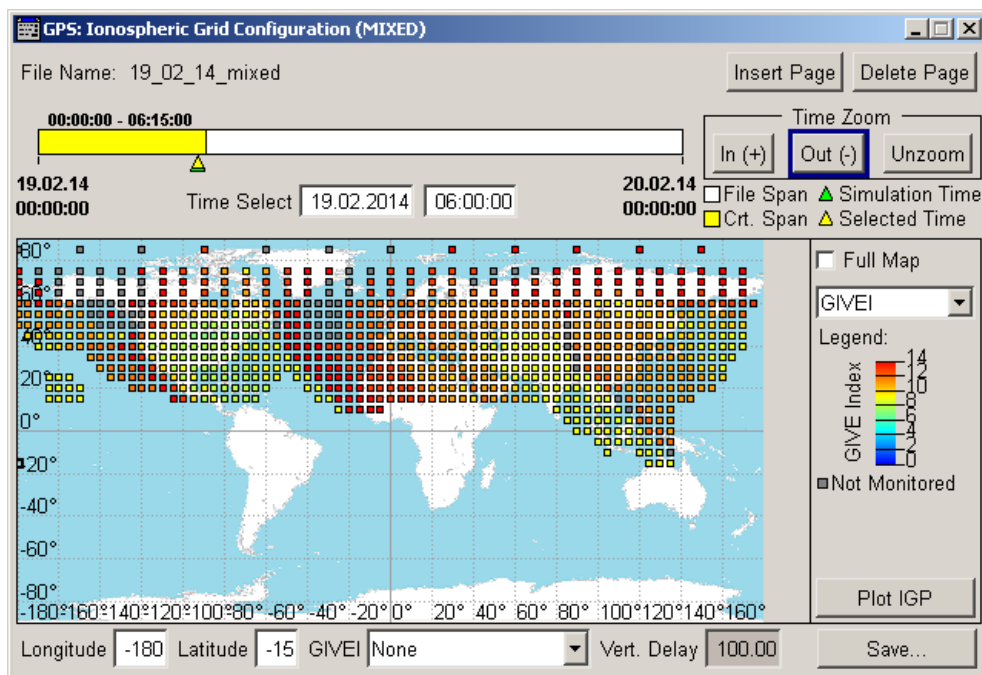
**MOPS-DO-229D Parameters**

The simulation of ionospheric delays follows the pierce point interpolation technique described in the RTCA MOPS DO-229.

In instruments equipped with option Differential GPS (R&S SMBV-K110), enables you to select a predefined or user-defined "Ionospheric Grid File" per SBAS regional system or with mixed ionospheric information on the enabled GNSS systems.



- To create a suitable file with mixed ionospheric information, select "File Conversion Tool > Conversion Mode > Merge Multiple Ionospheric Grids".
- To change the ionospheric configuration, use the "Edit" function.



- To display the 24h vertical delay distribution function, in the "Ionospheric Grid Configuration" dialog, select a particular position on the map and select "Plot IGP".

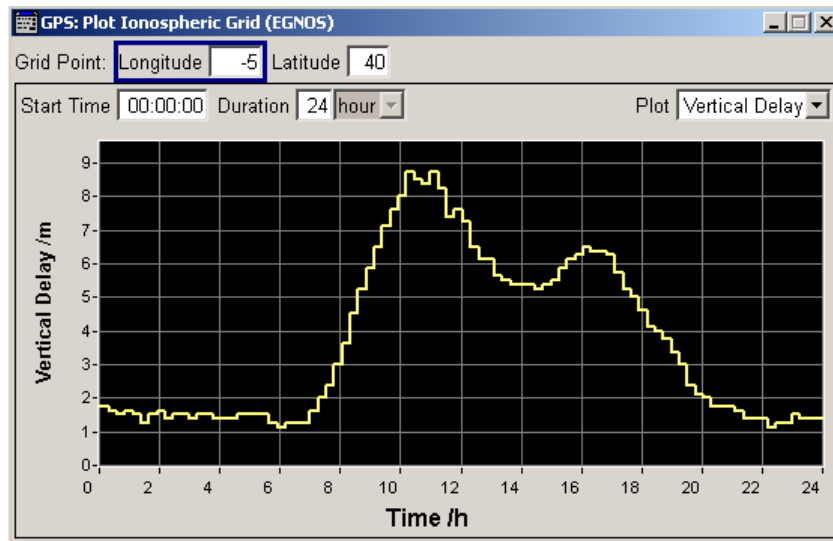


Fig. 4-14: Example: 24h Vertical Delay distribution for a given position (the curve shows the MOPS-DO-229D distribution)

See also:

- [chapter 4.9.5, "Ionospheric Grid File Configuration"](#), on page 99
- [chapter 4.8, "File Conversion Tool Settings"](#), on page 88
- ["To synchronize the ionospheric delays to the MOPS-DO-229D model"](#) on page 239

Remote command:

`<subsystem>:ATMospheric:IONospheric:MOPS:FILE` on page 361

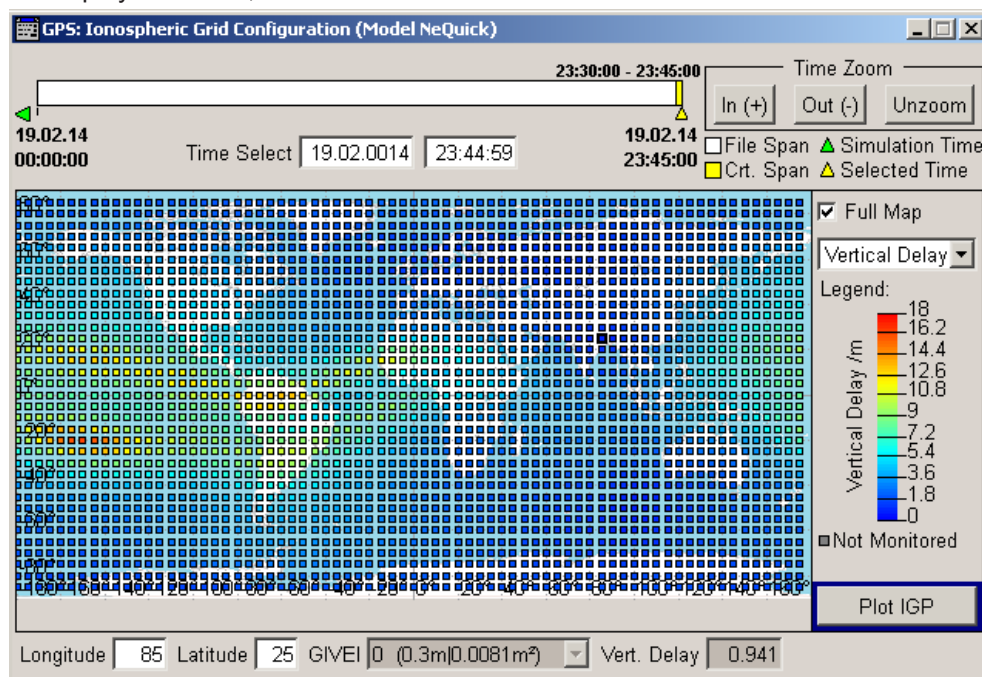
### NeQuick Parameters

The NeQuick model provides electron density in the ionosphere as a function of the position (longitude, latitude and height), time (UTC or TOW) and the solar activity.

It is based on the original profiler proposed by [Di Giovanni and Radicella, 1990](#). The NeQuick FORTRAN 77 code is available for download at the [website of the International Telecommunication Union Radiocommunication Sector \(ITU-R\)](#).

The solar activity is defined with *one* of the following parameters:

- "Solar Flux"  
that is the flux level generated by the sun at the earth's orbit at a 10.7 cm wavelength (F10.7)
- "Sunspot Number R12"  
that is the averaged sunspot number R12  
You can set the R12 value or, if the "Simulation Time" is within the period from year 1931 to year 2001, use real R12 values ("Use Measured Sunspot Number R12 > On").
- To display the result, select "Show Earth Grid".



- To display the 24h vertical delay distribution function, in the "Ionospheric Grid Configuration" dialog, select a particular position on the map and select "Plot IGP".

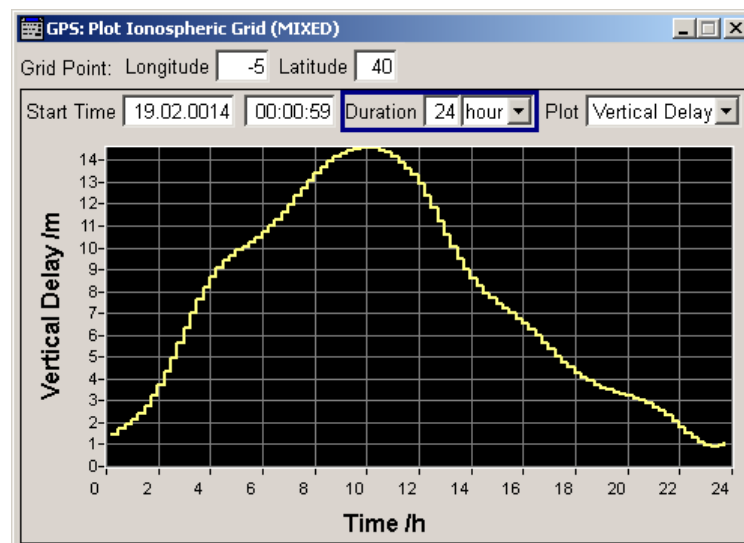


Fig. 4-15: Example: 24h Vertical Delay distribution for a given position (the curve shows the typical NeQuick distribution)

See:

- [chapter 4.9.5, "Ionospheric Grid File Configuration"](#), on page 99
- ["GALILEO Ionospheric Navigation Parameters"](#) on page 162
- ["To synchronize the ionospheric delays to the NeQuick and Klobuchar models"](#) on page 240

Remote command:

`<subsystem>:ATMospheric:IONospheric:NEQuick:SFLux` on page 360

`<subsystem>:ATMospheric:IONospheric:NEQuick:UMSN` on page 360

`<subsystem>:ATMospheric:IONospheric:NEQuick:SUNSpot` on page 360

### Klobuchar Ionospheric Navigation Parameters

The Klobuchar model assumes that the vertical delays are constant values at night time and follow a half-cosine function in daytime, see [figure 4-16](#).

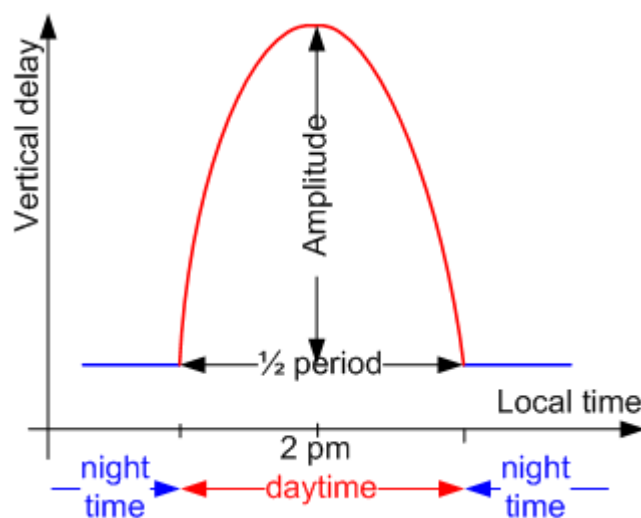


Fig. 4-16: Klobuchar ionospheric model



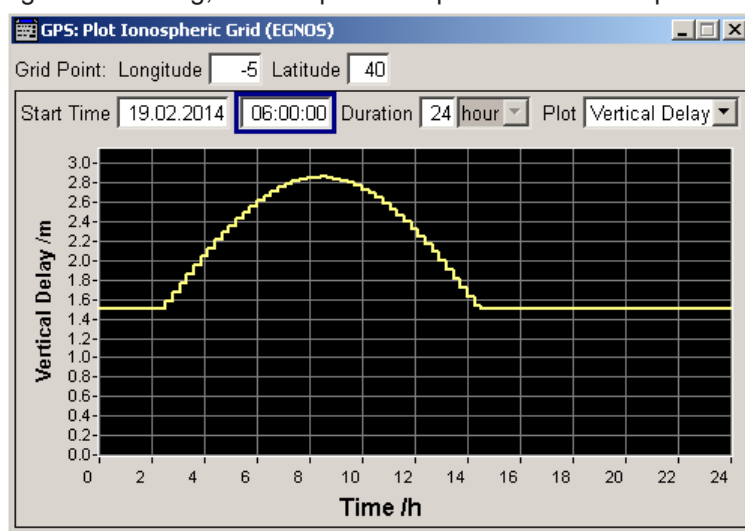
The amplitude and the period of this function depend on the receiver location and are calculated from the eight broadcast coefficients "alpha\_0 .. alpha\_3" and "beta\_0 .. beta\_3". These coefficients are included in the navigation message of the simulated satellites.

**Note:** If ionospheric modeling is disabled, the set coefficients are nevertheless included in the generated navigation message.

Setting the 8 Klobuchar coefficients to zero is not equivalent to disabling ionospheric modeling.

Changing the ionospheric model has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation > 2.5/5/7.5/10)".

- To display the ionospheric configuration, select "Show Earth Grid".
- To display the 24h vertical delay distribution function, in the "Ionospheric Grid Configuration" dialog, select a particular position on the map and select "Plot IGP".



*Fig. 4-17: Example: 24h Vertical Delay distribution for a given position (the curve shows the typical Klobuchar distribution)*

As expected, the Klobuchar distribution function has a maximum at around 2 pm ("Start Time" + "Time/h" = 6 am + 8h).

See also:

- [chapter 4.9.5, "Ionospheric Grid File Configuration"](#), on page 99
- ["To synchronize the ionospheric delays to the NeQuick and Klobuchar models"](#) on page 240

Remote command:

`<subsystem>:ATMospheric:<GNSS>:IONospheric:ALPHA<ch0>` on page 361

`<subsystem>:ATMospheric:<GNSS>:IONospheric:BETA<ch0>` on page 362

**Sync from Simulated Ionospheric Model**

Synchronizes the ionospheric navigation parameters of the GNSS standard with the parameters of the current ionospheric model.

Remote command:

- <subsystem>:ATMospheric:GPS:IONospheric:SYNC on page 361
- <subsystem>:ATMospheric:GALileo:IONospheric:SYNC on page 361
- <subsystem>:ATMospheric:BEIDou:IONospheric:SYNC on page 361
- <subsystem>:ATMospheric:QZSS:IONospheric:SYNC on page 361
- <subsystem>:ATMospheric:SBAS:IONospheric:SYNC on page 361

**GALILEO Ionospheric Navigation Parameters**

The GALILEO ionospheric model includes the broadcast coefficients  $a_{i0}$ ,  $a_{i1}$  and  $a_{i2}$  used to compute the Effective Ionization Level  $A_z$  and the Ionospheric Disturbance Flag, given for five different regions.

Changing the ionospheric model has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation > 2.5/5/7.5/10°)".

Remote command:

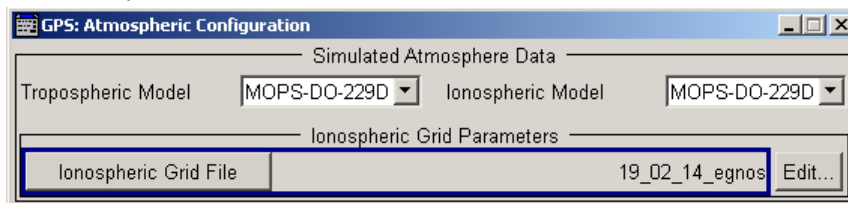
- <subsystem>:ATMospheric:GALileo:IONospheric:AI<ch0> on page 362
- <subsystem>:ATMospheric:GALileo:IONospheric:SF<ch> on page 362

**SBAS Ionospheric Navigation Parameters**

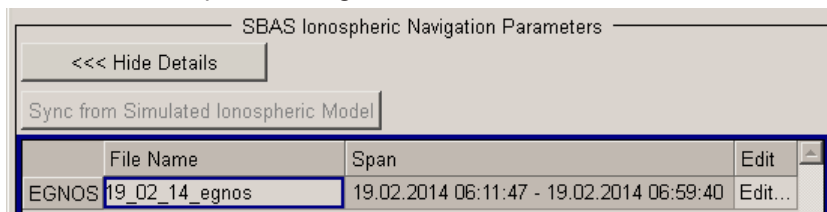
In instruments equipped with option Differential GPS (R&S SMBV-K110), displays the currently used SBAS ionospheric grid files per enabled regional system.

Load the same ionospheric grid file for the parameters listed bellow. Modification of one of the ionospheric grids would lead to a deviation between the SBAS corrections and the ionospheric perturbations:

- the "Ionospheric Grid File"



- the "SBAS Ionospheric Navigation Parameters > File"



SBAS ionospheric grid files are defined with:

- "System" Indicates the "Augmentation System" the SBAS message files belong to.
- "File name" Accesses the standard File Select dialog to select predefined or user defined files.  
If a file is selected, displayed is the file name and file path.

"Span"	Displays information on the time span the file is defined for.
"Edit"	Accesses the dialog with further settings to configure the content of the SBAS ionospheric grid files. See <a href="#">chapter 4.9.4, "Rinex File Configuration"</a> , on page 98
"Iono Grid Sampling Period"	For "GNSS System Configuration > Sync Ionospheric Errors form SBAS Data > Off", sets the resolution of the ionospheric grid file that is generated with the function <a href="#">Sync from Simulated Ionospheric Model</a> . The "Iono Grid Sampling Period = 1 s" corresponds to the real world data, but the generated <code>sync_*.ion_grid</code> file is big in size. The default value is a resolution, that is sufficient for test purposes, maintains the size of the output file and is a multiple of the default "Period", see <a href="#">"SBAS message files table"</a> on page 92.

Remote command:

`<subsystem>:ATMospheric:SBAS:IONospheric:IGSPeriod` on page 361

## 4.12 Real-Time S.P.O.T. Settings

To access this settings:

1. Select "Baseband > Satellite Navigation > GPS".
2. Select "Simulation Mode > Auto Localization/User Localization".

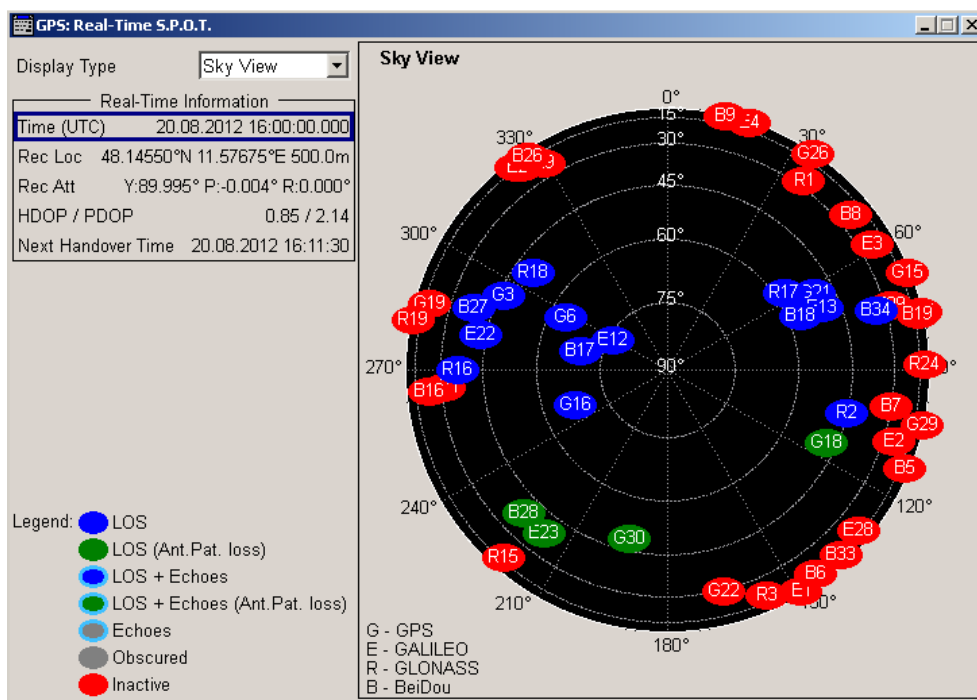
The "Real-Time S.P.O.T." (Satellites and Position Online Tracker) view is a dynamic display that provides real-time information on:

- current satellite's constellation
- receiver position
- current simulation time
- power levels of the active satellites
- HDOP, PDOP.

The displayed settings are grouped into different views:

- The "Sky View" displays the current position and state (active or inactive) of the satellites in the current satellites constellation. Enable "Simulation Mode > Auto Localization" to observe the situation of disappearance and re-appearance of satellites.

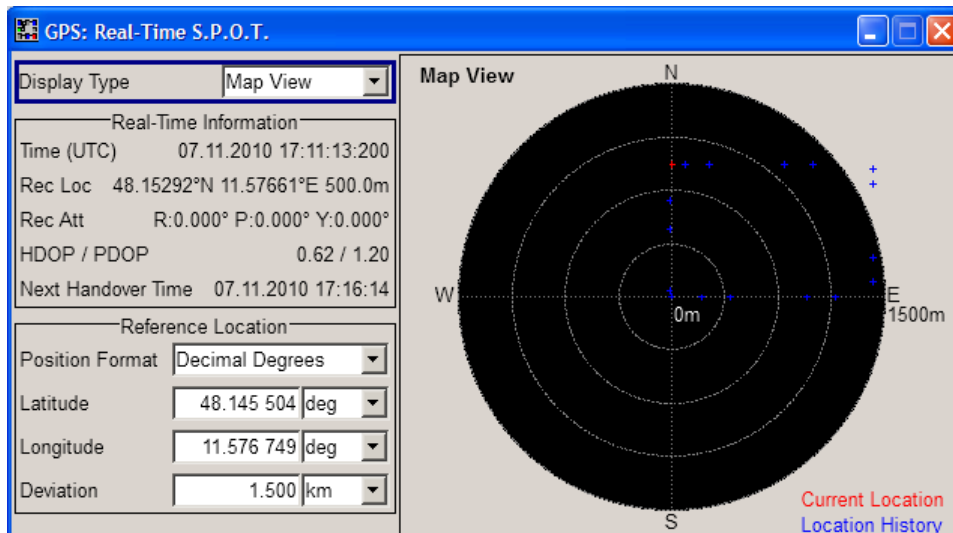
For instruments equipped with option R&S SMBV-K101, the "Sky View" indicates also the obscured satellites, the satellites with echoes, etc. For example, the satellites which signal is not visible from the current receivers position because there is an obstacle between the receiver and the satellite, are displayed in grey color.



- LOS = Line of Sight; visible satellite
- LOS (A.P. loss) = Visible satellite with antenna pattern loss
- LOS + Echoes = Visible satellite with echoes
- LOS + Echoes (A. P. loss) = Visible satellite with antenna pattern loss and echoes
- Echoes = Obscured satellite, only echoes available for example due to buildings
- Obscured = Obscured satellite, for example due to buildings
- Inactive = Satellite is not simulated

To query the satellite's constellation for the selected time, use the SCPI command: `<subsystem>:RT:SCONstellation?` on page 389

- The "Map View" display the trajectory of moving receiver or the position of a static one.



If GNSS receiver software is used to analyze the generated GNSS signal, a slight difference between the receiver position displayed on the "Map View" and the posi-

tion displayed on the receiver software may be noticed at the beginning of a simulation. This accuracy of the "Map View" display is progressively increasing with the time elapsed and after the first satellite handover the deviation should completely disappear.

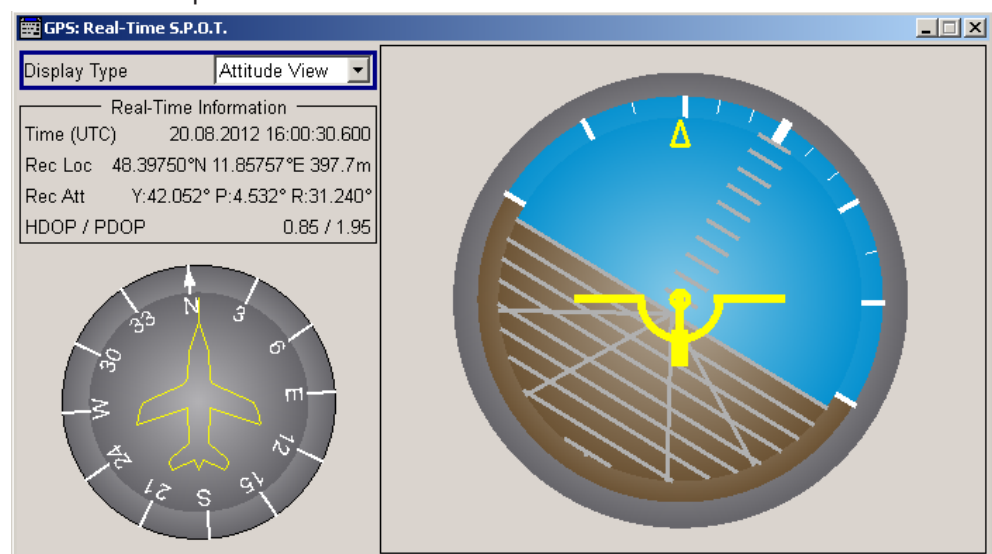
To query the receiver location for the selected time, use the SCPI commands:

- `<subsystem>:RT:RLOCation:COORDinates:DECimal?` on page 386
- `<subsystem>:RT:RLOCation:COORDinates:DMS?` on page 388

To query the "Map View" radius

- `<subsystem>:SPOT:MAP:DEViation` on page 382

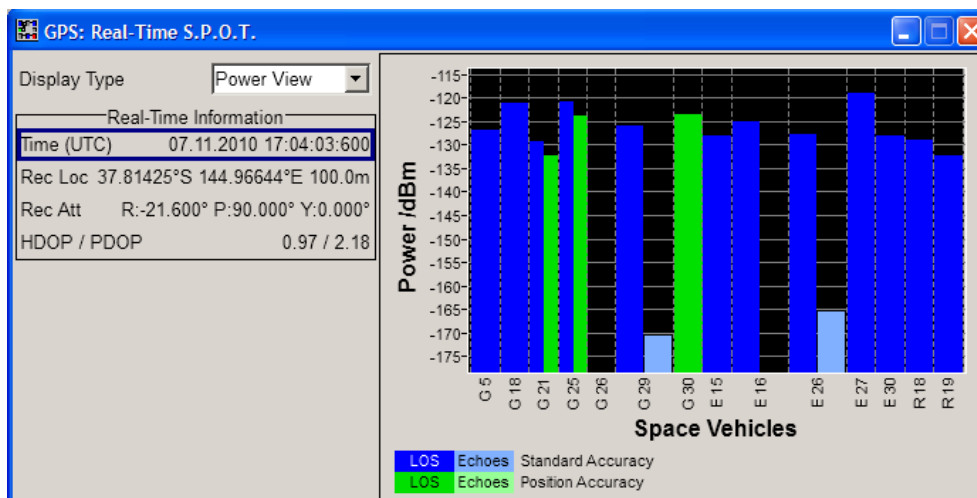
- The "Attitude View" displays a compass showing the geographic direction of a moving receiver, typically an airplane, and an attitude indicator showing the orientation of this airplane relative to Earth's horizon.



The displayed attitude indicator is known from the flight simulators. The yellow sign in the middle represents the airplane with its nose and wings. The brown part of the display is the earth, where as the sky is displayed in blue; the line between the two parts is the horizon.

The "Attitude View" is changes updated in real time:

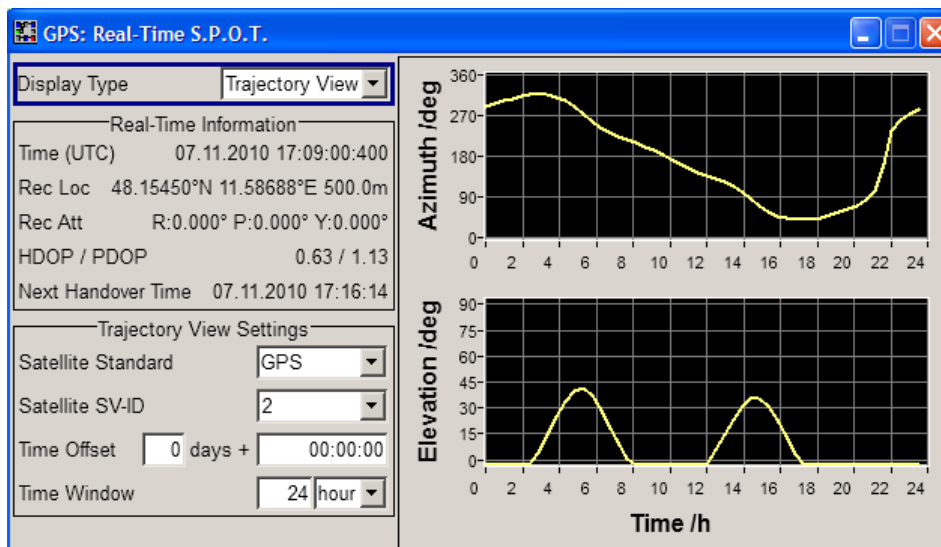
- If the yellow circle, i.e. the nose of the airplane is on the blue background, than the airplane is nose up.
- If a spinning and roll are enabled, the attitude indicator also visualizes pitch and roll (i.e. bank or side to side tilt).
- The "Power View" displays the current power levels of the signals of the active satellites and their echos. The displayed values are updated in real time.



To query the satellite's absolute power for the selected time, use the SCPI command:

– `<subsystem>:RT:<GNSS>:SVID<ch>:TAP<us>:POWER:ABSolute`  
on page 385

- The "Trajectory View" displays the time variation of the azimuth and the satellite's elevation in the selected time window.



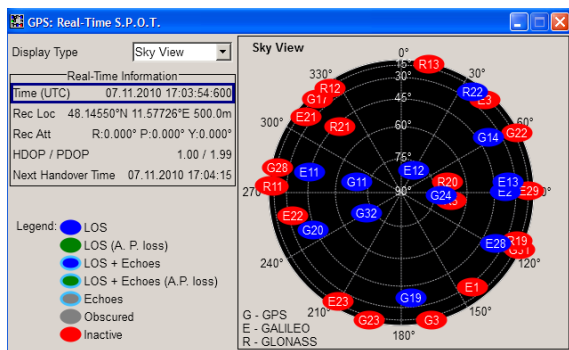
To query the satellite's position for the selected time, use the SCPI commands:

- `<subsystem>:RT:<GNSS>:SVID<ch>:AZIMuth` on page 382
- `<subsystem>:RT:<GNSS>:SVID<ch>:ELEVation` on page 383

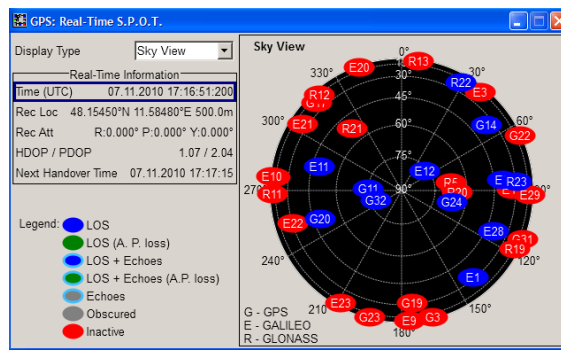
**Example:**

The figures in this section show the "Real-Time S.P.O.T. > Sky View" display of the same custom build GPS, Galileo and GLONASS hybrid GNSS scenario with automatic exchange of the satellites but the second one is made around 15 min later (compare the value of the parameter "Time" in both figures).

**Sky View (Start moment)**



**Sky View (15 min later)**



The current position and state of the satellites is displayed on the "Sky View". This is a hybrid GNSS scenario with 12 satellites. Compare the satellite constellations, the position and number of active and inactive satellites; some satellites had disappeared behind the horizon.

**4.12.1 Display Type**

**Display Type**

Switches between the available views.

See [chapter 4.12, "Real-Time S.P.O.T. Settings"](#), on page 163.

Remote command:

`<subsystem>:SPOT:DISPlay` on page 381

**4.12.2 Real-Time Information**

The "Real-Time Information" section is common for all views and provides dynamic real-time information about several parameters like "HDOP", "PDOP", "Receiver Location", "Elapsed Time" and "Time of Simulation".

<a href="#">Time (UTC)</a> .....	168
<a href="#">Receiver Location</a> .....	168
<a href="#">Receiver Attitude</a> .....	168
<a href="#">HDOP / PDOP</a> .....	168
<a href="#">Next Constellation Change</a> .....	168

**Time (UTC)**

Displays the current date and time of the simulation. The value is displayed in format DD.MM.YYY HH:MM:SS and is updated every 5 sec.

Remote command:

n.a

**Receiver Location**

Displays the current location of the receiver in decimal format.

For static [Geographic Location/Attitude](#), the "Receiver Location" is as selected in the "Localization Data" dialog.

For moving receivers however, the receiver position specified in the "Localization Data" section of the main dialog is the initial location of the receiver. The current receiver location is retrieved from the waypoints file as function of the simulation "Time" and displayed in the "Real-Time S.P.O.T. > Map View" display.

Remote command:

n.a

**Receiver Attitude**

Displays the current receiver attitude parameters yaw/heading, pitch/elevation, roll/bank in degrees.

The initial receiver attitude parameters are selected in the "Localization Data" dialog.

Remote command:

[<subsystem>:RT:RATTitude?](#) on page 392

**HDOP / PDOP**

Displays the current HDOP and PDOP value of the selected satellite constellation.

The HDOP (Horizontal Dilution of Precision) can be used as an indication of 2D positioning quality. The PDOP (Position Dilution of Precision) can be used as an indication of 3D positioning quality.

The general rule here is that the smaller the HDOP and PDOP are, the better the precision of the position fix will be.

Remote command:

n . a .

**Next Constellation Change**

(enabled for "Auto Localization" mode)

Displays the expected date and time of the upcoming satellites handover.

Remote command:

[<subsystem>:SPOT:NHOTime?](#) on page 381



### 4.12.3 Reference Location

The "Reference Location" section is enabled in "Map View" display and provides the settings for configuration of the reference location.

[Reference Location Coordinates](#)..... 169  
[Deviation](#)..... 169

#### Reference Location Coordinates

The reference location is identified by a latitude and a longitude. The values can be displayed in decimal or DMS format. The display format is determined by the parameter "Position Format".

For static receivers, the initial values of the latitude and longitude are automatically set to the values of the [Geographic Location/Attitude](#) selected in the Localization Data section of the main dialog. When simulating moving receivers, the initial values are derived from the waypoints file and set to the coordinates of the first receiver position.

Parameter	Description
"Position Format"	Sets the format in which the Latitude and Longitude are displayed. <ul style="list-style-type: none"> <li>"DEG:MIN:SEC" The display format is Degree:Minute:Second and Direction, i.e. <math>XX^{\circ}XX'XX.XX</math> Direction, where direction can be North/South and East/West.</li> <li>"Decimal Degree" The display format is decimal degree, i.e. <math>+/-XX.XXXXX^{\circ}</math>, where "+" indicates North and East and "-" indicates South and West.</li> </ul> The Position Format selected here changes the format the <a href="#">Receiver Location</a> is displayed.
"Latitude"	Sets the latitude of the reference location.
"Longitude"	Sets the longitude of the reference location.

Remote command:  
n.a

#### Deviation

Sets the deviation in terms of meters from the Reference Location and determines the radius of the "Map View" display.

Remote command:  
n . a .

### 4.12.4 Trajectory View Settings

This settings section is available in the "Trajectory View" display and comprises the settings for customization of the displayed Azimuth and Elevation trajectories.

[Satellite Standard](#)..... 170  
[Satellite SV-ID](#)..... 170  
[Time Offset](#)..... 170  
[Time Window](#)..... 170

**Satellite Standard**

Determines the navigation standard the [Satellite SV-ID](#) is belonging to.

Remote command:

determined by the <GNSS> block of the SCPI command

**Satellite SV-ID**

Determines the SV-ID of the satellite for that the Azimuth and Elevation trajectories are displayed.

Remote command:

determined by the suffix in the `SVID<ch>` block of the SCPI command

**Time Offset**

Determines the time offset as number of days and number of hours.

Remote command:

n.a.

**Time Window**

Sets the time window the trajectories are displayed in, i.e. determines the resolution of the x-axis of the Trajectory View.

Remote command:

n.a.

## 4.13 Data Logging Settings

Data logging is a features that enables you to acquire and download navigation data. Data is acquired (i.e. logged) in real time or offline. Logged data is stored in files on the hard disk, in any network directory or on a remote computer.

Download and offline postprocessing of navigation data can be useful source for basic analysis, e.g. for validation of the received parameters, for monitoring or documentation tasks. For example, you can log the simulated longitude, latitude and altitude parameters or the ionospheric errors and compare these values with the values at the receiver.

**Impact of enabled simulation accuracy features on the logged data**

If the [Simulation Accuracy](#) functions are enabled, the pseudorange, satellites and receiver position values are automatically corrected.

That is, the logged values include the corrections. The logged data may deviate from the expected not corrected parameters.

See "[Pseudorange calculation](#)" on page 40.

---

### Filename syntax

The generated files are stored in the selected [Directory](#) and their filenames follow the syntax `<Prefix>_<Mode>_<Logging_Category/Format>[_<YYMMDD>_<HHMMSS>]`, where:

- `<Prefix>` is defined with the parameter [Base Filename](#)
- `<Mode>` corresponds to the selected ["Mode"](#) on page 173
- `<Logging_Category/Format>` corresponds to the enabled category/format in the [Logging formats and categories](#) table.  
The available categories/formats are: Satellite, User Motion.
- `<YYMMDD>_<HHMMSS>` is the system time, if [Append System Time](#) is enabled.

The parameter [Filename](#) indicates the current file name.

### File format of the generated files

Logged navigation data is stored as `*.csv` files. The comma separated file format is self-explanatory.

### File content

Two kind of parameters define the content of the logging files: parameters that set what is logged and parameter that set how long and how often it is logged.

The logged data per file format and logging category is defined in the dialogs:

- ["Logged Satellite Paramters"](#) on page 178
- ["Loded User Motion Parameters"](#) on page 179

The time span, the number of logged records and the time stamp of the first logged record are:

- **Time span**  
If logging is performed offline, the parameter "Duration" defines the time span that is logged.  
In real-time mode, the time span is the time that elapses from the moment you select "Off" (that is you start the logging) to the moment you stop the logging with "On".
- **Number of logged records**  
The number of logged records is defined by the logged time span and by the logging resolution ("Log Step").
- **First logged record**  
In real-time mode, the time stamp of the first logged record is the time indicated with the parameter "Simulation Time".  
In offline mode, it is defined as "Logging Start Time" + "Log Step".

**Example:**

- "GNSS System Configuration > GPS > On"
- "Simulation Mode > Auto Localization"
- "Satellite Configuration > Max. Number of Satellites = 4"
- "Data Logging > Logging Start Time = UTC 19:02:2014 06:00:00.000", "Duration = 60s", "Logging Category > Satellite > On", "Log Step = 10s"
- "Data Logging > Generate"

Created is the file `gnss_log_offline_Satellite.csv` with file content as shown on [figure 4-18](#).

The file content have been formatted for better reading; line numbers are included for description purposes.

Elapsed Time [s]	UTC Date [dd/mm/yyyy]	UTC Time [hh:mm:ss.ms]	Standard	ID	Elevation [deg]	Azimuth [deg]
10.0	19.02.2014	06:00:10.000	G	14	166.314	-652.826
10.0	19.02.2014	06:00:10.000	G	15	441.335	861.655
20.0	19.02.2014	06:00:10.000	G	18	691.797	-962.890
10.0	19.02.2014	06:00:10.000	G	25	200.406	-1.740.554
20.0	19.02.2014	06:00:20.000	G	14	166.815	-652.321
20.0	19.02.2014	06:00:20.000	G	15	440.842	862.494
20.0	19.02.2014	06:00:20.000	G	18	691.877	-965.182
20.0	19.02.2014	06:00:20.000	G	25	201.147	-1.740.627
30.0	19.02.2014	06:00:30.000	G	14	167.317	-651.815
30.0	19.02.2014	06:00:30.000	G	15	440.349	863.332
30.0	19.02.2014	06:00:30.000	G	18	691.954	-967.476
30.0	19.02.2014	06:00:30.000	G	25	201.889	-1.740.700
40.0	19.02.2014	06:00:40.000	G	14	167.818	-651.310
40.0	19.02.2014	06:00:40.000	G	15	439.856	864.168
40.0	19.02.2014	06:00:40.000	G	18	692.027	-969.772
40.0	19.02.2014	06:00:40.000	G	25	202.631	-1.740.772
50.0	19.02.2014	06:00:50.000	G	14	168.320	-650.805
50.0	19.02.2014	06:00:50.000	G	15	439.362	865.004
50.0	19.02.2014	06:00:50.000	G	18	692.096	-972.071
50.0	19.02.2014	06:00:50.000	G	25	203.373	-1.740.844

**Fig. 4-18: Data Logging: Example of a logged data (File extract)**

1 = Logging time; first record made at "Logging Start Time + Log Step"

2 = Logged are 4 GPS satellites (SV IDs = 14, 15, 18, 25)

3 = Logged parameters (not all possible are enabled)

Rows 4, 5 = Difference in time between the rows 4 and 5, 8 and 9 etc. is the "Log Step"

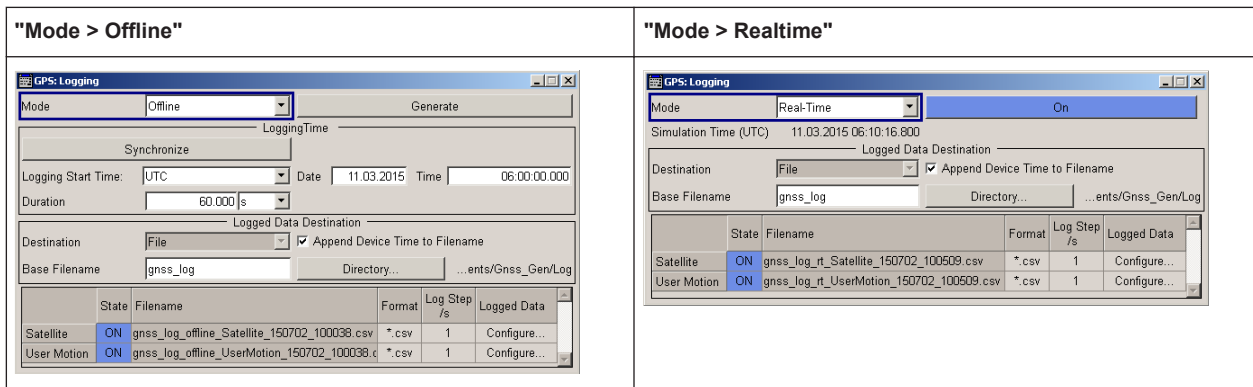
Row 20 = Last record made 50s after the logging start ("Log Step = 10s" and the next record would be exact 60s after logging start, that is the end of the logging duration)

### 4.13.1 Data Logging General Settings

To access this dialog:

- ▶ Select "GNSS > Data Logging".

The provide settings depend on the selected **Mode**. The difference are self-explanatory.



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#### Mode

Sets the logging mode.

- "Real-Time"      Logged is true navigation data in run time.
- "Offline"        The logged navigation data is emulated.  
This mode is not available if a "User Environment > Vehicle Type > HIL" is used.

Remote command:

<subsystem>:LOGGING:MODE on page 396

#### Generate, On/Off

Starts/stops data logging.

**Note:** Existing files with the same name are overwritten. If you store the logged data to files, first check whether the selected folder **Logged Data Destination** is empty.

To prevent overwriting, add a time stamp to the file name ("Append Device Time to Filename > On").

"Generate"      Logging files are created and saved.

"Off"            Logging is initialized and logging starts.

"On"             Logging files are saved.

Remote command:

`<subsystem>:LOGGING:OFFLINE:GENERATE` on page 396

`<subsystem>:LOGGING:OFFLINE:ABORT` on page 396

`<subsystem>:LOGGING:RT:STATE` on page 397

### Simulation Time (UTC)

In real-time logging mode, indicates the current simulation date and time, where the simulation start time is selected with the parameter [Simulation Start Time](#).

The simulation time is displayed in UTC format, i.e. DD.MM.YYY HH:MM:SS.

### Logging Time Parameters

Use the following parameters to set the simulation time and duration in "Mode > Offline".

#### Synchronize ← Logging Time Parameters

Synchronizes the logged time to the simulation start time, as set with the parameter [Simulation Start Time](#).

Remote command:

`<subsystem>:LOGGING:OFFLINE:SYNCHRONIZE[:TIME]` on page 397

#### Logging Start Time ← Logging Time Parameters

Sets or displays the logging start time.

Depending on the selected time basis, the logging start time is defined as:

"Date [dd.mm.yyyy], Time [hh:mm:ss:xxx]"

Start date in DD.MM.YYYY format of the Gregorian calendar and the logging start time in UTC time format.

Remote command:

`<subsystem>:LOGGING:OFFLINE:DATE` on page 398

`<subsystem>:LOGGING:OFFLINE:TIME` on page 398

"Week Number, Time of Week (TOW)"

Week number and the start time within the selected "Week Number", expressed in number of seconds.

The value is reset to zero at the end of each week.

Remote command:

`<subsystem>:LOGGING:OFFLINE:WNUMBER` on page 398

`<subsystem>:LOGGING:OFFLINE:TOWEEK` on page 398

Remote command:

`<subsystem>:LOGGING:OFFLINE:TBASIS` on page 397

**Duration** ← **Logging Time Parameters**

Sets the time span that will be logged.

Remote command:

`<subsystem>:LOGGing:OFFLine:DURation` on page 399

**Logged Data Destination**

In offline mode, logged data is stored in files, for that you can:

- Define the storage place ("Directory")
- Change the file prefix ("Base Filename")
- Add a time stamp to the file name ("Append Device Time to Filename > On")

See also "[Filename syntax](#)" on page 171.

Remote command:

`<subsystem>:LOGGing:DESTination?` on page 397

`<subsystem>:LOGGing:DESTination:FILE:DIRectory` on page 399

`<subsystem>:LOGGing:DESTination:FILE:BNAMe` on page 399

`<subsystem>:LOGGing:DESTination:FILE:TAPPend:STATe` on page 400

**Logging formats and categories**

The logging categories and logging formats are listed in table form.

Each logging category is defined with:

**State** ← **Logging formats and categories**

Enables/disables logging of this particular category.

Remote command:

`<subsystem>:LOGGing:CATegory:SATellite:STATe` on page 400

`<subsystem>:LOGGing:CATegory:UMOTion:STATe` on page 400

**Filename** ← **Logging formats and categories**

Indicates the file names the logged data is stored to, see "[Filename syntax](#)" on page 171.

Remote command:

`<subsystem>:LOGGing:CATegory:SATellite:FILE?` on page 400

`<subsystem>:LOGGing:CATegory:UMOTion:FILE?` on page 400

**Format** ← **Logging formats and categories**

Sets the file format the logged data is stored as.

Remote command:

`<subsystem>:LOGGing:CATegory:UMOTion:FORMat` on page 400

**Log Step, s** ← **Logging formats and categories**

Sets the logging step, i.e. the resolution of the logged data per format and category.

**Example:**

A file generated in "Mode > Offline" with "Duration = 60s" and "Log Step = 10s" will have 6 records per SV ID, where the first one is made 10s after the "Simulation Start Time" and the next steps are made after 10s each .

Observe also the file content of the log file. The first logged parameter `Elapsed_Time_ms` indicates the log steps.

Remote command:

`<subsystem>:LOGGING:CATegory:SATellite:STEP` on page 401

`<subsystem>:LOGGING:CATegory:UMOTION:STEP` on page 401

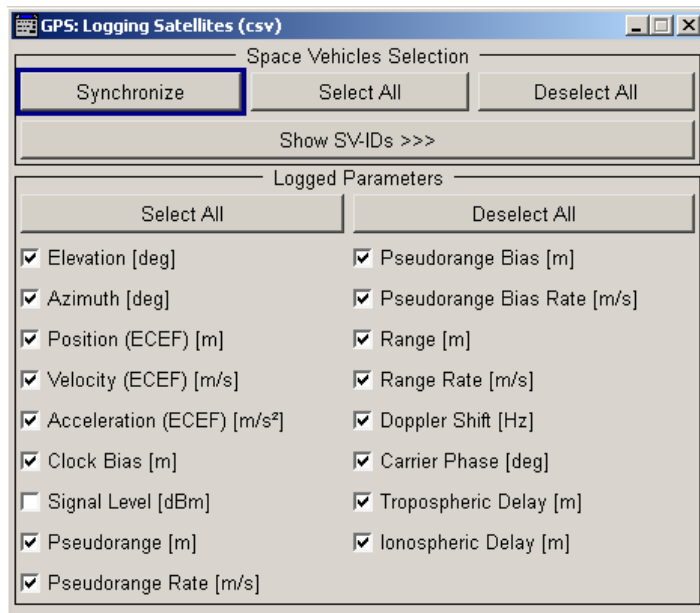
**Configure Logging** ← Logging formats and categories

Accesses the "Logging Satellites/User Motion" dialog to configure the messages to be logged, see [chapter 4.13.2, "Configure Logging Settings"](#), on page 176.

**4.13.2 Configure Logging Settings**

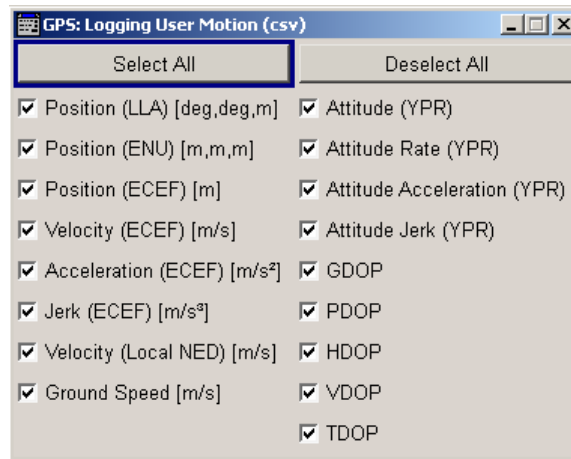
To access this dialog:

1. Select "GNSS > Data Logging".
2. In the logging formats and category table, select "Satellite > Logged Data > Configure...".



3. Select "User Motion > Logged Data > Configure...".





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**Space Vehicle Selection**

Sets the satellites to be included in the logging.

"Synchronize" Retrieves the SV ID as configured in the [Satellite Configuration Settings](#) dialog. You can subsequently change the selected satellites. In [Simulation Mode](#) > Static/User Localization, synchronized are the SV ID active at the simulation start.

Remote command:

`<subsystem>:LOGGing:CATegory:SATellite:SVID:SYNChronize`  
 on page 401

"Select All/Deselect All"

Enables/disables all of the available SV IDs.

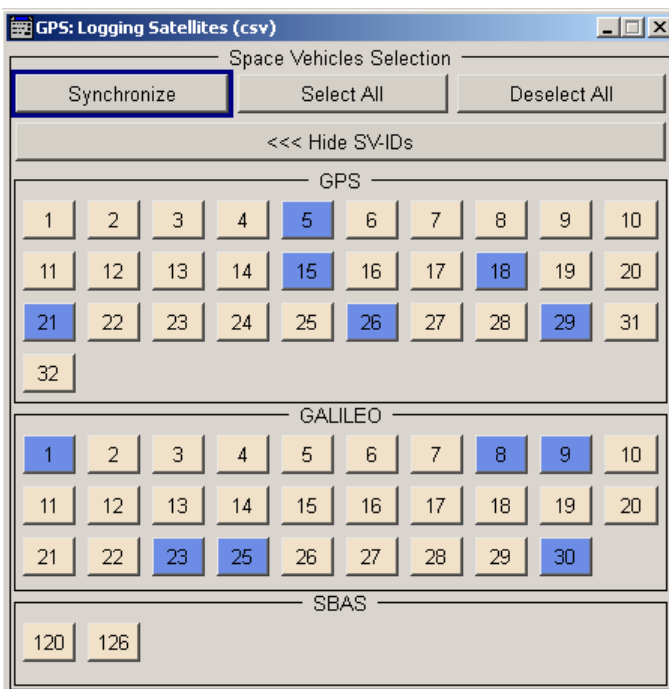
Remote command:

`<subsystem>:LOGGing:CATegory:SATellite:SVID:SELEct:ALL` on page 401  
`<subsystem>:LOGGing:CATegory:SATellite:SVID:SELEct:NONE`  
 on page 401

"Show/Hide SV-ID"

Displays all SV ID that are available in the almanac of the [Activate Systems](#), i.e. the GNSS systems that are enabled in the "GNSS System Configuration" dialog.

The blue color indicates the SV ID for that the specified parameters will be logged.



"Space Vehicle State"

Enables/disables a space vehicle with the selected SV ID for logging.

Remote command:

`<subsystem>:LOGGing:CATegory:SATellite:GPS:SVID<ch>` on page 401

`<subsystem>:LOGGing:CATegory:SATellite:GLONass:SVID<ch>`  
on page 401

`<subsystem>:LOGGing:CATegory:SATellite:GALileo:SVID<ch>`  
on page 401

`<subsystem>:LOGGing:CATegory:SATellite:BEIDou:SVID<ch>` on page 401

`<subsystem>:LOGGing:CATegory:SATellite:QZSS:SVID<ch>` on page 401

`<subsystem>:LOGGing:CATegory:SATellite:SBAS:SVID<ch>` on page 401

**Logged Satellite Paramters**

Selects the information to be logged.

Use the "Select All/Deselect All" function to quickly select all or none of the paramters.

Parameter	Description	Remote command
Elevation [deg] Azimuth [deg]	Elevation and azimuth arrival angles of the satellites signal	<code>&lt;subsystem&gt;:LOGGING:CATegory:SATellite:ELEVation</code> on page 402 <code>&lt;subsystem&gt;:LOGGING:CATegory:SATellite:AZIMuth</code> on page 402
Position (ECEF) [m] Velocity (ECEF) [m/s] Acceleration (ECEF) [m/s <sup>2</sup> ]	Satellites position, velocity and acceleration	<code>&lt;subsystem&gt;:LOGGING:CATegory:SATellite:POSition:ECEF</code> on page 402 <code>&lt;subsystem&gt;:LOGGING:CATegory:SATellite:VELocity:ECEF</code> on page 402 <code>&lt;subsystem&gt;:LOGGING:CATegory:SATellite:ACCEleration:ECEF</code> on page 402
Clock Bias [m]	Change in satellite's range in the satellite clock over a time interval	<code>&lt;subsystem&gt;:LOGGING:CATegory:SATellite:CBias</code> on page 402
Signal Level [dBm]	Power of the LOS (Line of sight) signal; multipath effects or attenuation because of used antenna pattern are not considered	<code>&lt;subsystem&gt;:LOGGING:CATegory:SATellite:SLEVel</code> on page 402
Pseudorange [m]	Simulated signal delay	<code>&lt;subsystem&gt;:LOGGING:CATegory:SATellite:PRANge</code> on page 402
Pseudorange Rate [m/s]	Rate of change of simulated signal delay	<code>&lt;subsystem&gt;:LOGGING:CATegory:SATellite:PRANge:RATE</code> on page 402
Pseudorange Bias [m]		<code>&lt;subsystem&gt;:LOGGING:CATegory:SATellite:PRANge:BIAS</code> on page 402
Pseudorange Bias Rate [m/s]		<code>&lt;subsystem&gt;:LOGGING:CATegory:SATellite:PRANge:BIAS:RATE</code> on page 402
Range [m]	Satellite range	<code>&lt;subsystem&gt;:LOGGING:CATegory:SATellite:RANge</code> on page 402
Range Rate [m/s]	Rate of change of range	<code>&lt;subsystem&gt;:LOGGING:CATegory:SATellite:RANge:RATE</code> on page 402
Doppler Shift [Hz]	Pseudorange rate converted to frequency	<code>&lt;subsystem&gt;:LOGGING:CATegory:SATellite:DSHift</code> on page 402
Carrier Phase [cycles]	Phase offset of the carrier	<code>&lt;subsystem&gt;:LOGGING:CATegory:SATellite:CPHase</code> on page 402
Troposphere/Ionosphere Delay [m]	Signal delay	<code>&lt;subsystem&gt;:LOGGING:CATegory:SATellite:TDElay</code> on page 402 <code>&lt;subsystem&gt;:LOGGING:CATegory:SATellite:IDelay</code> on page 402

Remote command:

`<subsystem>:LOGGING:CATegory:SATellite:SElect:ALL` on page 401

`<subsystem>:LOGGING:CATegory:SATellite:SElect:NONE` on page 401

#### Logged User Motion Parameters

Selects the parameters to be logged.

Use the "Select All/Deselect All" function to quickly select all or none of the parameters.

Parameter	Description	Remote command
Position (LLA) [deg,deg,m]	Latitude, Longitude, Altitude of a vehicle in WGS84 coordinates, rad	<code>&lt;subsystem&gt;:LOGGING:CATegory:UMOTion[:CSV]:POSition:LLA</code> on page 402
Position (ENU) [m,m,m]	Position of the vehicle in ENU (East, North, Up) Cartesian coordinates	<code>&lt;subsystem&gt;:LOGGING:CATegory:UMOTion[:CSV]:POSition:ENU</code> on page 402
Position (ECEF) [m] Velocity (ECEF) [m/s] Acceleration (ECEF) [m/s <sup>2</sup> ] Jerk (ECEF) [m/s <sup>3</sup> ]	Vehicle's position, velocity and acceleration in ECEF coordinates	<code>&lt;subsystem&gt;:LOGGING:CATegory:UMOTion[:CSV]:POSition:ECEF</code> on page 402 <code>&lt;subsystem&gt;:LOGGING:CATegory:UMOTion[:CSV]:VELocity:ECEF</code> on page 402 <code>&lt;subsystem&gt;:LOGGING:CATegory:UMOTion[:CSV]:ACCEleration:ECEF</code> on page 402 <code>&lt;subsystem&gt;:LOGGING:CATegory:UMOTion[:CSV]:JERK:ECEF</code> on page 402
Velocity (Local NED) [m/s]		<code>&lt;subsystem&gt;:LOGGING:CATegory:UMOTion[:CSV]:VELocity:LNED</code> on page 403
Ground Speed [m/s]	Vehicle speed	<code>&lt;subsystem&gt;:LOGGING:CATegory:UMOTion[:CSV]:GSPeed</code> on page 402
Altitude (YPR) Altitude Rate (YPR) Altitude Acceleration (YPR) Altitude Jerk (YPR)	Parameters in local Geodetic coordinates (Yaw/Heading, Pitch/Elevation, Roll/Bank) where the altitude is the HAE (Height Above the Ellipsoid) altitude	<code>&lt;subsystem&gt;:LOGGING:CATegory:UMOTion[:CSV]:ATTitude</code> on page 402 <code>&lt;subsystem&gt;:LOGGING:CATegory:UMOTion[:CSV]:ATTitude:JERK</code> on page 402 <code>&lt;subsystem&gt;:LOGGING:CATegory:UMOTion[:CSV]:ATTitude:ACCEleration</code> on page 402 <code>&lt;subsystem&gt;:LOGGING:CATegory:UMOTion[:CSV]:ATTitude:JERK</code> on page 402
GDOP PDOP HDOP VDOP TDOP	Geometric DOP Positional DOP Horizontal DOP Vertical DOP Time DOP	<code>&lt;subsystem&gt;:LOGGING:CATegory:UMOTion[:CSV]:GDOP</code> on page 402 <code>&lt;subsystem&gt;:LOGGING:CATegory:UMOTion[:CSV]:PDOP</code> on page 402 <code>&lt;subsystem&gt;:LOGGING:CATegory:UMOTion[:CSV]:HDOP</code> on page 402 <code>&lt;subsystem&gt;:LOGGING:CATegory:UMOTion[:CSV]:VDOP</code> on page 402 <code>&lt;subsystem&gt;:LOGGING:CATegory:UMOTion[:CSV]:TDOP</code> on page 402

Remote command:

`<subsystem>:LOGGING:CATegory:UMOTion[:CSV]:SElect:ALL` on page 401

`<subsystem>:LOGGING:CATegory:UMOTion[:CSV]:SElect:NONE` on page 401

## 4.14 Assistance Data Generation Settings



The "Assistance Data Generation" dialog is available for instrument equipped with:

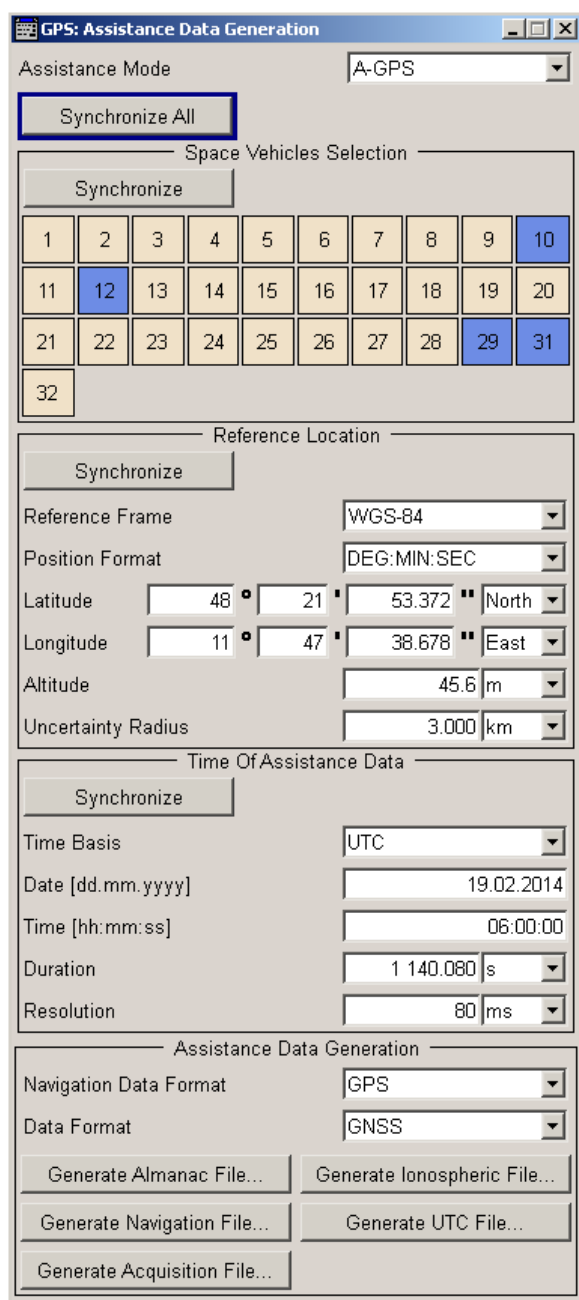
- the basic BeiDou option (R&S SMBV-K107) or the QZSS option (R&S SMBV-K105)
- one of options for assisted satellite navigation, e.g. A-GPS (R&S SMBV-K65)

To access the "Assistance Data Generation" dialog:

1. Select "Main Dialog > Simulation Mode > User Localization"
2. Select "Assistance Data Generation".

The "Assistance Data Generation" dialog is used to generate assistance data files for Assisted-GNSS testing. In a test setup with a protocol tester and a DUT, the generated assistance data files can be formatted into mobile communication's message formats and used to accelerate the Time To First Fix (TTFF).

See also [chapter 5.8, "Generating an GNSS Assistance Data"](#), on page 206.



The R&S SMBV provides a two-level synchronization concept:

- **"Synchronize All"** performs a fast reload of all parameters in the dialog
- **"Synchronize"** performs a selective settings alignment.

We recommend that you retrieve the values for the relevant parameters for the GNSS general dialog . You can subsequently change the satellite selection, the configuration of the reference location and the time configuration parameters.

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**Assistance Mode**

Defines the type of assistance data to be loaded.

Value	Required Option
A-GPS	R&S SMBV-K65
A-GALILEO	R&S SMBV-K67
A-GLONASS	R&S SMBV-K95
A-QZSS	R&S SMBV-K105
A-BeiDou	R&S SMBV-K107

Remote command:

`<subsystem>:ADGeneration:MODE` on page 370

**Synchronize All/Synchronize**

Parameter	Description	SCPI command
"Synchronize All"	Synchronizes the parameters of the satellites configuration and of the reference location configuration blocks and the time configuration parameters with the settings performed in: <ul style="list-style-type: none"> <li>• <a href="#">Satellite Configuration Settings</a></li> <li>• <a href="#">GNSS General Settings</a>.</li> </ul> <b>Note:</b> Synchronized are only the satellites of the corresponding entry standard; all other satellites, are disregarded.	<code>&lt;subsystem&gt;:ADGeneration:GPS:SYNChronize</code> on page 370
"Synchronize"	Synchronizes the settings of the corresponding parameter group.	<code>&lt;subsystem&gt;:ADGeneration:GPS:SVID:SYNChronize</code> on page 370 <code>&lt;subsystem&gt;:ADGeneration:GPS:LOCation:SYNChronize</code> on page 370 <code>&lt;subsystem&gt;:ADGeneration:GPS:TOAData:SYNChronize</code> on page 370

**Space Vehicle State**

Enables/disables a space vehicle with the selected SV ID for generation of assistance data.

Use the "Synchronize" function to retrieve the SV ID belonging to the selected navigation standard ([Assistance Mode](#)), as configured in the "Satellite Configuration" dialog.

Remote command:

`<subsystem>:ADGeneration:GPS:SVID<ch>:STATe` on page 370

**Reference Frame**

Select the reference frame used to define the receiver coordinates.

The transformation between the reference frames is performed automatically.

Both reference frames are ECEF frames with a set of associated parameters.

"WGS-84"            The World Geodetic System WGS-84 is the reference frame used by GPS.

"PZ 90.11 (GLONASS)"            Parametry Zemli PZ (Parameters of the Earth) is the reference frame used by GLONASS.

Remote command:

`<subsystem>:ADGeneration:<GNSS>:LOCation:COORDinates:RFrame` on page 371

**Reference Location**

The reference location section provides access to the parameters for setting the coordinates of the reference location.



Parameter	Description
"Position Format"	<p>Sets the format in which the Latitude and Longitude are displayed.</p> <ul style="list-style-type: none"> <li>"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.</li> <li>"Decimal Degree" The display format is decimal degree, i.e. +/-XX.XXXXXX°, where "+" indicates North and East and "-" indicates South and West.</li> </ul>
"Altitude"	Sets the geographic altitude of the reference location in meters above sea level.
"Latitude"	Sets the latitude of the reference location.
"Longitude"	Sets the longitude of the reference location.
"Uncertainty Radius"	<p>Sets the maximum radius of the area within which the two dimensional location of the UE is bounded.</p> <p>The uncertainty radius determines the required sensitivity of the DUT.</p>

Remote command:

`<subsystem>:ADGeneration:<GNSS>:LOCation:URADius` on page 374

to enter the coordinates in Degree:Minute:Second format

`<subsystem>:ADGeneration:<GNSS>:LOCation:COORDinates:DMS:WGS|PZ`  
on page 372

to enter the coordinates in decimal degree format

`<subsystem>:ADGeneration:<GNSS>:LOCation:COORDinates:DECimal:WGS|PZ` on page 371

### Time of Assistance Data

Comprises the time of assistance data parameters

#### Time Basis ← Time of Assistance Data

Determines the time basis used to enter the time of assistance data parameters.

Remote command:

`<subsystem>:ADGeneration:GPS:TOAData:TBASis` on page 374

#### Date [dd.mm.yyyy] ← Time of Assistance Data

(enabled for "Time Basis" set to UTC or GLONASS)

Enters the date for the assistance data in DD.MM.YYYY format of the Gregorian calendar.

Remote command:

`<subsystem>:ADGeneration:GPS:TOAData:DATE` on page 374

#### Time [hh:mm:ss] ← Time of Assistance Data

(enabled for "Time Basis" set to UTC or GLONASS)

Enters the exact start time for the assistance data in UTC time format.

Remote command:

`<subsystem>:ADGeneration:GPS:TOAData:TIME` on page 375

**Week Number ← Time of Assistance Data**

(enabled for "Time Basis" set to GPS, GALILEO, QZSST or BDT)

Enters week number (WN) the assistance data is generated for.

Remote command:

`<subsystem>:ADGeneration:GPS:TOAData:WNUMber` on page 376

**Time of Week ← Time of Assistance Data**

(enabled for "Time Basis" set to GPS, GALILEO, QZSST or BDT)

Determines the Time of Week (TOW) the assistance data is generated for.

Remote command:

`<subsystem>:ADGeneration:GPS:TOAData:TOWeek` on page 376

**Duration ← Time of Assistance Data**

Sets the duration (in ms) of the assistance data.

Remote command:

`<subsystem>:ADGeneration:GPS:TOAData:DURation` on page 375

**Resolution ← Time of Assistance Data**

Sets the resolution (in ms) of the assistance data.

Remote command:

`<subsystem>:ADGeneration:GPS:TOAData:RESolution` on page 376

**Navigation Data Format**

In "Assistance Mode > A-GPS", sets format in that the generated navigation data file.

Remote command:

`<subsystem>:ADGeneration:NAVigation:DFOFormat` on page 377

**Data Format**

In "Assistance Mode > A-GPS", determines the data format, "GPS" or "GNSS", of the generated acquisition files.

Affected are the [Almanac file](#), the [Navigation file](#) and the [acquisition file](#).

Remote command:

`<subsystem>:ADGeneration[:ACquisition]:DFOFormat` on page 377

**Generate Almanac File ...**

Access the "Generate Almanac File" dialog for saving the generated almanac file. The file name is user definable; the data format is defined with the parameter [Data Format](#).

The almanac file is generated in one of the listed file formats:

- in a comma separated file format `.rs_al` (see [table 4-20](#))
- as standard Yuma formatted file `.rs_yuma`
  - This file format is not supported for A-GLONASS.
  - In case of GPS, Galileo, QZSS and BeiDou the `.rs_yuma` almanac file can be used as the main almanac source for the specific GNSS standard.

**Table 4-20: Contents of the generated almanac file (GPS)**

Parameter	Unit
SatID	-
e	dimensionless
toa	sec
delta_i	semi-circles
OMEGADOT	semi-circles/sec
SV Health	boolean
SQRT(A)	meters
OMEGA0	semi-circles
M0	semi-circles
w	semi-circles
af0	seconds
af1	sec/sec

The generated almanac file is conform to the format appended to standards 3GPP 34.108 v.8.0.0, 3GPP TS 51.010-1v.7.7.0 and 37.571 v10.0. The file lists all possible satellites, available from the source almanac file.

See also [chapter 5.8, "Generating an GNSS Assistance Data"](#), on page 206.

Remote command:

`<subsystem>:ADGeneration:ALManac:CREate` on page 378

#### Generate Ionospheric File ...

Access the "Select Ionospheric File" dialog for storing the generated ionospheric model.

The generated ionospheric file is file with extension `.rs_ion` and specified file name.

The parameters listed in this file (see the example in [table 4-21](#)) are according to the parameters used for describing the near satellite ionospheric model.

- For GPS and QZSS these are the Klobuchar parameters
- For Galileo, the Galileo Ionosphere parameters
- For GLONASS, the file is empty because GLONASS satellites do not transmit any information about the ionosphere

**Table 4-21: Contents of the generated ionospheric file (GPS)**

Parameter	Unit
alpha_0	seconds
alpha_1	sec/semi-circles
alpha_2	sec/(semi-circles) <sup>2</sup>
alpha_3	sec/(semi-circles) <sup>3</sup>
beta_0	seconds

Parameter	Unit
beta_1	sec/semi-circles
beta_2	sec/(semi-circles) <sup>2</sup>
beta_3	sec/(semi-circles) <sup>3</sup>

See also [chapter 5.8, "Generating an GNSS Assistance Data"](#), on page 206.

Remote command:

`<subsystem>:ADGeneration:IONospheric:CREate` on page 379

### Generate Navigation File ...

Access the "Select Navigation File" dialog for saving the generated navigation model (ephemeris) as a navigation or a RINEX file, see [table 4-22](#).

**Table 4-22: Navigation files: file extension and file content**

Generated file	File content	GPS/ Galileo/ BeiDou	GLONASS	QZSS
Navigation file	Data format as defined with the parameter <a href="#">Data Format</a> Comprises the GNSS standard ephemeris and clock correction parameters of the navigation model, see <a href="#">table 4-23</a>	.rs_nav	.rs_nav	.rs_nav
Standard conformed RINEX file	Comprises the ephemeris page of each satellite for the selected <a href="#">Time of Assistance Data</a> RINEX file format, see <a href="#">chapter A.2.1, "RINEX Format Description"</a> , on page 427	.<XX>n	.<XX>g	.<XX>q
	Rinex File format (Rinex 3.02)	.RNX	.RNX	.RNX

where <XX> indicates for the year of the recording. For example, the extensions .12n indicates a GPS ephemeris file, recorded in 2012.

**Table 4-23: Contents of the generated navigation file (GPS)**

Parameter	Unit
SatID	-
Sat Status	-
C/A or P on L2	boolean
URA Index	boolean
SV Health	boolean
IODC	-
L2 P Data Flag	boolean
SF 1 Reserved	-
T <sub>GD</sub>	sec
t <sub>oc</sub>	sec

Parameter	Unit
af2	sec/sec <sup>2</sup>
af1	sec/sec
af0	sec
$C_{rs}$	meters
delta_n	semi-circles/sec
$M_0$	semi-circles
$C_{UC}$	radians
e	-
$C_{US}$	radians
$(A)^{1/2}$	meters <sup>1/2</sup>
$T_{oe}$	sec
Fit Interval Flag	boolean
AODO	sec
$C_{is}$	radians
$I_0$	semi-circles
$C_{rc}$	meters
omega	semi-circles
OMEGAdot	semi-circles/sec
ldot	semi-circles/sec

The generated `.rs_nav` comma separated format is conform to the format appended to standards 3GPP 34.108 v.8.0.0, 3GPP TS 51.010-1v.7.7.0 and 37.571v10.0. The file contains one row per satellite.

See also [chapter 5.8, "Generating an GNSS Assistance Data"](#), on page 206.

Remote command:

`<subsystem>:ADGeneration:NAVigation:CREate` on page 378

#### Generate UTC File ...

Access the "Select UTC File" dialog for saving the generated UTC file. The generated UTC file is a file with extension `.rs_utc` and the selected file name.

The file contains all standard UTC parameters (`SatID`, `A_0`, `A_1`, `delta_t_LSF`, `t_ot`, `WN_t`, `WN_LSF`, `DN`, and `Delta_t_LSF`) that are necessary to transform GNSS time to the normal UTC time.

The generated UTC file contains one entry per standard.

See also [chapter 5.8, "Generating an GNSS Assistance Data"](#), on page 206.

Remote command:

`<subsystem>:ADGeneration:UTC:CREate` on page 378

**Generate Acquisition File ...**

Access the "Select Acquisition File" dialog for saving the generated acquisition file. The generated Acquisition file is a file with extension `.rs_acq`, the selected file name and data format as defined with the parameter [Data Format](#).

This file consists of:

- one or more rows, each corresponding to
  - the Receiver Referenced GNSS Time of Week (`GNSS TOW`) for GPS, Galileo, QZSS and BeiDou satellites
  - elapsed time, relative to GLONASS Time of Assistance data (`Time of Validity(ms)`) for GLONASS satellites.

The number of generated rows is calculated as follow:

Number Of Generated Rows = "Duration Of Assistance Data" / "Resolution of Assistance Data"

- one or more sequential acquisition blocks per row, where each block comprises the parameters listed in [table 4-24](#).  
The number of the acquisition blocks depends on the number of enabled space vehicles.

The generated acquisition file is conformed to the format appended to standards 3GPP 34.108 v.8.0.0, 3GPP TS 51.010-1v.7.7.0 and 37.571v10.0.

**Table 4-24: Contents of the generated acquisition file (one acquisition block)**

Parameter	Description	Unit (GPS, BeiDou)	Unit (GLONASS, Galileo)
SVID/PRNID	Satellite ID that corresponds to the record	-	-
Doppler (0 <sup>th</sup> order term)	Zero Order Doppler Term	Hz	Hz
Doppler (1 <sup>st</sup> order term)	1st order Doppler Term	Hz/sec	Hz/sec
Doppler Uncertainty	Uncertainty Doppler	Hz	m/s
Code Phase	Code Phase or half-Chip index at epoch Time of Transmission (GPS Sat Time)	chips	ms
Integer Code Phase	Integer Code Phase or ms unit index at epoch Time of Transmission (GPS Sat Time)	-	ms
GPS Bit Number	Corresponding Bit number (modulo 4) at epoch Time of Transmission (GPS Sat Time)	-	NA
Code Phase Search Window	Correlation Code phase Search Radius	chips	ms

Parameter	Description	Unit (GPS, BeiDou)	Unit (GLONASS, Galileo)
Azimuth	Azimuth Angle of the Satellite in ENU orthonormal coordinate System centered at reference point	deg	deg
Elevation	Elevation Angle of the Satellite in ENU orthonormal coordinate System centered at reference point	deg	deg

See also [chapter 5.8, "Generating an GNSS Assistance Data"](#), on page 206.

Remote command:

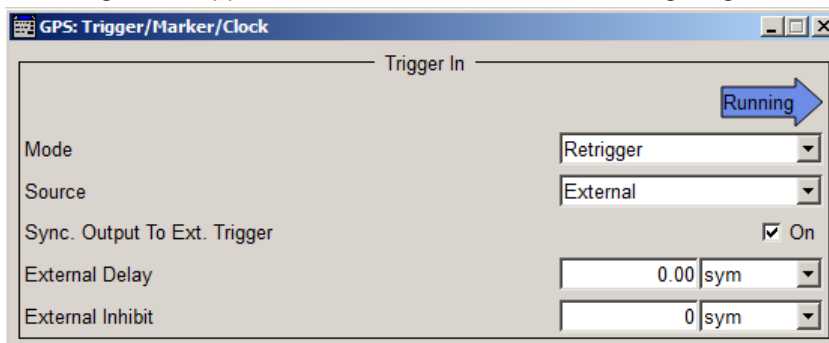
`<subsystem>:ADGeneration:ACquisition:CREate` on page 377

## 4.15 Trigger/Marker/Clock Settings

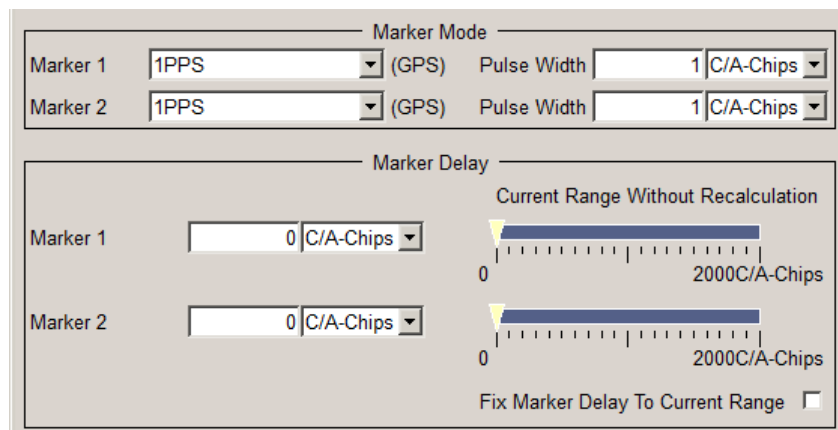
This dialog provides access to the settings necessary to select and configure the trigger, the marker output signal and the clock mode.

To access this dialog, perform one of the following:

1. Select "Main Dialog > Trigger/Marker..".
  2. Select "Main Dialog > Clock..".
- In the "Trigger In" section, you can determine the settings of the trigger for the signal. The parameters provided vary according to the used trigger source. "Running" or "Stopped" indicates the current status of signal generation.

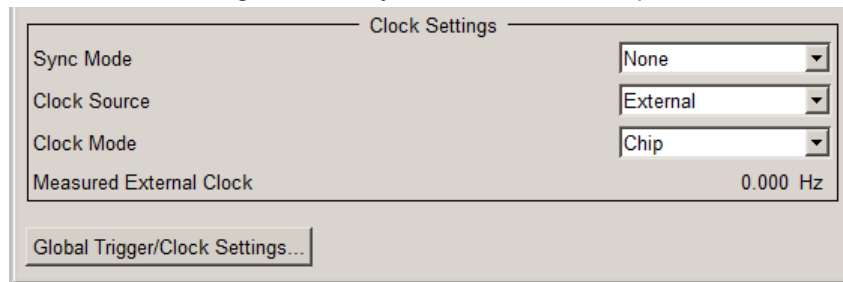


- The "Marker Mode" and "Marker Delay" sections contain the parameters for configuring the marker output signal.



You can define a marker delay either without restriction, or restricted to the current range, that means you can modify the settings without restarting signal and marker signal generation.

- In the "Clock Settings" section, you can set the clock parameters.



"Global Trigger/Clock Settings" provide access to dialogs for configuring general trigger, clock and mapping settings.

### 4.15.1 Trigger In

This section provides the parameters for configuring the trigger. The selected trigger source determines the associated parameters.

Trigger Mode.....	192
Signal Duration.....	193
Running/Stopped.....	193
Arm.....	193
Execute Trigger.....	194
Trigger Source.....	194
Sync. Output to External Trigger.....	194
External Delay.....	195
External Inhibit.....	195

#### 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:

`<subsystem>[:TRIGger]:SEQuence` on page 403

### Signal Duration

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

It is possible to output deliberately just part of the signal, an exact sequence of the signal, or a defined number of repetitions of the signal.

Remote command:

`<subsystem>:TRIGger:SLENgth` on page 403

### Running/Stopped

Displays the status of signal generation for all trigger modes. This display appears only when signal generation is enabled ("State" On).

- "Running"  
The modulation signal is generated; a trigger was (internally or externally) initiated in triggered mode.  
If "Armed\_Auto" and "Armed\_Retrigger" have been selected, generation of signals can be stopped with the "Arm" button. A new trigger (internally with "Execute Trigger" or externally) causes a restart.
- "Stopped"  
The signal is not generated, and the instrument waits for a trigger event (internal or external).

Remote command:

`<subsystem>:TRIGger:RMODe?` on page 404

### Arm

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

Remote command:

`<subsystem>:TRIGger:ARM:EXECute` on page 404

**Execute Trigger**

For internal trigger source, executes trigger manually.

Remote command:

`<subsystem>:TRIGger:EXECute` on page 405

**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:

`<subsystem>:TRIGger:SOURce` on page 405

**Sync. Output to External Trigger**

(enabled for Trigger Source External)

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

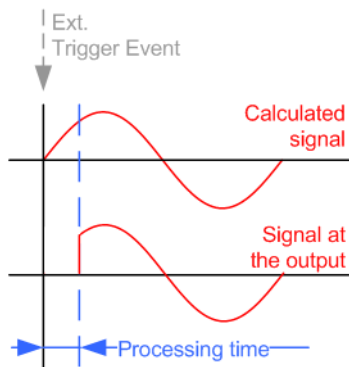
For R&S SMBV instruments:

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.

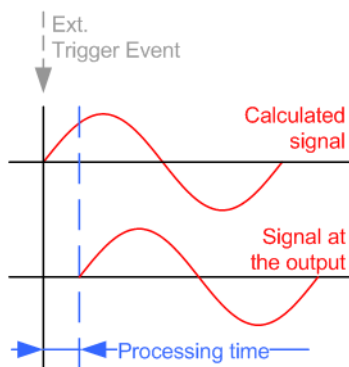
**Typical Applications**

- 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:  
[<subsystem>:TRIGger:EXTernal:SYNChronize:OUTPut](#) on page 405

**External Delay**

Sets the trigger signal delay in samples on external triggering. This enables the R&S SMBV to be synchronized with the device under test or other external devices.

Remote command:  
[<subsystem>:TRIGger\[:EXTernal<ch>\]:DELay](#) on page 407

**External Inhibit**

Sets the duration for inhibiting a new trigger event subsequent to triggering. The input is to be expressed in samples.

In the "Retrigger" mode, every trigger signal causes signal generation to restart. This restart is inhibited for the specified number of samples.

This parameter is only available on external triggering.

Remote command:

`<subsystem>:TRIGger[:EXternal<ch>]:INHibit` on page 407

#### 4.15.2 Marker Settings

Provides the settings necessary to define the marker output signal for synchronizing external instruments.

Marker Mode.....	196
Marker x Delay.....	197

##### 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.

**Note:** One marker signal. In instruments equipped with option R&S SMBV-K96, disabled parameter [Use Position Accuracy \(P-Code\) GPS](#) and enabled satellites constellation with more than 12 satellites, only one marker signal is available!

"1PPS"	A marker signal is generated for every start of second. The used time basis is displayed right to the field. The "Pulse Width" is set in the corresponding field. The input is expressed as a number of chips.
"10PPS"	A marker signal is generated ten times per second hence once every 100 ms.
"1PP2S"	A marker signal is generated for every second start of second. The used time basis is displayed right to the field. The "Pulse Width" is set in the corresponding field. The input is expressed as a number of chips.

Remote command:

`<subsystem>:TRIGger:OUTPut<ch>:PULSe:WIDTh` on page 410

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

Remote command:

`<subsystem>:TRIGger:OUTPut<ch>:PULSe:DIVider` on page 409

`<subsystem>:TRIGger:OUTPut<ch>:PULSe:FREQuency?` on page 409

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

Remote command:

`<subsystem>:TRIGger:OUTPut<ch>:PATtern` on page 409

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



Remote command:

`<subsystem>:TRIGger:OUTPut<ch>:ONTime` on page 408

`<subsystem>:TRIGger:OUTPut<ch>:OFFTime` on page 408

"Trigger" A marker signal is generated only when a trigger event occurs. Then the signal is generated continuously. Every subsequent trigger event causes a restart.

Remote command:

`<subsystem>:TRIGger:OUTPut<ch>:MODE` on page 408

**Marker x Delay**

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

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

Remote command:

`<subsystem>:TRIGger:OUTPut<ch>:DELAy` on page 406

"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:

`<subsystem>:TRIGger:OUTPut<ch>:DELAy:MINimum?` on page 406

`<subsystem>:TRIGger:OUTPut<ch>:DELAy:MAXimum?` on page 406

"Fix marker delay to current range"

Restricts the marker delay setting range to the dynamic range.

Remote command:

`<subsystem>:TRIGger:OUTPut:DELAy:FIXed` on page 406

**4.15.3 Clock Settings**

Use the provided settings to set the clock source and a delay, if required.

[Sync. Mode](#)..... 198

[Set Synchronization Settings](#)..... 198

[Clock Source](#)..... 198

[Clock Mode](#)..... 198

[Clock Multiplier](#)..... 199

[Measured External Clock](#)..... 199

**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:

`<subsystem>:CLOCK:SYNChronization:MODE` on page 412

**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:

`<subsystem>:CLOCK:SYNChronization:EXECute` on page 412

**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:

`<subsystem>:CLOCK:SOURce` on page 411

**Clock Mode**

Enters the type of externally supplied clock.

- "Chip"  
A chip clock is supplied via the CLOCK connector.
- "Multiple"

A multiple of the chip clock is supplied via the CLOCK connector; the symbol clock is derived internally from this.

Remote command:

`<subsystem>:CLOCK:MODE` on page 410

#### **Clock Multiplier**

Enters the multiplication factor for clock type Multiple.

Remote command:

`<subsystem>:CLOCK:MULTIPLIER` on page 411

#### **Measured External Clock**

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

Remote command:

`CLOCK:INPUT:FREQUENCY?`

### **4.15.4 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 How to Perform Typical Signal Generation Tasks with the GNSS Options



The workflow examples provided in this section assume an instrument, fully equipped with all available GNSS options.

---

The general workflow shows the main configuration steps to be performed for almost all configuration tasks. Therefore, the examples generally refer to the workflow. Additional steps and settings are described in the examples explicitly.

The block diagram in the [figure 5-1](#) shows an overview of the configuration steps, that are common for the most of the configurations tasks.



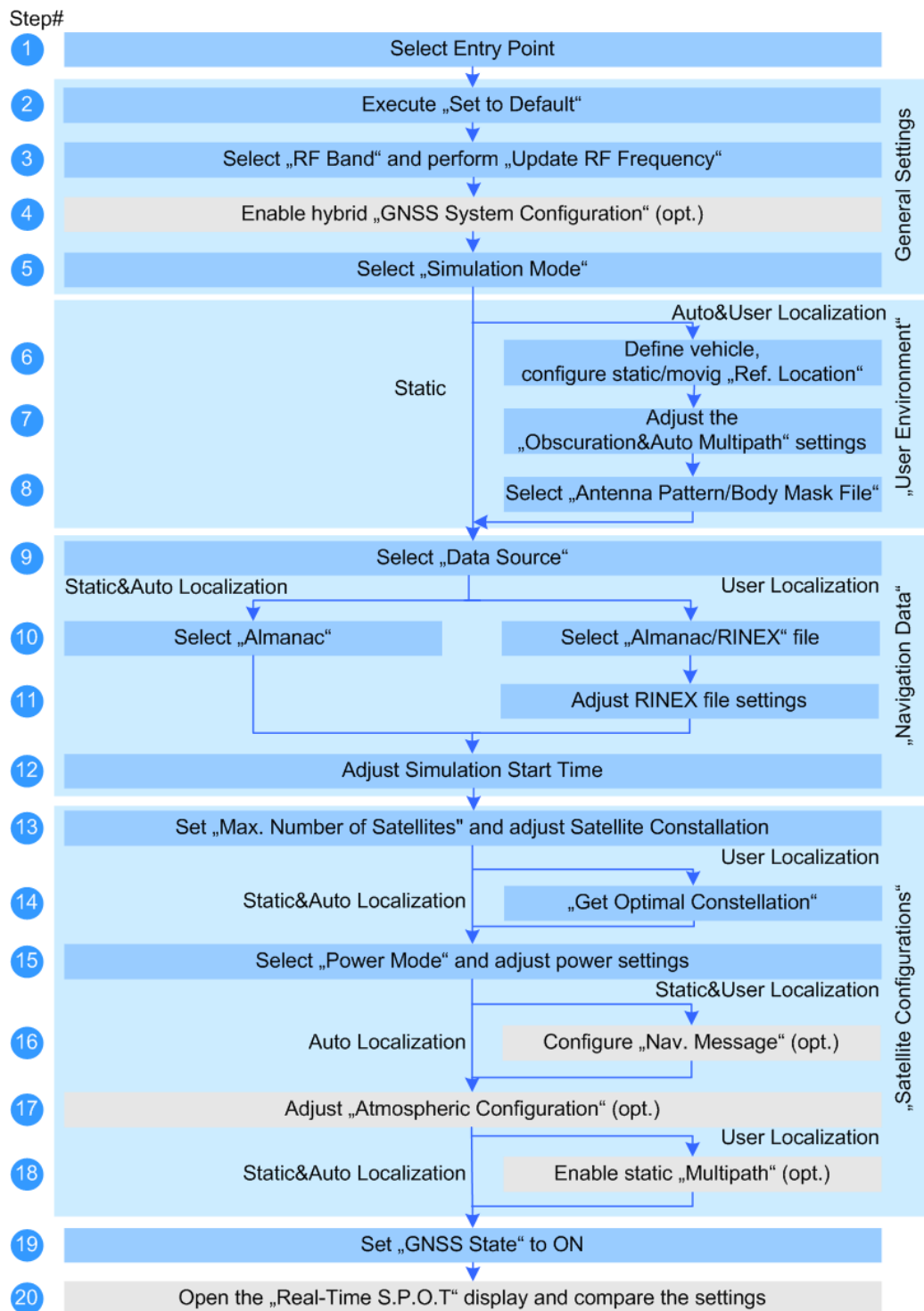


Fig. 5-1: General workflow

## 5.1 Generating a GNSS Signal for Simple Receiver Tests (Static Mode)

Follow the [General workflow](#) and:

1. Perform steps 1 to 3.
2. If required, select "GNSS System Configuration" and enable a hybrid GNSS satellite constellation.
3. Select "GNSS Main Dialog > Simulation Mode > Static".
4. Perform relevant steps 9 to 17.
5. Select "GNSS Main Dialog > State > ON".

The generated GNSS signal is calculated according to the satellite configuration settings, the selected almanac file and selected moment of time (date and time).

## 5.2 Generating a GNSS Signal with Automatic Dynamic Exchange of the Satellites (Auto Localization Mode)

Follow the [General workflow](#) and:

1. Perform steps 1 to 3.
2. Select "GNSS Main Dialog > Simulation Mode > Auto Localization".
3. Perform relevant steps 6 to 17.
4. Select "GNSS Main Dialog > State > On".

The instrument generates the GNSS signal for the selected satellites' constellation, calculated to fulfill the minimum PDOP and satellite visibility criteria. The selected satellites are dynamically and on-the-fly exchanged as soon as an exchange of satellites is necessary. The satellites parameters displayed in the "Satellite Configurations" dialog and the "Navigation Message" parameters are read-only.

Open the [Real-Time S.P.O.T. Settings](#) display to show the position of the active and inactive satellites. The current values of the parameters "PDOP/HDOP", "Receiver Location" and simulation "Time" are also displayed. If a moving receiver has been configured, the "Real-Time S.P.O.T. > Map View" displays the trajectory the receiver should have.

## 5.3 Generating a GNSS Signal with Manual Exchange of the Satellites (User Localization Mode)

Follow the [General workflow](#) and:

1. Perform steps 1 to 3.
2. Select "GNSS Main Dialog > Simulation Mode > User Localization".
3. Perform steps 6 to 18.
  - a) To reproduce the exact satellite navigation message, it is recommended to select a RINEX file, if one exists.  
See [chapter 5.11, "Configuring the Navigation Parameters"](#), on page 212.
  - b) If required, select "GNSS Main Dialog > Satellite Configuration > Atmospheric Configuration" and adjust the settings.
  - c) If required, select "GNSS Main Dialog > Satellite Configuration > Time Conversion Configuration" and adjust the settings.
  - d) Select "GNSS Main Dialog > Satellite Configuration > Power Mode > Auto" to enable the dynamic automatic calculation of the power level and adjust the required power settings.  
See also [chapter 5.12, "Adjusting the Power Settings"](#), on page 213.
4. Select "GNSS Main Dialog > State > On".

The instrument generates the GNSS signal for the selected satellites' constellation. The satellite parameters can be additionally reconfigured to simulate multipath effects for instance, see [chapter 5.9, "Creating Multipath Scenarios"](#), on page 207. Open the [Real-Time S.P.O.T. Settings](#) display to show the position of the active and inactive satellites. The current values of the parameters "PDOP/HDOP", "Receiver Location" and simulation "Time" are also displayed. If a moving receiver has been configured, the "Real-Time S.P.O.T. > Map View" displays the trajectory the receiver should have.
5. To trigger a manual satellite's exchange for Sat#3 for instance, select "GNSS Main Dialog > Satellite Configuration > Sat#3 > State > Off".
6. Select "Satellite Configuration > Sat#3 > Navigation Message" and adjust the parameters as required.
7. Enable the satellite again or add a new satellite to the satellite's constellation.

The [Real-Time S.P.O.T. Settings](#) displays the updated position of the active and inactive satellites.

## 5.4 Generating an QZSS Test Signal

1. Use the GPS standard as an entry standard and perform steps 1 to 3 according to [General workflow](#).
2. Select "GNSS Main Dialog > Simulation Mode > User Localization".
3. Select "GNSS System Configuration > QZSS > On".
4. Select "User Environment > Localization Data" and select "Geographic Location > City > Asia > Tokio".
5. Select "GNSS Main Dialog > Navigation Data" and:
  - a) select the simulation "Date" and "Time".
  - b) select "Almanac/RINEX" and select suitable GPS and QZSS almanac files.
  - c) select "Satellite Configuration" and perform "Get Optimal Constellation"The selected satellite constellation consist of GPS satellites and one QZSS satellite with SV-ID = 193.
6. Select "GNSS Main Dialog > State > On".
7. Select "GNSS Main Dialog > Real-Time S.P.O.T".

The displayed "Sky View" confirms the satellite constellation.



Consider to enable "User Environment > Obscuration & Multipath" to simulate, for example, an urban canyon scenario (see [chapter 5.15, "Creating GNSS Scenarios in a User Environment"](#), on page 216).

Switch the QZSS satellite on and off and compare the test results.

## 5.5 Generating A-GPS Custom Build Scenarios (User Localization Mode)

This description lists the steps necessary to configure an A-GPS custom build scenario and explains the configuration in principle. The required steps for the other assisted scenarios are analogical.

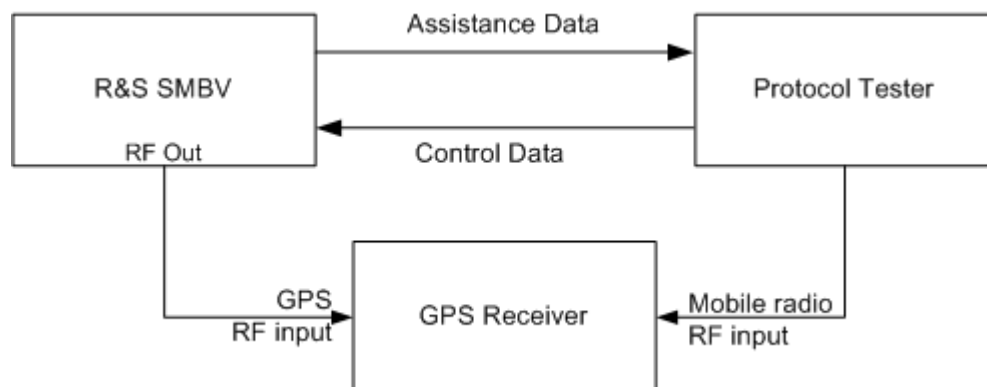
Follow the [General workflow](#) and:

1. Perform steps 1 to 3.
2. Select "GNSS Main Dialog > Simulation Mode > User Localization".
3. Perform steps 6 to 19 from from [General workflow](#).
  - a) It is recommended to select a RINEX file, if one exists.  
See [chapter 5.11, "Configuring the Navigation Parameters"](#), on page 212.

- b) Select a start simulation time around to beginning of the ephemeris span.  
For GPS, the age of ephemeris is 2 hours and the selected simulation time is aligned to the even hours of the day, for example, 00:00, 02:00, 04:00 etc.  
See also [chapter 3.1.11, "Simulation of uninterrupted location fix"](#), on page 23.
  - c) Disable "Satellite Configuration > Global Ephemeris Real-Time Projection".
  - d) Select "Satellite Configuration > Sat# > Navigation Message" and adjust the parameters as required.  
**Note:** The parameters "Satellite Configuration > Global Ephemeris Real-Time Projection" and "Satellite Configuration > Sat# > Navigation Message > Real-Time Projection" must be disabled!
  - e) Select "GNSS Main Dialog > Satellite Configuration > Power Mode > User" and adjust the required power settings.  
See [chapter 5.12, "Adjusting the Power Settings"](#), on page 213.
4. Select "GNSS Main Dialog > State > On".
  5. Generate the required "Assistance Data", see [chapter 5.8, "Generating an GNSS Assistance Data"](#), on page 206.

The instrument generates an A-GPS signal according to the settings made.

## 5.6 Generating an A-GPS Test Signal



*Fig. 5-2: Example of A-GPS Test Setup*

The generic workflow for generation of A-GPS test scenarios in conformance to A-GPS 2G/3G Protocol and Conformance Test Cases is as follow:

1. Execute "GPS Main Dialog > Set To Default" to adjust the instrument's settings to a standard set of operating conditions.
2. Select "GPS Main Dialog > Test Scenario > A-GNSS" and select a predefined GSM, 3GPP FDD, 3GPP2 (CDMA2000) or EUTRA/LTE test scenario.  
See also [chapter 3.3.2, "Full Set of Pre-defined Test Scenarios as Basis for A-GPS/A-GLONASS/A-GNSS Protocol and Conformance Test Cases"](#), on page 25.

3. Select "GNSS Main Dialog > State > ON".

The instrument generates an A-GPS signal according to the selected test scenario. Refer to the corresponding specification and customize the test scenario signal for the predefined specific test case, i.e. perform the necessary changes on the satellite constellation, receiver location, simulation time and power settings.

## 5.7 Generating an A-GNSS Test Signal

The generic workflow for generation of A-GNSS test scenarios in conformance to Protocol and Conformance Test Cases is as follow:

1. Select "GNSS Main Dialog > Set To Default" to adjust the instrument's settings to a standard set of operating conditions.
2. Select "GNSS Main Dialog > Test Scenario > A-GNSS" and select a predefined 3GPP FDD or EUTRA/LTE test scenario, e.g. "3GPP TS 37.571-2: S7 Signaling ST4".
3. Select "GNSS Main Dialog > State > ON".

The instrument generates an A-GNSS signal according to the selected test scenario.

Refer to the corresponding specification and customize the test scenario signal for the predefined specific test case, i.e. perform the necessary changes on the satellite constellation, receiver location, simulation time and power settings.

## 5.8 Generating an GNSS Assistance Data

This step-by-step description explains the configuration in principle.



In hybrid A-GNSS scenario, generate the assistance data of the GNSS standards separately in different files.

1. Select "GNSS Main Dialog > Simulation Mode > User Localization" and perform the required settings  
See e.g. [chapter 5.5, "Generating A-GPS Custom Build Scenarios \(User Localization Mode\)"](#), on page 204.
2. Execute "GNSS Main Dialog > Assistance Data" and select the "Assistance Mode > A-GPS/A-Galileo/A-GLONASS".
3. Select "Synchronize All" to align the assistance data settings with the settings that have been already made for the satellites of the selected standard.

4. If required, reselect the space vehicles for which assistance data is to be generated.
5. Reconfigure the reference location (i.e. enter the coordinates of the BS location instead of receiver location).
6. Adjust the "Duration" and the "Resolution" of assistance data.
7. Select the "Assistance Data generation > Acquisition Data Format".
8. Generate the required assistance data (almanac file, ionospheric file, etc.).

The generated assistance data files are stored in the selected folder. Refer to the description of the corresponding file for description of the file format used.

## 5.9 Creating Multipath Scenarios

See:

- ["To simulate a static multipath based on the tabbed delay model"](#) on page 207
- ["To simulate a multipath based on the LMM \(Land Mobile Multipath\) model"](#) on page 208

### To simulate a static multipath based on the tabbed delay model

1. Perform steps 1 to 3 according to [General workflow](#).
2. Select "GNSS Main Dialog > Simulation Mode > User Localization".
3. Select "Satellite Configuration > Sat# > Multipath".
4. Select the "Number of Taps" and configure the additional "Time Shift", "Power", "Doppler Shift" and "Carrier Phase" per tap.
5. Select "Multipath Configuration > State > On".

The graph displays the selected propagation conditions.

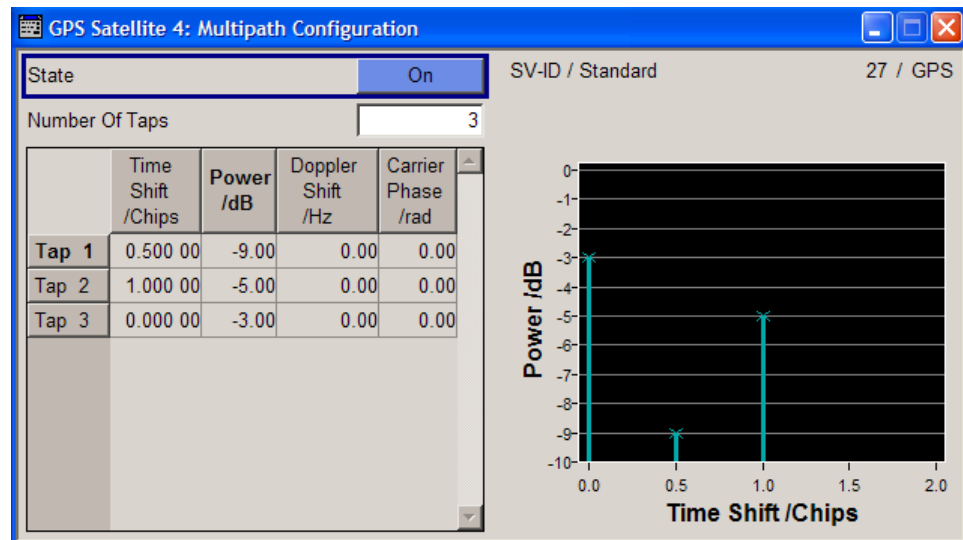


Fig. 5-3: Example of "Multipath Configuration"

6. Select "GNSS Main Dialog > State > On".

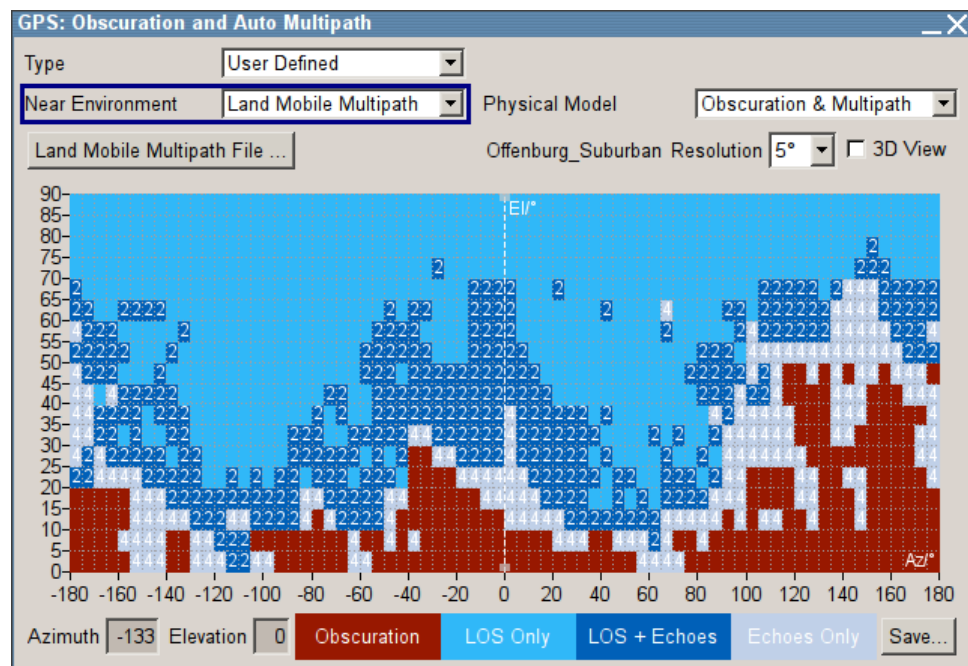
The instrument will generate the GNSS signal of satellites that experience static multipath propagation.

#### To simulate a multipath based on the LMM (Land Mobile Multipath) model

1. Connect an USB mouse to one of the USB interfaces of the R&S SMBV. You can perform the following configurations also using the front panel keys of the instrument, but an operation with a connected mouse is more convenient. See the R&S SMBV Getting Started manual for more information.
2. Perform steps 1 to 3 according to [General workflow](#).
3. Select "GNSS Main Dialog > Simulation Mode > Auto/User Localization".
4. Select "GNSS Main Dialog > Obscuration&Auto Multipath > Type > User Defined" and enable "Near Environment > Land Mobile Multipath".
5. Select a file describing the land mobile multipath, e.g. select "Land Mobile Multipath File > Select Predefined LMM > Offenburg\_Suburban".

The dialog shows the LMM model as a grid of segments, each described with its azimuth and elevation angle, number of multipath taps and its channel state.





The display is color coded, where the different channel states are indicated with different colors.

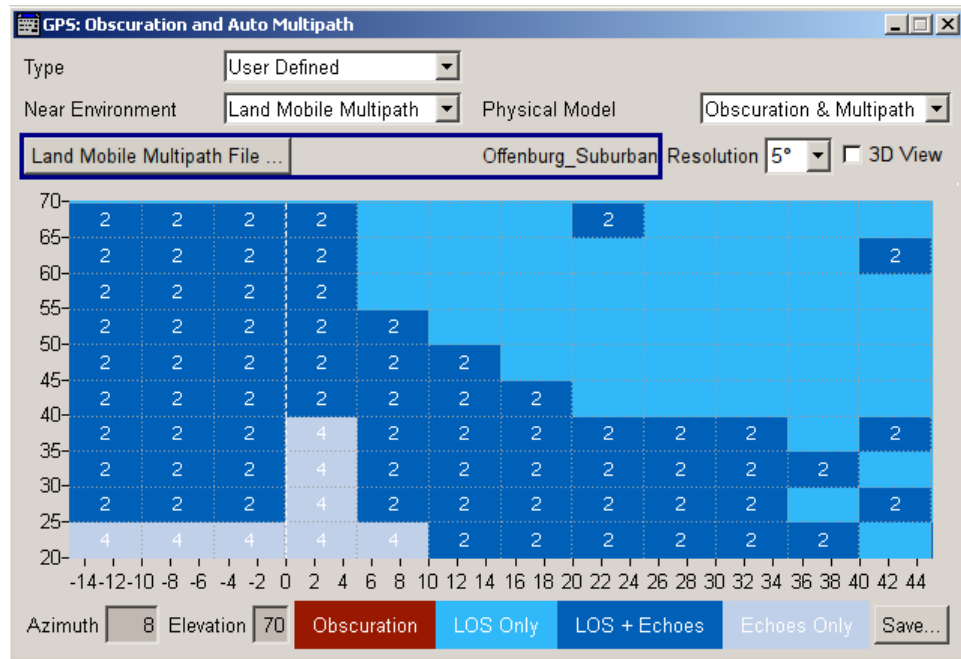
6. To retrieve more information about a segment, move the cursor on the display and select this segment.

The "Azimuth" and "Elevation" display the current values.

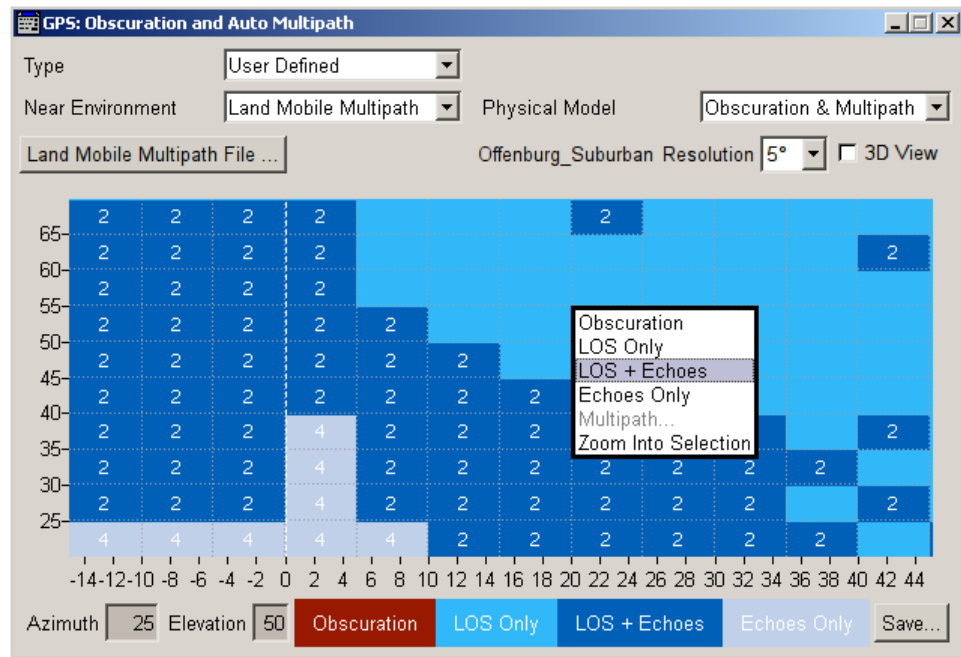
7. To zoom into an area, select a rectangular area, left mouse click to access the context menu and select "Zoom Into Selection".

Displayed is only the selected area. Values outside this area are not lost. The used "Resolution" is not changed.

8. In the LMM graph, use the mouse to drag a rectangular area for that the channel state information and multipath are to be applied.

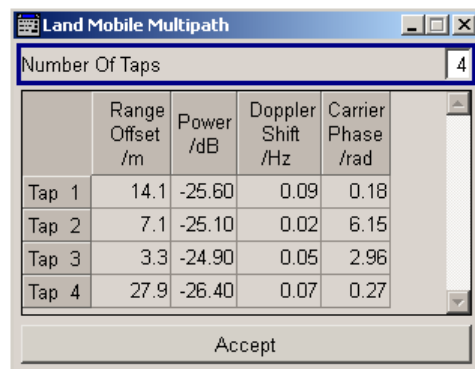


9. Left mouse click to access the context menu and select for example "LOS + Echos".



The "Land Mobile Multipath" dialog opens.

10. In the "Land Mobile Multipath" dialog:
  - a) Enter "Number of Taps".
  - b) Change the parameters "Range Offset", "Power", "Doppler Shift", "Carrier Phase" per tap.
  - c) Confirm with "Accept"



11. In the "Obscuration and Auto Multipath" dialog, right mouse click on the LMM graph, to zoom out.
12. To save the LMM pattern into file:
  - a) Select "Save"
  - b) Navigate to the required network folder and enter a file name.
  - c) Confirm with "Save".

## 5.10 Generating a GPS Signal Modulated with P Code

Follow the [General workflow](#) and:

1. Perform steps 1 to 3.
2. In the "GNSS System Configuration" dialog enable "Activate GNSS Standards > GPS".
3. Enable "GNSS System Configuration > Use Position Accuracy (P-Code)".
4. In "Simulation Mode > User Localization", select "Satellite Configurations > Sat# > Standard > GPS" and enable "Signals > P" or "C/A+P" for this GPS satellite as required.

**Note:** Not enough hardware resources

This error message appears and the satellite is disabled if the available hardware resources are not enough to generate the desired signal.

Hybrid GNSS configurations, multipath configurations, signals modulated by P-Code and activated satellites consume hardware resources. Refer to [chapter A.5, "Channel Budget"](#), on page 436 for description on the how the available hardware resources are distributed.

5. In "Simulation Mode > Auto Localization", select "Satellite Configurations > Global Signal Config" and adjust the signals of the GPS satellites.
6. Perform relevant steps 5 to 19.

7. Select "GNSS Main Dialog > State > ON".

The instrument generates the GNSS signal for the selected satellites' constellation.

## 5.11 Configuring the Navigation Parameters

See:

- ["To extract the navigation message from the almanac file"](#) on page 212
- ["To manually configure the navigation parameters"](#) on page 212
- ["To extract the ephemeris, the satellite clock correction parameters and the GLO-NASS frequency numbers from RINEX file"](#) on page 212
- ["To extract the ionospheric and time conversion parameters from RINEX file"](#) on page 213

### To extract the navigation message from the almanac file

- ▶ Select "GNSS Main Dialog > Almanac" and select an almanac file.

The almanac file is used to extract all navigation parameters. These parameters are transmitted as part of the navigation message.

### To manually configure the navigation parameters

1. Select "GNSS Main Dialog > Simulation Mode > User Localization".
2. Select "GNSS Main Dialog > Satellite Configuration > Sat# > Navigation".
3. Adjust the "Navigation Message Configuration > Number of Pages"
4. Select "Navigation Message Configuration > Page Number" and configure the content of the selected ephemeris page(s).
5. Repeat steps 2 to 4 for all GNSS satellites

### To extract the ephemeris, the satellite clock correction parameters and the GLO-NASS frequency numbers from RINEX file

1. Select "GNSS Main Dialog > Simulation Mode > User Localization".
2. Select "GNSS Main Dialog > RINEX" and select RINEX file.
3. Select "GNSS System Configuration > RINEX Configuration > Import RINEX Files".
4. Enable "GNSS System Configuration > RINEX Configuration > Update Frequency Number (GLONASS) > On".
5. Select "GNSS System Configuration > RINEX Configuration > State On".

The ephemeris and satellite clock correction part of the navigation message are extracted from the selected RINEX file for a GNSS system and used to simulate the position of the satellites of this particular GNSS system. If a GLONASS file is used, the frequency number allocations are also extracted.

The ephemeris and the clock correction parameters and, for GLONASS satellites, the frequency number allocation of all satellites that are not available in the RINEX files or had not been configured manually are extracted from the selected almanac of the corresponding GNSS system.

**To extract the ionospheric and time conversion parameters from RINEX file**

1. Select "GNSS Main Dialog > Simulation Mode > User Localization".
2. Select "GNSS Main Dialog > RINEX" and select RINEX file.
3. Perform "GNSS System Configuration > RINEX Configuration > Import RINEX Files".
4. Enable "GNSS System Configuration > RINEX Configuration > Update UTC and Atmospheric Parameters".
5. Select "GNSS System Configuration > RINEX Configuration > State On".

The ionospheric and time conversion parameters are extracted from the header of the selected RINEX file.

If required, adjust the extracted ionospheric and time conversion parameters.

## 5.12 Adjusting the Power Settings

Refer to [chapter 4.10.1, "Power Configuration"](#), on page 115 for explanation and example on the power level calculation.

See:

- ["To set the power settings in "Auto" power mode"](#) on page 213
- ["To set the power settings in "User" power mode"](#) on page 214
- [chapter 5.13, "Generating a GNSS Signal for Receiver Sensitivity Tests"](#), on page 214

**To set the power settings in "Auto" power mode**

We assume, that the reference power is specified by a reference satellite.

1. Select "GNSS Main Dialog > Satellite Configuration > Power Mode > Auto".
2. Set the "Satellite Configuration > Reference Power".
3. Set the "Satellite Configuration > Reference Satellite".
4. If a hybrid "GNSS System Configuration" is activated, select "Satellite Power Tuning > Inter-Standard Tuning > Set to Standard" to simulate the nominal power difference between the GNSS standard as defined in the standard.
5. For the satellites undergoing static multipath effects:
  - a) Select "Sat# > Multipath Configuration > Power" and adjust the power level of the corresponding fading tap.
  - b) Enable "Multipath Configuration > State > On".

6. Set "GNSS Main Dialog > State > On".

The power level of the generated GNSS signal is displayed with the parameter "Total Power".



The power levels displayed in the "Satellite Configuration > Constellation Table" are the power level at the simulation's start moment.

Select "Real-Time SPOT > Display Type > Power View" to display the current power levels.

### To set the power settings in "User" power mode

This power mode is enabled in both "Auto Localization" and "User Localization" simulation modes.

1. Select "GNSS Main Dialog > Satellite Configuration > Power Mode > User".
2. Set the "Satellite Configuration > Reference Power".
3. Set the "Satellite Configuration > Constellation Table > Sat# > Power" level of the individual satellites.
4. For the satellites undergoing static multipath effects:
  - a) Select "Sat# > Multipath Configuration > Power" and adjust the power level of the corresponding fading tap.
  - b) Enable "Multipath Configuration > State > On".
5. If you work in "Auto Localization" mode, select "Satellite Configuration > Global Signal and Relative Power Configuration" and allocate the signals and the power values for the satellites that are not simulated yet.
6. If not already enabled, set "GNSS Main Dialog > State > On".

The power level of the generated GNSS signal is displayed with the parameter "Total Power".

## 5.13 Generating a GNSS Signal for Receiver Sensitivity Tests

Sensitivity tests build an important part of the GNSS receiver testing. They are measure of the receiver's ability to acquire and track GNSS signal at low power level. The GNSS testing distinguish between two kind of sensitivity, the acquisition sensitivity and the tracking sensitivity.

The goal of the test is to find out the signal with the minimum level that the DUT requires to correctly acquire ( $P_{acq}$ ) and track ( $P_{track}$ ) the GNSS signal, where the  $P_{track} < P_{acq}$ .

We use the advantages of the user power mode and vary the level of the generated GNSS signal.

**To generate a simple GNSS signal for acquisition sensitivity tests**

1. Press PRESET to set the R&S SMBV to a definite state.
2. Select "Baseband > GNSS > GPS"
3. Use the default settings and select "Update RF Frequency"
4. Select "Simulation Mode > Static".
5. Select "Satellite Configuration" and set:
  - a) "Maximum Number of Satellites = 1"
  - b) "Ref. Power = -60 dBm"
6. Select "GPS > State > On".
7. Select "RF > State > On"  
The R&S SMBV generates a GPS signal with four satellites.
8. In the "GPS > Satellite Configuration" dialog, vary the "Ref. Power" value and measure the received power level at the GPS receiver.  
For example, to simulate conditions of a weak signal, decrease the "Ref. Power" e.g. down to -120 dBm.
9. Check whether the receiver can still acquire the GPS signal.  
The parameter "Total Power" indicates the current GPS signal power level.  
The sensitivity level ( $P_{acq}$ ) of the receiver is the level at that the receiver fails to acquire the GPS signal.

**To generate a simple GNSS signal for tracking sensitivity tests**

1. Perform the steps described in ["To generate a simple GNSS signal for acquisition sensitivity tests"](#) on page 215.  
The receiver correctly acquires the GNSS signal.
2. In the "GPS > Satellite Configuration" dialog, decrease the "Ref. Power" value.  
Alternatively, if the required dynamic range is within 30 dBm, you can decrease the "Power" value per satellite, e.g. "Power = -30 dBm".
3. Check whether the receiver can still acquire the GPS signal.  
The sensitivity level ( $P_{track}$ ) of the receiver is the level at that the receiver fails to keep lock on the GPS signal.

For more information on the power level calculation, the provided power modes and settings, see:

- [chapter 4.10.1, "Power Configuration"](#), on page 115
- [chapter 5.12, "Adjusting the Power Settings"](#), on page 213
- Application Note [1GP86](#) "GPS, Glonass, Galileo, BeiDou Receiver Testing Using a GNSS Signal Simulator"

## 5.14 Handling NMEA Files

1. On your receiver, record the NMEA messages to a log file with an extension `*.nmea`.
2. Use an external hard disk, USB stick or a LAN connection and transfer this NMEA log file to a network directory or the instrument.
3. Select the "GNSS main dialog > Geographic Location > Waypoints".
4. Select the "GNSS main dialog > Select Waypoint File", navigate to the directory the loaded NMEA file is stored and select the file.

The instrument decodes the logged NMEA file (`*.nmea`) and automatically configures the user location to the values retrieved from the logged file. The information about possible receiver's moving is considered too.

If required, re-configure the automatically applied settings.



The instrument decodes the complete NMEA file but settings related to deactivated or not installed navigation standards are ignored.



Refer to [chapter A.3, "NMEA Scenarios"](#), on page 429 for detailed description of the NMEA file format.

## 5.15 Creating GNSS Scenarios in a User Environment

The R&S SMBV provides predefined files and settings to simplify the configuration of common scenarios. If you rely on the predefined files, it is recommended that you use the combinations listed in [table 5-1](#).

**Table 5-1: Suitable configurations**

Scenario	"Vehicle Type"	Predefined Vehicle Description File	Waypoint File	"Obscuration&Auto Multi-path > Type"	"Antenna Pattern/Body Mask File"
Urban Canyon	Pedestrian Land Vehicle	Pedestrian1.xvd Land Vehicle1.xvd	Scen_Urban_Canyon_1.txt	Urban Canyon	Car_Medium Car_Medium_OpenRoof SUV VAN
City Block	Pedestrian Land Vehicle	Pedestrian1.xvd Land Vehicle1.xvd	Scen_City_Block.txt	City Block	Car_Medium Car_Medium_OpenRoof SUV VAN



Scenario	"Vehicle Type"	Predefined Vehicle Description File	Waypoint File	"Obscuration&Auto Multipath > Type"	"Antenna Pattern/Body Mask File"
Suburban	Pedestrian Land Vehicle	Pedestrian1.xvd Land Vehicle1.xvd	Scen_Circle_5km.txt	Suburban Area	Car_Medium Car_Medium_OpenRoof SUV VAN
Highway/Cutting	Land Vehicle	Land Vehicle1.xvd	Scen_Circle_5km.txt	Highway Cutting	Car_Medium Car_Medium_OpenRoof SUV VAN
Parking	Land Vehicle	Land Vehicle1.xvd	Scen_Parking_1min.txt Scen_Parking_10min.txt Scen_Parking_1h.txt	Parking - 1min Parking -10 min Parking -1 h	Car_Medium Car_Medium_OpenRoof SUV VAN
Bridge/Tunnels	Land Vehicle	Land Vehicle1.xvd	Scen_Circle_5km.txt	Bridge 1 Bridge 2 Long Tunnel Multiple Tunnels	Car_Medium Car_Medium_OpenRoof SUV VAN

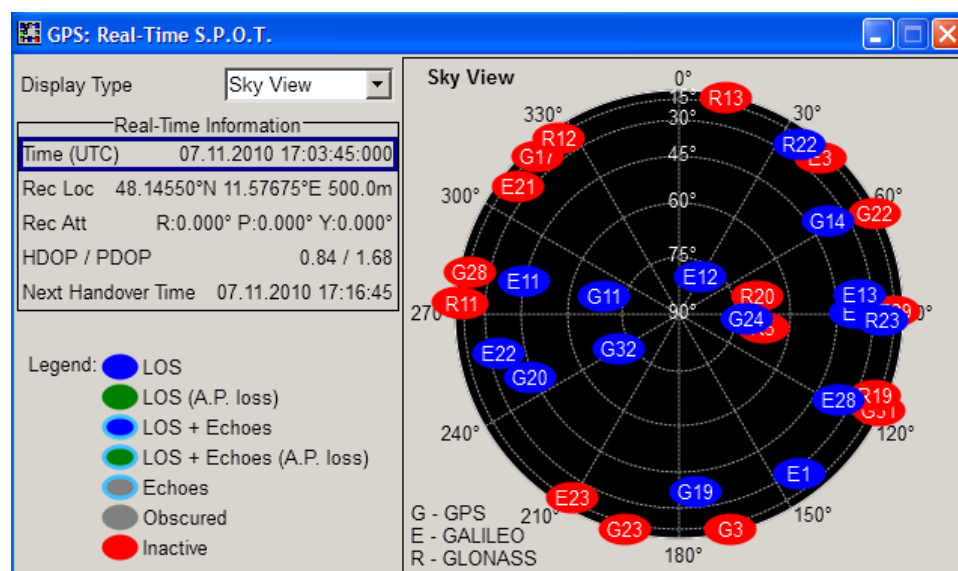
### To configure a city block scenario

This step-by-step description is based on the scenario City Block (see [table 5-1](#)) and explains the configuration steps in principle. The main goal is to demonstrate the impact of enabled obstacles and multipath effects on the simulated signal.

1. Execute "GNSS Main Dialog > Set To Default" to adjust the instrument's settings to a standard set of operating conditions.
2. Select "GNSS Main Dialog > GNSS System Configuration" and enable the required navigation systems, e.g. a hybrid GPS, Galileo and GLONASS configuration.
3. Enable "GNSS Main Dialog > Simulation Mode > Auto Localization".
4. Select "GNSS Main Dialog > Satellite Configuration > Maximum Number of Satellites > 24".
5. Select "GNSS Main Dialog > User Environment > Vehicle Type > Land Vehicle"
6. Select "GNSS Main Dialog > User Environment > Vehicle Description File" and select `LandVehicle1`.
7. Select "GNSS Main Dialog > Localization Data" and select "Geographic Location/Attitude > Waypoints" to enable a moving receiver.
8. In the "Localization Data" dialog:
  - a) select "Waypoints File > Select Predefined Waypoints", navigate to a predefined moving scenario, e.g. `Scen_City_Block.txt` and execute "Select"
  - b) select "Read Out Mode > Round Trip"

**Tip:** In automotive applications and if the instrument is not equipped with option R&S SMBV-K103, force the attitude to the motion direction of the vehicle. The attitude parameters are extracted from the selected waypoint file.

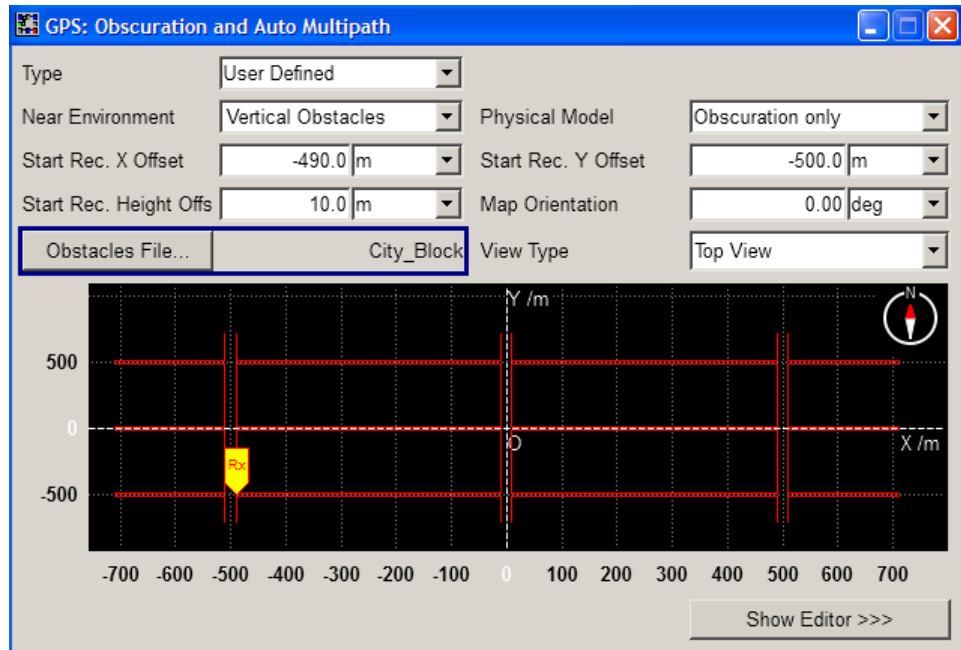
9. Select "GNSS Main Dialog > State > On" to enable signal generation.
10. Select "GNSS Main Dialog > Real-Time S.P.O.T > Display Type > Sky View" to visualize the automatically selected satellite constellation.



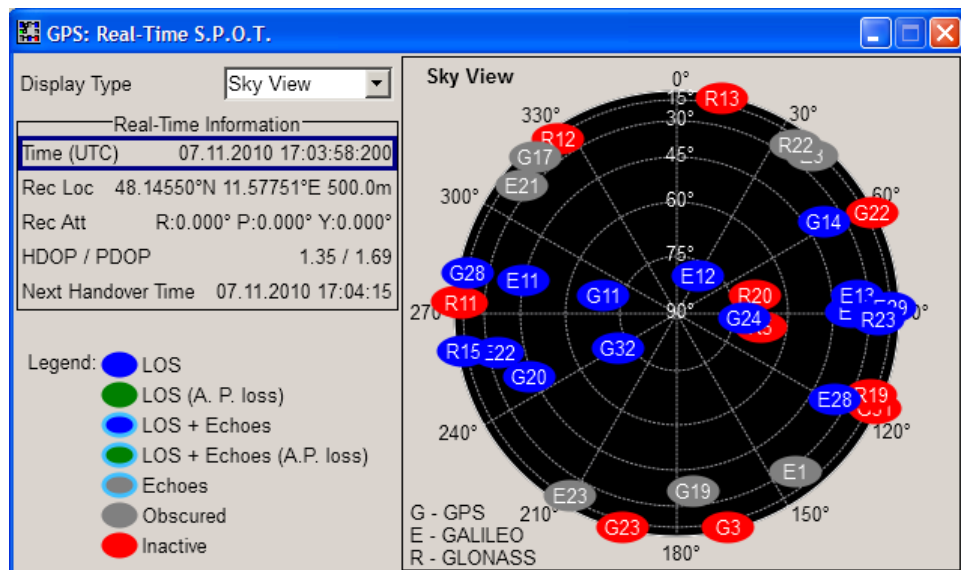
The "Sky View" displays the satellite constellation with the active GNSS satellites. To observe the movement trajectory, use the "Display Type > Map View".

11. Select "GPS Main Dialog > Obscuration&Auto Multipath > Type > City Block" and enable "Physical Model > Obscuration Only".

The instrument applies automatically the predefined "Obstacles File > City\_Block" to simulate a real word environment conditions



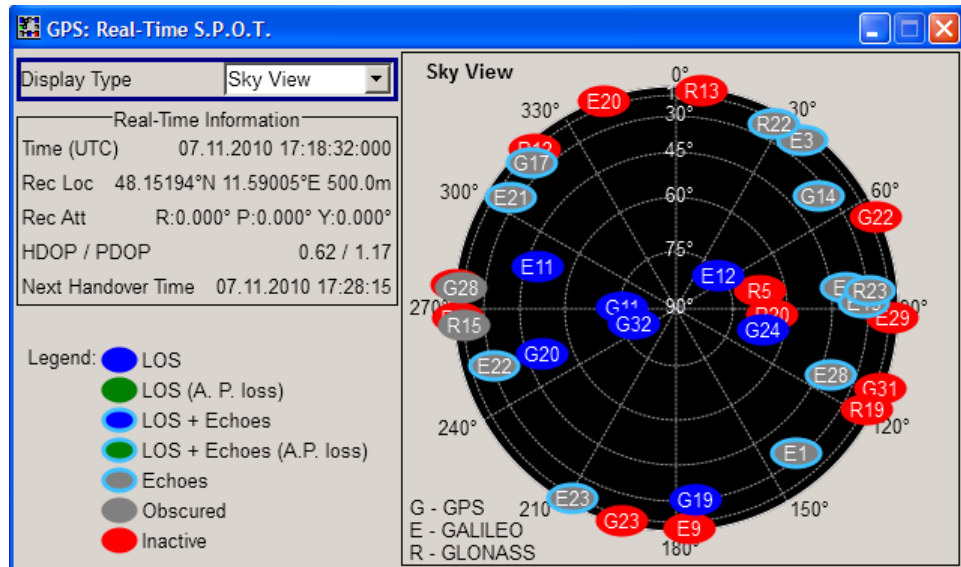
- In the "GPS Main Dialog > Real-Time S.P.O.T > Display Type > Sky View", compare the displayed satellite constellation.



Grey color = invisible satellites, i.e. satellites that are obscured for example by buildings

For the current receiver's position in the selected environment, some of the satellites are not visible.

- Select "GPS Main Dialog > Obscuration&Auto Multipath" and enable "Physical Model > Obscuration & Multipath".
- In the "GPS Main Dialog > Real-Time S.P.O.T > Display Type > Sky View", compare the displayed satellite constellation.

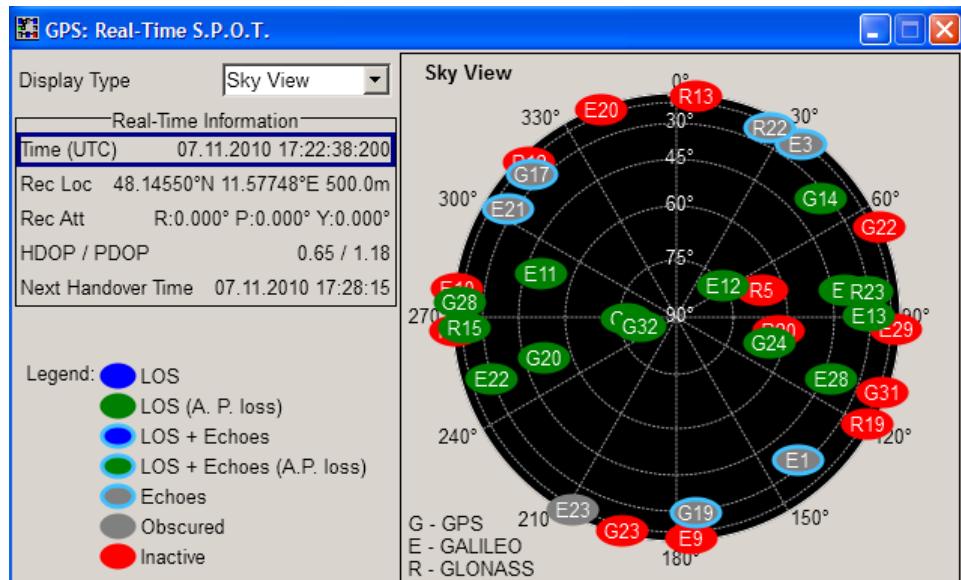


Blue border = satellites receiving an echo signal, for example from multipath

For the current receiver's position in the selected environment, the receiver receives the reflected signal from several of the invisible satellites.

15. To observe how the signal received by a receiver placed for example in a car changes:

- a) select "GNSS Main Dialog > Antenna Pattern/Body Mask File > Select Predefined Antenna Pattern"
- b) navigate to a predefined antenna pattern file, e.g. Car\_Small and execute "Select"



Green color = visible satellite with antenna power loss

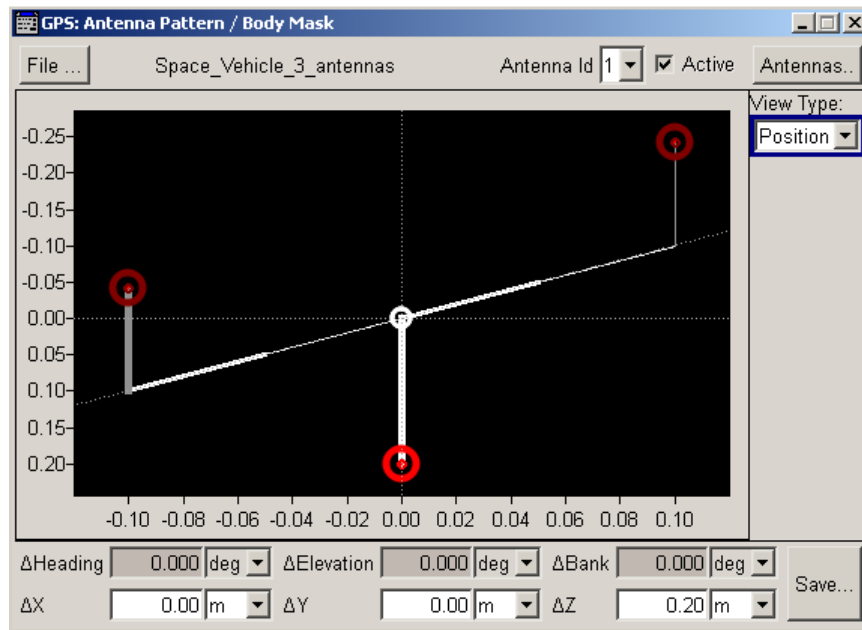
**Possible further configurations**

- If your goal is to reproduce the exact satellite navigation message as in the reality, load a RINEX file.
- Adjust the start simulation time. The RINEX file should be around the same day of the start simulation time.
- Adjust the atmospheric parameters

For more information, see Application Note [1GP101](#) "Simulating Automatic Obscuration and Multipath for Realistic GNSS Receiver Testing".

## 5.16 Visualizing the Effect of an Antenna Pattern

1. Select "GNSS Main Dialog > Set To Default".
2. Select "GNSS Main Dialog > GNSS System Configuration" and enable the required navigation systems, e.g. a hybrid GPS, Galileo and GLONASS configuration.
3. Enable "GNSS Main Dialog > Simulation Mode > User Localization".
4. Select "GNSS Main Dialog > User Environment > Vehicle Type > Aircraft"  
The software automatically selects suitable waypoint file and vehicle description file.
5. Select "GNSS Main Dialog > Localization Data" and select:
  - a) set "Yaw/Pitch > From Motion > On"
  - b) set "Roll > From Spinning > On"
  - c) set "Spinning Rate = 0.1 Hz"
6. Select "GNSS Main Dialog > User Environment > Antenna Pattern/Body Mask > File > Predefined/User Defined Files" and navigate to the \*.ant\_pat file, e.g. Space\_Vehicle\_3\_antennas.ant\_pat.  
In the "Antenna Pattern/Body Mask" dialog, select "View Type > Position" to confirm that three antennas are configured.

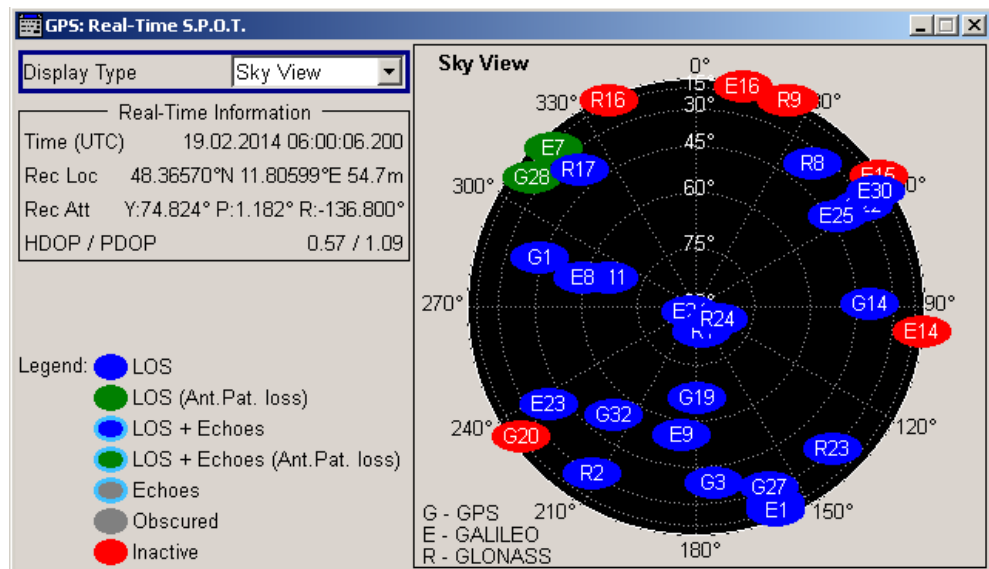


**Tip:**

See also:

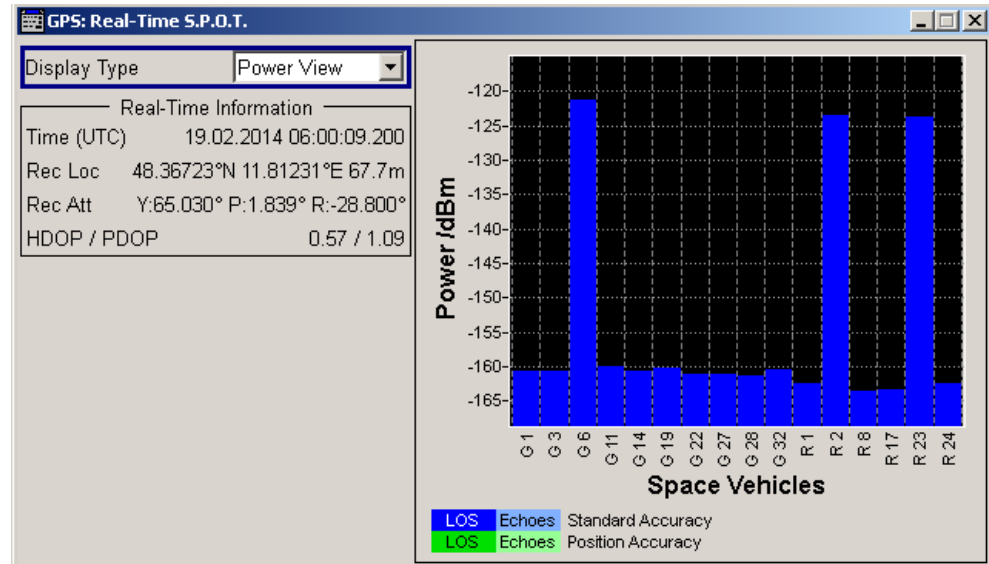
- [chapter 5.17, "Creating and Modifying Antenna Patterns and Body Masks"](#), on page 224
- [example "Antenna with four sectors"](#) on page 424 for an example of an antenna pattern file that describes an antenna with four sectors.

7. Select "GNSS Main Dialog > Satellite Configuration > Maximum Number of Satellites = 24" and select "Get Optimal Constellation".
8. Select "GNSS Main Dialog > State > On" to enable signal generation.
9. Select "GPS Main Dialog > Real-Time S.P.O.T > Display Type > Sky View".



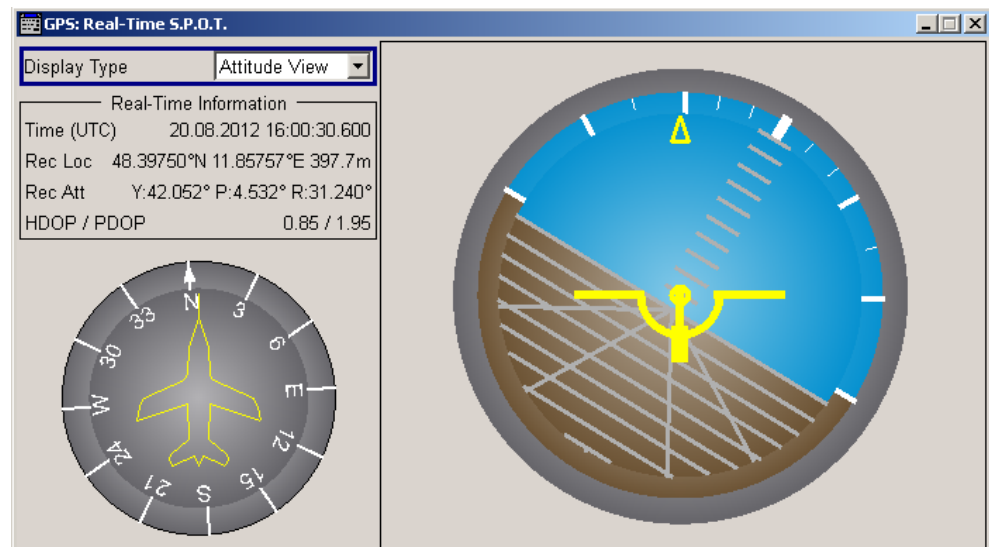
The display is updated in real time and you can observe how depending on the current GNSS receiver position, the spinning rate and the current active antenna the received GNSS signal changes.

10. Select "Display Type > Power View".



The power levels of the space vehicles are updated in real time.

11. Select "Display Type > Attitude View".



The attitude indicator confirms the enabled spinning.

12. Try out also the following:
- Select "GNSS Main Dialog > User Environment > Obscuration & Auto Multipath"
  - Select "Near Environment > Ground/Sea Reflection" and adjust the settings.

- c) Observe the "GPS Main Dialog > Real-Time S.P.O.T > Display Type > Sky View".

## 5.17 Creating and Modifying Antenna Patterns and Body Masks

See:

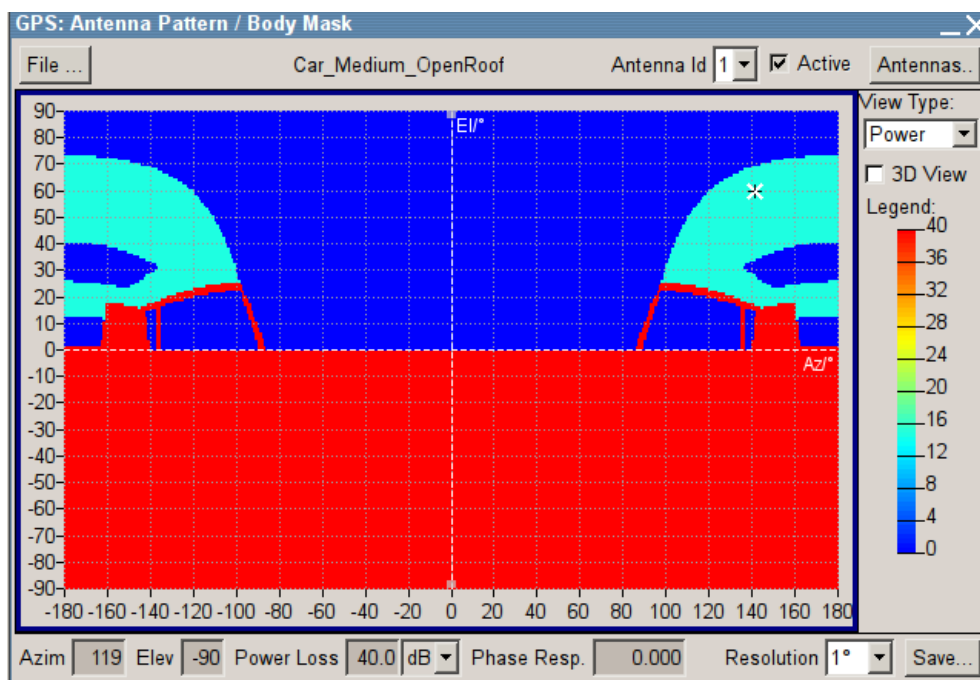
- ["To load an antenna pattern file and display the power response"](#) on page 224
- ["To display antenna pattern on a 3D view and retrieve exact information"](#) on page 225
- ["To add an antenna and modify the power values"](#) on page 227

### To load an antenna pattern file and display the power response

1. Connect an USB mouse to one of the USB interfaces of the R&S SMBV.  
You can perform the following configurations also using the front panel keys of the instrument, but an operation with a connected mouse is more convenient.  
See the R&S SMBV Getting Started manual for more information.
2. Select "GNSS Main Dialog > Set To Default".
3. Enable "GNSS Main Dialog > Simulation Mode > User Localization".
4. Select "GNSS Main Dialog > User Environment > Antenna Pattern/Body Mask".
5. Select "File > Select Predefined Antenna Pattern" and select an antenna pattern file, e.g. `Car_Medium_OpenRoof.ant_pat`.

Per default the "View Type > Power" and the dialog displays the power response of the antenna for the current car body mask.





The display is color coded, where the different power levels are indicated with different colors (see "Legend").

See also [figure 3-4](#).

With a selected antenna pattern, the instrument simulates the satellite power and carrier phase depending on the antenna pattern and attitude parameters.

For automotive applications, select "GNSS Main Dialog > User Environment > Localization Data > From Motion" to extract the attitude parameters from the way-point file.

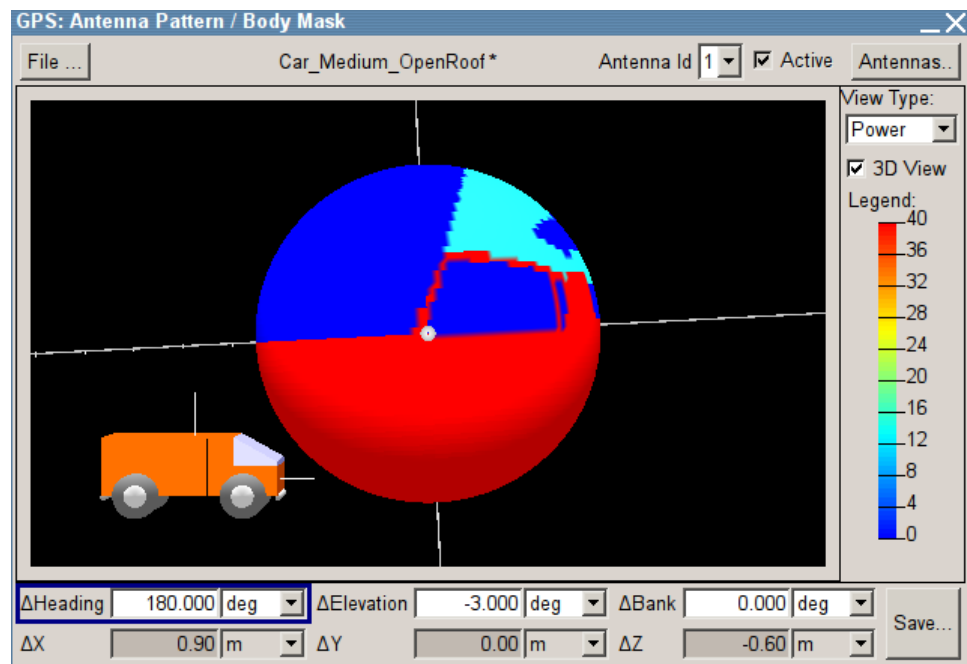
### To display antenna pattern on a 3D view and retrieve exact information

We assume you have performed the steps described in "[To load an antenna pattern file and display the power response](#)" on page 224.

1. To retrieve an exact information about the power level at one particular point, move the cursor on the display and select this point.

The "Azim", "Elev", "Power Loss" and "Phase Resp." display the current values.

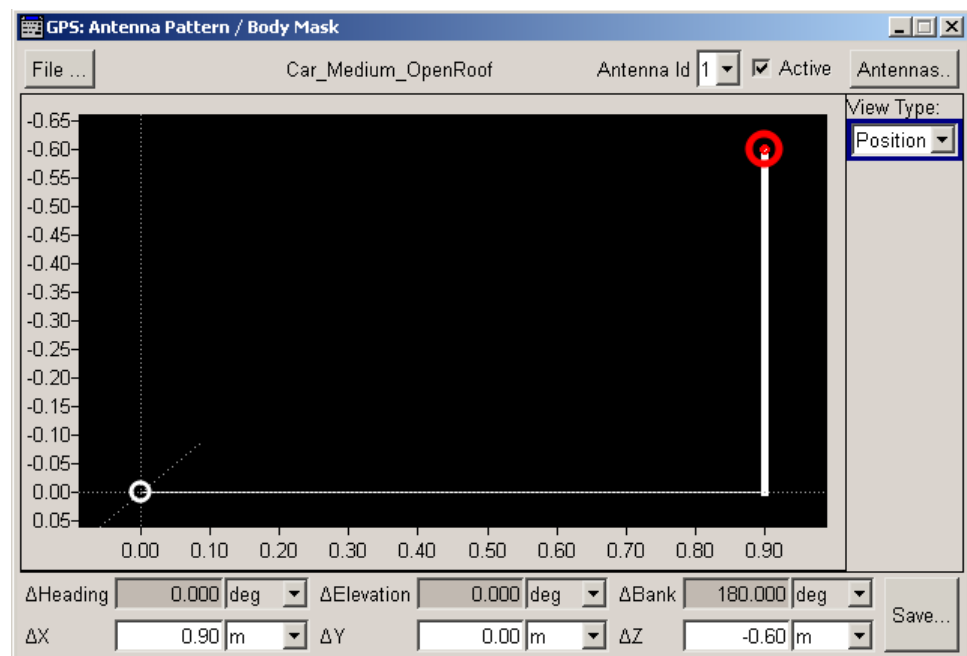
2. Select "3D View > On" and:
  - Use a connected mouse to turn the 3D view on the y axis.
  - Set the parameters " $\Delta$ Heading/ $\Delta$ Elevation/ $\Delta$ Bank" to observe their effect.



3. Select "View Type > Phase" to visualize the phase response.

The instrument retrieves the phase response matrix from the \*.phase file. If the required \*.phase file does not exist, the instrument sets the carrier phase matrix to zero.

4. Select "View Type > Position" to visualize where the antenna is located compared to the center of body mass and it is oriented.



The dialog displays the current antenna position defined with the parameters  $\Delta X$ ,  $\Delta Y$  and  $\Delta Z$ .

The selected antenna is highlighted. The  $\Delta$ Heading,  $\Delta$ Elevation,  $\Delta$ Bank parameters provide information on its orientation.

- To change the antenna position, vary the  $\Delta$ X,  $\Delta$ Y,  $\Delta$ Z values.

#### To add an antenna and modify the power values

We assume you have performed the steps described in "To load an antenna pattern file and display the power response" on page 224.

- Select "Antennas > Add an Antenna", enter "ID of an Antenna to Add = 2" and select "Close".

Second antenna is added at the body mask center, i.e.  $\Delta$ X= $\Delta$ Y= $\Delta$ Z=0.

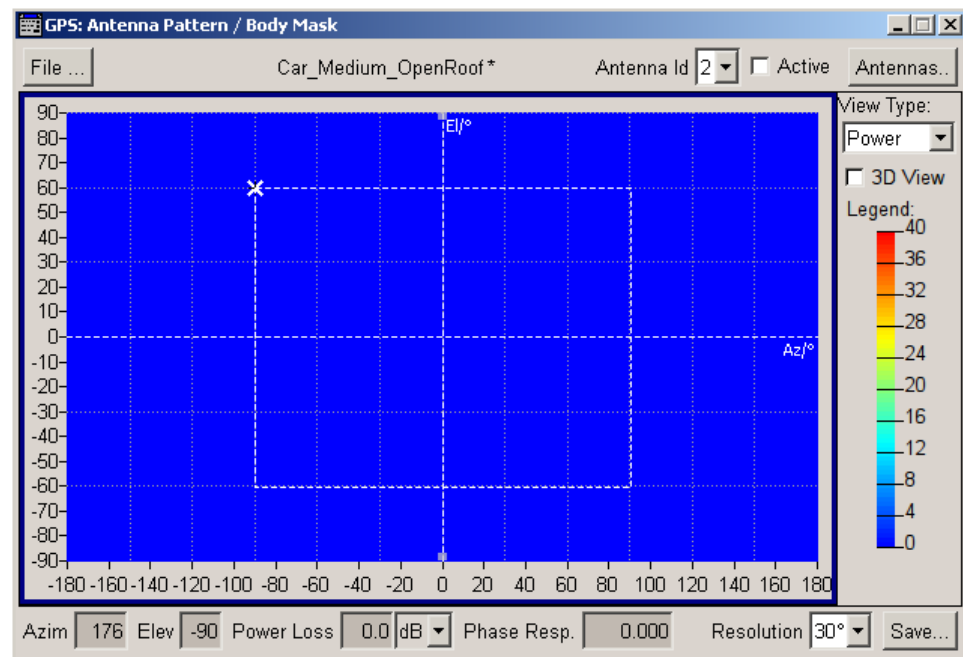
- Select "Antenna ID = 2" to enable the second antenna for editing and change the  $\Delta$  values to place the antenna at the required position.

- Select "View Type > Power".

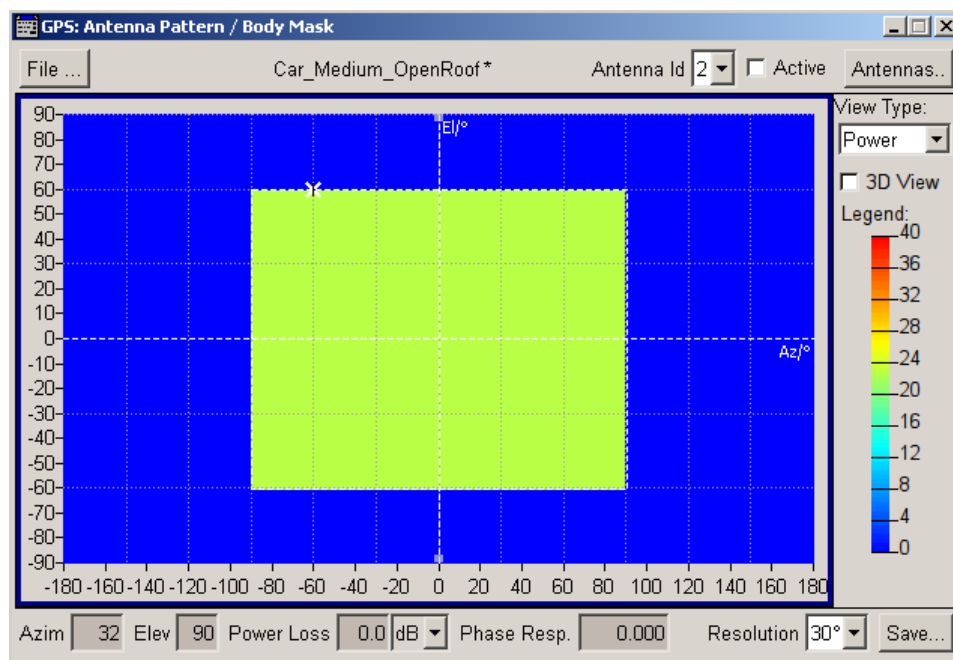
The power graph indicates a "Power Loss = 0 dB".

- Change the "Resolution = 30°" and select "For Editing".

- In the power graph, use the mouse to drag a rectangular area to that a power loss is to be applied.



- Left mouse click to access the context menu, select "Edit Selection", enter a "Power" and select "Close".



7. To zoom into an area, select a rectangular area, open the context menu and select "Zoom Into Selection".  
Displayed is only the selected area. Values outside this area are not lost. The used "Resolution" is not changed.
8. Right mouse click, to zoom out.
9. To save the antenna pattern into file:
  - a) Select "Antenna Pattern/Body Mask > Save"
  - b) Navigate to the required network folder and enter a file name
  - c) Select "Save".

## 5.18 Using the File Conversion Tool

See:

- ["To load and convert EMS files"](#) on page 228
- ["To load and convert NSTB files"](#) on page 230
- ["To load, convert and use the NSTB files to generate GPS almanac and RINEX files"](#) on page 231
- ["To merge multiple ionospheric grid files"](#) on page 231

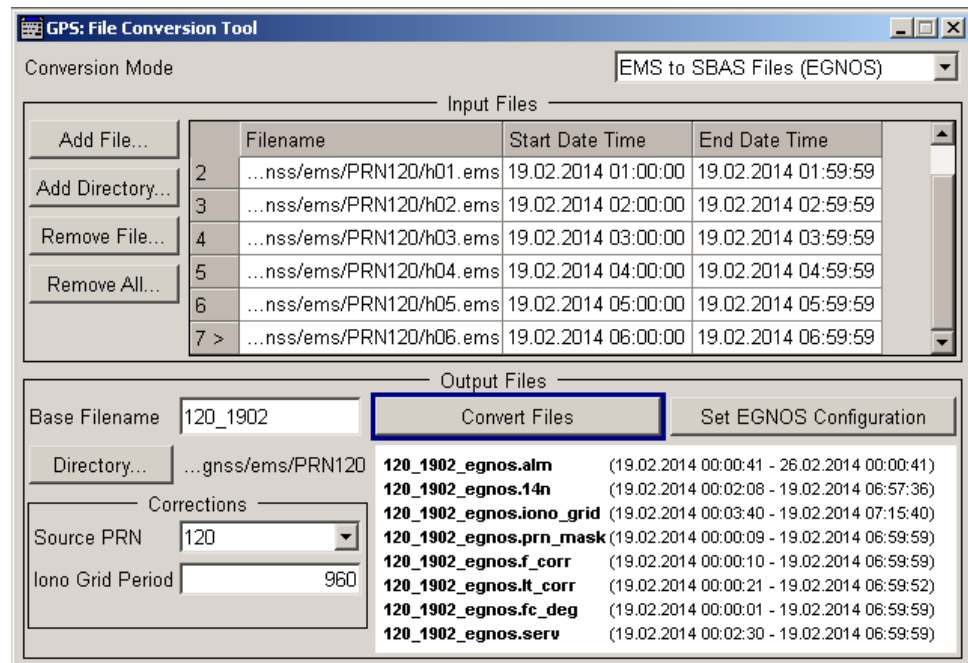
### To load and convert EMS files

While the WAAS NSTB files comprise a 24 hours time span, the EGNOS EMS data is fragmented into 1 hour files.



For longer simulation time, we recommend that you use 24h files and enable the parameter [Time Projection of Navigation Data](#).

1. Download the required \*.ems files, for example the all 24 files (h00 .. h23) for one particular day (e.g. d108, y2014) for all available PRNs (PRN120, PRN122, PRN124, PRN126 and PRN131).
2. Use one of the standard file transfer methods to transfer and store the files on the instrument's hard disk.  
Organize the EMS files of the same PRN into a separated directory, e.g. /var/user/temp/gnss/ems/PRN120.
3. Perform one of the following:
  - a) Select "GNSS > Navigation Data > GNSS/RNSS Configuration > File Conversion Tool"
  - b) Select "GNSS > Navigation Data > SBAS Configuration > File Conversion Tool"
4. Select "Conversion Mode > EMS to SBAS Files (EGNOS)"
5. Select "Input Files > Add Directory > Select User EMS", navigate to the directory the files are stored in and select all files.  
The "Start/End Date Time" are retrieved from the file.
6. Add a file prefix to indicate the converted files, e.g. set "Output Files > Base File-name > 120\_1902".
7. Select "Output Files > Directory" and set the output directory the converted files will be stored in.
8. Set "Output Files > Source PRN = 120" to extract the correction data for the \*.ems file of PRN120.
9. Set the "Iono Grid Sampling Period = 960 s" to define the resolution of the generated ionospheric grid file.  
The "Iono Grid Sampling Period = 1 s" corresponds to the real world data, but the generated \*.ion\_grid file is big in size.
10. Select "Output Files > Convert Files".

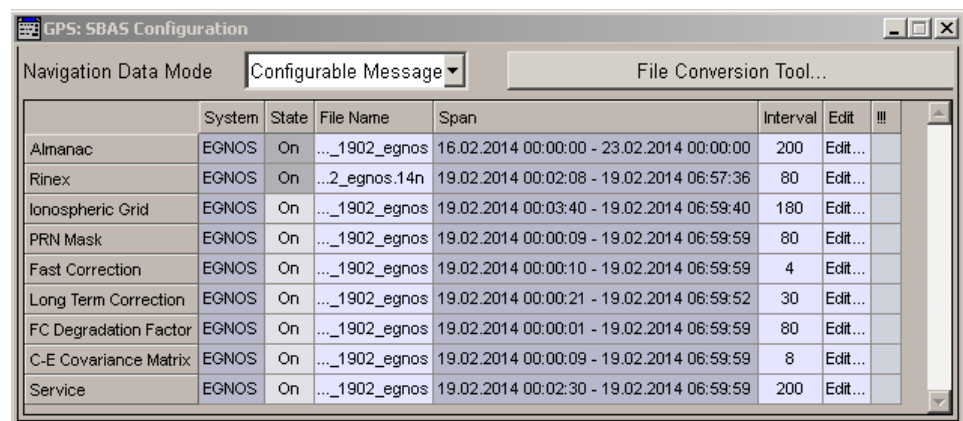


Created is a set of SBAS files with the selected file prefix.

If the \*.ems file does not contain information on a particular MT, the corresponding SBAS file is not created.

The SBAS files are XML files with Rohde & Schwarz file format, as required for the generation of SBAS signal in the [SBAS Configuration Settings](#) dialog.

11. Select "Output Files > Set EGNOS Configuration" to automatically load and enable the converted files in the "SBAS Configuration" dialog.
12. Select "GNSS > Navigation Data > SBAS Configuration".



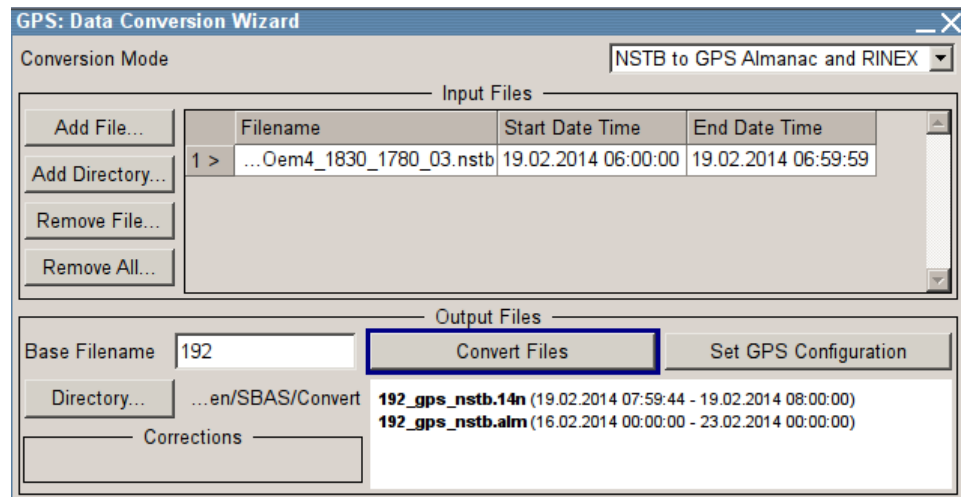
The dialog confirms that the converted files are used.

**To load and convert NSTB files**

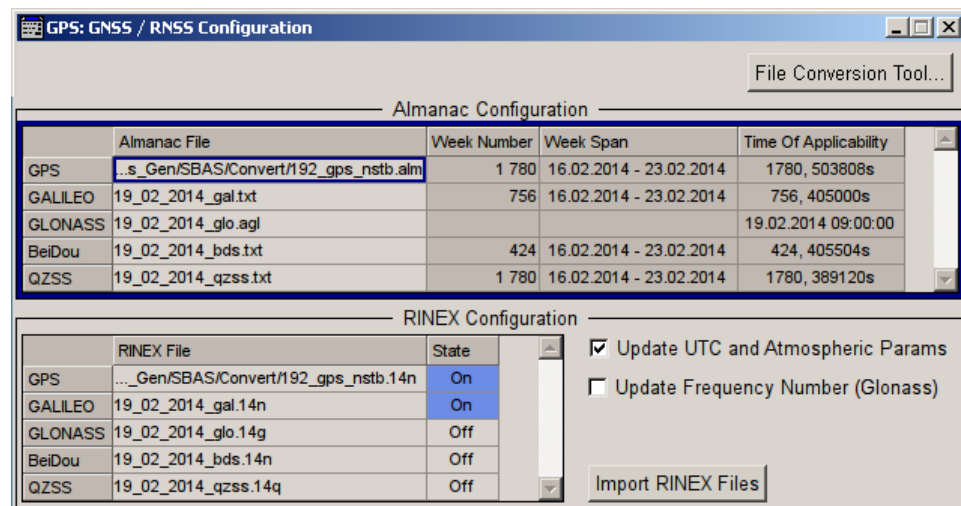
- ▶ Download the \*.nsth files and follow the steps described in ["To load and convert EMS files"](#) on page 228

### To load, convert and use the NSTB files to generate GPS almanac and RINEX files

1. Download the \*.nstb files and follow the steps described in "To load and convert EMS files" on page 228
2. Open the "File Conversion Tool" and select "Conversion Mode > NSTB to GPS Almanac and RINEX".
3. Load the \*.nstb file, select "Convert Files" and select "Set GPS Configuration".



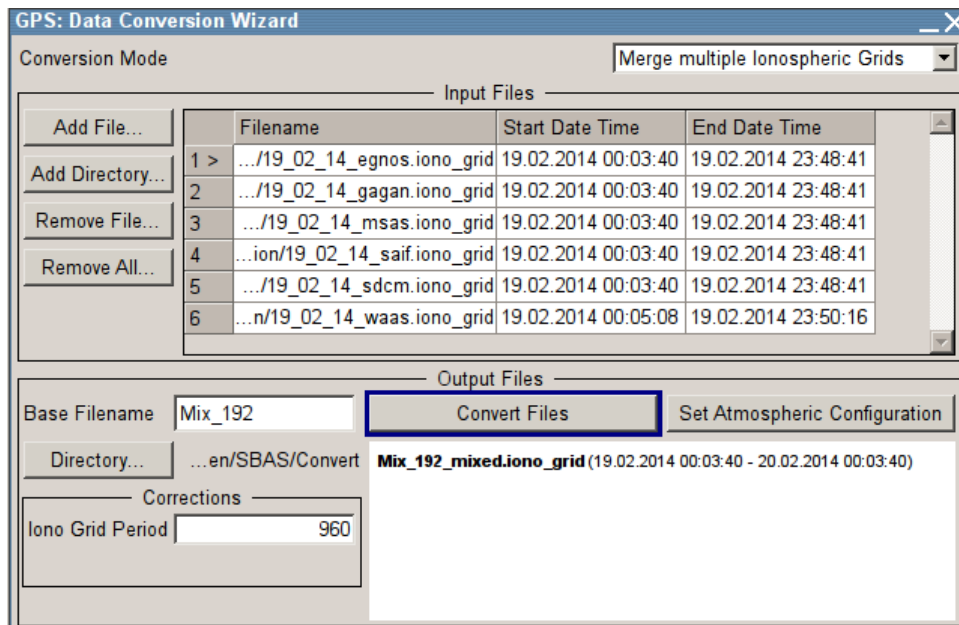
4. Select "GNSS > Navigation Data > GNSS/RNSS Configuration" and observe the selected Almanac and RINEX files.



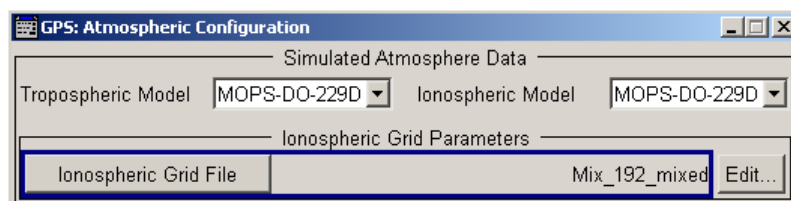
### To merge multiple ionospheric grid files

1. Select and load several ionospheric grid files.  
Follow the steps described in "To load and convert EMS files" on page 228.
2. Open the "File Conversion Tool" and select "Conversion Mode > Merge Multiple Ionospheric Grids".

3. Select "Convert Files" and select "Set Atmospheric Configuration".



4. Select "GNSS > Atmospheric Configuration", select "Tropospheric Model > MOPS-DO-229D" and "Ionospheric Model > MOPS-DO-229D".
5. Observe the selected "Ionospheric Grid File" in the "Ionospheric Grid Parameters" and "SBAS Ionospheric Navigation Parameters" sections.



## 5.19 Using the SBAS Settings

See:

- ["To access the SBAS settings"](#) on page 232
- ["To configure the fast correction data and simulate a short term alarm"](#) on page 233
- ["To configure the long term correction data"](#) on page 233
- ["To change the ionospheric correction data"](#) on page 235

### To access the SBAS settings

1. Select "GNSS > General > GNSS/RNSS Configuration".
2. Enable at least one "Augmentation System".



3. Select "GNSS > General > SBAS Configuration".
4. Select "Navigation Data Mode > Configurable Message".

#### To configure the fast correction data and simulate a short term alarm

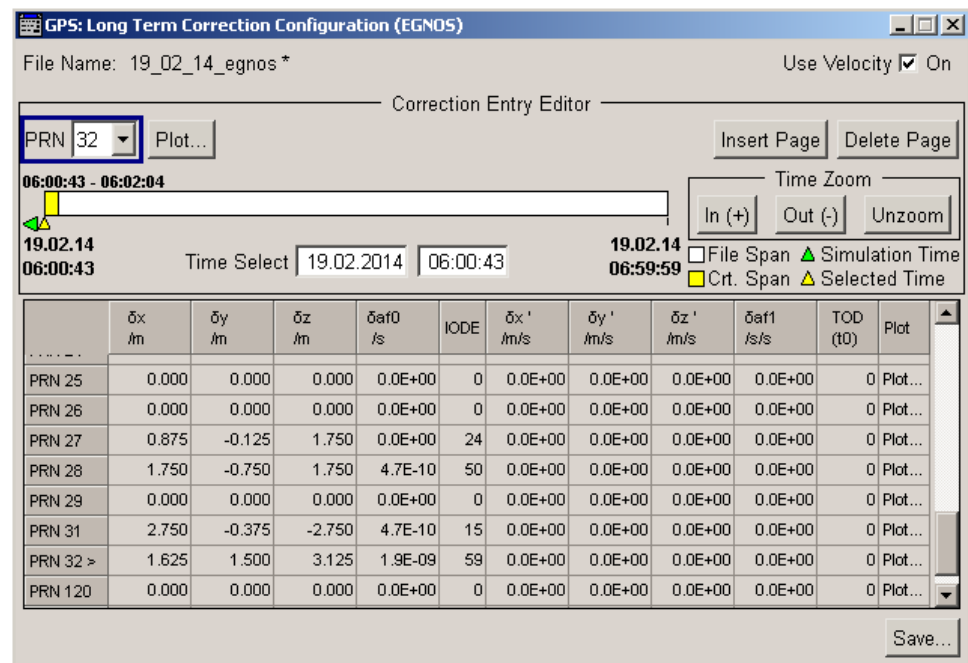
1. In the "SBAS Configuration", for "System > EGNOS", select "Fast Correction > On" and select "Edit".
2. Select a PRN, e.g. set "PRN = 16".  
The display is adjusted so that the fast correction data for the selected PRN is displayed.
3. Set the "UDREI" index, e.g. select "UDREI = 7".  
The "UDRE" and "Sigma" values are updated automatically according to [table 4-6](#).
4. To simulate a short term alarm:
  - a) Set "Alert > On".  
The corresponding IODF is set to 3. The displayed initial value is not updated.
  - b) Open the \*.f\_corr file and add an ALERT = "ON" tag for the particular PRN, e.g.  

```
<F_CORR_ENTRY DateTime = "14-02-19 11:24:07" PRN = " 16"
PRC = " 0.875" UDREI = " 7.00" ALERT = "ON">
```

 For more information on the file format, see [chapter A.4, "SBAS Message Files Format"](#), on page 430.
5. Select "Plot" to visualize the variation of the "UDRE", "PRC" or "Alarm" for that particular PRN.  
See [chapter 4.9.13, "Visualizing the Parameters Variation Over Time"](#), on page 110.
6. Set for example the "IODF > MT3 = 1".
7. Select "Save" to store the changes into a file.

#### To configure the long term correction data

1. In the "SBAS Configuration", for "System > EGNOS", select "Long Term Correction > On" and select "Edit".
2. Select a PRN, e.g. set "PRN = 32".  
The display is adjusted so that the long term correction data (" $\delta x/\delta y/\delta z$ ", " $\delta af0$ " and "IODE") for the selected PRN is displayed.



3. Select "Use Velocity > On" to transmit velocity and clock drift corrections " $\delta x'/\delta y'/\delta z'$ ,  $\delta af1$ " and Time of Day ("TOD").
4. Select "GNSS > GNSS System Configuration" and set "Sync IOD/URA from SBAS Data > On" to ensure integrity.
5. Select "GNSS > Satellite Configuration > PRN32 > Navigation".
6. In the "Navigation Message Configuration" dialog, change the "Current Page Index" to display the navigation message parameters for the current simulation time.
7. Compare the "IODC/IODE" value in the GNSS navigation message with the "IODE" value.

If a realistic RINEX file have been loaded, the these values would match.

GPS Satellite 4: Navigation Message Configurations

SV-ID / Standard 32 / GPS

Number Of Navigation Pages 12

Current Page Index 4

Real-Time Projection  On

Set To Almanac

Ephemeris Parameters

<<< Hide Details

Code On L2 P Code ON

L2 P Data Flag  On

Fit Interval Flag  On

SV Accuracy / URA Index 0

SV Health 0

IODC 59

IODE 59

8. In the "Long Term Correction Configuration" dialog, select "Plot" to visualize the variation of the " $\delta x/\delta y/\delta z$ " and "IODE" for that particular PRN.
9. Select "Save" to store the changes into a file.

#### To change the ionospheric correction data

1. In the "SBAS Configuration" dialog, for "System > EGNOS", select "Ionospheric Grid > On" and select "Edit".
2. Set the "Initial IODI".  
The IODI is incremented internally.
3. To change the "GIVEI/Vertical Delay" values of an IPG:
  - a) select the required page, i.e. set the "Time Select"  
(see also [chapter 4.9.2, "Timing Setting"](#), on page 94)
  - b) to select an IGP, click on the map or set the "Longitude, Latitude" values
  - c) enter the "GIVEI" and "Vertical Delay" values.
4. Select "Plot IGP" to visualize the variation of the "GIVEI" and "Vertical Delay" for that particular IGP.  
See also [chapter 4.9.13, "Visualizing the Parameters Variation Over Time"](#), on page 110.
5. Select "Save" to store the changes into a file.

## 5.20 Simulating SV Perturbations and Errors

SV perturbations and errors are terms describing errors in the channel between the receiver and the satellite. Typical SV errors are the pseudorange correction errors, the clock biases and the SV position errors, as well as the ionospheric and tropospheric delays.

In this implementation, SV errors are simulated by using the corrections in SBAS message files, in particular the fast correction file, the long term correction file and the ionospheric grid file.

To make use of the SBAS message files, at least one augmentation system is activated.

As described in [chapter 3.9.3, "Improving the Simulation Accuracy and Simulation of SV Perturbation and Errors"](#), on page 40, the corrections (i.e. the intentional errors) influence the pseudorange.

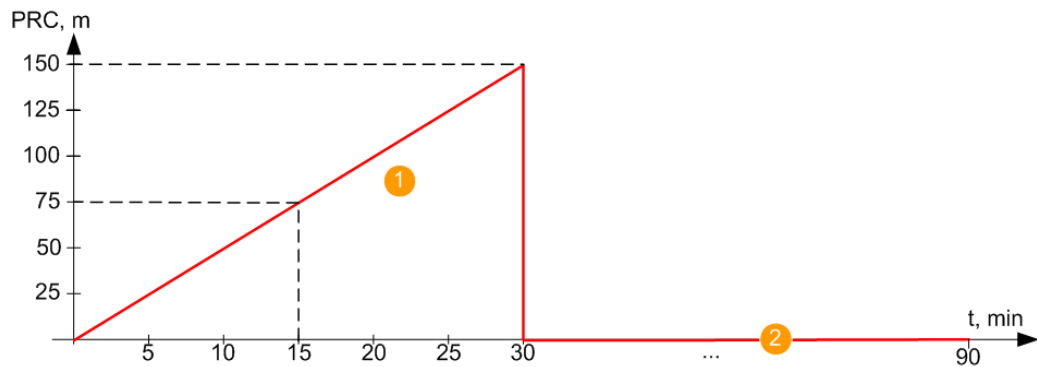
Errors can be simulated exclusively or simultaneously. For better overview, in the following examples the errors are simulated exclusively, i.e.:

- If pseudorange corrections (PRC) are simulated, the long term corrections (satellite position and clock biases) are set to zero.  
See ["To vary and apply pseudorange corrections \(PRC\) that follow a linear ramp function"](#) on page 236.
- If satellite position errors are simulated, the fast corrections (PRC) and the clock errors are set to zero and vice versa.  
If clock biases are simulated, the fast corrections (PRC) and the satellite position errors are set to zero.  
See ["To configure clock or satellite position errors"](#) on page 238.
- If ionospheric delays are simulated, the fast and long term correction files should be disabled.  
See
  - ["To synchronize the ionospheric delays to the MOPS-DO-229D model"](#) on page 239
  - ["To synchronize the ionospheric delays to the NeQuick and Klobuchar models"](#) on page 240.

This section explains the generation of SV errors as a principle. Not all required steps are listed.

### **To vary and apply pseudorange corrections (PRC) that follow a linear ramp function**

This example shows you how to create a fast correction file so that the pseudorange corrections (PRC) of a satellite are linearly increasing from 0 to 150 m over a duration of 30 min with a pseudorange rate of 5 m each 60 sec.



**Fig. 5-4: Example: PRC distribution function**

- 1 = Linearly increasing PRC from 0 to 150 m over 30 min  
 2 = PRC = 0 for 60 min

The example uses only one satellite with PRN = 16 to explain the principle.

The long term corrections (satellite position and clock biases) are set to zero.

- Select "GNSS > GNSS System Configuration":
  - set "GPS > On" and "EGNOS > On"
  - set "Sync SV Biases from SBAS Data > On".
- If you use "User Localization" mode, you can select "GNSS > Satellite Configuration" and disable all SBAS satellites (i.e. "Standard > SBAS > State > Off").
- Follow the XML structure shown in "[19\\_02\\_14\\_egnos.f\\_corr](#)" on page 433. Create a \*.f\_corr file in that the PRC values are increased each 3 sec with a step size of 0.250 m.

```

<F_CORR_ENTRY DateTime = "14-02-19 06:00:00" PRN = "16" PRC = "0.000" UDREI = "Not Monitored"/>
<F_CORR_ENTRY DateTime = "14-02-19 06:00:03" PRN = "16" PRC = "0.250" UDREI = "Not Monitored"/>
<F_CORR_ENTRY DateTime = "14-02-19 06:00:06" PRN = "16" PRC = "0.500" UDREI = "Not Monitored"/>
...
<F_CORR_ENTRY DateTime = "14-02-19 06:30:00" PRN = "16" PRC = "150.000" UDREI = "Not Monitored"/>
<F_CORR_ENTRY DateTime = "14-02-19 06:30:01" PRN = "16" PRC = "0.000" UDREI = "Not Monitored"/>
<F_CORR_ENTRY DateTime = "14-02-19 07:29:59" PRN = "16" PRC = "0.000" UDREI = "Not Monitored"/>
  
```

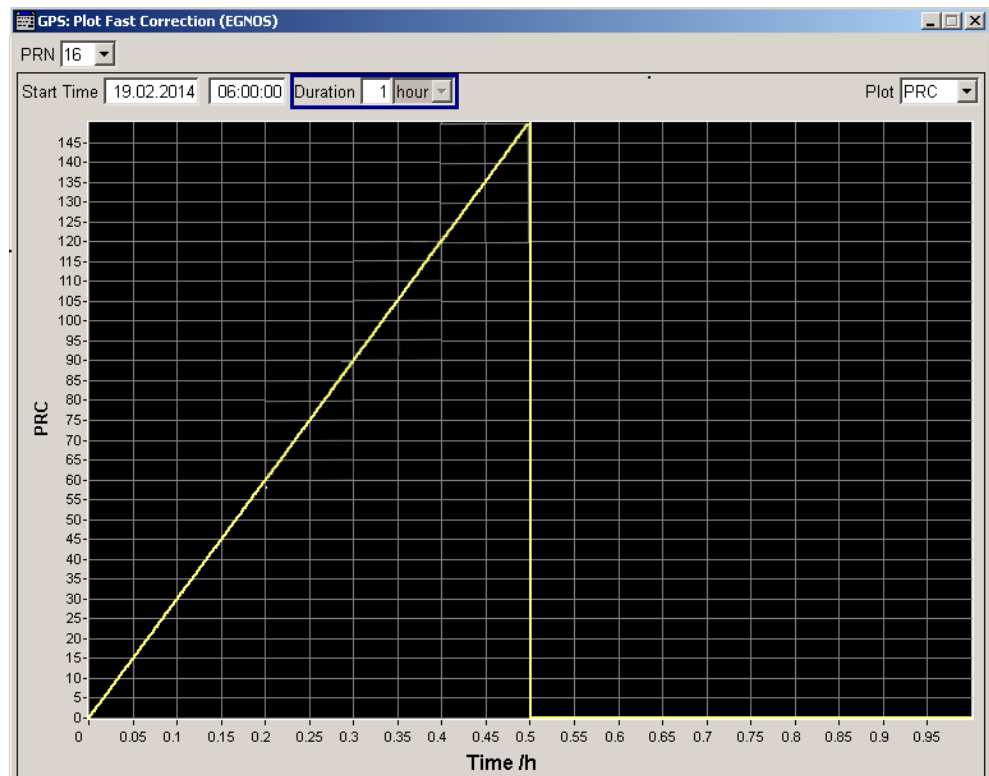
**Fig. 5-5: Example: Fast correction message file content (extract)**

- 1 = 3 sec (time interval between two consecutive entries)  
 2 = 0.250 m (PRC step size)  
 3 = PRC = 0 for 60 min

For more information, see [chapter A.4.2, "Interpolation and Correction Data Sampling Principle"](#), on page 435.

- Select "GNSS > General > SBAS Configuration".
- For "System > EGNOS", select "Long Term Correction > Off".
- For "System > EGNOS", select "Fast Correction > On" and load the created \*.f\_corr file.
- Select "Edit", set "PRN = 16" and select "Plot".

8. Set "Start Time = 06:00:00" and "Duration = 1 h" to display the ramp function.



If your test scenario require a linearly increasing pseudorange ramp with different value range, for example 0 to 300 m, try out to:

- configure the PRC values in the value range form -150 m to + 150 m
- offset the ramp by adding a **Pseudorange Bias** of 150 m for the simulated satellites.

#### To configure clock or satellite position errors

1. Select "GNSS > GNSS System Configuration":
  - a) set "GPS > On" and "EGNOS > On"
  - b) set "Sync IOD/URA from SBAS Data > On".
2. If you use "User Localization" mode, you can select "GNSS > Satellite Configuration" and disable all SBAS satellites (i.e. "Standard > SBAS > State > Off").
3. In the "SBAS Configuration" select "System > EGNOS":
  - a) set "Fast Correction > Off"
  - b) set "Long Term Correction > On" and select "Edit".
4. Follow the XML structure shown in "[19\\_02\\_14\\_egnos.lt\\_corr](#)" on page 434 and create a \*.lt\_corr file in that the clock corrections (CLKL) or the satellite positions (XLC, YLC, ZLC) vary.

For more information, see [chapter A.4.2, "Interpolation and Correction Data Sampling Principle"](#), on page 435.

- a) To simulate clock biases (errors) only, set the satellite position parameters  
XLC=" 0.000" YLC=" 0.000" ZLC=" 0.000".
- b) To simulate satellite position errors only, set the clock parameter CLKL=" 0.000".



You can use the data logging function to acquire the navigation data with and without simulated SV errors and compare the results.

See [chapter 4.13, "Data Logging Settings"](#), on page 170.

### To synchronize the ionospheric delays to the MOPS-DO-229D model

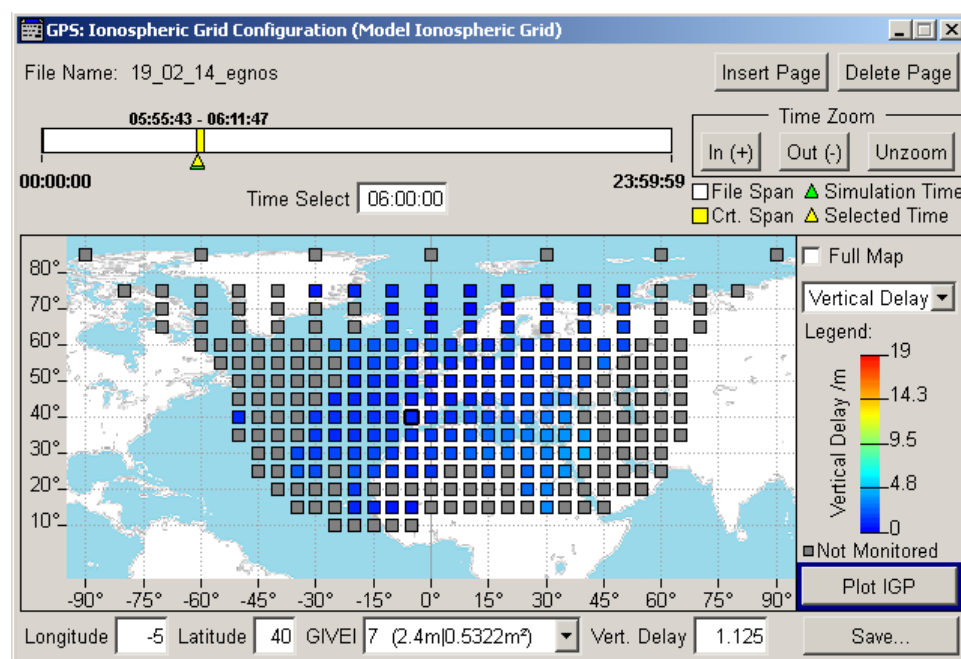
This example shows you how to simulate ionospheric delays according to the MOPS-DO-229D model.

The example also shows how to display the 24h vertical delay distribution function at the IGP with "Longitude = - 5" and "Latitude = 40".

1. Select "GNSS > GNSS System Configuration":
  - a) set "GPS > On" and "EGNOS > On"
  - b) set **"Sync Ionospheric Delays form SBAS Data > On"**.
2. Select "Atmospheric Configuration".

The dialog confirms that the following settings are performed automatically: "Ionospheric Grid File > 19\_02\_14\_egnos" and "Tropospheric and Ionospheric Model > MOPS-DO-229D".

3. Select "Ionospheric Grid File > Edit".



4. To visualize the "GIVEI/Vertical Delay" values of an IPG, click on the map or set the "Longitude, Latitude" values.
5. Select "Plot IGP".

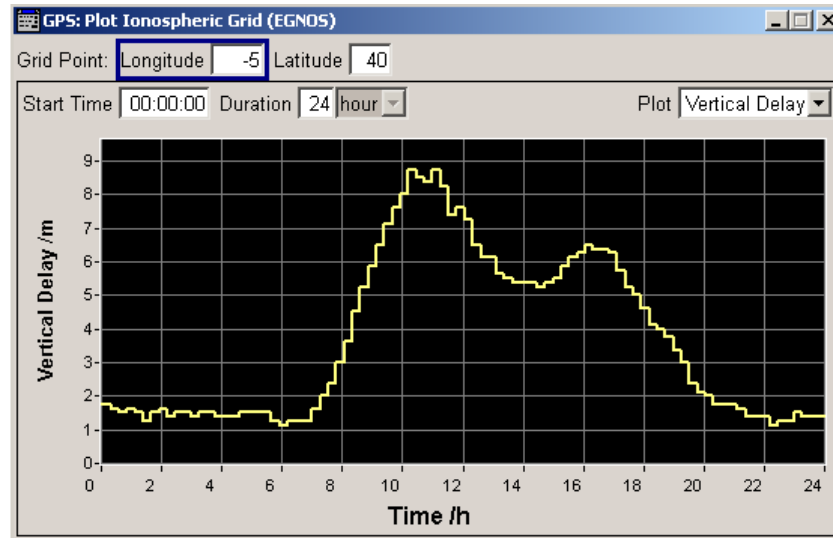


Fig. 5-6: Example: 24h Vertical Delay distribution for a given position (the curve follows the MOPS-DO-229D distribution)

The plot displays the vertical delays variation over a period of 24 h.

#### To synchronize the ionospheric delays to the NeQuick and Klobuchar models

This example shows you how to simulate ionospheric delays according to the NeQuick and Klobuchar models.

The example uses the same IGP as the example described in ["To synchronize the ionospheric delays to the MOPS-DO-229D model"](#) on page 239.

1. Select "GNSS > GNSS System Configuration":
  - a) set "GPS > On" and "EGNOS > On"
  - b) set "**Sync Ionospheric Delays form SBAS Data > Off**".
2. Select "**Atmospheric Configuration > Ionospheric Model > Klobuchar**".
3. Select "Sync from Simulated Ionospheric Model".
4. Select "Show Earth Grid".
5. Set "Longitude = - 5" and "Latitude = 40" and select "Plot IGP".



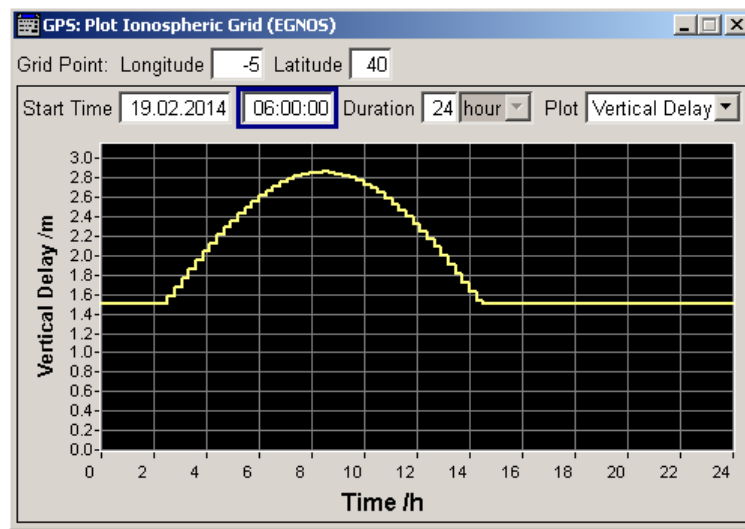
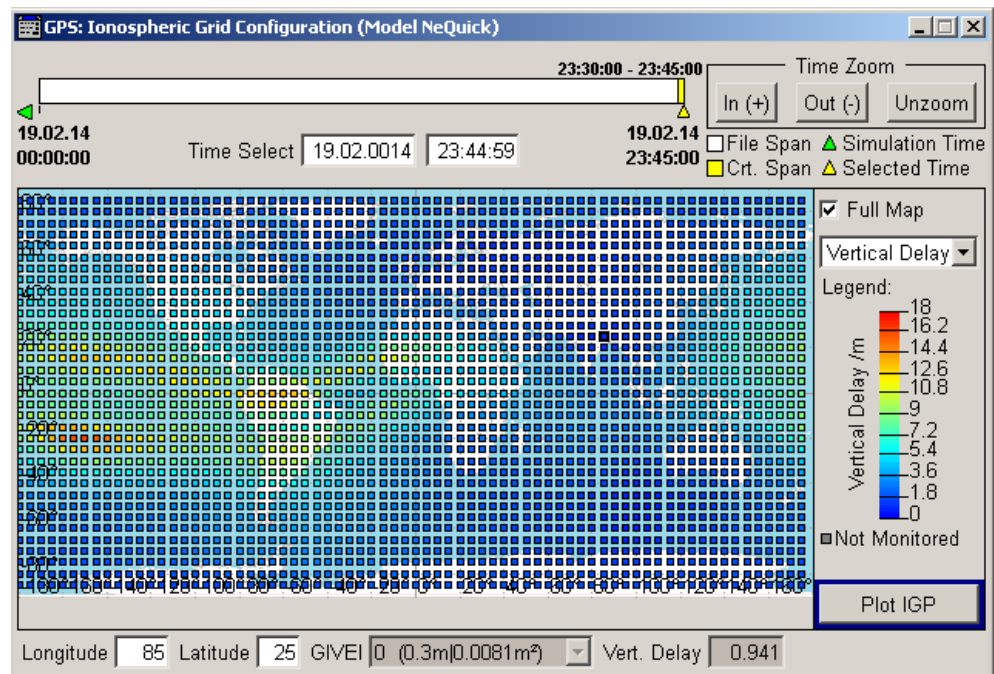


Fig. 5-7: Example: 24h Vertical Delay distribution for a given position (the curve shows the typical Klobuchar distribution)

The curve follows the expected Klobuchar distribution function with a maximum at around 2 pm ("Start Time" + "Time/h" = 6 am + 8h).

6. In the "Atmospheric Configuration" dialog, select "**Ionospheric Model > NeQuick**".
7. Select "Sync from Simulated Ionospheric Model", wait the calculation process to finish and select "Show Earth Grid".



8. Select "Plot IGP" for the same IGP.

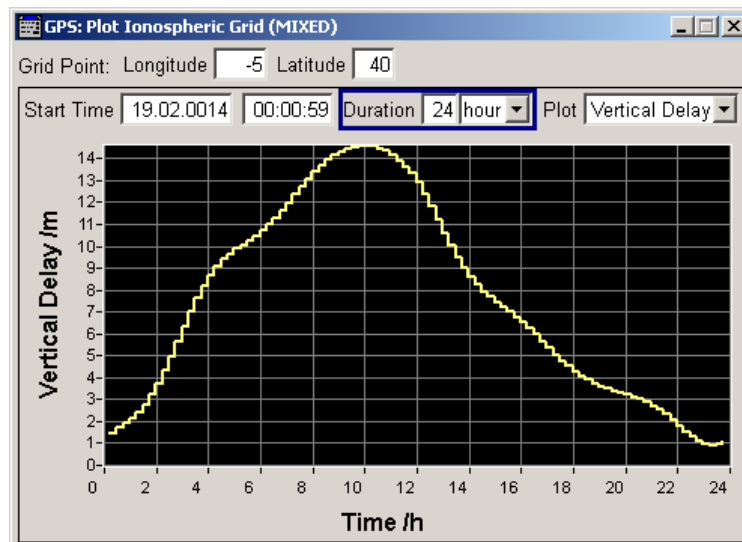


Fig. 5-8: Example: 24h Vertical Delay distribution for a given position (the curve shows the NeQuick distribution)

9. Compare the ionospheric delay distribution functions, see:

- [figure 5-6](#)
- [figure 5-7](#)
- [figure 5-8.](#)

The ionospheric models use different ionospheric corrections.

## 5.21 Generating GNSS Signal with Several Instruments

This section provides example on connection and configuration of two R&S SMBV instruments for generating common GNSS signal.

### 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)
- option Phase Coherence (R&S SMBV-B90)

#### Instrument#2

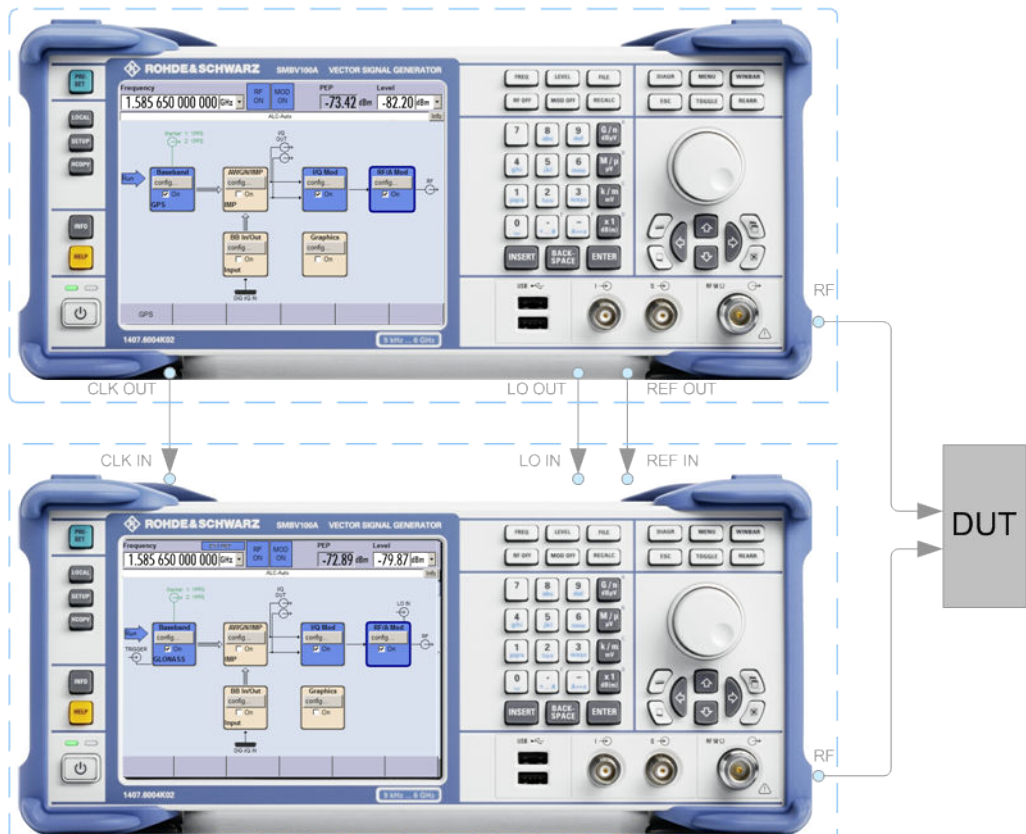
- option GLONASS (R&S SMBV-K94)
- GNSS global option R&S SMBV-K91 (Extension to 12 Satellites)
- generation of more than 12 satellites requires additionally GNSS global option R&S SMBV-K96 (Extension to 24 Satellites)
- option Phase Coherence (R&S SMBV-B90)



In this description, only the GNSS 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 [1GP67](#) "Phase Adjustment of Two MIMO Signal Sources with Option B90 (Phase Coherence)"
- Application Note [1GP84](#) "Time Synchronous Signals with Multiple R&S SMBV100A Vector Signal Generators"

The [figure 5-9](#) provides an example of test setup. The two instruments are connected to work in master-slave mode and the local oscillators (LO) are coupled. The first instrument provides the second one with its system clock, trigger, reference and LO signals.



*Fig. 5-9: Example: Connecting two R&S SMBV to generate GNSS signal using common RF frequency*



The following lists **only the required task related settings**.

We assume that the instruments are configured to ensure a carrier phase coherence.

1. In the Instrument#1, perform the required steps according to [General workflow](#) and configure the instrument to generate GPS signal with 12 or more satellites and "RF Band > L1/E1" (see also [figure 3-1](#)).

- a) Select "GPS > GNSS System Configuration > Use Common RF Frequency > ON".
- b) Execute "GPS > Update RF Frequency".

The value in the "Frequency" display in the header of the instrument is set to 1.58565 GHz. The GPS signal is however modulated on the GPS frequency L1 = 1.57542 GHz.

2. In the Instrument#2, perform the required steps according to [General workflow](#) and configure the instrument to generate GLONASS signal with 12 more satellites and "RF Band > L1/E1".

- a) Select "GLONASS > GNSS System Configuration > Use Common RF Frequency > ON".
- b) Execute "GLONASS > Update RF Frequency".

The value in the "Frequency" display in the header of the instrument is set to 1.58565 GHz. The GLONASS signal is however modulated on the GLONASS frequency L1 = 1.602 GHz.

3. In both instruments, in the "GNSS > Satellite Configuration" dialog, enable:
  - a) "Reference Satellite > N.A."
  - b) select the same "Reference Standard"
  - c) set the same "Reference Power"

## 6 Remote-Control Commands

The following commands are required to perform signal generation with the satellite navigation options 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.

The `SOURCE:BB:GPS|GALileo|GLONass|BEIDou` subsystem contains commands for configuring the GNSS standards.

### Placeholder <Subsystem>

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



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

### Example:

SCPI command: `<subsystem>:STATE`

- Entry Standard = GPS  
`SOURCE:BB:GPS:STATE`
- Entry Standard = Galileo  
`SOURCE:BB:GALileo:STATE`
- Entry Standard = GLONASS  
`SOURCE:BB:GLONass:STATE`
- Entry Standard = BeiDou  
`SOURCE:BB:BEIDou:STATE`
- invalid command  
`<Subsystem>:STAT`

### Placeholder <GNSS>

The placeholder <GNSS> is introduced to simplify the description of group of commands with similar syntax. Depending on the navigation standard to be controlled, replace this placeholder <GNSS> with `GPS`, `GALileo`, `GLONass`, `QZSS` or `BEIDou`.

**Example:**

SCPI command: `<subsystem>:HYBRid:<GNSS>[:STATe]`

- Entry Standard = GPS  
replace the placeholder `<subsystem>` with `SOURce:BB:GPS`
- In a hybrid GNSS configuration, the navigation standard of the entry point (GPS) is always enabled. To enable the Galileo satellites, replace the placeholder `<GNSS>` with `GALileo`  
`SOURce:BB:GPS:HYBRid:GALileo:STATe`
- invalid commands  
`<Subsystem>:HYBRid:GALileo:STATe`  
`SOURce:BB:GPS:HYBRid:<GNSS>:STATe`

**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
EXTernal<ch>	1	external trigger connector
SVID<ch>	1 .. 37 for GPS satellites 1 .. 50 for Galileo satellite 193 ... 195 for QZSS satellites	distinguishes between the SV IDs <b>Note:</b> The SV ID must correspond to a healthy satellite!
TAP<us>	1 .. 10	taps in the multipath configuration
Satellite<st>	1 .. 24	distinguishes between the satellites
PAGE<us>	1 .. 12	navigation page

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

- [Programming Examples](#).....247
- [Primary Settings](#).....247
- [GNSS System Configuration](#).....253
- [User Environment, Antenna Pattern and Body Mask](#).....255
- [Localization Data](#).....260
- [Navigation Data](#).....266
- [Obscuration and Auto Multipath](#).....269
- [Hardware in the Loop \(HIL\)](#).....281
- [Almanac / RINEX Configuration](#).....285
- [Time Conversion Configuration](#).....292
- [SBAS Configuration](#).....298
- [Static Multipath Configuration](#).....308
- [Satellites Configuration and Satellites Signal Settings](#).....313
- [Modulation Control](#).....322
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## 6.1 Programming Examples

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

The programming examples have been tested with a software tool which provides an environment for the development and execution of remote tests. To keep the examples as simple as possible, only the "clean" SCPI syntax elements are reported. Non-executable command lines (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 R&S SMBV 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.

In all of the examples we assume that a remote PC is connected to the instrument, the remote PC and the instrument are switched on and a connection between them is established.

## 6.2 Primary Settings

The following examples use GPS entry standard.

### Example: Save/Recall Files with user settings

This example shows how to query and load settings files, stored with the save/recall function.

```
*****
MMEM:CDIR '/var/user/settings'
SOURcel:BB:GPS:SETTing:CATalog?
// Response: gps_settings,settings
SOURcel:BB:GLONass:SETTing:CATalog?
// Response: glo_settings,settings
SOURcel:BB:GALileo:SETTing:CATalog?
// Response: gal_settings
```

```
// There are five files in the /var/user/settings directory:
// gps_settings.gps, settings.gps, glo_settings.glonass,
// settings.glonass and gal_settings.galileo
SOURCE1:BB:GPS:SETTING:STORE '/var/user/settings/gps_settings_new'
SOURCE1:BB:GPS:SETTING:LOAD '/var/user/settings/gps_settings'
SOURCE1:BB:GPS:SETTING:DELETE '/var/user/settings/settings'
// Deletes the file settings.gps
SOURCE1:BB:GPS:SETTING:CATALOG?
// Response: gps_settings,gps_settings_new
SOURCE1:BB:GLONASS:SETTING:CATALOG?
// Response: glo_settings,settings
```

### Example: Selecting a predefined test scenario

This example shows how to enable an A-GPS test scenario. The A-GNSS test scenarios require a GPS/GLONASS hybrid GNSS configuration.

```
*****
// select and enable the predefined A-GNSS test scenario
// 3GPP FDD Performance Test Scenario 2
// *****
SOURCE1:BB:GPS:PRESET
SOURCE1:BB:GPS:ATSCENARIO W3GPER2
SOURCE1:BB:GPS:STATE ON

<subsystem>:PRESET.....248
<subsystem>:STATE.....249
<subsystem>:RFBAND.....249
<subsystem>:PRFFREQUENCY.....249
<subsystem>:SMODE.....250
[:SOURCE<hw>]:BB:GPS:ATSCENARIO.....250
[:SOURCE<hw>]:BB:GLONASS:ATSCENARIO.....251
<subsystem>:SETTING:CATALOG.....252
[:SOURCE<hw>]:BB:BEIDOU:SETTING:CATALOG?.....252
[:SOURCE<hw>]:BB:GALILEO:SETTING:CATALOG?.....252
[:SOURCE<hw>]:BB:GLONASS:SETTING:CATALOG?.....252
[:SOURCE<hw>]:BB:GPS:SETTING:CATALOG?.....252
<subsystem>:SETTING:STORE.....252
<subsystem>:SETTING:STORE:FAST.....252
<subsystem>:SETTING:LOAD.....253
<subsystem>:SETTING:DELETE.....253
```

---

#### <subsystem>:PRESET

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

Not affected is the state set with the command `SOURCE<hw>:BB:<GNSS>:STATE`

**Example:** `SOURCE1:BB:GPS:PRESET`  
 See also [example "Selecting a predefined test scenario"](#) on page 248.



**Usage:** Event

**Manual operation:** See ["Set to default"](#) on page 44

#### **<subsystem>:STATE <State>**

Enables/disables the GNSS signal simulation.

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

A continuous GNSS signal is generated for up to 24 satellites in real time mode. The number is determined by the command `<subsystem>:SATellite:COUNT` and the maximum value depends on the installed SW options.

**Parameters:**

<State> 0 | 1 | OFF | ON

\*RST: 0

**Example:**

SOURce1:BB:GPS:STATE ON

See also [example "Selecting a predefined test scenario"](#) on page 248.

**Manual operation:** See ["State"](#) on page 43

#### **<subsystem>:RFBand <RfBand>**

Selects the RF band.

**Parameters:**

<RfBand> L1 | L2

Available values depend on selected standard.

\*RST: L1

**Example:**

SOURce1:BB:GPS:RFBand L1

**Manual operation:** See ["RF Band"](#) on page 45

#### **<subsystem>:PRFFrequency**

Sets the "Status Bar > Frequency" display to the resulting frequency.

The RF Frequency is calculated automatically depending on:

- selected `<subsystem>:RFBand`
- entry standard
- enabled navigation standards

**Example:**

```
SOURce1:BB:GPS:RFBand L1
SOURce1:BB:GPS:PRFFrequency
FREquency?
// 1585650000
```

**Usage:** Event

**Manual operation:** See ["Update RF Frequency"](#) on page 45

---

**<subsystem>:SMODE <SMode>**

Selects the simulation mode.

**Parameters:**

<SMode>                    STATic | AUTO | USER  
                               \*RST:        STATic

**Manual operation:** See ["Simulation Mode"](#) on page 46

---

**[:SOURCE<hw>]:BB:GPS:ATSCENARIO <Scenario>**

Selects the file with the predefined A-GPS/A-GNSS test scenario.

**Table 6-1: A-GPS test scenarios**

Test Scenario	SCPI
3GPP TS 51.010: 10.9 Signaling	GSMSIG
3GPP TS 51.010: 10.10 Performance 1/2/3	GSMPEP1   GSMPEP2   GSMPEP3
3GPP TS 34.108: 10.7 Signaling	W3GSIG
3GPP TS 34.108: 10.1.2 Performance 1/2/3	W3GPER1   W3GPER2   W3GPER3
3GPP2 C.S0036: 2.1.1 Stationary	W3G2M
3GPP2 C.S0036: 2.1.2 Moving	W3G2S
3GPP TS 37.571-2: S7 Signaling ST1	LTESIGST1
3GPP TS 37.571-1: S7 Performance 1/2/5 ST1	LTEPER1ST1   LTEPER2ST1   LTEPER5ST1

**Table 6-2: A-GNSS test scenarios**

Test Scenario	SCPI
3GPP TS 37.571-2: S6 Signaling ST4	W3GSIGST4
3GPP TS 37.571-1: S6 Performance 1/2/5 ST4	W3GPER1ST4   W3GPER2ST4   W3GPER5ST4
3GPP TS 37.571-2: S7 Signaling ST4	LTESIGST4
3GPP TS 37.571-1: S7 Performance 1/2/5 ST5	LTEPER1ST5   LTEPER2ST5   LTEPER5ST5

**Parameters:**

<Scenario> USER | GSMSIG | GSMPER1 | GSMPER2 | GSMPER3 | W3GSIG | W3GPER1 | W3GPER2 | W3GPER3 | W3G2S | W3G2M | W3GSIGST4 | W3GPER1ST4 | W3GPER2ST4 | W3GPER5ST4 | LTESIGST1 | LTESIGST4 | LTEPER1ST1 | LTEPER1ST5 | LTEPER2ST1 | LTEPER2ST5 | LTEPER5ST1 | LTEPER5ST5

**User**

No predefined test scenario is selected.

\*RST: USER

**Example:**

See [example "Selecting a predefined test scenario"](#) on page 248.

**Manual operation:**

See ["Test Scenario"](#) on page 46

**[:SOURce<hw>]:BB:GLONass:ATSCenario <Scenario>**

Selects the file with the predefined A-GLONASS/A-GNSS test scenario.

*Table 6-3: A-GLONASS test scenarios*

Test Scenario	SCPI
3GPP TS 37.571-2: S6 Signaling ST1	W3GSIGST1
3GPP TS 37.571-1: S6 Performance 1/2/5	W3GPER1ST1   W3GPER2ST1   W3GPER5ST1
3GPP TS 37.571-2: S7 Signaling ST2	LTESIGST2
3GPP TS 37.571-1: S7 Performance 1/2/5 ST2	LTEPER1ST2   LTEPER2ST2   LTEPER5ST2

*Table 6-4: A-GNSS test scenarios*

Test Scenario	SCPI
3GPP TS 37.571-2: S6 Signaling ST4	W3GSIGST4
3GPP TS 37.571-1: S6 Performance 1/2/5 ST4	W3GPER1ST4   W3GPER2ST4   W3GPER5ST4
3GPP TS 37.571-2: S7 Signaling ST4	LTESIGST4
3GPP TS 37.571-1: S7 Performance 1/2/5 ST5	LTEPER1ST5   LTEPER2ST5   LTEPER5ST5

**Parameters:**

<Scenario> USER | W3GSIGST1 | W3GSIGST4 | W3GPER1ST1 | W3GPER5ST4 | W3GPER5ST1 | W3GPER2ST4 | W3GPER2ST1 | W3GPER1ST4 | LTESIGST2 | LTESIGST4 | LTEPER1ST2 | LTEPER1ST5 | LTEPER2ST2 | LTEPER2ST5 | LTEPER5ST2 | LTEPER5ST5

**User**

No predefined test scenario is selected.

\*RST: USER

**Manual operation:**

See ["Test Scenario"](#) on page 46

---

```
<subsystem>:SETTING:CATalog
[:SOURCE<hw>]:BB:BEIDou:SETTING:CATalog?
[:SOURCE<hw>]:BB:GALileo:SETTING:CATalog?
[:SOURCE<hw>]:BB:GLONass:SETTING:CATalog?
[:SOURCE<hw>]:BB:GPS:SETTING:CATalog?
```

Reads out the files with GNSS settings in the default directory, set with the command `M MEM:CDIRectory`.

Listed are files with the file extension `.gps`, `.galileo`, `.glonass` and `.bdu`.

**Return values:**

<Catalog>                    string

**Example:**                    See [example "Save/Recall Files with user settings"](#) on page 247.

**Usage:**                        Query only

**Manual operation:**    See ["Save/Recall"](#) on page 44

---

```
<subsystem>:SETTING:STORe <Filename>
```

Stores the current settings of the specified GNSS standard into the selected file. The directory is set using command `M MEM:CDIRectory`. Only the file name has to be entered; configurations are stored with the predefined file extensions.

**Setting parameters:**

<Filename>                    string

**Example:**                    See [example "Save/Recall Files with user settings"](#) on page 247.

**Usage:**                        Setting only

**Manual operation:**    See ["Save/Recall"](#) on page 44

---

```
<subsystem>:SETTING:STORe:FAST <Fast>
```

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:**

<Fast>                        0 | 1 | OFF | ON

\*RST:                        1

**Manual operation:**    See ["Save/Recall"](#) on page 44

**<subsystem>:SETTING:LOAD <Filename>**

Loads the selected file with GNSS settings from the directory set with the command `MMEM:CDIRectory`. A path can also be specified, in which case files in the specified directory are read. Loaded are files with the file extension `*.gps`, `*.galileo`, `*.glonass` or `*.bdu`.

**Setting parameters:**

<Filename> string

**Example:** See [example "Save/Recall Files with user settings"](#) on page 247.

**Usage:** Setting only

**Manual operation:** See ["Save/Recall"](#) on page 44

**<subsystem>:SETTING:DELEte <Filename>**

Deletes the selected file with GNSS settings.

**Setting parameters:**

<Filename> string

**Example:** See [example "Save/Recall Files with user settings"](#) on page 247.

**Usage:** Setting only

**Manual operation:** See ["Save/Recall"](#) on page 44

## 6.3 GNSS System Configuration

<code>&lt;subsystem&gt;:HYBRid:&lt;GNSS&gt;[:STATe]</code> .....	254
<code>&lt;subsystem&gt;:HYBRid:SBAS[:STATe]?</code> .....	254
<code>&lt;subsystem&gt;:HYBRid:SBAS:EGNOS[:STATe]</code> .....	254
<code>&lt;subsystem&gt;:HYBRid:SBAS:MSAS[:STATe]</code> .....	254
<code>&lt;subsystem&gt;:HYBRid:SBAS:WAAS[:STATe]</code> .....	254
<code>&lt;subsystem&gt;:HYBRid:QZSS[:STATe]</code> .....	254
<code>&lt;subsystem&gt;:HYBRid:BEIDou[:STATe]</code> .....	254
<code>&lt;subsystem&gt;:HYBRid:GALileo[:STATe]</code> .....	254
<code>&lt;subsystem&gt;:HYBRid:GLONass[:STATe]</code> .....	254
<code>&lt;subsystem&gt;:HYBRid:GPS[:STATe]</code> .....	254
<code>&lt;subsystem&gt;:UCRF</code> .....	254
<code>&lt;subsystem&gt;:UMGPs</code> .....	254
<code>&lt;subsystem&gt;:SATellite:ASPOofing</code> .....	254
<code>&lt;subsystem&gt;:SSVBias</code> .....	255
<code>&lt;subsystem&gt;:SIDelay</code> .....	255
<code>&lt;subsystem&gt;:SIOD</code> .....	255

---

```

<subsystem>:HYBRid:<GNSS>[:STATe]
<subsystem>:HYBRid:SBAS[:STATe]?
<subsystem>:HYBRid:SBAS:EGNOS[:STATe] <State>
<subsystem>:HYBRid:SBAS:MSAS[:STATe] <State>
<subsystem>:HYBRid:SBAS:WAAS[:STATe] <State>
<subsystem>:HYBRid:QZSS[:STATe] <State>
<subsystem>:HYBRid:BEIDou[:STATe] <State>
<subsystem>:HYBRid:GALileo[:STATe] <State>
<subsystem>:HYBRid:GLONass[:STATe] <State>
<subsystem>:HYBRid:GPS[:STATe] <State>

```

Defines the navigation standards that will be part of the hybrid configuration. Only the satellites of an enabled standard are configurable (see [chapter 6.13, "Satellites Configuration and Satellites Signal Settings"](#), on page 313).

**Parameters:**

```

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

```

**Options:** R&S SMBV-K44/K66/K94/K107

---

```

<subsystem>:UCRF <UseCentral_RF>

```

Use this command if several R&S SMBV instruments are connected to generate GNSS signal in the same GNSS band.

**Parameters:**

```

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

```

**Manual operation:** See ["Use Common RF Frequency"](#) on page 55

---

```

<subsystem>:UMGPs <State>

```

Enables the configuration of GPS signals modulates with P code, see [<subsystem>:SATellite<st>:SIGNal](#).

**Parameters:**

```

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

```

**Options:** R&S SMBV-K93

**Manual operation:** See ["Use Position Accuracy \(P-Code\) GPS"](#) on page 55

---

```

<subsystem>:SATellite:ASpoofing <State>

```

Activates anti spoofing flag in the GPS navigation message.

**Parameters:**

```

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

```

**Example:** SOURce1:BB:GPS:SATellite:ASpoofing ON

**Manual operation:** See ["GPS Anti-Spoofing"](#) on page 56

**<subsystem>:SSVBias <SyncSvErrors>**

Synchronizes the SV bisases (errors) to the values retrieved form the SBAS fast correction data.

**Parameters:**

<SyncSvErrors> 0 | 1 | OFF | ON  
\*RST: 1

**Example:** see [example "Configuring the SBAS settings"](#) on page 299

**Manual operation:** See ["Sync SV Biases from SBAS Data"](#) on page 56

**<subsystem>:SIDelay <SynclonoErrors>**

Synchronizes the ionospheric delays to the values retrieved form the SBAS ionospheric correction data.

**Parameters:**

<SynclonoErrors> 0 | 1 | OFF | ON  
\*RST: 1

**Example:** see [example "Configuring the SBAS settings"](#) on page 299

**Manual operation:** See ["Sync Ionospheric Delay form SBAS Data"](#) on page 56

**<subsystem>:SIOD <Translod>**

Synchronizes the IODE and URA parameters of the GPS navigation message to the values retrieved form the SBAS fast and long term correction files.

**Parameters:**

<Translod> 0 | 1 | OFF | ON  
\*RST: 1

**Example:** see [example "Configuring the SBAS settings"](#) on page 299

**Manual operation:** See ["Sync IOD/URA from SBAS Data"](#) on page 56

## 6.4 User Environment, Antenna Pattern and Body Mask

**Example: Defining the vehicle type and selectg a \*.xvd file**

The following example uses the GPS entry standard.

```
//Query the available vehicle description files and load one of them
SOURCE1:BB:GPS:SMODE AUTO
SOURCE1:BB:GPS:VEHICLE:TYPE PEDESTRIAN
SOURCE1:BB:GPS:VEHICLE:CATALOG:PREDEFINED?
// Response: Aircraft,Ship,Pedestrian,...
MMEM:CDIR "/var/user/myXVDFiles"
SOURCE1:BB:GPS:VEHICLE:CATALOG:USER?
// Response: xvd_pedestrian
SOURCE1:BB:GPS:VEHICLE:FILE "/var/user/myXVDFiles/my_pedestrian"
```

### Example: Selecting an antenna file

The following example uses the GPS entry standard. A user defined antenna pattern file exist. The file contents are described in [chapter A.1.3, "Antenna Pattern / Body Mask Files"](#), on page 423.

```
//Query the available antenna pattern files and loads one of them
SOURCE1:BB:GPS:SMODE AUTO
SOURCE1:BB:GPS:APATTERN:CATALOG:PREDEFINED?
// Response: Bus,Car_Small,Isotropic,...
MMEM:CDIR "/var/user/antenna_patterns"
SOURCE1:BB:GPS:APATTERN:CATALOG:USER?
// Response: ant_pat_3ant
SOURCE1:BB:GPS:APATTERN:FILE "/var/user/antenna_patterns/ant_pat_3ant"
SOURCE1:BB:GPS:APATTERN:LIST?
// Response: 1,2,3
// three antennas with antenna IDs 1, 2 and 3 are defined
// select the antenna with antenna ID=2
SOURCE1:BB:GPS:APATTERN:ID 2
// switch the antenna in real time after elapsing the specified time
SOURCE1:BB:GPS:RT:UPDATE:ANTENNA 12500,1
```

<subsystem>:VEHICLE:CATALOG:PREDEFINED?.....	256
<subsystem>:VEHICLE:CATALOG:USER?.....	257
<subsystem>:VEHICLE:FILE.....	257
<subsystem>:VEHICLE:TYPE.....	257
<subsystem>:APATTERN:CATALOG:PREDEFINED?.....	257
<subsystem>:APATTERN:CATALOG:USER?.....	258
<subsystem>:APATTERN:FILE.....	258
<subsystem>:APATTERN:ANTENNA:LIST?.....	258
<subsystem>:APATTERN:ANTENNA:ID.....	258
<subsystem>:RT:UPDATE:ANTENNA.....	259

---

### <subsystem>:VEHICLE:CATALOG:PREDEFINED?

Queries the names of the predefined vehicle description files in the system directory. Only files with the file extension \*.xvd are listed.

**Example:** see [example "Defining the vehicle type and selectg a \\*.xvd file"](#) on page 255

**Usage:** Query only



**Manual operation:** See ["Vehicle Description File"](#) on page 49

#### <subsystem>:VEHicle:CATalog:USER?

Queries the names of the user-defined vehicle description files in the default directory. The default directory is set using command `M MEM:CDIRectory`. Only files with the file extension `*.xvd` are listed.

**Example:** see [example "Defining the vehicle type and selectg a \\*.xvd file"](#) on page 255

**Usage:** Query only

**Manual operation:** See ["Vehicle Description File"](#) on page 49

#### <subsystem>:VEHicle:FILE <Filename>

Loads the selected vehicle description file. Use the command `M MEM:CDIRectory` to define the directory. Only files with the file extension `*.xvd` are loaded.

**Parameters:**

<Filename> string

**Example:** see [example "Defining the vehicle type and selectg a \\*.xvd file"](#) on page 255

**Manual operation:** See ["Vehicle Description File"](#) on page 49

#### <subsystem>:VEHicle:TYPE <Type>

Sets the vehicle type.

**Parameters:**

<Type> HIL | SPACecraft | AIRCRAFT | SHIP | LVEHicle | PEDestrian  
 HIL, Spacecraft, Aircraft, Ship, Land Vehicle, Pedestrian  
 \*RST: LVEHicle

**Example:** see [example "Defining the vehicle type and selectg a \\*.xvd file"](#) on page 255

**Manual operation:** See ["Vehicle Type"](#) on page 49

#### <subsystem>:APATtern:CATalog:PREDefined?

Queries the names of the predefined antenna pattern files in the system directory. Only files with the file extension `*.ant_pat` are listed.

**Example:** see [example "Selecting an antenna file"](#) on page 256

**Usage:** Query only

**Options:** R&S SMBV-K102

**Manual operation:** See ["File"](#) on page 82

**<subsystem>:APATtern:CATalog:USER?**

Queries the names of the user-defined antenna pattern files in the default directory. The default directory is set using command `MMEM:CDIRectory`. Only files with the file extension `*.ant_pat` are listed.

**Example:** see [example "Selecting an antenna file"](#) on page 256

**Usage:** Query only

**Options:** R&S SMBV-K102

**Manual operation:** See ["File"](#) on page 82

**<subsystem>:APATtern:FILE <Filename>**

Loads the selected antenna pattern file. Only files with the file extension `*.ant_pat` are loaded, see [chapter A.1.3, "Antenna Pattern / Body Mask Files"](#), on page 423.

**Parameters:**

<Filename> string

**Example:** see [example "Selecting an antenna file"](#) on page 256

**Options:** R&S SMBV-K102

**Manual operation:** See ["File"](#) on page 82

**<subsystem>:APATtern:ANTenna:LIST?**

Queries the antenna identifiers `<antenna id>` specified in the selected `*.ant_pat` file.

**Return values:**

<List> <antenna id#1>,<antenna id#2>,<antenna id#2>,<antenna id#4>

Returns a comma separated list of the used antenna identifiers (ID).

A maximum of four antennas can be specified in one file, i.e. the list contains maximum of four `<antenna id>`.

**Example:** see [example "Selecting an antenna file"](#) on page 256

**Usage:** Query only

**Options:** R&S SMBV-K102

**Manual operation:** See ["Antenna ID, Active Antenna"](#) on page 82

**<subsystem>:APATtern:ANTenna:ID <Antennald>**

Selects one particular antenna by its antenna ID. To query the list of all antenna IDs, use the `<subsystem>:APATtern:ANTenna:LIST?`.

**Parameters:**

<AntennaId> integer  
 Range: 0 to INT\_MAX  
 \*RST: 0

**Example:** see [example "Selecting an antenna file"](#) on page 256

**Options:** R&S SMBV-K102

**Manual operation:** See ["Antenna ID, Active Antenna"](#) on page 82

**<subsystem>:RT:UPDate:ANTenna**

Triggers the software to schedule a real time switch of the used antenna at a specific future time, as specified in the antenna pattern (\*.ant\_pat) file.

For description of the file format, refer to [chapter A.1.3, "Antenna Pattern / Body Mask Files"](#), on page 423.

The switching is scheduled only if the following rules are respected:

- the selected <AntennaId> is specified in the selected antenna pattern file
- the SCPI command is sent at least 5 seconds ahead of the execution time specified with the parameter <ElapsedTime>
- the execution of last successfully scheduled SCPI command <subsystem>:RT:UPDate:ANTenna is completed
- the selected <AntennaId> is different than the currently active antenna:
  - different from <AntennaId> specified in the last executed SCPI command
  - different from the initially selected <AntennaId>, if this is the first command

**Note:** The listed prerequisites for correct real time antenna switching are mandatory. If the SCPI command fails to abide by those rules, it will be ignored.

**Parameters:**

<ElapsedTime> float  
 Elapsed time from the simulation start time at which a switch to the defined <AntennaId> is performed.  
 Range: 0 to 99999999  
 Increment: 0.01  
 Default unit: s

<AntennaId> integer  
 Use the command <subsystem>:APATtern:ANTenna:LIST? to query the antenna IDs defined in the currently selected antenna pattern file.  
 Range: 1 to 100

**Example:** see [example "Selecting an antenna file"](#) on page 256

**Usage:** Event

**Options:** R&S SMBV-K102

**Manual operation:** See "File" on page 82

## 6.5 Localization Data

### Example: Selecting a waypoint file

The following example uses GPS entry standard.

```
SOURcel:BB:GPS:LOCation:CATalog?
// Response: User Defined,Waypoints,New York,San Francisco,Beijing,Seoul,...
SOURcel:BB:GPS:LOCation:SElect "Waypoints"
MMEM:CAT?'/var/user/Lists/Gnss/Waypoints'
// Response: 583768,52428800000,".,DIR,0",".,DIR,0","3gpp2.txt,ASC,233703",
// "Melbourne.txt,ASC,238949","Melbourne_Movement.txt,ASC,2104
SOURcel:BB:GPS:LOCation:WAYPoints:FILE '/var/user/Lists/Gnss/Waypoints/Melbourne.txt'
SOURcel:BB:GPS:LOCation:WAYPoints:ROMode CYCLic
SOURcel:BB:GPS:LOCation:COORdinateS:RFRame WGS84
SOURcel:BB:GPS:LOCation:COORdinateS:DECimal?
// Response: 144.966658,-37.816663,100
// Coordinates of the first simulation position defined in the selected file
SOURcel:BB:GPS:LOCation:COORdinateS:DMS?
// Response: 44,57,59.970,EAST,37,48,59.987,SOUT,100
SOURcel:BB:GPS:LOCation:COORdinateS:RFRame PZ90
SOURcel:BB:GPS:LOCation:COORdinateS:DECimal:PZ?
// Response: 139.776902,35.666667,20
SOURcel:BB:GPS:LOCation:COORdinateS:DMS:PZ?
// Response: 139,46,36.847,EAST,35,40,0.002,NORT,20
```

<subsystem>:LOCation:CATalog?	261
<subsystem>:LOCation[:SElect]	261
<subsystem>:LOCation:WAYPoints:FILE	261
<subsystem>:LOCation:WAYPoints:ROMode	262
<subsystem>:LOCation:COORdinateS:RFRame	262
<subsystem>:LOCation:COORdinateS:DECimal:WGS PZ	262
<subsystem>:LOCation:COORdinateS:DECimal:PZ	262
<subsystem>:LOCation:COORdinateS:DECimal[:WGS]	262
<subsystem>:LOCation:COORdinateS:DMS:WGS PZ	263
<subsystem>:LOCation:COORdinateS:DMS:PZ	263
<subsystem>:LOCation:COORdinateS:DMS[:WGS]	263
<subsystem>:LOCation:YAW	264
<subsystem>:LOCation:PITCh	264
<subsystem>:LOCation:ROLL	264
<subsystem>:LOCation:YAW:FMOTion	264
<subsystem>:LOCation:PITCh:FMOTion	264
<subsystem>:LOCation:ROLL:FSPinning	264
<subsystem>:LOCation:SPIN:RATE	265
<subsystem>:LOCation:SPIN:SRoll	265
<subsystem>:LOCation:SMOVement	265

---

**<subsystem>:LOCation:CATalog?**

Queries the names of the predefined geographic locations.

**Example:** See [example "Selecting a waypoint file"](#) on page 260.

**Usage:** Query only

**Manual operation:** See ["Geographic Location/Attitude"](#) on page 57

---

**<subsystem>:LOCation[:SElect] <Location>**

Selects the geographic location of the GNSS receiver.

**Parameters:**

<Location> "User Defined" | "New York" | "San Francisco" | "Beijing" | "Seoul" | "Singapore" | "Taipei" | "Tokyo" | "Sydney" | "London" | "Moscow" | "Munich" | "Paris" | "Waypoints"

**User Defined**

Enables the definition of the "Latitude", "Longitude" and "Altitude" of the GNSS receiver with fixed position in the ECEF WGS84 coordinate system.

**Waypoints**

(requires option GNSS Enhancements R&S SMBV-K92)  
Enables defining a moving scenario, i.e. the simulation of a moving receiver.

**"New York" | "San Francisco" | "Beijing" | "Seoul" | "Singapore" | "Taipei" | "Tokyo" | "Sydney" | "London" | "Moscow" | "Munich" | "Paris"**

Selects one of the predefined fixed geographic locations. The parameters "Latitude", "Longitude" and "Altitude" are set according to the selected position.

**Example:** See [example "Selecting a waypoint file"](#) on page 260.

**Manual operation:** See ["Geographic Location/Attitude"](#) on page 57

---

**<subsystem>:LOCation:WAYPoints:FILE <WayPoints>**

Selects a predefined waypoint file. A waypoint file must have the extension `.txt`, `.nmea` or `.xtd`.

This setting is only available if `<subsystem>:LOCation[:SElect]` is set to `Waypoints`.

**Parameters:**

<WayPoints> string

**Example:** See [example "Selecting a waypoint file"](#) on page 260.

**Options:** R&S SMBV-K92

**Manual operation:** See ["Waypoint/Attitude File ..."](#) on page 59

---

---

**<subsystem>:LOCation:WAYPoints:ROMode <RoMode>**

Defines the way the waypoint file is to be read.

This setting is only available if `<subsystem>:LOCation[:SElect]` is set to `Waypoints`.

**Parameters:**

<RoMode>

CYCLic | RTRip | OWAY

**CYCLic**

The waypoint file is read out cyclic.

Using this read out mode is only recommended for waypoint files that describe a circle moving scenario or moving scenario in which the start and the end point are close to each other.

**OWAY (One Way)**

The file is read out only once.

When the end of the file is reached, the last described position is assumed to be a static one.

**RTRip (Round Trip)**

When the end of the file is reached, the file is read out backwards.

\*RST: OWAY

**Example:** See [example "Selecting a waypoint file"](#) on page 260.

**Options:** R&S SMBV-K92

**Manual operation:** See ["Read Out Mode"](#) on page 60

---

**<subsystem>:LOCation:COORDinates:RFRame <ReferenceFrame>**

Sets the reference frame.

**Parameters:**

<ReferenceFrame> PZ90 | WGS84

\*RST: WSG84

**Example:** See [example "Selecting a waypoint file"](#) on page 260.

**Manual operation:** See ["Reference Frame"](#) on page 60

---

**<subsystem>:LOCation:COORDinates:DECimal:WGS|PZ**

**<subsystem>:LOCation:COORDinates:DECimal:PZ** <Longitude>, <Latitude>, <Altitude>

**<subsystem>:LOCation:COORDinates:DECimal[:WGS]** <Longitude>, <Latitude>, <Altitude>

Defines the coordinates of the geographic location of the GNSS receiver in decimal format.

**Parameters:**

<Longitude>	float
	Range: -180 to 180
	Increment: 1E-7
	*RST: 0
<Latitude>	float
	Range: -90 to 90
	Increment: 1E-7
	*RST: 0
<Altitude>	float
	Altitude in meters above sea level.
	Range: -10E3 to 2500E3
	Increment: 0.01
	*RST: 0

**Example:** See [example "Selecting a waypoint file"](#) on page 260.

---

**<subsystem>:LOCation:COORdinateS:DMS:WGS|PZ**

**<subsystem>:LOCation:COORdinateS:DMS:PZ** <LongitudeDeg>, <LongitudeMin>, <LongitudeSec>, <LongitudeDir>, <LatitudeDeg>, <LatitudeMin>, <LatitudeSec>, <LatitudeDir>, <Altitude>

**<subsystem>:LOCation:COORdinateS:DMS[:WGS]** <LongitudeDeg>, <LongitudeMin>, <LongitudeSec>, <LongitudeDir>, <LatitudeDeg>, <LatitudeMin>, <LatitudeSec>, <LatitudeDir>, <Altitude>

Defines the coordinates of the geographic location of the GNSS receiver in degrees, minutes and seconds.

**Parameters:**

<LongitudeDeg>	integer
	Defines the longitude degrees.
	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: 1E-4
	*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: 1E-4 *RST: 0
<LatitudeDir>	NORTH   SOUTH Defines the latitude direction. *RST: NORT
<Altitude>	float Defines the altitude in meters above sea level. Range: -10E3 to 2500E3 Increment: 0.01 *RST: 0

**Example:** See [example "Selecting a waypoint file"](#) on page 260.

---

```

<subsystem>:LOCation:YAW <Yaw>
<subsystem>:LOCation:PITCh <Pitch>
<subsystem>:LOCation:ROLL <Roll>

```

Sets the attitude parameters relative to the local horizon.

**Parameters:**

```

<Roll> float
Range: -180 to 180
Increment: 0.001
*RST: 0

```

**Options:** R&S SMBV-K103

**Manual operation:** See ["Yaw/Heading, Pitch/Elevation, Roll/Bank"](#) on page 61

---

```

<subsystem>:LOCation:YAW:FMOTion <State>
<subsystem>:LOCation:PITCh:FMOTion <State>
<subsystem>:LOCation:ROLL:FSPinning <FromSpinning>

```

Force the attitude parameters to motion direction. Usefull in automotive applications.



**Parameters:**

<FromSpinning> 0 | 1 | OFF | ON  
 \*RST: OFF

**Options:** R&S SMBV-K103 for <subsystem>:LOCation:ROLL:FSPinning

**Manual operation:** See ["From Motion/From Spinning"](#) on page 61

**<subsystem>:LOCation:SPIN:RATE <Rate>**

Simulates a constant rate of change of the roll.

**Parameters:**

<Rate> float  
 Range: -500 to 500  
 Increment: 0.01  
 \*RST: 0

**Options:** R&S SMBV-K103

**Manual operation:** See ["Spinning Rate"](#) on page 62

**<subsystem>:LOCation:SPIN:SRoll <StartRollAngle>**

Defines the start angles of rotation of the vehicle.

**Parameters:**

<StartRollAngle> float  
 Range: -180 to 180  
 Increment: 0.001  
 \*RST: 0

**Example:**

```
SOURce1:BB:GPS:LOCation:ROLL:FSPinning ON
SOURce1:BB:GPS:LOCation:SPIN:RATE 0.25
SOURce1:BB:GPS:LOCation:SPIN:SRoll 90
```

**Options:** R&S SMBV-K103

**Manual operation:** See ["Vehicle Body Start Roll"](#) on page 62

**<subsystem>:LOCation:SMOVement <SmoothMovement>**

Enables an internal algorithm to smooth the trajectory, see also [chapter 3.5.7, "Motion Smoothing Using Vehicle Description File"](#), on page 29.

**Parameters:**

<SmoothMovement> 0 | 1 | OFF | ON  
 \*RST: OFF

**Example:**

```
SOURce1:BB:GPS:LOCation:SMOVement
```

**Options:** R&S SMBV-K92

**Manual operation:** See ["Smooth Movement"](#) on page 59

## 6.6 Navigation Data

### Example: Selecting Real Navigation Data

The following example uses GPS entry standard.

```
SOURcel:BB:GPS:NAVigation:DATA RND
SOURcel:BB:GPS:NAVigation:ALManac:GPS:FILE "GPS_SEM585.txt"
SOURcel:BB:GPS:NAVigation:SIMulation:TBASis UTC
SOURcel:BB:GPS:NAVigation:SIMulation:DATE?
//Response: 2008,7,13
SOURcel:BB:GPS:NAVigation:SIMulation:TIME?
//Response: 17,4,0
SOURcel:BB:GPS:NAVigation:SIMulation:TBASis GPS
SOURcel:BB:GPS:NAVigation:SIMulation:WNUMber?
//Response: 1488
SOURcel:BB:GPS:NAVigation:SIMulation:TOWeek?
//Response: 61455
```

<subsystem>:NAVigation:DATA.....	266
<subsystem>:NAVigation:DATA:DSElect.....	267
<subsystem>:NAVigation:DATA:PATtern.....	267
<subsystem>:NAVigation:SIMulation:TBASis.....	267
<subsystem>:NAVigation:SIMulation:DATE.....	267
<subsystem>:NAVigation:SIMulation:TIME.....	268
<subsystem>:NAVigation:SIMulation:WNUMber.....	268
<subsystem>:NAVigation:SIMulation:TOWeek.....	269

---

### <subsystem>:NAVigation:DATA <Data>

Determines the data source for the navigation information.

#### Parameters:

<Data> ZERO | ONE | PATtern | PN9 | PN11 | PN15 | PN16 | PN20 |  
PN21 | PN23 | DLISt | RNData

#### RNData

Real navigation data provided by an almanac file.

Use the command <subsystem>:NAVigation:ALManac:  
<GNSS>:FILE to select the almanac file.

#### ZERO | ONE | PATtern | PNxx | DLISt

Standard data sources (a sequence of 0 or 1, a pseudo-random sequence with different length, a pattern or a data list)

\*RST: RNData

**Example:** See [example "Selecting Real Navigation Data"](#) on page 266.

**Manual operation:** See ["Data Source"](#) on page 50

**<subsystem>:NAVigation:DATA:DSElect <DSelect>**

Selects a data list as data source.

Data lists are files with file extensions `*.dm_iqd` that are stored in a directory of the user's choice.

To set the default directory, use the command `MMEMoRY:CDIR`. To access the files in this directory, you only have to give the file name, without the path and the file extension.

**Parameters:**

`<DSelect>` string

**Example:**

```
SOURce1:BB:GPS:NAVigation:DATA DLIS
SOURce1:BB:GPS:NAVigation:DATA:DLIST
"/var/user/temp/GNSS_list1"
```

selects file "GNSS\_list1" as the data source.

This file must be in the directory `/var/user/temp/` and have the file extension `*.dm_iqd`.

**Manual operation:** See ["Data Source"](#) on page 50

**<subsystem>:NAVigation:DATA:PATtern <Pattern>**

Determines the bit pattern for `<subsystem>:NAVigation:DATA PATtern`.

**Parameters:**

`<Pattern>` 64 bit pattern

**Example:**

```
SOURce1:BB:GPS:NAVigation:DATA PATtern
SOURce1:BB:GPS:NAVigation:DATA:PATtern #H3F,8
```

**Manual operation:** See ["Data Source"](#) on page 50

**<subsystem>:NAVigation:SIMulation:TBASis <SystemTime>**

Determines the time basis used to enter the simulation start time.

**Parameters:**

`<SystemTime>` UTC | GPS | GST | GLO | BDT

\*RST: UTC

**Example:** See [example "Selecting Real Navigation Data"](#) on page 266.

**Manual operation:** See ["Simulation Start Time"](#) on page 52

**<subsystem>:NAVigation:SIMulation:DATE <Year>, <Month>, <Day>**

Defines the date for the simulation in `DD.MM.YYYY` format of the Gregorian calendar.

This setting is only available for `<subsystem>:NAVigation:DATA` set to `RNData` and `<subsystem>:NAVigation:SIMulation:TBASis` set to `UTC`.

**Parameters:**

<Year>	integer	
	Range:	1980 to 9999
<Month>	integer	
	Range:	1 to 12
<Day>	integer	
	Range:	1 to 31

**Example:** See [example "Selecting Real Navigation Data"](#) on page 266.

**Manual operation:** See ["Simulation Start Time"](#) on page 52

**<subsystem>:NAVigation:SIMulation:TIME <Hour>, <Minute>, <Second>**

Defines the exact simulation start time in UTC time format.

This setting is only available for `<subsystem>:NAVigation:DATA` set to `RNData` and `<subsystem>:NAVigation:SIMulation:TBASis` set to `UTC`.

**Parameters:**

<Hour>	integer	
	Range:	0 to 23
<Minute>	integer	
	Range:	0 to 59
<Second>	float	
	Range:	0 to 59.999
	Increment:	0.001

**Example:** See [example "Selecting Real Navigation Data"](#) on page 266.

**Manual operation:** See ["Simulation Start Time"](#) on page 52

**<subsystem>:NAVigation:SIMulation:WNUMber <Week>**

Enters the week number (WN) the navigation signal is generated for.

This setting is only available for `<subsystem>:NAVigation:SIMulation:TBASis` set to `GPS` or `GST` and `<subsystem>:NAVigation:DATA` set to `RNData`.

**Parameters:**

<Week>	integer	
		The weeks are numbered starting from a reference point of time (WN_REF=0), that depends on the navigation standard.
	Range:	0 to 9999*53
	*RST:	0

**Example:** See [example "Selecting Real Navigation Data"](#) on page 266.

**Manual operation:** See ["Simulation Start Time"](#) on page 52

**<subsystem>:NAVigation:SIMulation:TOWeek <TOW>**

Defines the simulation start time within the defined week (see <subsystem>:NAVigation:SIMulation:WNUMber).

This setting is only available for <subsystem>:NAVigation:SIMulation:TBASis set to GPS or GST.

**Parameters:**

<TOW> float  
 number of seconds since the beginning of the week  
 Range: 0 to 604799.999  
 Increment: 0.001  
 \*RST: 0

**Example:** See [example "Selecting Real Navigation Data"](#) on page 266.

**Manual operation:** See ["Simulation Start Time"](#) on page 52

## 6.7 Obscuration and Auto Multipath

**Example: Defining a full obscuration environment**

The following example uses GPS entry standard.

```
// Selecting and enabling a full obscuration user defined environment
SOURCE1:BB:GPS:OBSCuration:ENVIRONMENT FULL
SOURCE1:BB:GPS:OBSCuration:TYPE USER
SOURCE1:BB:GPS:OBSCuration:OBSCuration

// Defining a full obscuration area as a sequence of obscured zones
SOURCE1:BB:GPS:OBSCuration:FULL:SCALE DISTANCE
SOURCE1:BB:GPS:OBSCuration:FULL:AREA:COUNT 2
SOURCE1:BB:GPS:OBSCuration:FULL:AREA1:REFERENCE 0.5
SOURCE1:BB:GPS:OBSCuration:FULL:AREA1:LENGTH 0.1
SOURCE1:BB:GPS:OBSCuration:FULL:AREA2:REFERENCE 2.5
SOURCE1:BB:GPS:OBSCuration:FULL:AREA2:LENGTH 1
SOURCE1:BB:GPS:OBSCuration:FULL:AREA:APPEND
SOURCE1:BB:GPS:OBSCuration:FULL:AREA:COUNT?
// Response: 3
SOURCE1:BB:GPS:OBSCuration:FULL:AREA3:DELETE
SOURCE1:BB:GPS:OBSCuration:FULL:AREA:COUNT?
// Response: 2
SOURCE1:BB:GPS:OBSCuration:FULL:AREA1:INSERT
SOURCE1:BB:GPS:OBSCuration:FULL:AREA2:REFERENCE 1.5
SOURCE1:BB:GPS:OBSCuration:FULL:AREA2:LENGTH 0.5
SOURCE1:BB:GPS:OBSCuration:FULL:AREA:COUNT?
Response: 3
```

```
// Defining a full obscuration area as a zone pattern
SOURCEl:BB:GPS:OBSCuration:FULL:SCALE TIME
SOURCEl:BB:GPS:OBSCuration:FULL:RWINDow 1000
SOURCEl:BB:GPS:OBSCuration:FULL:RWINDow:STATE ON
// the defined objects are repeated eacht 1000 s
```

### Example: Selectng a vertical obscuration environment

The following example uses GPS entry standard.

```
SOURCEl:BB:GPS:SMODE AUTO
// Selecting and enabling a vertical obscuration environment
SOURCEl:BB:GPS:OBSCuration:ENVIRONMENT VOBS
SOURCEl:BB:GPS:OBSCuration:TYPE URB1
SOURCEl:BB:GPS:OBSCuration:OMPath
// Query the available obstacles files and loads one of them
SOURCEl:BB:GPS:OBSCuration:VOBS:CATalog:PREDEFINED?
// Response: Urban_Canyon_1
MME:CDIR "/var/user/my_vobs"
SOURCEl:BB:GPS:OBSCuration:VOBS:CATalog:USER?
// Response: canyon_2
SOURCEl:BB:GPS:OBSCuration:VOBS:FILE "/var/user/my_vobs/canyon_2"
// defining the receiver position
SOURCEl:BB:GPS:OBSCuration:VOBS:ROFFset:X 15
SOURCEl:BB:GPS:OBSCuration:VOBS:ROFFset:Y 2
SOURCEl:BB:GPS:OBSCuration:VOBS:ROFFset:HEIGHT 0
```

### Example: Defining a user defined ground and sea reflection

The following example uses GPS entry standard.

```
SOURCEl:BB:GPS:SMODE AUTO
SOURCEl:BB:GPS:VEHICLE:TYPE AIRCRAFT
// Selecting and enabling a ground and sea reflection environment
SOURCEl:BB:GPS:OBSCuration:ENVIRONMENT GSR
SOURCEl:BB:GPS:OBSCuration:TYPE USER
SOURCEl:BB:GPS:OBSCuration:OMPath
// Defining the material property parameters
SOURCEl:BB:GPS:OBSCuration:GSP:SType USER
SOURCEl:BB:GPS:OBSCuration:GSP:MPROperty PERM
SOURCEl:BB:GPS:OBSCuration:GSP:PERmittivity 10
SOURCEl:BB:GPS:OBSCuration:GSP:CONductivity 1
// Defining the obstacles and the distance to them and to ground
SOURCEl:BB:GPS:OBSCuration:GSP:GALTitude 0
SOURCEl:BB:GPS:OBSCuration:GSP:O1Height 500
SOURCEl:BB:GPS:OBSCuration:GSP:O2Height 1000
SOURCEl:BB:GPS:OBSCuration:GSP:O1Distance 1000
SOURCEl:BB:GPS:OBSCuration:GSP:O2Distance 1000
```

```
<subsystem>:OBSCuration:TYPE.....271
<subsystem>:OBSCuration:ENVIRONMENT.....272
<subsystem>:OBSCuration:PMODEL.....272
```

<subsystem>:OBSCuration:VOBS:ROFFset:X.....	273
<subsystem>:OBSCuration:VOBS:ROFFset:Y.....	273
<subsystem>:OBSCuration:VOBS:ROFFset:HEIGht.....	273
<subsystem>:OBSCuration:VOBS:ROFFset:MOrientatIon.....	273
<subsystem>:OBSCuration:LMM:CATalog:PREDefined?.....	274
<subsystem>:OBSCuration:VOBS:CATalog:PREDefined?.....	274
<subsystem>:OBSCuration:RPL:CATalog:PREDefined?.....	274
<subsystem>:OBSCuration:LMM:CATalog:USER?.....	274
<subsystem>:OBSCuration:VOBS:CATalog:USER?.....	274
<subsystem>:OBSCuration:RPL:CATalog:USER?.....	274
<subsystem>:OBSCuration:LMM:FILE.....	274
<subsystem>:OBSCuration:VOBS:FILE.....	274
<subsystem>:OBSCuration:RPL:FILE.....	274
<subsystem>:OBSCuration:RPL:ROFFset:HEIGht.....	275
<subsystem>:OBSCuration:RPL:RWINdow.....	275
<subsystem>:OBSCuration:RPL:RWINdow:STATe.....	275
<subsystem>:OBSCuration:RPL:ILENght.....	276
<subsystem>:OBSCuration:FULL:SCALe.....	276
<subsystem>:OBSCuration:FULL:RWINdow.....	276
<subsystem>:OBSCuration:FULL:RWINdow:STATe.....	276
<subsystem>:OBSCuration:FULL:AREA:COUNT?.....	277
<subsystem>:OBSCuration:FULL:AREA:APPend.....	277
<subsystem>:OBSCuration:FULL:AREA<ch>:INSert.....	277
<subsystem>:OBSCuration:FULL:AREA<ch>:DELete.....	277
<subsystem>:OBSCuration:FULL:AREA<ch>:REFerence.....	277
<subsystem>:OBSCuration:FULL:AREA<ch>:LENGth.....	278
<subsystem>:OBSCuration:GSR:MPROperty.....	278
<subsystem>:OBSCuration:GSR:STYPe.....	278
<subsystem>:OBSCuration:GSR:PERMittivity.....	279
<subsystem>:OBSCuration:GSR:CONDUCTivity.....	279
<subsystem>:OBSCuration:GSR:PLOSS.....	279
<subsystem>:OBSCuration:GSR:O1Distance.....	280
<subsystem>:OBSCuration:GSR:O2Distance.....	280
<subsystem>:OBSCuration:GSR:O1Height.....	280
<subsystem>:OBSCuration:GSR:O2Height.....	280
<subsystem>:OBSCuration:GSR:GALTitude.....	280
<subsystem>:OBSCuration:GSR:OOrientatIon.....	281

---

**<subsystem>:OBSCuration:TYPE <Type>**

Selects a predefined obscuration model or enables the configuration of the near environment and physical model.

**Parameters:**

<Type> USER | CITY | SUB1 | URB1 | LTUNnel | MTUNnel | BR1 |  
BR2 | P1M | P10M | P1H | HIGHway | CUTTING

USER = User defined  
CITY = City block  
SUB1 = Suburban area  
URB1 = Urban canyon  
LTUNnel | MTUNnel = Long tunnel | Multiple tunnel  
BR1 | BR2 = Bridge 1/2  
P1M | P10M | P1H = Parking 1min/10min/1h  
HIGHway = Highway  
CUTTING = Cutting

\*RST: USER

**Example:** see [example "Defining a full obscuration environment"](#) on page 269

**Options:** R&S SMBV-K101

**Manual operation:** See ["Type"](#) on page 63

**<subsystem>:OBSCuration:ENVIRONMENT <Environment>**

Selects a near environment model for obscuration & auto multipath.

**Parameters:**

<Environment> LOS | VOBS | RPL | FULL | GSR | LMM

LOS = Line of Sight (LOS)  
VOBS = Vertical Obstacles  
RPL = Roadside Planes  
FULL = Full Obscuration  
GSR = Ground/Sea Reflection  
LMM = Land Mobile Multipath

\*RST: LOS

**Example:** see [example "Defining a full obscuration environment"](#) on page 269

**Options:** R&S SMBV-K101

**Manual operation:** See ["Near Environment"](#) on page 64

**<subsystem>:OBSCuration:PMODEl <PhysicalModel>**

Selects the physical effects to be simulated on the GNSS signal, i.e. obscuration only (OBSCuration) or obscuration and multipath propagation (OMPPath).

**Parameters:**

<PhysicalModel> OBSCuration | OMPPath

\*RST: OBSCuration



**Example:** see [example "Defining a full obscuration environment"](#) on page 269

**Options:** R&S SMBV-K101, OMPath requires R&S SMBV-K92

**Manual operation:** See ["Physical Model"](#) on page 65

**<subsystem>:OBSCuration:VOBS:ROFFset:X <XOffset>**

**<subsystem>:OBSCuration:VOBS:ROFFset:Y <YOffset>**

**<subsystem>:OBSCuration:VOBS:ROFFset:HEIGHT <HeightOffset>**

Determines the start position of a receiver in terms of height and X/Y offset.

**Parameters:**

**<XOffset>** float  
 Range: -1500 to 1500  
 Increment: 0.1  
 \*RST: 0

**<YOffset>** float  
 Range: -1500 to 1500  
 Increment: 0.1  
 \*RST: 0

**<HeightOffset>** float  
 Range: 0 to 500  
 Increment: 0.1  
 \*RST: 0

**Example:** see [example "Selectng a vertical obscuration environment"](#) on page 270

**Options:** R&S SMBV-K101

**Manual operation:** See ["Receiver Offset"](#) on page 67

**<subsystem>:OBSCuration:VOBS:ROFFset:MORientation <MapOrientation>**

Represents the map orientation.

**Parameters:**

**<MapOrientation>** float  
 Range: 0 to 359.99  
 Increment: 0.01  
 \*RST: 0

**Example:** SOURce1:BB:GPS:OBSCuration:VOBS:ROFFset:  
 MORientation 90  
 OX orientation to the north

**Options:** R&S SMBV-K101

**Manual operation:** See ["Map Orientation"](#) on page 68

---

**<subsystem>:OBSCuration:LMM:CATalog:PREDefined?**  
**<subsystem>:OBSCuration:VOBS:CATalog:PREDefined?**  
**<subsystem>:OBSCuration:RPL:CATalog:PREDefined?**

Queries the names of the predefined files in the system directory.

Listed are only the following files types:

- obstacles description files (\*.rs\_obst)
- roadside buildings description files (\*.rs\_buil)
- land mobile multipath (LMM) files (\*.lmm)

**Example:** see [example "Selectng a vertical obscuration environment"](#) on page 270

**Usage:** Query only

**Options:** R&S SMBV-K101

**Manual operation:** See ["Planes File"](#) on page 71

---

**<subsystem>:OBSCuration:LMM:CATalog:USER?**  
**<subsystem>:OBSCuration:VOBS:CATalog:USER?**  
**<subsystem>:OBSCuration:RPL:CATalog:USER?**

Queries the names of the user-defined files in the default directory. The default directory is set using command `MMEM:CDIRectory`

Listed are only the following files types:

- obstacles description files (\*.rs\_obst)
- roadside buildings description files (\*.rs\_buil)
- land mobile multipath (LMM) files (\*.lmm)

**Example:** see [example "Selectng a vertical obscuration environment"](#) on page 270

**Usage:** Query only

**Options:** R&S SMBV-K101

**Manual operation:** See ["Planes File"](#) on page 71

---

**<subsystem>:OBSCuration:LMM:FILE <Filename>**  
**<subsystem>:OBSCuration:VOBS:FILE <Filename>**  
**<subsystem>:OBSCuration:RPL:FILE <Filename>**

Loads the selected file.

Loaded are only obstacles description files (\*.rs\_obst) respectively roadside buildings description files (\*.rs\_buil).

Loaded are only the following files types:

- obstacles description files (\*.rs\_obst)
- roadside buildings description files (\*.rs\_buil)

- land mobile multipath (LMM) files (\*.lmm)

**Parameters:**

<Filename> string

**Example:** see [example "Selectng a vertical obscuration environment"](#) on page 270

**Options:** R&S SMBV-K101

**Manual operation:** See ["Planes File"](#) on page 71

**<subsystem>:OBSCuration:RPL:ROFFset:HEIGHt <Heigh>**

Sets the receiver height offset, i.e. the antenna altitude relative to the ground.

**Parameters:**

<Heigh> float  
 Range: 0 to 500  
 Increment: 0.1  
 \*RST: 0

**Example:** SOURce1:BB:GPS:OBSCuration:RPL:ROFFset:HEIGHt  
 20  
 SOURce1:BB:GPS:OBSCuration:RPL:ILENGth ON

**Options:** R&S SMBV-K101

**Manual operation:** See ["Receiver Height Offset"](#) on page 71

**<subsystem>:OBSCuration:RPL:RWINDow <RepWindow>**

Sets the repeating period (in km) of repeating objects.

**Parameters:**

<RepWindow> integer  
 Range: 1 to 1E6  
 \*RST: 10E3

**Options:** R&S SMBV-K101

**Manual operation:** See ["Repetition Window"](#) on page 71

**<subsystem>:OBSCuration:RPL:RWINDow:STATe <State>**

Enables the repetition of the defined objects.

**Parameters:**

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

**Example:** SOURce1:BB:GPS:OBSCuration:RPL:RWINDow 10E3  
 SOURce1:BB:GPS:OBSCuration:RPL:RWINDow:STATe ON  
 The defined objects are repeated eacht 10km

**Options:** R&S SMBV-K101

**Manual operation:** See ["Repetition Window"](#) on page 71

**<subsystem>:OBSCuration:RPL:ILENgtH <State>**

If enabled, assumes roadside planes with infinite width.

**Parameters:**

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

**Options:** R&S SMBV-K101

**Manual operation:** See ["Set Length to Infinite"](#) on page 71

**<subsystem>:OBSCuration:FULL:SCALE <ReferenceScale>**

Defines whether the obstacles' positions are defined as distance (in km) or as time (in s).

**Parameters:**

<ReferenceScale> TIME | DISTance  
\*RST: DIST

**Example:** see [example "Defining a full obscuration environment"](#) on page 269

**Options:** R&S SMBV-K101

**Manual operation:** See ["Reference Scale"](#) on page 74

**<subsystem>:OBSCuration:FULL:RWINDow <RepWindow>**

Sets the repeating period (in km or s) of repeating objects.

**Parameters:**

<RepWindow> integer  
Range: 0 to 1000  
\*RST: 10

**Example:** see [example "Defining a full obscuration environment"](#) on page 269

**Options:** R&S SMBV-K101

**Manual operation:** See ["Repetition Window"](#) on page 74

**<subsystem>:OBSCuration:FULL:RWINDow:STATe <State>**

Enables the repetition of the defined objects.

**Parameters:**

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

**Example:** see [example "Defining a full obscuration environment"](#) on page 269

**Options:** R&S SMBV-K101

**Manual operation:** See ["Repetition Window"](#) on page 74

**<subsystem>:OBSCuration:FULL:AREA:COUNT?**

Sets the number of the obscured area/zones.

**Return values:**

<AreasCount> integer  
 Range: 0 to 50  
 \*RST: 0

**Example:** see [example "Defining a full obscuration environment"](#) on page 269

**Usage:** Query only

**Options:** R&S SMBV-K101

**Manual operation:** See ["Full Obscuration Configuration Table"](#) on page 74

**<subsystem>:OBSCuration:FULL:AREA:APPend**  
**<subsystem>:OBSCuration:FULL:AREA<ch>:INSert**  
**<subsystem>:OBSCuration:FULL:AREA<ch>:DELete**

Appends/inserts or deletes an obscured zone.

**Example:** see [example "Defining a full obscuration environment"](#) on page 269

**Usage:** Event

**Options:** R&S SMBV-K101

**Manual operation:** See ["Full Obscuration Configuration Table"](#) on page 74

**<subsystem>:OBSCuration:FULL:AREA<ch>:REFerence <Reference>**

Defines the reference starting position (in km) or time stamp (in s) of a specific obscured zone.

**Suffix:**

<ch> 1 to 50  
 Use the command `<subsystem>:OBSCuration:FULL:AREA:COUNT?` to define the number of the obscured zones.

**Parameters:**

<Reference> float  
 Range: 0 to 1E4  
 Increment: 1E-3  
 \*RST: 0

**Example:** see [example "Defining a full obscuration environment"](#) on page 269

**Options:** R&S SMBV-K101

**Manual operation:** See ["Full Obscuration Configuration Table"](#) on page 74

**<subsystem>:OBSCuration:FULL:AREA<ch>:LENGth <Length>**

Length of the obscuring zone, defined in km or sec.

**Parameters:**

<Length> float  
 Range: 1E-3 to 50  
 Increment: 1E-3  
 \*RST: 0.1

**Example:** see [example "Defining a full obscuration environment"](#) on page 269

**Options:** R&S SMBV-K101

**Manual operation:** See ["Full Obscuration Configuration Table"](#) on page 74

**<subsystem>:OBSCuration:GSR:MPPropert <MaterialPropert>**

Define whether the material is defined by its permittivity or power loss characteristic.

**Parameters:**

<MaterialPropert> PLOSS | PERM  
 \*RST: PERM

**Example:** see [example "Defining a user defined ground and sea reflection"](#) on page 270

**Options:** R&S SMBV-K101

**Manual operation:** See ["Material Property"](#) on page 75

**<subsystem>:OBSCuration:GSR:STYPe <SurfaceType>**

Describes the surface.

**Parameters:**

<SurfaceType> SEA | WATER | WET | MDRY | DRY | USER  
 \*RST: USER

**Example:** see [example "Defining a user defined ground and sea reflection"](#) on page 270

**Options:** R&S SMBV-K101

**Manual operation:** See ["Surface Type"](#) on page 75

**<subsystem>:OBSCuration:GSR:PERMittivity <Permittivity>**

Sets the surface permittivity.

**Parameters:**

<Permittivity> float  
 Range: 1 to 100  
 Increment: 0.1  
 \*RST: 10

**Example:** see [example "Defining a user defined ground and sea reflection"](#) on page 270

**Options:** R&S SMBV-K101

**Manual operation:** See ["Ground Permittivity/Conductivity, Power Loss"](#) on page 75

**<subsystem>:OBSCuration:GSR:CONDuctivity <Conductivity>**

Sets the surface conductivity.

**Parameters:**

<Conductivity> float  
 Range: 1E-6 to 20  
 Increment: 1E-6  
 \*RST: 1

**Example:** see [example "Defining a user defined ground and sea reflection"](#) on page 270

**Options:** R&S SMBV-K101

**Manual operation:** See ["Ground Permittivity/Conductivity, Power Loss"](#) on page 75

**<subsystem>:OBSCuration:GSR:PLOs <PowerLoss>**

Sets the surface power loss.

**Parameters:**

<PowerLoss> integer  
 Range: 0 to 20  
 \*RST: 5

**Example:** see [example "Defining a user defined ground and sea reflection"](#) on page 270

**Options:** R&S SMBV-K101

**Manual operation:** See ["Ground Permittivity/Conductivity, Power Loss"](#) on page 75

**<subsystem>:OBSCuration:GSR:O1Distance** <Distance>

**<subsystem>:OBSCuration:GSR:O2Distance** <Distance>

Sets the distance between the receiver and the obstacles.

**Parameters:**

<Distance> float  
 Range: 0 to 1E4  
 Increment: 0.1  
 \*RST: 1000

**Example:** see [example "Defining a user defined ground and sea reflection"](#) on page 270

**Options:** R&S SMBV-K101

**Manual operation:** See ["h1/h2, d1/d2"](#) on page 76

**<subsystem>:OBSCuration:GSR:O1Height** <Height>

**<subsystem>:OBSCuration:GSR:O2Height** <Height>

Determines the height of the left/right obstacle.

**Parameters:**

<Height> float  
 Range: 0 to 10000  
 Increment: 0.1  
 \*RST: 100

**Example:** see [example "Defining a user defined ground and sea reflection"](#) on page 270

**Options:** R&S SMBV-K101

**Manual operation:** See ["h1/h2, d1/d2"](#) on page 76

**<subsystem>:OBSCuration:GSR:GALTitude** <GroundAltitude>

Sets the altitude of the receiver according to the WGS84 geodetic system.

**Parameters:**

<GroundAltitude> float  
 Range: 0 to 10000  
 Increment: 0.1  
 \*RST: 0

**Example:** see [example "Defining a user defined ground and sea reflection"](#) on page 270

**Options:** R&S SMBV-K101

**Manual operation:** See ["Ground Altitude"](#) on page 76



**<subsystem>:OBSCuration:GSR:OORientation <Orientation>**

Sets the obstacle orientation.

**Parameters:**

<Orientation> float  
 Range: 0 to 359.99  
 Increment: 0.01  
 \*RST: 0

**Options:** R&S SMBV-K101

**Manual operation:** See "Obstacle Orientation" on page 76

## 6.8 Hardware in the Loop (HIL)



The HIL settings are enabled for instrument equipped with option GNSS Enhanced (R&S SMBV-K92).

<subsystem>:RT:HILPosition:MODE:A.....281  
 <subsystem>:RT:HILPosition:MODE:B.....282  
 <subsystem>:RT:HILPosition:LATency?.....284  
 <subsystem>:LOCation:DELay.....284

**<subsystem>:RT:HILPosition:MODE:A <ElapsedTime>, <X>, <Y>, <Z>, <XDot>, <YDot>, <ZDot>, <XDotDot>, <YDotDot>, <ZDotDot>, <XDotDotDot>, <YDotDotDot>, <ZDotDotDot>, <Yaw>, <Pitch>, <Roll>, <YawDot>, <PitchDot>, <RollDot>, <YawDotDot>, <PitchDotDot>, <RollDotDot>, <YawDotDotDot>, <PitchDotDotDot>, <RollDotDotDot>**

Sets hardware in loop position of third order ECEF dynamics and attitude.

The yaw/heading, pitch/elevation, roll/bank rotation angles and their derivatives are obtained by rotating the body (XYZ) frame starting from an aligned state with the local NED frame by a sequence of three consecutive Euler rotations about z axis then y axis and then x axis.

The attitude parameters Yaw, Pitch, Roll, RDot etc. are optional

**Table 6-5: Parameter description**

Parameter	Description	Default unit
<X>, <Y>, <Z>	coordinate in the Earth Fixed Earth Centered (ECEF) coordinate system	m
<XDot>, <YDot>, <ZDot>	(equivalently Vx, Vy, Vz ) Velocity vector in ECEF	meter/second
<XDotDot>, <YDotDot>, <ZDotDot>	(equivalently Ax, Ay, Az ) Acceleration vector in ECEF	meter/second^2

Parameter	Description	Default unit
<XDotDotDot>, <YDotDotDot>, <ZDotDotDot>	(equivalently Jx, Jy, Jz ) Jerk vector in ECEF	meters/ second^3
[<Roll>,<Pitch>, <Yaw>]	attitude angles (yaw/heading, pitch/elevation, roll/bank) unlimited value range to simulate more that one cycle rotation between two updates	radians
[<RDot>,<PDot>, <YDot>]	attitude angular rate of change	rad/sec
[<RDotDot>,<PDotDot>, <YDotDot>]	attitude angular second order derivative	rad/sec^2
[<RDotDotDot>, <PDotDotDot>, <YDotDotDot>]	attitude angular third order derivative	rad/sec^3

See also [chapter 3.5.8, "Hardware in the Loop \(HIL\)"](#), on page 30.

**Parameters:**

<ElapsedTime> float  
 Elapsed time from the simulation start  
 For description of the other parameters, see [table 6-5](#).  
 Range: 0 to 999999999

**Usage:** Setting only

**Options:** R&S SMBV-K92 (motion only), R&S SMBV-K92/-K103 (motion +attitude)

---

**<subsystem>:RT:HILPosition:MODE:B** <ElapsedTime>, <Latitude>, <Longitude>,  
 <Altitude>, <NDot>, <EDot>, <DDot>, <NDotDot>, <EDotDot>, <DDotDot>,  
 <NDotDotDot>, <EDotDotDot>, <DDotDotDot>, <Yaw>, <Pitch>, <Roll>,  
 <YawDot>, <PitchDot>, <RollDot>, <YawDotDot>, <PitchDotDot>,  
 <RollDotDot>, <YawDotDotDot>, <PitchDotDotDot>, <RollDotDotDot>

Sets hardware in loop position of third order GEOD/NED dynamics and attitude.

The yaw/heading, pitch/elevation, roll/bank rotation angles and their derivatives are obtained by rotating the body (XYZ) frame starting from an aligned state with the local NED frame by a sequence of three consecutive Euler rotations about z axis then y axis and then x axis.

The attitude parameters Yaw, Pitch, Roll, RDot etc. are optional.

**Table 6-6: Parameter description**

Parameter	Description	Default unit
<Latitude>, <Longitude>, <Altitude>	Geodetic location	degrees
<NDot>,<EDot>,<DDot>	(equivalently Vn, Ve,Vd ) Velocity vector in the North East Down (NED) coordinate system	meters/ second

Parameter	Description	Default unit
<NDotDot>, <EDotDot>, <DDotDot>	(equivalently $A_n, A_e, A_d$ ) Acceleration vector in NED	meters/second <sup>2</sup>
<NDotDotDot>, <EDotDotDot>, <DDotDotDot>	(equivalently $J_n, J_e, J_d$ ) Jerk vector in NED	meters/second <sup>3</sup>
[<Roll>, <Pitch>, <Yaw>]	attitude angles (yaw/heading, pitch/elevation, roll/bank) unlimited value range to simulate more than one cycle rotation between two updates	radians
[<RDot>, <PDot>, <YDot>]	attitude angular rate of change	rad/sec
[<RDotDot>, <PDotDot>, <YDotDot>]	attitude angular second order derivative	rad/sec <sup>2</sup>
[<RDotDotDot>, <PDotDotDot>, <YDotDotDot>]	attitude angular third order derivative	rad/sec <sup>3</sup>

See also [chapter 3.5.8, "Hardware in the Loop \(HIL\)"](#), on page 30.

**Parameters:**

<ElapsedTime> float  
 Elapsed time from the simulation start  
 For description of the other parameters, see [table 6-6](#).  
 Range: 0 to 99999999

<Latitude>

<Longitude>

<Altitude>

<NDot>

<EDot>

<DDot>

<NDotDot>

<EDotDot>

<DDotDot>

<NDotDotDot>

<EDotDotDot>

<DDotDotDot>

<Yaw> motion+attitude

<Pitch> motion+attitude

<Roll> motion+attitude

<YawDot> motion+attitude

<PitchDot>	motion+attitude
<RollDot>	motion+attitude
<YawDotDot>	motion+attitude
<PitchDotDot>	motion+attitude
<RollDotDot>	motion+attitude
<YawDotDotDot>	motion+attitude
<PitchDotDotDot>	motion+attitude
<RollDotDotDot>	motion+attitude
<b>Usage:</b>	Setting only
<b>Options:</b>	R&S SMBV-K92 (motion only), R&S SMBV-K92/-K103 (motion +attitude)

---

#### <subsystem>:RT:HILPosition:LATency?

Queries the time delay (or prediction latency) between the time specified with the parameter <ElapsedTime> in a HIL command (<subsystem>:RT:HILPosition:MODE:A or <subsystem>:RT:HILPosition:MODE:B) and the time this command is actually executed in the R&S SMBV.

You can use the determined value for latency calibration.

See also [chapter 3.5.8, "Hardware in the Loop \(HIL\)"](#), on page 30.

#### Return values:

<Latency>	float
Range:	min to max
Increment:	0.001
*RST:	0

**Example:** SOURce1:BB:GPS:RT:HILPosition:LATency?

**Usage:** Query only

---

#### <subsystem>:LOCation:DELay <Delay>

Adds an artificial delay (i.e. buffer time) in the response of the command <subsystem>:RT:HILPosition:LATency?. That is, the latency of the R&S SMBV response increases *to the selected value*.

This mechanism compensates the command jitter caused by the sending side (e.g. a Flight simulator). During the buffer time, the R&S SMBV aligns the commands.

**Table 6-7: Value range as a function of the HIL update rate**

HIL update rate, [s]	<Delay> value range, [s]
0.01	0.02
0.02	0.02 .. 0.03

HIL update rate, [s]	<Delay> value range, [s]
0.03	0.02 .. 0.03
0.04	0.02 .. 0.04
0.05	0.02 .. 0.04
0.06	0.02 .. 0.05
0.07	0.02 .. 0.05
0.08	0.02 .. 0.06
0.09	0.02 .. 0.06
0.10	0.02 .. 0.07
x	0.02 .. (0.02 + x/2), where x/2 is the nearest multiple of 10 ms

**Parameters:**

&lt;Delay&gt;

float

Range: 0.02 to 0.05

Increment: 0.01

\*RST: 0.02

The minimum value 20 ms and corresponds to the hardware processing time of the R&S SMBV, see [table 6-7](#).

**Example:**

```
// HIL update rate is 10 ms
SOURCE1:BB:GPS:LOCATION:DELAY 0.02
// No additional delay is added, i.e. buffer time = 0 ms
```

**Example:**

```
// HIL update rate is 100 ms
// Delay should be between 20 ms and 70 ms
SOURCE1:BB:GPS:LOCATION:DELAY 0.05
// Additional delay added; buffer time = 30 ms
```

**Options:**

R&amp;S SMBV-K92

**Manual operation:** See "[Delay for Removal of Command Jitter](#)" on page 62

## 6.9 Almanac / RINEX Configuration

**Example: Selecting an Almanac file**

The following examples use GPS entry standard. It is assumed, that a RF Band common for the GNSS standards is selected.

```
SOURCE1:BB:GPS:HYBRID:GALILEO:STATE ON
SOURCE1:BB:GPS:NAVIGATION:ALMANAC:GPS:FILE 'GPS_SEM585.txt'
SOURCE1:BB:GPS:NAVIGATION:ALMANAC:GALILEO:FILE 'GAL_Yuma585.txt'
SOURCE1:BB:GPS:NAVIGATION:ALMANAC:GLONASS:FILE 'GLO_585.agl'
SOURCE1:BB:GPS:SVID:GPS:LIST?
```

```
//Response:2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,
// 28,29,30,31,32
SOURCEl:BB:GPS:SVID:GALileo:LIST?
//Response:1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,
// 28,29,30
SOURCEl:BB:GPS:SVID:GLONass:LIST?
//Response:1,2,5,8,9,10,11,12,13,15,16,17,18,19,20,21,22,23,24
```

**Example: Configuring a RINEX file**

The following examples use GPS entry standard.

```
SOURCEl:BB:GPS:NAVigation:RINex:GPS:FILE
'/var/user/Lists/GNSS/GPS/Rinex/GPS_Week585_Day0.10n'
SOURCEl:BB:GPS:NAVigation:RINex:GPS:IMPort
SOURCEl:BB:GPS:NAVigation:RINex:GPS:UUASate
SOURCEl:BB:GPS:NAVigation:RINex:GPS:STATe ON
```



Some commands of the following description do not apply to the GLONASS satellites. If so, it is explicitly pointed out.

- <subsystem>:NAVigation:ALManac:<GNSS>:FILE.....287
- <subsystem>:NAVigation:ALManac:BEIDou:FILE..... 287
- <subsystem>:NAVigation:ALManac:GALileo:FILE..... 287
- <subsystem>:NAVigation:ALManac:GLONass:FILE..... 287
- <subsystem>:NAVigation:ALManac:GPS:FILE.....287
- <subsystem>:NAVigation:ALManac:<GNSS>:SPAN?.....287
- <subsystem>:NAVigation:ALManac:BEIDou:SPAN?.....287
- <subsystem>:NAVigation:ALManac:GALileo:SPAN?..... 287
- <subsystem>:NAVigation:ALManac:QZSS:SPAN?..... 287
- <subsystem>:NAVigation:ALManac:GPS:SPAN?..... 287
- <subsystem>:NAVigation:ALManac:<GNSS>:DATE:BEGIn..... 288
- <subsystem>:NAVigation:ALManac:BEIDou:DATE:BEGIn?.....288
- <subsystem>:NAVigation:ALManac:GALileo:DATE:BEGIn?..... 288
- <subsystem>:NAVigation:ALManac:GPS:DATE:BEGIn?.....288
- <subsystem>:NAVigation:ALManac:<GNSS>:DATE:END..... 288
- <subsystem>:NAVigation:ALManac:BEIDou:DATE:END?.....288
- <subsystem>:NAVigation:ALManac:GALileo:DATE:END?.....288
- <subsystem>:NAVigation:ALManac:GPS:DATE:END?..... 288
- <subsystem>:NAVigation:ALManac:GLONass:TOAPplicability:DATE?.....289
- <subsystem>:NAVigation:ALManac:GLONass:TOAPplicability:TIME?.....289
- <subsystem>:NAVigation:ALManac:<GNSS>:TOAPplicability:TOWeek.....290
- <subsystem>:NAVigation:ALManac:BEIDou:TOAPplicability:TOWeek?.....290
- <subsystem>:NAVigation:ALManac:GALileo:TOAPplicability:TOWeek?.....290
- <subsystem>:NAVigation:ALManac:GPS:TOAPplicability:TOWeek?.....290
- <subsystem>:NAVigation:ALManac:<GNSS>:TOAPplicability:WNUMber.....290
- <subsystem>:NAVigation:ALManac:BEIDou:TOAPplicability:WNUMber?.....290
- <subsystem>:NAVigation:ALManac:GALileo:TOAPplicability:WNUMber?.....290
- <subsystem>:NAVigation:ALManac:GPS:TOAPplicability:WNUMber?.....290

<subsystem>:NAVigation:ALManac:<GNSS>:WNUMBER.....	290
<subsystem>:NAVigation:ALManac:BEIDou:WNUMBER?.....	290
<subsystem>:NAVigation:ALManac:GALileo:WNUMBER?.....	290
<subsystem>:NAVigation:ALManac:GPS:WNUMBER?.....	290
<subsystem>:NAVigation:RINex:<GNSS>:FILE.....	291
<subsystem>:NAVigation:RINex:BEIDou:FILE.....	291
<subsystem>:NAVigation:RINex:GALileo:FILE.....	291
<subsystem>:NAVigation:RINex:GLONass:FILE.....	291
<subsystem>:NAVigation:RINex:GPS:FILE.....	291
<subsystem>:NAVigation:RINex:<GNSS>:STATE.....	291
<subsystem>:NAVigation:RINex:BEIDou:STATE.....	291
<subsystem>:NAVigation:RINex:GALileo:STATE.....	291
<subsystem>:NAVigation:RINex:GLONass:STATE.....	291
<subsystem>:NAVigation:RINex:GPS:STATE.....	291
<subsystem>:NAVigation:RINex:IMPort.....	291
<subsystem>:NAVigation:RINex:UUASate.....	292
<subsystem>:NAVigation:RINex:UFNSate.....	292
<subsystem>:SVID:<GNSS>:LIST.....	292
<subsystem>:SVID<ch>:SBAS:LIST?.....	292
<subsystem>:SVID<ch>:BEIDou:LIST?.....	292
<subsystem>:SVID<ch>:GALileo:LIST?.....	292
<subsystem>:SVID<ch>:GLONass:LIST?.....	292
<subsystem>:SVID<ch>:GPS:LIST?.....	292

---

**<subsystem>:NAVigation:ALManac:<GNSS>:FILE**

**<subsystem>:NAVigation:ALManac:BEIDou:FILE** <Almanac>

**<subsystem>:NAVigation:ALManac:GALileo:FILE** <Almanac>

**<subsystem>:NAVigation:ALManac:GLONass:FILE** <Almanac>

**<subsystem>:NAVigation:ALManac:GPS:FILE** <Almanac>

Defines the almanac file for the navigation standard.

**Parameters:**

<Almanac>                    string

The file name is sufficient to select a predefined almanac file or almanacs in the default directory.

The complete file path with file name and extension is required to select almanac files stored elsewhere.

**Example:**                    See [example "Selecting an Almanac file"](#) on page 285.

---

**<subsystem>:NAVigation:ALManac:<GNSS>:SPAN?**

**<subsystem>:NAVigation:ALManac:BEIDou:SPAN?**

**<subsystem>:NAVigation:ALManac:GALileo:SPAN?**

**<subsystem>:NAVigation:ALManac:QZSS:SPAN?**

**<subsystem>:NAVigation:ALManac:GPS:SPAN?**

Queries the time span of the selected almanac file.

**Return values:**

<Span> <Start date and time> - <End date and time>  
 Almanac file span, where the start and end date and time strings follow the syntax <DD.MM.YYYY HH:MM:SS>

**Example:**

```
SOURcel:BB:GPS:NAVigation:ALManac:GPS:SPAN?
// "16.02.2014 00:00:00 - 23.02.2014 23:59:59"
```

**Usage:**

Query only

**<subsystem>:NAVigation:ALManac:<GNSS>:DATE:BEgIn**

**<subsystem>:NAVigation:ALManac:BEIDou:DATE:BEgIn?**

**<subsystem>:NAVigation:ALManac:GALileo:DATE:BEgIn?**

**<subsystem>:NAVigation:ALManac:GPS:DATE:BEgIn?**

Queries the start date of the week span of the selected almanac file for the navigation standard. The file is selected using <subsystem>:NAVigation:ALManac:<GNSS>:FILE.

**Return values:**

<Year> integer  
 Range: 1980 to 9999

<Month> integer  
 Range: 1 to 12

<Day> integer  
 Range: 1 to 31

**Example:**

```
BB:GPS:NAV:ALM:GAL:DATE:BEg?
Response: 2010,11,07
```

**Usage:**

Query only

**<subsystem>:NAVigation:ALManac:<GNSS>:DATE:END**

**<subsystem>:NAVigation:ALManac:BEIDou:DATE:END?**

**<subsystem>:NAVigation:ALManac:GALileo:DATE:END?**

**<subsystem>:NAVigation:ALManac:GPS:DATE:END?**

Queries the end date of the week span of the selected almanac file for the navigation standard. The file is selected using <subsystem>:NAVigation:ALManac:<GNSS>:FILE.

**Return values:**

<Year> integer  
 Range: 1980 to 9999

<Month> integer  
 Range: 1 to 12

<Day> integer  
 Range: 1 to 31



**Example:** BB:GPS:NAV:ALM:GAL:DATE:END?  
Response: 2010,11,14

**Usage:** Query only

#### <subsystem>:NAVigation:ALManac:GLONass:TOAPplicability:DATE?

Queries the date of applicability of the selected almanac file for the navigation standard.

**Note:** This setting is available for Glonass. It is no longer supported for GPS and Galileo satellites. To get the applicability data of GPS and Galileo satellites, refer to the commands [<subsystem>:NAVigation:ALManac:<GNSS>:TOAPplicability:TOWeek](#) on page 290 and [<subsystem>:NAVigation:ALManac:<GNSS>:TOAPplicability:WNUmber](#) on page 290.

#### Return values:

<Year>	integer	
	Range:	1996 to 9999
<Month>	integer	
	Range:	1 to 12
<Day>	integer	
	Range:	1 to 31

**Example:** BB:GPS:NAV:ALM:GLON:TOAP:DATE?  
Response: 2010,11,07

**Usage:** Query only

**Manual operation:** See "[Almanac Configuration](#)" on page 86

#### <subsystem>:NAVigation:ALManac:GLONass:TOAPplicability:TIME?

Queries the start time of applicability of the selected almanac file for the navigation standard.

**Note:** This setting is available for Glonass. It is no longer supported for GPS and Galileo satellites. To get the applicability data of GPS and Galileo satellites, refer to the commands [<subsystem>:NAVigation:ALManac:<GNSS>:TOAPplicability:TOWeek](#) on page 290 and [<subsystem>:NAVigation:ALManac:<GNSS>:TOAPplicability:WNUmber](#) on page 290.

#### Return values:

<Hour>	integer	
	Range:	0 to 23
<Minute>	integer	
	Range:	0 to 59

<Second> float  
 Range: 0 to 59.999  
 Increment: 0.001

**Example:** BB:GPS:NAV:ALM:GLON:TOAP:TIME?  
 Response: 17, 0, 0

**Usage:** Query only

**Manual operation:** See "[Almanac Configuration](#)" on page 86

**<subsystem>:NAVigation:ALManac:<GNSS>:TOApplicability:TOWeek**  
**<subsystem>:NAVigation:ALManac:BEIDou:TOApplicability:TOWeek?**  
**<subsystem>:NAVigation:ALManac:GALileo:TOApplicability:TOWeek?**  
**<subsystem>:NAVigation:ALManac:GPS:TOApplicability:TOWeek?**

Determines the Time of Week (TOW) the selected almanac is used for (time of applicability).

**Return values:**

<Tow> float  
 Range: 0 to 604799.999  
 Increment: 0.001  
 \*RST: 0

**Usage:** Query only

**<subsystem>:NAVigation:ALManac:<GNSS>:TOApplicability:WNUmber**  
**<subsystem>:NAVigation:ALManac:BEIDou:TOApplicability:WNUmber?**  
**<subsystem>:NAVigation:ALManac:GALileo:TOApplicability:WNUmber?**  
**<subsystem>:NAVigation:ALManac:GPS:TOApplicability:WNUmber?**

Determines the Week Number for which the selected almanac is used for (time of applicability).

**Return values:**

<WN> integer  
 Range: 0 to 9999.0\*53  
 \*RST: 1488

**Usage:** Query only

**<subsystem>:NAVigation:ALManac:<GNSS>:WNUmber**  
**<subsystem>:NAVigation:ALManac:BEIDou:WNUmber?**  
**<subsystem>:NAVigation:ALManac:GALileo:WNUmber?**  
**<subsystem>:NAVigation:ALManac:GPS:WNUmber?**

Queries the week number of the selected almanac file for the navigation standard. The file is selected using `<subsystem>:NAVigation:ALManac:<GNSS>:FILE`.

**Return values:**

<WeekNumber> integer  
 Range: 0 to 529947  
 \*RST: 1488

**Example:**

BB:GPS:NAV:ALM:GPS:WNUM?  
 Response: 585

**Usage:**

Query only

**<subsystem>:NAVigation:RINex:<GNSS>:FILE**

**<subsystem>:NAVigation:RINex:BEIDou:FILE** <Filename>

**<subsystem>:NAVigation:RINex:GALileo:FILE** <Filename>

**<subsystem>:NAVigation:RINex:GLONass:FILE** <Filename>

**<subsystem>:NAVigation:RINex:GPS:FILE** <Filename>

Selects and activates one RINEX file per navigation standard. Perform [<subsystem>:NAVigation:RINex:IMPort](#) to upload the selected file.

**Parameters:**

<Filename> string

**Example:**

See [example "Configuring a RINEX file"](#) on page 286.

**Manual operation:**

See ["RINEX Configuration"](#) on page 87

**<subsystem>:NAVigation:RINex:<GNSS>:STATE**

**<subsystem>:NAVigation:RINex:BEIDou:STATE** <State>

**<subsystem>:NAVigation:RINex:GALileo:STATE** <State>

**<subsystem>:NAVigation:RINex:GLONass:STATE** <State>

**<subsystem>:NAVigation:RINex:GPS:STATE** <State>

Activates a RINEX configuration file previously selected (see [<subsystem>:NAVigation:RINex:GPS:FILE](#)) and imported (see [<subsystem>:NAVigation:RINex:IMPort](#)).

**Parameters:**

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

**Example:**

See [example "Configuring a RINEX file"](#) on page 286.

**Manual operation:**

See ["RINEX Configuration"](#) on page 87

**<subsystem>:NAVigation:RINex:IMPort**

Uploads the RINEX file selected by [<subsystem>:NAVigation:RINex:GPS:FILE](#).

**Example:**

See [example "Configuring a RINEX file"](#) on page 286.

**Usage:**

Event

**Manual operation:**

See ["RINEX Configuration"](#) on page 87

---

**<subsystem>:NAVigation:RINex:UUASState <State>**

Synchronizes the time conversion and the atmospheric parameters to the corresponding values retrieved from the RINEX file.

**Parameters:**

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

**Example:**                    See [example "Configuring a RINEX file"](#) on page 286.

**Manual operation:**    See ["RINEX Configuration"](#) on page 87

---

**<subsystem>:NAVigation:RINex:UFNSState <State>**

Updates the frequency number for Glonass satellites automatically at import of a RINEX File.

**Parameters:**

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

**Example:**                    BB:GPS:NAV:RIN:UFNS 1

**Manual operation:**    See ["RINEX Configuration"](#) on page 87

---

**<subsystem>:SVID:<GNSS>:LIST**

**<subsystem>:SVID<ch>:SBAS:LIST?**

**<subsystem>:SVID<ch>:BEIDou:LIST?**

**<subsystem>:SVID<ch>:GALileo:LIST?**

**<subsystem>:SVID<ch>:GLONass:LIST?**

**<subsystem>:SVID<ch>:GPS:LIST?**

Queries the list of valid satellites (SV IDs) of the selected almanac file for the navigation standard.

To select the file, use the command `<subsystem>:NAVigation:ALManac:<GNSS>:FILE`.

**Example:**                    See [example "Selecting an Almanac file"](#) on page 285.

**Usage:**                    Query only

---

## 6.10 Time Conversion Configuration

**Example: Configuring the time conversion and leap seconds settings**

The following example uses GPS entry standard.

```
SOURce1:BB:GPS:PRESet
SOURce1:BB:GPS:SMOD USER
```

```
SOURcel:BB:GPS:NAVigation:TCONversion:GPS:AZERo?
//Response: 0
SOURcel:BB:GPS:NAVigation:TCONversion:GPS:AONE?
//Response: 0
SOURcel:BB:GPS:NAVigation:TCONversion:GPS:TOT?
//Response: 0
SOURcel:BB:GPS:NAVigation:TCONversion:GPS:WNOT?
//Response: 0
SOURcel:BB:GPS:NAVigation:TCONversion:LEAP:SYNC
```

```
SOURcel:BB:GPS:NAVigation:TCONversion:LEAP:SLSTransition:STATE ON
SOURcel:BB:GPS:NAVigation:TCONversion:LEAP:SECONDS?
//Response:15
SOURcel:BB:GPS:NAVigation:TCONversion:LEAP:DATE?
//Response: 2010,11,8
SOURcel:BB:GPS:NAVigation:TCONversion:LEAP:SIGN?
//Response: PLUS
```

<subsystem>:NAVigation:TCONversion:<GNSS>:AONE.....	294
<subsystem>:NAVigation:TCONversion:SBAS:EGNOS:AONE.....	294
<subsystem>:NAVigation:TCONversion:SBAS:GAGAN:AONE.....	294
<subsystem>:NAVigation:TCONversion:SBAS:MSAS:AONE.....	294
<subsystem>:NAVigation:TCONversion:SBAS:SAIF:AONE.....	294
<subsystem>:NAVigation:TCONversion:SBAS:SDCM:AONE.....	294
<subsystem>:NAVigation:TCONversion:SBAS:WAAS:AONE.....	294
<subsystem>:NAVigation:TCONversion:QZSS:AONE.....	294
<subsystem>:NAVigation:TCONversion:BEIDou:AONE.....	294
<subsystem>:NAVigation:TCONversion:GALileo:AONE.....	294
<subsystem>:NAVigation:TCONversion:GLONass:AONE.....	294
<subsystem>:NAVigation:TCONversion:GPS:AONE.....	294
<subsystem>:NAVigation:TCONversion:<GNSS>:AZERo.....	295
<subsystem>:NAVigation:TCONversion:SBAS:EGNOS:AZERo.....	295
<subsystem>:NAVigation:TCONversion:SBAS:SAIF:AZERo.....	295
<subsystem>:NAVigation:TCONversion:SBAS:GAGAN:AZERo.....	295
<subsystem>:NAVigation:TCONversion:SBAS:MSAS:AZERo.....	295
<subsystem>:NAVigation:TCONversion:SBAS:SDCM:AZERo.....	295
<subsystem>:NAVigation:TCONversion:SBAS:WAAS:AZERo.....	295
<subsystem>:NAVigation:TCONversion:QZSS:AZERo.....	295
<subsystem>:NAVigation:TCONversion:BEIDou:AZERo.....	295
<subsystem>:NAVigation:TCONversion:GALileo:AZERo.....	295
<subsystem>:NAVigation:TCONversion:GLONass:AZERo.....	295
<subsystem>:NAVigation:TCONversion:GPS:AZERo.....	295
<subsystem>:NAVigation:TCONversion:<GNSS>:TOT.....	295
<subsystem>:NAVigation:TCONversion:SBAS:EGNOS:TOT.....	295
<subsystem>:NAVigation:TCONversion:SBAS:GAGAN:TOT.....	295
<subsystem>:NAVigation:TCONversion:SBAS:MSAS:TOT.....	295
<subsystem>:NAVigation:TCONversion:SBAS:MSAS:WNOT.....	295
<subsystem>:NAVigation:TCONversion:SBAS:SAIF:TOT.....	295
<subsystem>:NAVigation:TCONversion:SBAS:SDCM:TOT.....	295
<subsystem>:NAVigation:TCONversion:SBAS:WAAS:TOT.....	295
<subsystem>:NAVigation:TCONversion:QZSS:TOT.....	295

<subsystem>:NAVigation:TCONversion:BEIDou:TOT.....	295
<subsystem>:NAVigation:TCONversion:GALileo:TOT.....	295
<subsystem>:NAVigation:TCONversion:GLONass:TOT.....	295
<subsystem>:NAVigation:TCONversion:GPS:TOT.....	295
<subsystem>:NAVigation:TCONversion:<GNSS>:WNOT.....	296
<subsystem>:NAVigation:TCONversion:SBAS:EGNOS:WNOT.....	296
<subsystem>:NAVigation:TCONversion:SBAS:GAGAN:WNOT.....	296
<subsystem>:NAVigation:TCONversion:SBAS:SAIF:WNOT.....	296
<subsystem>:NAVigation:TCONversion:SBAS:SDCM:WNOT.....	296
<subsystem>:NAVigation:TCONversion:SBAS:WAAS:WNOT.....	296
<subsystem>:NAVigation:TCONversion:QZSS:WNOT.....	296
<subsystem>:NAVigation:TCONversion:BEIDou:WNOT.....	296
<subsystem>:NAVigation:TCONversion:GALileo:WNOT.....	296
<subsystem>:NAVigation:TCONversion:GLONass:WNOT.....	296
<subsystem>:NAVigation:TCONversion:GPS:WNOT.....	296
<subsystem>:NAVigation:TCONversion:UTCSu:AONE.....	296
<subsystem>:NAVigation:TCONversion:UTCSu:AZERo.....	296
<subsystem>:NAVigation:TCONversion:UTCSu:DATE?.....	297
<subsystem>:NAVigation:TCONversion:LEAP:SLSTransition[:STATE].....	297
<subsystem>:NAVigation:TCONversion:LEAP:DATE.....	297
<subsystem>:NAVigation:TCONversion:LEAP:SECONDS.....	297
<subsystem>:NAVigation:TCONversion:LEAP:SIGN.....	298
<subsystem>:NAVigation:TCONversion:LEAP:SYNC.....	298

---

**<subsystem>:NAVigation:TCONversion:<GNSS>:AONE**  
**<subsystem>:NAVigation:TCONversion:SBAS:EGNOS:AONE <AOne>**  
**<subsystem>:NAVigation:TCONversion:SBAS:GAGAN:AONE <AOne>**  
**<subsystem>:NAVigation:TCONversion:SBAS:MSAS:AONE <AOne>**  
**<subsystem>:NAVigation:TCONversion:SBAS:SAIF:AONE <AOne>**  
**<subsystem>:NAVigation:TCONversion:SBAS:SDCM:AONE <AOne>**  
**<subsystem>:NAVigation:TCONversion:SBAS:WAAS:AONE <AOne>**  
**<subsystem>:NAVigation:TCONversion:QZSS:AONE <AOne>**  
**<subsystem>:NAVigation:TCONversion:BEIDou:AONE <AOne>**  
**<subsystem>:NAVigation:TCONversion:GALileo:AONE <AOne>**  
**<subsystem>:NAVigation:TCONversion:GLONass:AONE <AOne>**  
**<subsystem>:NAVigation:TCONversion:GPS:AONE <AOne>**

For <subsystem>:SMODESTATIC or USER, defines the 1<sup>st</sup> order term of polynomial,  $A_1$ .

**Parameters:**

<AOne>                    integer  
                               Range:        -8388608 to 8388607  
                               \*RST:        0

**Example:**                See [example "Configuring the time conversion and leap seconds settings"](#) on page 292.

**Manual operation:**    See ["Time Conversion Parameters"](#) on page 84

---

```

<subsystem>:NAVigation:TCONversion:<GNSS>:AZERo
<subsystem>:NAVigation:TCONversion:SBAS:EGNOS:AZERo <AZero>
<subsystem>:NAVigation:TCONversion:SBAS:SAIF:AZERo <AZero>
<subsystem>:NAVigation:TCONversion:SBAS:GAGAN:AZERo <AZero>
<subsystem>:NAVigation:TCONversion:SBAS:MSAS:AZERo <AZero>
<subsystem>:NAVigation:TCONversion:SBAS:SDCM:AZERo <AZero>
<subsystem>:NAVigation:TCONversion:SBAS:WAAS:AZERo <AZero>
<subsystem>:NAVigation:TCONversion:QZSS:AZERo <AZero>
<subsystem>:NAVigation:TCONversion:BEIDou:AZERo <AZero>
<subsystem>:NAVigation:TCONversion:GALileo:AZERo <AZero>
<subsystem>:NAVigation:TCONversion:GLONass:AZERo <AZero>
<subsystem>:NAVigation:TCONversion:GPS:AZERo <AZero>

```

For <subsystem>:SMODESTATIC or USER, defines the constant term of polynomial,  $A_0$ .

**Parameters:**

```

<AZero>          integer
                  Range:    -2147483648 to 2147483647
                  *RST:     0

```

**Example:** See [example "Configuring the time conversion and leap seconds settings"](#) on page 292.

**Manual operation:** See ["Time Conversion Parameters"](#) on page 84

---

```

<subsystem>:NAVigation:TCONversion:<GNSS>:TOT
<subsystem>:NAVigation:TCONversion:SBAS:EGNOS:TOT <Tot>
<subsystem>:NAVigation:TCONversion:SBAS:GAGAN:TOT <Tot>
<subsystem>:NAVigation:TCONversion:SBAS:MSAS:TOT <Tot>
<subsystem>:NAVigation:TCONversion:SBAS:MSAS:WNOT <Wnot>
<subsystem>:NAVigation:TCONversion:SBAS:SAIF:TOT <Tot>
<subsystem>:NAVigation:TCONversion:SBAS:SDCM:TOT <Tot>
<subsystem>:NAVigation:TCONversion:SBAS:WAAS:TOT <Tot>
<subsystem>:NAVigation:TCONversion:QZSS:TOT <Tot>
<subsystem>:NAVigation:TCONversion:BEIDou:TOT <Tot>
<subsystem>:NAVigation:TCONversion:GALileo:TOT <Tot>
<subsystem>:NAVigation:TCONversion:GLONass:TOT <Tot>
<subsystem>:NAVigation:TCONversion:GPS:TOT <Tot>

```

For <subsystem>:SMODESTATIC or USER, defines the UTC data reference time of week,  $t_{ot}$ .

**Parameters:**

```

<Tot>           integer
                  Range:    0 to 255
                  *RST:     0

```

**Example:** See [example "Configuring the time conversion and leap seconds settings"](#) on page 292.

**Manual operation:** See ["Time Conversion Parameters"](#) on page 84

---

```

<subsystem>:NAVigation:TCONversion:<GNSS>:WNOT
<subsystem>:NAVigation:TCONversion:SBAS:EGNOS:WNOT <Wnot>
<subsystem>:NAVigation:TCONversion:SBAS:GAGAN:WNOT <Wnot>
<subsystem>:NAVigation:TCONversion:SBAS:SAIF:WNOT <Wnot>
<subsystem>:NAVigation:TCONversion:SBAS:SDCM:WNOT <Wnot>
<subsystem>:NAVigation:TCONversion:SBAS:WAAS:WNOT <Wnot>
<subsystem>:NAVigation:TCONversion:QZSS:WNOT <Wnot>
<subsystem>:NAVigation:TCONversion:BEIDou:WNOT <Wnot>
<subsystem>:NAVigation:TCONversion:GALileo:WNOT <Wnot>
<subsystem>:NAVigation:TCONversion:GLONass:WNOT <Wnot>
<subsystem>:NAVigation:TCONversion:GPS:WNOT <Wnot>

```

For `<subsystem>:SMODE` `STATIC` or `USER`, defines the UTC data reference week number,  $WN_t$ .

**Parameters:**

```

<Wnot>          integer
                  Range:    0 to 255
                  *RST:    0

```

**Example:** See [example "Configuring the time conversion and leap seconds settings"](#) on page 292.

**Manual operation:** See ["Time Conversion Parameters"](#) on page 84

---

```

<subsystem>:NAVigation:TCONversion:UTCSu:AONE <A_1>

```

Defines the 1<sup>st</sup> order term of polynomial,  $A_1$ .

**Parameters:**

```

<A_1>          integer
                  Range:    -512 to 511
                  *RST:    0

```

**Options:** R&S SMBV-K94

**Manual operation:** See ["UTC-UTC\(SU\)"](#) on page 85

---

```

<subsystem>:NAVigation:TCONversion:UTCSu:AZERo <A_0>

```

Defines the constant term of polynomial,  $A_0$ .

**Parameters:**

```

<A_0>          integer
                  Range:    -1024 to 1023
                  *RST:    0

```

**Options:** R&S SMBV-K94

**Manual operation:** See ["UTC-UTC\(SU\)"](#) on page 85



**<subsystem>:NAVigation:TCONversion:UTCSu:DATE?**

Enters the date for the UTC-UTC(SU) data in DMS format.

**Return values:**

<Year>	integer	
	Range:	1996 to 9999
<Month>	integer	
	Range:	1 to 12
<Day>	integer	
	Range:	1 to 31

**Usage:** Query only

**Options:** R&S SMBV-K94

**Manual operation:** See "[UTC-UTC\(SU\)](#)" on page 85

**<subsystem>:NAVigation:TCONversion:LEAP:SLSTransition[:STATE] <State>**

Enables/disables the simulation of the leap second transition.

**Parameters:**

<State>	0   1   OFF   ON
*RST:	Off

**Manual operation:** See "[Leap Second Configuration](#)" on page 85

**<subsystem>:NAVigation:TCONversion:LEAP:DATE <Year>, <Month>, <Day>**

Defines the date of the next UTC time correction.

**Parameters:**

<Year>	integer	
	Range:	1980 to 9999
<Month>	integer	
	Range:	1 to 12
<Day>	integer	
	Range:	1 to 31

**Example:** See [example "Configuring the time conversion and leap seconds settings"](#) on page 292.

**Options:** R&S SMBV-K92

**Manual operation:** See "[Leap Second Configuration](#)" on page 85

**<subsystem>:NAVigation:TCONversion:LEAP:SECONDS <LeapSeconds>**

Defines the currently used leap second.

**Parameters:**

<LeapSeconds> integer  
 Range: 0 to 50  
 \*RST: 16

**Example:** See [example "Configuring the time conversion and leap seconds settings"](#) on page 292.

**Manual operation:** See ["Leap Second Configuration"](#) on page 85

**<subsystem>:NAVigation:TCONversion:LEAP:SIGN <Sign>**

Defines whether one second is added to or subtracted from the current leap second value during synchronization.

**Parameters:**

<Sign> PLUS | MINus  
 \*RST: PLUS

**Example:** See [example "Configuring the time conversion and leap seconds settings"](#) on page 292.

**Options:** R&S SMBV-K92

**Manual operation:** See ["Leap Second Configuration"](#) on page 85

**<subsystem>:NAVigation:TCONversion:LEAP:SYNC**

Synchronizes the leap second according to the simulation time.

**Example:** See [example "Configuring the time conversion and leap seconds settings"](#) on page 292.

**Usage:** Event

**Manual operation:** See ["Leap Second Configuration"](#) on page 85

## 6.11 SBAS Configuration



The SBAS configuration requires option R&S SMBV-K110.

**Placeholders <RegSystem> and <MessageFile>**

These placeholders are introduced to simplify the description of group of commands with similar syntax.

- Depending on the enabled SBAS regional system, replace the placeholder <RegSystem> with EGNOS, MSAS or WAAS.

- Depending on the SBAS message, replace the placeholder <MessageFile> with ALManac, CECovariance, DFACTOR, FCDegradation, FCORrection, IGRid, LTCORrection, PRNMask, RINex, SERVICE or UTCOffset.

### Example: Configuring the SBAS settings

The following example uses GPS entry standard.

```

SOURCE:BB:GPS:HYBRid:GPS:STATe 1
// SOURCE:BB:GPS:HYBRid:GALileo:STATe 1
SOURCE:BB:GPS:NAVigation:SBAS:EGNOS:STATe 1
SOURCE:BB:GPS:SVDelay 1
SOURCE:BB:GPS:SIOD 1
SOURCE:BB:GPS:SSVBias 1

SOURCE:BB:GPS:NAVigation:DATA RNDData
SOURCE:BB:GPS:NAVigation:SIMulation:TBASis UTC
SOURCE:BB:GPS:NAVigation:SIMulation:DATE 2014,02,16
SOURCE:BB:GPS:NAVigation:SIMulation:TIME 16,00,00.00

// SOURCE:BB:GPS:NAVigation:SBAS:NDMode RAW
// SOURCE:BB:GPS:NAVigation:SBAS:EGNOS:PRN120:FILE "/var/user/converted_PRN120_19_02_14.ems"
// SOURCE:BB:GPS:NAVigation:SBAS:EGNOS:PRN120:SPAN?
// Response: "19.02.2014 06:00:00 - 19.02.2014 06:59:59"
// SOURCE:BB:GPS:NAVigation:SBAS:EGNOS:PRN120:DURation?
// Response: 3583
// SOURCE:BB:GPS:NAVigation:SBAS:EGNOS:PRN120:STATe 1

// SOURCE:BB:NAVigation:SBAS:RSDDaily 0
SOURCE:BB:GPS:NAVigation:SBAS:ITUTc 200
SOURCE:BB:NAVigation:SBAS:MIX 0
SOURCE:BB:NAVigation:SBAS:PIDelays 1
SOURCE:BB:NAVigation:SBAS:PSVSignals 1
SOURCE:BB:NAVigation:SBAS:TIOD 1

SOURCE:BB:GPS:NAVigation:SBAS:NDMode MESSAge
SOURCE:BB:GPS:NAVigation:SBAS:EGNOS:ALManac:STATe 1
SOURCE:BB:GPS:NAVigation:SBAS:EGNOS:RINex:STATe 1
SOURCE:BB:GPS:NAVigation:SBAS:EGNOS:PRNMask:STATe 1
SOURCE:BB:GPS:NAVigation:SBAS:EGNOS:UTCOffset:STATe 1
SOURCE:BB:GPS:NAVigation:SBAS:EGNOS:IGRid:STATe 1
SOURCE:BB:GPS:NAVigation:SBAS:EGNOS:FCORrection:STATe 1
SOURCE:BB:GPS:NAVigation:SBAS:EGNOS:LTCORrection:STATe 1
SOURCE:BB:GPS:NAVigation:SBAS:EGNOS:FCDegradation:STATe 1
SOURCE:BB:GPS:NAVigation:SBAS:EGNOS:CECovariance:STATe 1
SOURCE:BB:GPS:NAVigation:SBAS:EGNOS:SERVICE:STATe 1

SOURCE:BB:GPS:NAVigation:SBAS:EGNOS:ALManac:FILE "19_02_14_egnos.alm"
SOURCE:BB:GPS:NAVigation:SBAS:EGNOS:ALManac:SPAN?
// Response: "16.02.2014 00:00:00 - 23.02.2014 00:00:00"

```

```

SOURCE:BB:GPS:NAVigation:SBAS:EGNOS:ALManac:PERiod?
// Response: 200

SOURCE:BB:GPS:NAVigation:SBAS:EGNOS:RINex:FILE "19_02_14_egnos.14n"
SOURCE:BB:GPS:NAVigation:SBAS:EGNOS:RINex:SPAN?
// Response: "19.02.2014 00:02:08 - 19.02.2014 23:58:08"
SOURCE:BB:GPS:NAVigation:SBAS:EGNOS:IGRid:FILE "19_02_14_egnos.iono_grid"
SOURCE:BB:GPS:NAVigation:SBAS:EGNOS:IGRid:SPAN?
// Response: "19.02.2014 06:00:00 - 19.02.2014 06:45:00"
SOURCE:BB:GPS:NAVigation:SBAS:EGNOS:PRNMask:FILE "19_02_14_egnos.prn_mask"
SOURCE:BB:GPS:NAVigation:SBAS:EGNOS:PRNMask:SPAN?
// Response: "19.02.2014 06:00:27 - 19.02.2014 06:59:59"
SOURCE:BB:GPS:NAVigation:SBAS:EGNOS:FCORrection:FILE "19_02_14_egnos.f_corr"
SOURCE:BB:GPS:NAVigation:SBAS:EGNOS:FCORrection:SPAN?
// Response: "19.02.2014 06:00:28 - 19.02.2014 06:59:59"
SOURCE:BB:GPS:NAVigation:SBAS:EGNOS:LTCORrection:FILE "19_02_14_egnos.lt_corr"
SOURCE:BB:GPS:NAVigation:SBAS:EGNOS:LTCORrection:SPAN?
// Response: "19.02.2014 06:00:43 - 19.02.2014 06:59:59"
...
SOURCE:BB:GPS:STATE ON
    
```

<subsystem>:NAVigation:SBAS:NDMode.....	303
<subsystem>:NAVigation:SBAS:<RegSystem>[:STATE]	303
<subsystem>:NAVigation:SBAS:WAAS[:STATE]	303
<subsystem>:NAVigation:SBAS:MSAS[:STATE]	303
<subsystem>:NAVigation:SBAS:EGNOS[:STATE]	303
<subsystem>:NAVigation:SBAS:<RegSystem>:<MessageFile>:STATE	304
<subsystem>:NAVigation:SBAS:WAAS:ALManac:STATE	304
<subsystem>:NAVigation:SBAS:MSAS:ALManac:STATE	304
<subsystem>:NAVigation:SBAS:EGNOS:ALManac:STATE	304
<subsystem>:NAVigation:SBAS:WAAS:RINex:STATE	304
<subsystem>:NAVigation:SBAS:MSAS:RINex:STATE	304
<subsystem>:NAVigation:SBAS:EGNOS:RINex:STATE	304
<subsystem>:NAVigation:SBAS:WAAS:UTCOffset:STATE?	304
<subsystem>:NAVigation:SBAS:MSAS:UTCOffset:STATE?	304
<subsystem>:NAVigation:SBAS:EGNOS:UTCOffset:STATE?	304
<subsystem>:NAVigation:SBAS:WAAS:IGRid:STATE	304
<subsystem>:NAVigation:SBAS:MSAS:IGRid:STATE	304
<subsystem>:NAVigation:SBAS:EGNOS:IGRid:STATE	304
<subsystem>:NAVigation:SBAS:WAAS:PRNMask:STATE	304
<subsystem>:NAVigation:SBAS:MSAS:PRNMask:STATE	304
<subsystem>:NAVigation:SBAS:EGNOS:PRNMask:STATE	304
<subsystem>:NAVigation:SBAS:WAAS:FCORrection:STATE	304
<subsystem>:NAVigation:SBAS:MSAS:FCORrection:STATE	304
<subsystem>:NAVigation:SBAS:EGNOS:FCORrection:STATE	304
<subsystem>:NAVigation:SBAS:WAAS:LTCORrection:STATE	304
<subsystem>:NAVigation:SBAS:MSAS:LTCORrection:STATE	304
<subsystem>:NAVigation:SBAS:EGNOS:LTCORrection:STATE	304
<subsystem>:NAVigation:SBAS:WAAS:CECOvariance:STATE	304
<subsystem>:NAVigation:SBAS:MSAS:CECOvariance:STATE	304

<subsystem>:NAVigation:SBAS:EGNOS:CECovariance:STATe.....	304
<subsystem>:NAVigation:SBAS:WAAS:FCDegradation:STATe.....	304
<subsystem>:NAVigation:SBAS:MSAS:FCDegradation:STATe.....	304
<subsystem>:NAVigation:SBAS:EGNOS:FCDegradation:STATe.....	304
<subsystem>:NAVigation:SBAS:WAAS:DFACtor:STATe.....	304
<subsystem>:NAVigation:SBAS:MSAS:DFACtor:STATe.....	304
<subsystem>:NAVigation:SBAS:EGNOS:DFACtor:STATe.....	304
<subsystem>:NAVigation:SBAS:WAAS:SERVice:STATe.....	304
<subsystem>:NAVigation:SBAS:MSAS:SERVice:STATe.....	304
<subsystem>:NAVigation:SBAS:EGNOS:SERVice:STATe.....	304
<subsystem>:NAVigation:SBAS:<RegSystem>:<MessageFile>:FILE.....	304
<subsystem>:NAVigation:SBAS:WAAS:ALManac:FILE.....	304
<subsystem>:NAVigation:SBAS:MSAS:ALManac:FILE.....	304
<subsystem>:NAVigation:SBAS:EGNOS:ALManac:FILE.....	304
<subsystem>:NAVigation:SBAS:WAAS:RINex:FILE.....	304
<subsystem>:NAVigation:SBAS:MSAS:RINex:FILE.....	304
<subsystem>:NAVigation:SBAS:EGNOS:RINex:FILE.....	304
<subsystem>:NAVigation:SBAS:WAAS:IGRid:FILE.....	304
<subsystem>:NAVigation:SBAS:MSAS:IGRid:FILE.....	305
<subsystem>:NAVigation:SBAS:EGNOS:IGRid:FILE.....	305
<subsystem>:NAVigation:SBAS:WAAS:PRNMask:FILE.....	305
<subsystem>:NAVigation:SBAS:MSAS:PRNMask:FILE.....	305
<subsystem>:NAVigation:SBAS:EGNOS:PRNMask:FILE.....	305
<subsystem>:NAVigation:SBAS:WAAS:FCORrection:FILE.....	305
<subsystem>:NAVigation:SBAS:MSAS:FCORrection:FILE.....	305
<subsystem>:NAVigation:SBAS:EGNOS:FCORrection:FILE.....	305
<subsystem>:NAVigation:SBAS:WAAS:LTCorrection:FILE.....	305
<subsystem>:NAVigation:SBAS:MSAS:LTCorrection:FILE.....	305
<subsystem>:NAVigation:SBAS:EGNOS:LTCorrection:FILE.....	305
<subsystem>:NAVigation:SBAS:WAAS:CECovariance:FILE.....	305
<subsystem>:NAVigation:SBAS:MSAS:CECovariance:FILE.....	305
<subsystem>:NAVigation:SBAS:EGNOS:CECovariance:FILE.....	305
<subsystem>:NAVigation:SBAS:WAAS:FCDegradation:FILE.....	305
<subsystem>:NAVigation:SBAS:MSAS:FCDegradation:FILE.....	305
<subsystem>:NAVigation:SBAS:EGNOS:FCDegradation:FILE.....	305
<subsystem>:NAVigation:SBAS:WAAS:DFACtor:FILE.....	305
<subsystem>:NAVigation:SBAS:MSAS:DFACtor:FILE.....	305
<subsystem>:NAVigation:SBAS:EGNOS:DFACtor:FILE.....	305
<subsystem>:NAVigation:SBAS:WAAS:SERVice:FILE.....	305
<subsystem>:NAVigation:SBAS:MSAS:SERVice:FILE.....	305
<subsystem>:NAVigation:SBAS:EGNOS:SERVice:FILE.....	305
<subsystem>:NAVigation:SBAS:<RegSystem>:<MessageFile>:SPAN.....	305
<subsystem>:NAVigation:SBAS:WAAS:ALManac:SPAN?.....	305
<subsystem>:NAVigation:SBAS:MSAS:ALManac:SPAN?.....	305
<subsystem>:NAVigation:SBAS:EGNOS:ALManac:SPAN?.....	305
<subsystem>:NAVigation:SBAS:WAAS:RINex:SPAN?.....	305
<subsystem>:NAVigation:SBAS:MSAS:RINex:SPAN?.....	305
<subsystem>:NAVigation:SBAS:EGNOS:RINex:SPAN?.....	305
<subsystem>:NAVigation:SBAS:WAAS:IGRid:SPAN?.....	305
<subsystem>:NAVigation:SBAS:MSAS:IGRid:SPAN?.....	305

<subsystem>:NAVigation:SBAS:EGNOS:IGRid:SPAN?	305
<subsystem>:NAVigation:SBAS:WAAS:PRNMask:SPAN?	305
<subsystem>:NAVigation:SBAS:MSAS:PRNMask:SPAN?	305
<subsystem>:NAVigation:SBAS:EGNOS:PRNMask:SPAN?	305
<subsystem>:NAVigation:SBAS:WAAS:FCORrection:SPAN?	306
<subsystem>:NAVigation:SBAS:MSAS:FCORrection:SPAN?	306
<subsystem>:NAVigation:SBAS:EGNOS:FCORrection:SPAN?	306
<subsystem>:NAVigation:SBAS:WAAS:LTCorrection:SPAN?	306
<subsystem>:NAVigation:SBAS:MSAS:LTCorrection:SPAN?	306
<subsystem>:NAVigation:SBAS:EGNOS:LTCorrection:SPAN?	306
<subsystem>:NAVigation:SBAS:WAAS:CECovariance:SPAN?	306
<subsystem>:NAVigation:SBAS:MSAS:CECovariance:SPAN?	306
<subsystem>:NAVigation:SBAS:EGNOS:CECovariance:SPAN?	306
<subsystem>:NAVigation:SBAS:WAAS:FCDegradation:SPAN?	306
<subsystem>:NAVigation:SBAS:MSAS:FCDegradation:SPAN?	306
<subsystem>:NAVigation:SBAS:EGNOS:FCDegradation:SPAN?	306
<subsystem>:NAVigation:SBAS:WAAS:DFACtor:SPAN?	306
<subsystem>:NAVigation:SBAS:MSAS:DFACtor:SPAN?	306
<subsystem>:NAVigation:SBAS:EGNOS:DFACtor:SPAN?	306
<subsystem>:NAVigation:SBAS:WAAS:SERVice:SPAN?	306
<subsystem>:NAVigation:SBAS:MSAS:SERVice:SPAN?	306
<subsystem>:NAVigation:SBAS:EGNOS:SERVice:SPAN?	306
<subsystem>:NAVigation:SBAS:<RegSystem>:<MessageFile>:PERiod	306
<subsystem>:NAVigation:SBAS:WAAS:ALManac:PERiod	306
<subsystem>:NAVigation:SBAS:MSAS:ALManac:PERiod	306
<subsystem>:NAVigation:SBAS:EGNOS:ALManac:PERiod	306
<subsystem>:NAVigation:SBAS:WAAS:RINex:PERiod	306
<subsystem>:NAVigation:SBAS:MSAS:RINex:PERiod	306
<subsystem>:NAVigation:SBAS:EGNOS:RINex:PERiod	306
<subsystem>:NAVigation:SBAS:WAAS:UTCOffset:PERiod	306
<subsystem>:NAVigation:SBAS:MSAS:UTCOffset:PERiod	306
<subsystem>:NAVigation:SBAS:EGNOS:UTCOffset:PERiod	306
<subsystem>:NAVigation:SBAS:WAAS:IGRid:PERiod	306
<subsystem>:NAVigation:SBAS:MSAS:IGRid:PERiod	306
<subsystem>:NAVigation:SBAS:EGNOS:IGRid:PERiod	306
<subsystem>:NAVigation:SBAS:WAAS:PRNMask:PERiod	306
<subsystem>:NAVigation:SBAS:MSAS:PRNMask:PERiod	306
<subsystem>:NAVigation:SBAS:EGNOS:PRNMask:PERiod	306
<subsystem>:NAVigation:SBAS:WAAS:FCORrection:PERiod	306
<subsystem>:NAVigation:SBAS:MSAS:FCORrection:PERiod	306
<subsystem>:NAVigation:SBAS:EGNOS:FCORrection:PERiod	306
<subsystem>:NAVigation:SBAS:WAAS:LTCorrection:PERiod	306
<subsystem>:NAVigation:SBAS:MSAS:LTCorrection:PERiod	306
<subsystem>:NAVigation:SBAS:EGNOS:LTCorrection:PERiod	306
<subsystem>:NAVigation:SBAS:WAAS:CECovariance:PERiod	307
<subsystem>:NAVigation:SBAS:MSAS:CECovariance:PERiod	307
<subsystem>:NAVigation:SBAS:EGNOS:CECovariance:PERiod	307
<subsystem>:NAVigation:SBAS:WAAS:FCDegradation:PERiod	307
<subsystem>:NAVigation:SBAS:MSAS:FCDegradation:PERiod	307
<subsystem>:NAVigation:SBAS:EGNOS:FCDegradation:PERiod	307

<subsystem>:NAVigation:SBAS:WAAS:DFACTOR:PERIOD.....	307
<subsystem>:NAVigation:SBAS:MSAS:DFACTOR:PERIOD.....	307
<subsystem>:NAVigation:SBAS:EGNOS:DFACTOR:PERIOD.....	307
<subsystem>:NAVigation:SBAS:WAAS:SERVICE:PERIOD.....	307
<subsystem>:NAVigation:SBAS:MSAS:SERVICE:PERIOD.....	307
<subsystem>:NAVigation:SBAS:EGNOS:SERVICE:PERIOD.....	307
<subsystem>:NAVigation:SBAS:EGNOS:SERVICE:PERIOD.....	307
<subsystem>:NAVigation:SBAS:<RegSystem>:LTCORRECTION:UFIG.....	307
<subsystem>:NAVigation:SBAS:WAAS:LTCORRECTION:UFIG.....	307
<subsystem>:NAVigation:SBAS:MSAS:LTCORRECTION:UFIG.....	307
<subsystem>:NAVigation:SBAS:EGNOS:LTCORRECTION:UFIG.....	307
<subsystem>:NAVigation:SBAS:<RegSystem>:PRN<ch>:DURATION.....	307
<subsystem>:NAVigation:SBAS:WAAS:PRN<ch>:DURATION?.....	307
<subsystem>:NAVigation:SBAS:MSAS:PRN<ch>:DURATION?.....	307
<subsystem>:NAVigation:SBAS:EGNOS:PRN<ch>:DURATION?.....	307
<subsystem>:NAVigation:SBAS:<RegSystem>:PRN<ch>:FILE.....	308
<subsystem>:NAVigation:SBAS:WAAS:PRN<ch>:FILE.....	308
<subsystem>:NAVigation:SBAS:MSAS:PRN<ch>:FILE.....	308
<subsystem>:NAVigation:SBAS:EGNOS:PRN<ch>:FILE.....	308
<subsystem>:NAVigation:SBAS:<RegSystem>:PRN<ch>:SPAN.....	308
<subsystem>:NAVigation:SBAS:WAAS:PRN<ch>:SPAN?.....	308
<subsystem>:NAVigation:SBAS:MSAS:PRN<ch>:SPAN?.....	308
<subsystem>:NAVigation:SBAS:EGNOS:PRN<ch>:SPAN?.....	308
<subsystem>:NAVigation:SBAS:<RegSystem>:PRN<ch>:STATE.....	308
<subsystem>:NAVigation:SBAS:WAAS:PRN<ch>:STATE.....	308
<subsystem>:NAVigation:SBAS:MSAS:PRN<ch>:STATE.....	308
<subsystem>:NAVigation:SBAS:EGNOS:PRN<ch>:STATE.....	308

---

#### <subsystem>:NAVigation:SBAS:NDMode <Mode>

Sets the SBAS navigation data mode.

##### Parameters:

<Mode>                    MESSage | RAW  
 \*RST:                    MESSage

**Example:**                see [example "Configuring the SBAS settings"](#) on page 299

**Manual operation:**    See ["Navigation Data Mode"](#) on page 92

---

```
<subsystem>:NAVigation:SBAS:<RegSystem>[:STATE]
<subsystem>:NAVigation:SBAS:WAAS[:STATE] <State>
<subsystem>:NAVigation:SBAS:MSAS[:STATE] <State>
<subsystem>:NAVigation:SBAS:EGNOS[:STATE] <State>
```

Defines the regional systems for that the SBAS messages will be generated.

##### Parameters:

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

**Example:**                see [example "Configuring the SBAS settings"](#) on page 299

---

```

<subsystem>:NAVigation:SBAS:<RegSystem>:<MessageFile>:STATe
<subsystem>:NAVigation:SBAS:WAAS:ALManac:STATe <State>
<subsystem>:NAVigation:SBAS:MSAS:ALManac:STATe <State>
<subsystem>:NAVigation:SBAS:EGNOS:ALManac:STATe <State>
<subsystem>:NAVigation:SBAS:WAAS:RINex:STATe <State>
<subsystem>:NAVigation:SBAS:MSAS:RINex:STATe <State>
<subsystem>:NAVigation:SBAS:EGNOS:RINex:STATe <State>
<subsystem>:NAVigation:SBAS:WAAS:UTCOffset:STATe?
<subsystem>:NAVigation:SBAS:MSAS:UTCOffset:STATe?
<subsystem>:NAVigation:SBAS:EGNOS:UTCOffset:STATe?
<subsystem>:NAVigation:SBAS:WAAS:IGRid:STATe <State>
<subsystem>:NAVigation:SBAS:MSAS:IGRid:STATe <State>
<subsystem>:NAVigation:SBAS:EGNOS:IGRid:STATe <State>
<subsystem>:NAVigation:SBAS:WAAS:PRNMask:STATe <State>
<subsystem>:NAVigation:SBAS:MSAS:PRNMask:STATe <State>
<subsystem>:NAVigation:SBAS:EGNOS:PRNMask:STATe <State>
<subsystem>:NAVigation:SBAS:WAAS:FCORrection:STATe <State>
<subsystem>:NAVigation:SBAS:MSAS:FCORrection:STATe <State>
<subsystem>:NAVigation:SBAS:EGNOS:FCORrection:STATe <State>
<subsystem>:NAVigation:SBAS:WAAS:LTCorrection:STATe <State>
<subsystem>:NAVigation:SBAS:MSAS:LTCorrection:STATe <State>
<subsystem>:NAVigation:SBAS:EGNOS:LTCorrection:STATe <State>
<subsystem>:NAVigation:SBAS:WAAS:CECovariance:STATe <State>
<subsystem>:NAVigation:SBAS:MSAS:CECovariance:STATe <State>
<subsystem>:NAVigation:SBAS:EGNOS:CECovariance:STATe <State>
<subsystem>:NAVigation:SBAS:WAAS:FCDegradation:STATe <State>
<subsystem>:NAVigation:SBAS:MSAS:FCDegradation:STATe <State>
<subsystem>:NAVigation:SBAS:EGNOS:FCDegradation:STATe <State>
<subsystem>:NAVigation:SBAS:WAAS:DFACTOR:STATe <State>
<subsystem>:NAVigation:SBAS:MSAS:DFACTOR:STATe <State>
<subsystem>:NAVigation:SBAS:EGNOS:DFACTOR:STATe <State>
<subsystem>:NAVigation:SBAS:WAAS:SERVice:STATe <State>
<subsystem>:NAVigation:SBAS:MSAS:SERVice:STATe <State>
<subsystem>:NAVigation:SBAS:EGNOS:SERVice:STATe <State>

```

Enables generation of the particular SBAS correction data and regional system.

**Parameters:**

<State>                    0 | 1 | OFF | ON

**Example:**                see [example "Configuring the SBAS settings"](#) on page 299

---

```

<subsystem>:NAVigation:SBAS:<RegSystem>:<MessageFile>:FILE
<subsystem>:NAVigation:SBAS:WAAS:ALManac:FILE <Filename>
<subsystem>:NAVigation:SBAS:MSAS:ALManac:FILE <Filename>
<subsystem>:NAVigation:SBAS:EGNOS:ALManac:FILE <Filename>
<subsystem>:NAVigation:SBAS:WAAS:RINex:FILE <Filename>
<subsystem>:NAVigation:SBAS:MSAS:RINex:FILE <Filename>
<subsystem>:NAVigation:SBAS:EGNOS:RINex:FILE <Filename>
<subsystem>:NAVigation:SBAS:WAAS:IGRid:FILE <Filename>

```



```

<subsystem>:NAVigation:SBAS:MSAS:IGRID:FILE <Filename>
<subsystem>:NAVigation:SBAS:EGNOS:IGRID:FILE <Filename>
<subsystem>:NAVigation:SBAS:WAAS:PRNMask:FILE <Filename>
<subsystem>:NAVigation:SBAS:MSAS:PRNMask:FILE <Filename>
<subsystem>:NAVigation:SBAS:EGNOS:PRNMask:FILE <Filename>
<subsystem>:NAVigation:SBAS:WAAS:FCORrection:FILE <Filename>
<subsystem>:NAVigation:SBAS:MSAS:FCORrection:FILE <Filename>
<subsystem>:NAVigation:SBAS:EGNOS:FCORrection:FILE <Filename>
<subsystem>:NAVigation:SBAS:WAAS:LTCorrection:FILE <Filename>
<subsystem>:NAVigation:SBAS:MSAS:LTCorrection:FILE <Filename>
<subsystem>:NAVigation:SBAS:EGNOS:LTCorrection:FILE <Filename>
<subsystem>:NAVigation:SBAS:WAAS:CECovariance:FILE <Filename>
<subsystem>:NAVigation:SBAS:MSAS:CECovariance:FILE <Filename>
<subsystem>:NAVigation:SBAS:EGNOS:CECovariance:FILE <Filename>
<subsystem>:NAVigation:SBAS:WAAS:FCDegradation:FILE <Filename>
<subsystem>:NAVigation:SBAS:MSAS:FCDegradation:FILE <Filename>
<subsystem>:NAVigation:SBAS:EGNOS:FCDegradation:FILE <Filename>
<subsystem>:NAVigation:SBAS:WAAS:DFACTOR:FILE <Filename>
<subsystem>:NAVigation:SBAS:MSAS:DFACTOR:FILE <Filename>
<subsystem>:NAVigation:SBAS:EGNOS:DFACTOR:FILE <Filename>
<subsystem>:NAVigation:SBAS:WAAS:SERVICE:FILE <Filename>
<subsystem>:NAVigation:SBAS:MSAS:SERVICE:FILE <Filename>
<subsystem>:NAVigation:SBAS:EGNOS:SERVICE:FILE <Filename>

```

Selects the SBAS file for the corresponding SBAS regional system.

#### Parameters:

<Filename> string

To load a predefined file, specify only the file name or for loading RINEX files, also the file extension, e.g. \*.14n.

To load an user-defined file, specify the absolute file path with filename and extension:

```

*.alm, *.14n, *.prn_mask, *.iono_grid, *.f_corr,
*.lt_corr, *.fc_deg, *.covar, *.deg_fact or *.serv

```

**Example:** see [example "Configuring the SBAS settings"](#) on page 299

---

```

<subsystem>:NAVigation:SBAS:<RegSystem>:<MessageFile>:SPAN
<subsystem>:NAVigation:SBAS:WAAS:ALManac:SPAN?
<subsystem>:NAVigation:SBAS:MSAS:ALManac:SPAN?
<subsystem>:NAVigation:SBAS:EGNOS:ALManac:SPAN?
<subsystem>:NAVigation:SBAS:WAAS:RINex:SPAN?
<subsystem>:NAVigation:SBAS:MSAS:RINex:SPAN?
<subsystem>:NAVigation:SBAS:EGNOS:RINex:SPAN?
<subsystem>:NAVigation:SBAS:WAAS:IGRID:SPAN?
<subsystem>:NAVigation:SBAS:MSAS:IGRID:SPAN?
<subsystem>:NAVigation:SBAS:EGNOS:IGRID:SPAN?
<subsystem>:NAVigation:SBAS:WAAS:PRNMask:SPAN?
<subsystem>:NAVigation:SBAS:MSAS:PRNMask:SPAN?
<subsystem>:NAVigation:SBAS:EGNOS:PRNMask:SPAN?

```

```

<subsystem>:NAVigation:SBAS:WAAS:FCORrection:SPAN?
<subsystem>:NAVigation:SBAS:MSAS:FCORrection:SPAN?
<subsystem>:NAVigation:SBAS:EGNOS:FCORrection:SPAN?
<subsystem>:NAVigation:SBAS:WAAS:LTCorrection:SPAN?
<subsystem>:NAVigation:SBAS:MSAS:LTCorrection:SPAN?
<subsystem>:NAVigation:SBAS:EGNOS:LTCorrection:SPAN?
<subsystem>:NAVigation:SBAS:WAAS:CECovariance:SPAN?
<subsystem>:NAVigation:SBAS:MSAS:CECovariance:SPAN?
<subsystem>:NAVigation:SBAS:EGNOS:CECovariance:SPAN?
<subsystem>:NAVigation:SBAS:WAAS:FCDegradation:SPAN?
<subsystem>:NAVigation:SBAS:MSAS:FCDegradation:SPAN?
<subsystem>:NAVigation:SBAS:EGNOS:FCDegradation:SPAN?
<subsystem>:NAVigation:SBAS:WAAS:DFACTOR:SPAN?
<subsystem>:NAVigation:SBAS:MSAS:DFACTOR:SPAN?
<subsystem>:NAVigation:SBAS:EGNOS:DFACTOR:SPAN?
<subsystem>:NAVigation:SBAS:WAAS:SERVICE:SPAN?
<subsystem>:NAVigation:SBAS:MSAS:SERVICE:SPAN?
<subsystem>:NAVigation:SBAS:EGNOS:SERVICE:SPAN?

```

Queries the date and time span of the current SBAS file for the selected regional system.

**Return values:**

<FileSpan>                    string

**Example:**                    see [example "Configuring the SBAS settings"](#) on page 299

**Usage:**                        Query only

---

```

<subsystem>:NAVigation:SBAS:<RegSystem>:<MessageFile>:PERiod
<subsystem>:NAVigation:SBAS:WAAS:ALManac:PERiod <Interval>
<subsystem>:NAVigation:SBAS:MSAS:ALManac:PERiod <Interval>
<subsystem>:NAVigation:SBAS:EGNOS:ALManac:PERiod <Interval>
<subsystem>:NAVigation:SBAS:WAAS:RINex:PERiod <Interval>
<subsystem>:NAVigation:SBAS:MSAS:RINex:PERiod <Interval>
<subsystem>:NAVigation:SBAS:EGNOS:RINex:PERiod <Interval>
<subsystem>:NAVigation:SBAS:WAAS:UTCOffset:PERiod <UtcOffsetPeriod>
<subsystem>:NAVigation:SBAS:MSAS:UTCOffset:PERiod <UtcOffsetPeriod>
<subsystem>:NAVigation:SBAS:EGNOS:UTCOffset:PERiod <UtcOffsetPeriod>
<subsystem>:NAVigation:SBAS:WAAS:IGRid:PERiod <Interval>
<subsystem>:NAVigation:SBAS:MSAS:IGRid:PERiod <Interval>
<subsystem>:NAVigation:SBAS:EGNOS:IGRid:PERiod <Interval>
<subsystem>:NAVigation:SBAS:WAAS:PRNMask:PERiod <Interval>
<subsystem>:NAVigation:SBAS:MSAS:PRNMask:PERiod <Interval>
<subsystem>:NAVigation:SBAS:EGNOS:PRNMask:PERiod <Interval>
<subsystem>:NAVigation:SBAS:WAAS:FCORrection:PERiod <Interval>
<subsystem>:NAVigation:SBAS:MSAS:FCORrection:PERiod <Interval>
<subsystem>:NAVigation:SBAS:EGNOS:FCORrection:PERiod <Interval>
<subsystem>:NAVigation:SBAS:WAAS:LTCorrection:PERiod <Interval>
<subsystem>:NAVigation:SBAS:MSAS:LTCorrection:PERiod <Interval>
<subsystem>:NAVigation:SBAS:EGNOS:LTCorrection:PERiod <Interval>

```

```

<subsystem>:NAVigation:SBAS:WAAS:CECovariance:PERiod <Interval>
<subsystem>:NAVigation:SBAS:MSAS:CECovariance:PERiod <Interval>
<subsystem>:NAVigation:SBAS:EGNOS:CECovariance:PERiod <Interval>
<subsystem>:NAVigation:SBAS:WAAS:FCDegradation:PERiod <Interval>
<subsystem>:NAVigation:SBAS:MSAS:FCDegradation:PERiod <Interval>
<subsystem>:NAVigation:SBAS:EGNOS:FCDegradation:PERiod <Interval>
<subsystem>:NAVigation:SBAS:WAAS:DFACTOR:PERiod <Interval>
<subsystem>:NAVigation:SBAS:MSAS:DFACTOR:PERiod <Interval>
<subsystem>:NAVigation:SBAS:EGNOS:DFACTOR:PERiod <Interval>
<subsystem>:NAVigation:SBAS:WAAS:SERVICE:PERiod <Interval>
<subsystem>:NAVigation:SBAS:MSAS:SERVICE:PERiod <Interval>
<subsystem>:NAVigation:SBAS:EGNOS:SERVICE:PERiod <Interval>
<subsystem>:NAVigation:SBAS:EGNOS:SERVICE:PERiod <Interval>

```

Sets the periodicity of the SBAS message.

**Parameters:**

```

<Interval>          integer
                    Range:    0 to 999
                    *RST:    200

```

**Example:** see [example "Configuring the SBAS settings"](#) on page 299

```

<subsystem>:NAVigation:SBAS:<RegSystem>:LTCorrection:UIFG
<subsystem>:NAVigation:SBAS:WAAS:LTCorrection:UIFG <State>
<subsystem>:NAVigation:SBAS:MSAS:LTCorrection:UIFG <State>
<subsystem>:NAVigation:SBAS:EGNOS:LTCorrection:UIFG <State>

```

Enables/disables the use of the parameter IODE from the GNSS configuration.

**Parameters:**

```

<State>             0 | 1 | OFF | ON

```

**Example:** SOURCE:BB:GPS:NAVigation:SBAS:EGNOS:  
LTCorrection:UIFG

```

<subsystem>:NAVigation:SBAS:<RegSystem>:PRN<ch>:DURATION
<subsystem>:NAVigation:SBAS:WAAS:PRN<ch>:DURATION?
<subsystem>:NAVigation:SBAS:MSAS:PRN<ch>:DURATION?
<subsystem>:NAVigation:SBAS:EGNOS:PRN<ch>:DURATION?

```

Queries the duration of the current raw file per PRN and SBAS regional system.

**Return values:**

```

<Duration>          integer
                    Range:    0 to 100000
                    *RST:    0

```

**Example:** see [example "Configuring the SBAS settings"](#) on page 299

**Usage:** Query only

---

```

<subsystem>:NAVigation:SBAS:<RegSystem>:PRN<ch>:FILE
<subsystem>:NAVigation:SBAS:WAAS:PRN<ch>:FILE <Filename>
<subsystem>:NAVigation:SBAS:MSAS:PRN<ch>:FILE <Filename>
<subsystem>:NAVigation:SBAS:EGNOS:PRN<ch>:FILE <Filename>

```

Selects the SBAS raw file for the corresponding SBAS regional system and PRN.

**Parameters:**

<Filename>                    string  
                                   To load a predefined file, specify the file name and the file extension, e.g.\* .ems.  
                                   To load an used-defined file, specify the absolute file path with filename and extension

**Example:**                    see [example "Configuring the SBAS settings"](#) on page 299

---

```

<subsystem>:NAVigation:SBAS:<RegSystem>:PRN<ch>:SPAN
<subsystem>:NAVigation:SBAS:WAAS:PRN<ch>:SPAN?
<subsystem>:NAVigation:SBAS:MSAS:PRN<ch>:SPAN?
<subsystem>:NAVigation:SBAS:EGNOS:PRN<ch>:SPAN?

```

Queries the date and time span of the raw file of the corresponding PRN.

**Return values:**

<FileSpan>                    string

**Example:**                    see [example "Configuring the SBAS settings"](#) on page 299

**Usage:**                      Query only

---

```

<subsystem>:NAVigation:SBAS:<RegSystem>:PRN<ch>:STATe
<subsystem>:NAVigation:SBAS:WAAS:PRN<ch>:STATe <State>
<subsystem>:NAVigation:SBAS:MSAS:PRN<ch>:STATe <State>
<subsystem>:NAVigation:SBAS:EGNOS:PRN<ch>:STATe <State>

```

Enables/disables a PRN.

**Parameters:**

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

**Example:**                    see [example "Configuring the SBAS settings"](#) on page 299

---

## 6.12 Static Multipath Configuration



The multipath settings are enabled for instrument equipped with option GNSS Enhanced (R&S SMBV-K92).

---

**Example: Configuring the multipath settings for SV ID#20**

The following example uses GPS entry standard.

```

SOURCEl:BB:GPS:PRESet
SOURCEl:BB:GPS:SMOD USER
SOURCEl:BB:GPS:SATellite:COUNT?
//Response: 8
SOURCEl:BB:GPS:SATellite2:SVID?
//Response: 20
SOURCEl:BB:GPS:SAT2:STAN?
//Response: GALileo
SOURCEl:BB:GPS:SVID20:GALileoMPATH:TAP:COUNT 2
SOURCEl:BB:GPS:SVID20:GALileoMPATH:TAP1:POWer -3
SOURCEl:BB:GPS:SVID20:GALileoMPATH:TAP1:DSHift 100
SOURCEl:BB:GPS:SVID20:GALileoMPATH:TAP1:CPHase 3.14
SOURCEl:BB:GPS:SVID20:GALileoMPATH:TAP2:TSHift 1
SOURCEl:BB:GPS:SVID20:GALileo:MPATH:TAP2:POWer -5
SOURCEl:BB:GPS:SVID20:GALileo:MPATH:STATe ON

<subsystem>:SVID<ch>:<GNSS>:MPATH:STATe.....310
<subsystem>:SVID<ch>:SBAS:MPATH:STATe..... 310
<subsystem>:SVID<ch>:QZSS:MPATH:STATe..... 310
<subsystem>:SVID<ch>:BEIDou:MPATH:STATe.....310
<subsystem>:SVID<ch>:GALileo:MPATH:STATe..... 310
<subsystem>:SVID<ch>:GLONass:MPATH:STATe.....310
<subsystem>:SVID<ch>:GPS:MPATH:STATe..... 310
<subsystem>:SVID<ch>:<GNSS>:MPATH:TAP:COUNT..... 310
<subsystem>:SVID<ch>:SBAS:MPATH:TAP:COUNT.....310
<subsystem>:SVID<ch>:QZSS:MPATH:TAP:COUNT..... 310
<subsystem>:SVID<ch>:BEIDou:MPATH:TAP:COUNT..... 310
<subsystem>:SVID<ch>:GALileo:MPATH:TAP:COUNT.....310
<subsystem>:SVID<ch>:GLONass:MPATH:TAP:COUNT..... 310
<subsystem>:SVID<ch>:GPS:MPATH:TAP:COUNT..... 310
<subsystem>:SVID<ch>:<GNSS>:MPATH:TAP<us>:CPHase..... 311
<subsystem>:SVID<ch>:SBAS:MPATH:TAP<us>:CPHase.....311
<subsystem>:SVID<ch>:QZSS:MPATH:TAP<us>:CPHase.....311
<subsystem>:SVID<ch>:BEIDou:MPATH:TAP<us>:CPHase..... 311
<subsystem>:SVID<ch>:GALileo:MPATH:TAP<us>:CPHase.....311
<subsystem>:SVID<ch>:GLONass:MPATH:TAP<us>:CPHase..... 311
<subsystem>:SVID<ch>:GPS:MPATH:TAP<us>:CPHase.....311
<subsystem>:SVID<ch>:<GNSS>:MPATH:TAP<us>:DSHift..... 311
<subsystem>:SVID<ch>:SBAS:MPATH:TAP<us>:DSHift..... 311
<subsystem>:SVID<ch>:QZSS:MPATH:TAP<us>:DSHift..... 311
<subsystem>:SVID<ch>:BEIDou:MPATH:TAP<us>:DSHift.....311
<subsystem>:SVID<ch>:GALileo:MPATH:TAP<us>:DSHift.....311
<subsystem>:SVID<ch>:GLONass:MPATH:TAP<us>:DSHift.....311
<subsystem>:SVID<ch>:GPS:MPATH:TAP<us>:DSHift..... 311
<subsystem>:SVID<ch>:<GNSS>:MPATH:TAP<us>:POWer..... 312
<subsystem>:SVID<ch>:SBAS:MPATH:TAP<us>:POWer..... 312
<subsystem>:SVID<ch>:QZSS:MPATH:TAP<us>:POWer..... 312

```

<subsystem>:SVID<ch>:BEIDou:MPATH:TAP<us>:POWer.....	312
<subsystem>:SVID<ch>:GALileo:MPATH:TAP<us>:POWer.....	312
<subsystem>:SVID<ch>:GLONass:MPATH:TAP<us>:POWer.....	312
<subsystem>:SVID<ch>:GPS:MPATH:TAP<us>:POWer.....	312
<subsystem>:SVID<ch>:<GNSS>:MPATH:TAP<us>:TSHift.....	312
<subsystem>:SVID<ch>:SBAS:MPATH:TAP<us>:TSHift.....	312
<subsystem>:SVID<ch>:QZSS:MPATH:TAP<us>:TSHift.....	312
<subsystem>:SVID<ch>:BEIDou:MPATH:TAP<us>:TSHift.....	312
<subsystem>:SVID<ch>:GALileo:MPATH:TAP<us>:TSHift.....	312
<subsystem>:SVID<ch>:GLONass:MPATH:TAP<us>:TSHift.....	312
<subsystem>:SVID<ch>:GPS:MPATH:TAP<us>:TSHift.....	312

---

```

<subsystem>:SVID<ch>:<GNSS>:MPATH:STATE
<subsystem>:SVID<ch>:SBAS:MPATH:STATE <State>
<subsystem>:SVID<ch>:QZSS:MPATH:STATE <State>
<subsystem>:SVID<ch>:BEIDou:MPATH:STATE <State>
<subsystem>:SVID<ch>:GALileo:MPATH:STATE <State>
<subsystem>:SVID<ch>:GLONass:MPATH:STATE <State>
<subsystem>:SVID<ch>:GPS:MPATH:STATE <State>

```

Enables/disables the generation of multipath signals for the satellite with the specified SV ID belonging to the specified GNSS standard. Settings made with the subsequent <subsystem>:SVID<ch>:<GNSS>:MPATH commands are considered only if the multipath configuration is enabled.

**Parameters:**

```

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

```

**Example:** See [example "Configuring the multipath settings for SV ID#20"](#) on page 309.

**Options:** R&S SMBV-K92

---

```

<subsystem>:SVID<ch>:<GNSS>:MPATH:TAP:COUNT
<subsystem>:SVID<ch>:SBAS:MPATH:TAP:COUNT <Taps>
<subsystem>:SVID<ch>:QZSS:MPATH:TAP:COUNT <Taps>
<subsystem>:SVID<ch>:BEIDou:MPATH:TAP:COUNT <Taps>
<subsystem>:SVID<ch>:GALileo:MPATH:TAP:COUNT <Taps>
<subsystem>:SVID<ch>:GLONass:MPATH:TAP:COUNT <Taps>
<subsystem>:SVID<ch>:GPS:MPATH:TAP:COUNT <Taps>

```

Sets the paths number. The value determines the number of rows available for configuration.

For details see ["Number of Taps"](#) on page 153.

**Parameters:**

```

<Taps>          integer
                  Range:    1 to 10
                  *RST:    1

```

**Example:** See [example "Configuring the multipath settings for SV ID#20"](#) on page 309.

**Options:** R&S SMBV-K92

---

```

<subsystem>:SVID<ch>:<GNSS>:MPATH:TAP<us>:CPHase
<subsystem>:SVID<ch>:SBAS:MPATH:TAP<us>:CPHase <Phase>
<subsystem>:SVID<ch>:QZSS:MPATH:TAP<us>:CPHase <Phase>
<subsystem>:SVID<ch>:BEIDou:MPATH:TAP<us>:CPHase <Phase>
<subsystem>:SVID<ch>:GALileo:MPATH:TAP<us>:CPHase <Phase>
<subsystem>:SVID<ch>:GLONass:MPATH:TAP<us>:CPHase <Phase>
<subsystem>:SVID<ch>:GPS:MPATH:TAP<us>:CPHase <Phase>

```

Sets the carrier phase, used in case of multipath simulation.

**Suffix:**

<us> 1..10

**Parameters:**

<Phase> float  
 Range: 0 to 6.28  
 Increment: 0.01  
 \*RST: 0  
 Default unit: rad

**Example:** See [example "Configuring the multipath settings for SV ID#20"](#) on page 309.

**Options:** R&S SMBV-K92

---

```

<subsystem>:SVID<ch>:<GNSS>:MPATH:TAP<us>:DSHift
<subsystem>:SVID<ch>:SBAS:MPATH:TAP<us>:DSHift <DopplerShift>
<subsystem>:SVID<ch>:QZSS:MPATH:TAP<us>:DSHift <DopplerShift>
<subsystem>:SVID<ch>:BEIDou:MPATH:TAP<us>:DSHift <DopplerShift>
<subsystem>:SVID<ch>:GALileo:MPATH:TAP<us>:DSHift <DopplerShift>
<subsystem>:SVID<ch>:GLONass:MPATH:TAP<us>:DSHift <DopplerShift>
<subsystem>:SVID<ch>:GPS:MPATH:TAP<us>:DSHift <DopplerShift>

```

Defines the additional Doppler shift of the simulated signal of the satellite, used to simulate multipath conditions.

**Suffix:**

<us> 1..10

**Parameters:**

<DopplerShift> float  
 Range: -10E3 to 10E3  
 Increment: 0.01  
 \*RST: 0  
 Default unit: Hz

**Example:** See [example "Configuring the multipath settings for SV ID#20"](#) on page 309.

**Options:** R&S SMBV-K92

---

```
<subsystem>:SVID<ch>:<GNSS>:MPATH:TAP<us>:POWER
<subsystem>:SVID<ch>:SBAS:MPATH:TAP<us>:POWER <Power>
<subsystem>:SVID<ch>:QZSS:MPATH:TAP<us>:POWER <Power>
<subsystem>:SVID<ch>:BEIDou:MPATH:TAP<us>:POWER <Power>
<subsystem>:SVID<ch>:GALileo:MPATH:TAP<us>:POWER <Power>
<subsystem>:SVID<ch>:GLONass:MPATH:TAP<us>:POWER <Power>
<subsystem>:SVID<ch>:GPS:MPATH:TAP<us>:POWER <Power>
```

Sets the additional power of the satellite in dB, used to simulate multipath conditions.

See [chapter 4.10.1, "Power Configuration"](#), on page 115 for information about the power calculation.

**Suffix:**

<us> 1..10  
Tap

**Parameters:**

<Power> float  
Range: -15 to 0  
Increment: 0.01  
\*RST: 0  
Default unit: dB

**Example:** See [example "Configuring the multipath settings for SV ID#20"](#) on page 309 and [example "Configuring the power settings "](#) on page 329.

**Options:** R&S SMBV-K92

---

```
<subsystem>:SVID<ch>:<GNSS>:MPATH:TAP<us>:TSHift
<subsystem>:SVID<ch>:SBAS:MPATH:TAP<us>:TSHift <TimeShift>
<subsystem>:SVID<ch>:QZSS:MPATH:TAP<us>:TSHift <TimeShift>
<subsystem>:SVID<ch>:BEIDou:MPATH:TAP<us>:TSHift <TimeShift>
<subsystem>:SVID<ch>:GALileo:MPATH:TAP<us>:TSHift <TimeShift>
<subsystem>:SVID<ch>:GLONass:MPATH:TAP<us>:TSHift <TimeShift>
<subsystem>:SVID<ch>:GPS:MPATH:TAP<us>:TSHift <TimeShift>
```

Sets an additional delay of the selected satellite, used to simulate multipath conditions.

**Suffix:**

<us> 1..10

**Parameters:**

<TimeShift> float  
Range: 0 to 9.99999  
Increment: 0.00001  
\*RST: 0  
Default unit: Chips



**Example:** See [example "Configuring the multipath settings for SV ID#20"](#) on page 309.

**Options:** R&S SMBV-K92

## 6.13 Satellites Configuration and Satellites Signal Settings

Configurations with more than 6 satellites require option R&S SMBV-K91, more than 12 satellites require option R&S SMBV-K96.

### Example: Configuring the satellite's constellation

The following example uses GPS entry standard.

```
SOURcel:BB:GPS:PRESet
SOURcel:BB:GPS:SMODE USER

// enable hybrid GNSS configuration
SOURcel:BB:GPS:HYBRid:GPS:STATe ON
SOURcel:BB:GPS:HYBRid:GALileo:STATe ON
SOURcel:BB:GPS:HYBRid:GLONass:STATe ON
SOURcel:BB:GPS:HYBRid:BEIDou:STATe ON

SOURcel:BB:GPS:RFBand L1
SOURcel:BB:GPS:PRFFrequency

SOURcel:BB:GPS:SEMask 7.5
SOURcel:BB:GPS:SATellite:COUNT 8

SOURcel:BB:GPS:SATellite:GRTP ON
SOURcel:BB:GPS:SATellite1:STANdard?
//Response: GPS
SOURcel:BB:GPS:SATellite1:SIGNal?
//Response: CAC
SOURcel:BB:GPS:SATellite1:SVID?
//Response: 30
SOURcel:BB:GPS:SATellite1:SCRate?
//Response: 1023000
SOURcel:BB:GPS:SATellite1:MODulation?
//Response: BPSK
SOURcel:BB:GPS:SATellite1:DURation?
//Response: 13329
SOURcel:BB:GPS:SATellite1:PRANge?
//Response: 20531267.5147461
SOURcel:BB:GPS:SATellite1:PRBias 0
SOURcel:BB:GPS:SATellite1:TSHift?
//Response: 70060.0902627953
SOURcel:BB:GPS:SATellite1:DSHift?
//Response: 1146.05037064872
```

```
SOURcel:BB:GPS:SATellite1:ICPHase?
//Response: 6.25362425028864
SOURcel:BB:GPS:SATellite1:FREQuency?
//Response: 1575421146.05037
SOURcel:BB:GPS:SATellite1:CACRate?
//Response: 1023000.74418801
SOURcel:BB:GPS:SVID19:GPS:MPAT:STATe?
//Response: 0
SOURcel:BB:GPS:SATellite1:STATe?
//Response: 1
```

```
SOURcel:BB:GPS:SATellite5:STANdard?
//Response: BEID
SOURcel:BB:GPS:SATellite5:SIGNal?
//Response: B1C
SOURcel:BB:GPS:SATellite5:SVID?
//Response: 33
SOURcel:BB:GPS:SATellite5:ORBit?
//Response: MEO
```

```
SOURcel:BB:GPS:SATellite7:STANdard?
//Response: GLON
SOURcel:BB:GPS:SATellite7:SIGNal?
//Response: RCA
SOURcel:BB:GPS:SATellite7:SVID?
//Response: 14
SOURcel:BB:GPS:SATellite7:FNUMber?
//Response: -7
SOURcel:BB:GPS:SATellite7:SCRate?
//Response: 511000
```

```
SOURcel:BB:GPS:STATe ON
SOURcel:BB:GPS:HDOP?
//Response: 1.12895407129922
SOURcel:BB:GPS:PDOP?
//Response: 2.15878433755758
```

<subsystem>:SPReading[:STATe]	315
<subsystem>:SEMAsk	315
<subsystem>:HDOP?	315
<subsystem>:PDOP?	316
<subsystem>:GOConstellation	316
<subsystem>:SATellite:GRTProjection	316
<subsystem>:SATellite:COUNT	316
<subsystem>:SATellite<st>:CACRate?	317
<subsystem>:SATellite<st>:DSHift	317
<subsystem>:SATellite<st>:DURation?	318
<subsystem>:SATellite<st>:FNUMber	318
<subsystem>:SATellite<st>:FREQuency?	318
<subsystem>:SATellite<st>:CPHase	318

<subsystem>:SATellite<st>:ICPHase.....	319
<subsystem>:SATellite<st>:PCRate?.....	319
<subsystem>:SATellite<st>:MODulation?.....	319
<subsystem>:SATellite<st>:ORBit?.....	320
<subsystem>:SATellite<st>:PRANge.....	320
<subsystem>:SATellite<st>:PRBias.....	320
<subsystem>:SATellite<st>:SCRate?.....	321
<subsystem>:SATellite<st>:SIGNal.....	321
<subsystem>:SATellite<st>:STANdard.....	321
<subsystem>:SATellite<st>:STATe.....	321
<subsystem>:SATellite<st>:SVID.....	322
<subsystem>:SATellite<st>:TSHift.....	322

---

### <subsystem>:SPReading[:STATe] <State>

Activates/deactivates spreading. When spreading is deactivated the pure navigation data is modulated onto the RF carrier.

This setting is only available for <subsystem>:SMODESTATIC.

#### Parameters:

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

#### Example:

```
BB:GPS:SMOD STAT
BB:GPS:SPR:STAT ON
```

**Manual operation:** See ["Use Spreading"](#) on page 123

---

### <subsystem>:SEMAsk <SEMAsk>

For <subsystem>:SMODE AUTO or USER, sets the satellite's elevation mask.

#### Parameters:

<SEMAsk>            float  
 Range:            2.5 to 10.0  
 \*RST:            5

#### Example:

See [example "Configuring the satellite's constellation"](#) on page 313.

**Manual operation:** See ["Elevation Mask"](#) on page 123

---

### <subsystem>:HDOP?

For <subsystem>:SMODE AUTO or USER, queries the HDOP (Horizontal Dilution of Precision) of the selected satellite constellation at the beginning of the simulation.

#### Return values:

<Hdop>            float  
 Increment:       0.01

**Example:** See [example "Configuring the satellite's constellation"](#) on page 313.

**Usage:** Query only

**Manual operation:** See ["Initial HDOP/PDOP"](#) on page 124

#### <subsystem>:PDOP?

For <subsystem>:SMODE AUTO or USER, queries the PDOP (Position Dilution of Precision) of the selected satellite constellation at the beginning of the simulation.

**Return values:**

<PDop> float  
 Increment: 0.01  
 \*RST: 0

**Example:** See [example "Configuring the satellite's constellation"](#) on page 313.

**Usage:** Query only

**Manual operation:** See ["Initial HDOP/PDOP"](#) on page 124

#### <subsystem>:GOConstellation

Retrieves an optimal satellite constellation for the selected Almanac/RINEX file, elevation mask and the enabled maximum number of satellites.

**Usage:** Event

**Manual operation:** See ["Get Optimal Constellation"](#) on page 124

#### <subsystem>:SATellite:GRTProjection <Glb\_RT\_proj>

Forces ephemeris projection for all satellites, i.e. performs the same action as the command <subsystem>:SVID<ch>:<GNSS>:NMESsage:RTPROjection.

**Parameters:**

<Glb\_RT\_proj> 0 | 1 | OFF | ON  
 \*RST: 0

**Example:** See [example "Configuring the satellite's constellation"](#) on page 313.

**Manual operation:** See ["Time Projection of Navigation Data"](#) on page 52

#### <subsystem>:SATellite:COUNT <SatCount>

Defines the maximum number of satellites that can be simulated.

The minimum allowed number depends on the selected simulation mode (see <subsystem>:SMODE on page 250) .

Configurations with one satellite are allowed only for `<subsystem>:SMODE STATIC`. For `<subsystem>:SMODE AUTO` or `USER`, four satellites or more are required.

The number of satellites determines the value range of the suffix for `<subsystem>:SATellite<st>` commands.

**Parameters:**

`<SatCount>` integer  
 Range: 1 to 12  
 \*RST: 1

**Example:** See [example "Configuring the satellite's constellation"](#) on page 313.

**Options:** R&S SMBV-K91 (more than 6 satellites)  
 R&S SMBV-K96 (more than 12 satellites)

**Manual operation:** See ["Maximum Number of Satellites"](#) on page 125

**`<subsystem>:SATellite<st>:CACRate?`**

Queries the currently valid values for the chip rate.

**Return values:**

`<CACRate>` float  
 Default unit: Hz

**Example:** See [example "Configuring the satellite's constellation"](#) on page 313.

**Usage:** Query only

**Manual operation:** See ["Resulting Start Chip Rate"](#) on page 131

**`<subsystem>:SATellite<st>:DSHift <DopplerShift>`**

Defines the Doppler shift of the simulated signal of the satellite.

**Parameters:**

`<DopplerShift>` float  
 Range: -100E3 to 100E3  
 Increment: 0.01  
 \*RST: 0  
 Default unit: Hz

**Example:** See [example "Configuring the satellite's constellation"](#) on page 313.

**Manual operation:** See ["\(Initial\) Doppler Shift"](#) on page 130

**<subsystem>:SATellite<st>:DURation?**

Queries the time the satellite's elevation is higher than 2.5, 5, 7.5 or 10° starting at the first simulation moment of the satellite of interest, as selected with the command [<subsystem>:SEMAsk](#).

**Return values:**

<Duration> float  
Default unit: s

**Example:** See [example "Configuring the satellite's constellation"](#) on page 313.

**Usage:** Query only

**Manual operation:** See ["Duration \(Elev. > 2.5/5/7.5/10°\)"](#) on page 129

**<subsystem>:SATellite<st>:FNUMBER <FrequencyNumber>**

The command sets or queries the frequency number, depending on the used data source. The parameter corresponds to the sub-carrier used to modulate the GLONASS satellite.

**Parameters:**

<FrequencyNumber> integer  
Range: -7 to 24  
\*RST: 0

**Manual operation:** See ["Frequency Number"](#) on page 128

**<subsystem>:SATellite<st>:FREQUENCY?**

Queries the currently valid values for Doppler-shifted carrier frequency.

**Return values:**

<Frequency> float  
Default unit: Hz

**Example:** See [example "Configuring the satellite's constellation"](#) on page 313.

**Usage:** Query only

**Manual operation:** See ["Resulting Start Frequency"](#) on page 131

**<subsystem>:SATellite<st>:CPHase <Code>**

Sets the initial code phase in chips while working in static simulation mode and using arbitrary navigation data source.

**Parameters:**

<Code> float  
 Range: 0 to 20459.99  
 Increment: 0.01  
 \*RST: 0

**Manual operation:** See ["Initial Code Phase"](#) on page 130

**<subsystem>:SATellite<st>:ICPhase <ICPhase>**

Sets the initial carrier phase.

This setting is only available for <subsystem>:SMODE STATIC. The parameter is updated automatically for USER and AUTO.

**Parameters:**

<ICPhase> float  
 Range: 0 to 6.28  
 Increment: 0.01  
 \*RST: 0

**Example:** See [example "Configuring the satellite's constellation"](#) on page 313.

**Manual operation:** See ["Initial Carrier Phase "](#) on page 131

**<subsystem>:SATellite<st>:PCRate?**

Queries the currently valid values for the chip rate of the P-code.

**Return values:**

<PCRate> float

**Usage:** Query only

**Options:** R&S SMBV-K93

**Manual operation:** See ["Resulting P-Code Chip Rate"](#) on page 132

**<subsystem>:SATellite<st>:MODulation?**

Queries the modulation used for modulating the carrier signal.

**Return values:**

<Modulation> BPSK | CBOC  
 \*RST: BPSK

**Example:** See [example "Configuring the satellite's constellation"](#) on page 313.

**Usage:** Query only

**Manual operation:** See ["Modulation"](#) on page 129

**<subsystem>:SATellite<st>:ORBit?**

For BeiDou satellites, queries the orbit type the corresponding satellite is using.

**Return values:**

<OrbitType> MEO | IGSO | GEO  
\*RST: GEO

**Example:** See [example "Configuring the satellite's constellation"](#) on page 313.

**Usage:** Query only

**Manual operation:** See ["Orbit Type"](#) on page 129

**<subsystem>:SATellite<st>:PRANge <Pseudorange>**

For `<subsystem>:SMODE STATIC`, defines the propagation delay from satellite to receiver in meters.

**Parameters:**

<Pseudorange> float  
Range: 0 to (2.499E6)/1.023E6\*SPEED\_OF\_LIGHT  
Increment: 0.001  
\*RST: 0  
Default unit: m

**Example:** See [example "Configuring the satellite's constellation"](#) on page 313.

**Manual operation:** See ["Pseudorange"](#) on page 130

**<subsystem>:SATellite<st>:PRBias <PseudorangeBias>**

Sets a bias to the pseudorange of a satellite (see also `<subsystem>:SATellite<st>:PRANge` on page 320).

This setting is only available for `<subsystem>:SMODE AUTO` or `USER`.

**Parameters:**

<PseudorangeBias> float  
Range: -1000 to 1000  
Increment: 0.001  
\*RST: 0  
Default unit: m

**Example:** See [example "Configuring the satellite's constellation"](#) on page 313.

**Manual operation:** See ["Pseudorange Bias"](#) on page 130



---

**<subsystem>:SATellite<st>:SCRate?**

Queries the standard chip rate.

**Return values:**

<ChipRate> float  
Default unit: Hz

**Example:** See [example "Configuring the satellite's constellation"](#) on page 313.

**Usage:** Query only

**Manual operation:** See ["Standard Chip Rate"](#) on page 128

---

**<subsystem>:SATellite<st>:SIGNal <Signal>**

Selects the type of signal the corresponding satellite is using.

Enabled [<subsystem>:UMGPs](#) is prerequisites for using P codes.

**Parameters:**

<Signal> CACode | PCODEe | CAPQ | CAPI | E1Def | RCA | B1CA | QCA | SCA  
\*RST: CACode

**Example:** See [example "Configuring the satellite's constellation"](#) on page 313.

**Manual operation:** See ["Signal\(s\)"](#) on page 126

---

**<subsystem>:SATellite<st>:STANDard <Standard>**

Selects the navigation standard the corresponding satellite belongs to. The available GNSS standards depend on the selected hybrid GNSS configuration and the installed options.

**Parameters:**

<Standard> GPS | GALileo | GLONass | BEIDou | QZSS | SBAS  
\*RST: GPS

**Example:** See [example "Configuring the satellite's constellation"](#) on page 313.

**Manual operation:** See ["Standard"](#) on page 126

---

**<subsystem>:SATellite<st>:STATe <State>**

Activates/deactivates the satellite.

**Parameters:**

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

**Example:** See [example "Configuring the satellite's constellation"](#) on page 313.

**Manual operation:** See ["Satellite State"](#) on page 126

**<subsystem>:SATellite<st>:SVID <Svid>**

Defines the Space Vehicle ID of the satellite to be simulated. This value is used to generate the corresponding spreading code.

For `<subsystem>:NAVigation:DATA:RNDaTa`, only the valid IDs which are listed in the almanac are selectable; for arbitrary data, any ID can be selected.

**Parameters:**

`<Svid>` integer  
 Range: 1 to 210  
 \*RST: 1  
 SV ID = -1 corresponds to the manual selection "N.A. (not assigned)"

**Example:** See [example "Configuring the satellite's constellation"](#) on page 313.

**Manual operation:** See ["SV-ID/PRN"](#) on page 127

**<subsystem>:SATellite<st>:TSHift <TimeShift>**

Defines the propagation delay from satellite to receiver.

**Parameters:**

`<TimeShift>` float  
 time shift in chips  
 Range: 0 to 2499999.999  
 Increment: 0.001  
 \*RST: 0

**Example:** See [example "Configuring the satellite's constellation"](#) on page 313.

**Manual operation:** See ["Time Shift/ chips"](#) on page 130

## 6.14 Modulation Control

<code>&lt;subsystem&gt;:SATellite&lt;st&gt;:MCONtrol:DATA&lt;ch&gt;[:STATe]</code> .....	323
<code>&lt;subsystem&gt;:SATellite&lt;st&gt;:MCONtrol:DRATe</code> .....	323
<code>&lt;subsystem&gt;:SATellite&lt;st&gt;:MCONtrol:MEANdering[:STATe]</code> .....	323
<code>&lt;subsystem&gt;:SATellite&lt;st&gt;:MCONtrol:SECONdary&lt;ch&gt;[:STATe]</code> .....	323
<code>&lt;subsystem&gt;:SATellite&lt;st&gt;:MCONtrol:SPReading&lt;ch&gt;[:STATe]</code> .....	323
<code>&lt;subsystem&gt;:SATellite&lt;st&gt;:MCONtrol:TSEquence[:STATe]</code> .....	324

---

**<subsystem>:SATellite<st>:MCONtrol:DATA<ch>[:STATe]** <DataSourceState>

Disables/enables the data signal component of a satellite navigation signal.

**Parameters:**

<DataSourceState> 0 | 1 | OFF | ON  
 \*RST: 1

**Manual operation:** See "[Modulation Control](#)" on page 133

---

**<subsystem>:SATellite<st>:MCONtrol:DRATe** <DataRate>

Sets the data rate of the satellite navigation signal.

**Parameters:**

<DataRate> D50HZ | D100HZ | D250HZ | D1000HZ

**Manual operation:** See "[Modulation Control](#)" on page 133

---

**<subsystem>:SATellite<st>:MCONtrol:MEANdering[:STATe]** <MeanderingState>

Disables/enables meandering, i.e. doubling the data rate of a GLONASS satellite navigation signal.

**Parameters:**

<MeanderingState> 0 | 1 | OFF | ON  
 \*RST: 1

**Manual operation:** See "[Modulation Control](#)" on page 133

---

**<subsystem>:SATellite<st>:MCONtrol:SECONdary<ch>[:STATe]**  
 <SecondaryCode>

Disables/enables the secondary code in the pilot channel of Galileo, or in the D1 Navigation Message for BeiDou.

**Parameters:**

<SecondaryCode> 0 | 1 | OFF | ON  
 \*RST: 1

**Manual operation:** See "[Modulation Control](#)" on page 133

---

**<subsystem>:SATellite<st>:MCONtrol:SPREading<ch>[:STATe]** <SpreadingState>

Disables/enables the spreading signal component of a satellite navigation signal.

Using the suffix *SPREading<ch>*, you can select between several spreading components.

**Parameters:**

<SpreadingState> 0 | 1 | OFF | ON  
 \*RST: 1

**Manual operation:** See "Modulation Control" on page 133

---

**<subsystem>:SATellite<st>:MCONtrol:TSEQUence[:STATE] <TimeSequence>**

Disables/enables the time signal component of GLONASS signals.

**Parameters:**

<TimeSequence> 0 | 1 | OFF | ON  
 \*RST: 1

**Manual operation:** See "Modulation Control" on page 133

## 6.15 Signal Dynamics

<subsystem>:SATellite<st>:SDYNamics:ACCel:MAX.....	324
<subsystem>:SATellite<st>:SDYNamics:CAPeriod.....	324
<subsystem>:SATellite<st>:SDYNamics:CONFig.....	325
<subsystem>:SATellite<st>:SDYNamics:CVPeriod.....	325
<subsystem>:SATellite<st>:SDYNamics:DSHift.....	325
<subsystem>:SATellite<st>:SDYNamics:DSHift:UNIT.....	326
<subsystem>:SATellite<st>:SDYNamics:IDSHift.....	326
<subsystem>:SATellite<st>:SDYNamics:JERK:MAX.....	326
<subsystem>:SATellite<st>:SDYNamics:PROFile.....	326
<subsystem>:SATellite<st>:SDYNamics:RPERiod?.....	327
<subsystem>:SATellite<st>:SDYNamics:TOFFset.....	327

---

**<subsystem>:SATellite<st>:SDYNamics:ACCel:MAX <MaxAccel>**

Queries the maximum acceleration of a predefined profile, or defines a user-specific value. Select the corresponding profile with <subsystem>:SATellite<st>:SDYNamics:CONFig.

**Parameters:**

<MaxAccel> float  
 Range: 0.01 to 1000  
 Increment: 0.0001  
 \*RST: 0.5

**Manual operation:** See "Max. Acceleration" on page 135

---

**<subsystem>:SATellite<st>:SDYNamics:CAPeriod <Period>**

Queries the constant acceleration period of a predefined profile, or sets a user-specific value. Select the corresponding profile with <subsystem>:SATellite<st>:SDYNamics:CONFig.

**Parameters:**

<Period> float  
 Range: 0.1 to 10800  
 Increment: 0.1  
 \*RST: 45

**Manual operation:** See "[Const. Acc. Period](#)" on page 135

**<subsystem>:SATellite<st>:SDYnamics:CONFig** <PredefinedConfi>

Selects a Doppler profile.

**Parameters:**

<PredefinedConfi> USER | VEL1 | VEL2  
**VEL1|VEL2**  
 Predefined Doppler profiles with firmly set parameters.  
**USER**  
 Enables the edit mode to define a user-specific Doppler profile.  
 \*RST: VEL1

**Manual operation:** See "[Predefined Config.](#)" on page 135

**<subsystem>:SATellite<st>:SDYnamics:CVPeriod** <Period>

Queries the constant velocity period of a predefined profile, or sets a user-specific value. . Select the corresponding profile with [<subsystem>:SATellite<st>:SDYnamics:CONFig](#).

**Parameters:**

<Period> float  
 Range: 0.1 to 10800  
 Increment: 0.1  
 \*RST: 5

**<subsystem>:SATellite<st>:SDYnamics:DSHift** <DopplerShift>

Sets the Doppler shift for a constant signal profile, selected with [<subsystem>:SATellite<st>:SDYnamics:PROFile](#) .

**Parameters:**

<DopplerShift> float  
 Range: -100E3 to 100E3  
 Increment: 0.01  
 \*RST: 0

**Manual operation:** See "[Doppler Shift \(Constant\)](#)" on page 135

---

**<subsystem>:SATellite<st>:SDYnAmics:DSHift:UNIT <DopplerShiftUni>**

Selects the unit for displaying the signal in the graph.

**Parameters:**

<DopplerShiftUni>    HZ | MPS  
                           \*RST:        HZ

**Manual operation:**    See "[Doppler Shift Unit](#)" on page 134

---

**<subsystem>:SATellite<st>:SDYnAmics:IDSHift <InitDopplShift>**

Queries the doppler shift of a predefined high order profile. For user-defined dynamics profiles, you can determine the parameter.

**Parameters:**

<InitDopplShift>        float  
                           Range:        -19042 to 19042  
                           Increment: 0.0001  
                           \*RST:        5

**Manual operation:**    See "[Initial Doppler Shift](#)" on page 135

---

**<subsystem>:SATellite<st>:SDYnAmics:JERK:MAX <MaxJerk>**

Queries the maximum jerk of a predefined profile, or determines a user-specific value. Select the corresponding profile with [<subsystem>:SATellite<st>:SDYnAmics:CONFig](#).

**Parameters:**

<MaxJerk>                float  
                           Range:        0.1 to 7E4  
                           Increment: 0.0001  
                           \*RST:        1

**Manual operation:**    See "[Max. Jerk](#)" on page 136

---

**<subsystem>:SATellite<st>:SDYnAmics:PROFile <Profile>**

Selects a signal dynamics profile.

**Parameters:**

<Profile>                CONStant | HIGH  
                           **CONStant**  
                           Constant signal with definable Doppler shift.  
                           **HIGH**  
                           Mode for using Doppler profiles with higher dynamics.  
                           \*RST:        CONStant

**Manual operation:**    See "[Dynamics Profile](#)" on page 134

---

**<subsystem>:SATellite<st>:SDYNAmics:RPERiod?**

Queries the time that elapses until the Doppler signal of a high order velocity profile repeats.

**Return values:**

<Period> float  
 Range: 0 to 90000  
 Increment: 0.1  
 \*RST: 0

**Usage:** Query only

**Manual operation:** See "[Const. Vel. Period](#)" on page 135

**<subsystem>:SATellite<st>:SDYNAmics:TOFFset <StartTimeOffset>**

Sets a time delay for the Doppler signal.

**Parameters:**

<StartTimeOffset> float  
 Range: 0 to 90000  
 Increment: 0.1  
 \*RST: 0

**Manual operation:** See "[Start Time Offset](#)" on page 135

## 6.16 Global Signal Configuration

<subsystem>:SVID:SIGNal:COUPling.....	327
<subsystem>:SVID<ch>:<GNSS>:SIGNal.....	328
<subsystem>:SVID<ch>:SBAS:SIGNal.....	328
<subsystem>:SVID<ch>:QZSS:SIGNal.....	328
<subsystem>:SVID<ch>:BEIDou:SIGNal.....	328
<subsystem>:SVID<ch>:GALileo:SIGNal.....	328
<subsystem>:SVID<ch>:GLONass:SIGNal.....	328
<subsystem>:SVID<ch>:GPS:SIGNal.....	328
<subsystem>:SVID<ch>:<GNSS>:POWer.....	328
<subsystem>:SVID<ch>:SBAS:POWer.....	328
<subsystem>:SVID<ch>:QZSS:POWer.....	328
<subsystem>:SVID<ch>:BEIDou:POWer.....	328
<subsystem>:SVID<ch>:GALileo:POWer.....	328
<subsystem>:SVID<ch>:GLONass:POWer.....	328
<subsystem>:SVID<ch>:GPS:POWer.....	328

**<subsystem>:SVID:SIGNal:COUPling <State>**

Enables the configuration of all SV IDs simultaneously. Current settings are overwritten.

**Parameters:**

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

**Manual operation:** See "SV ID Signal Coupling" on page 137

**<subsystem>:SVID<ch>:<GNSS>:SIGNal**  
**<subsystem>:SVID<ch>:SBAS:SIGNal** <Signal>  
**<subsystem>:SVID<ch>:QZSS:SIGNal** <Signal>  
**<subsystem>:SVID<ch>:BEIDou:SIGNal** <Signal>  
**<subsystem>:SVID<ch>:GALileo:SIGNal** <Signal>  
**<subsystem>:SVID<ch>:GLONass:SIGNal** <Signal>  
**<subsystem>:SVID<ch>:GPS:SIGNal** <Signal>

Sets the type of signal a SV ID will use in the moment the corresponding satellite becomes visible.

**Parameters:**

<Signal> CACode | PCODEe | CAPQ | CAPI | E1Def | RCA | B1CA | QCA | SCA  
 GPS signals: CACode|PCODEe|CAPQ|CAPI  
 Galileo signals: E1Def  
 GLONASS signals: RCA  
 BeiDou signals: B1CA  
 BeiDou signals: QCA  
 SBAS signals: SCA  
 \*RST: CACode

**Options:** R&S SMBV-K93

**<subsystem>:SVID<ch>:<GNSS>:POWer**  
**<subsystem>:SVID<ch>:SBAS:POWer** <Power>  
**<subsystem>:SVID<ch>:QZSS:POWer** <Power>  
**<subsystem>:SVID<ch>:BEIDou:POWer** <Power>  
**<subsystem>:SVID<ch>:GALileo:POWer** <Power>  
**<subsystem>:SVID<ch>:GLONass:POWer** <Power>  
**<subsystem>:SVID<ch>:GPS:POWer** <Power>

Sets the power a SV ID will use the moment the corresponding satellite becomes visible and is simulated.

**Parameters:**

<Power> float  
 Range: -21 to 0  
 Increment: 0.01  
 \*RST: 0

**Options:** R&S SMBV-K93



## 6.17 Power Tuning and Power Settings

### Example: Configuring the power settings

The following example uses GPS entry standard and specifies a reference satellite.

```

SOURCEl:BB:GPS:PRESet
SOURCEl:BB:GPS:SMODE USER
SOURCEl:BB:GPS:HYBRId:GALileo:STATe ON
SOURCEl:BB:GPS:SATellite:COUNT 8
SOURCEl:BB:GPS:GOConstellation
SOURCEl:BB:GPS:SATellite2:STANdard?
//Response: GALileo
SOURCEl:BB:GPS:SATellite2:SVID?
//Response: 23
SOURCEl:BB:GPS:SVID23:GALileo:MPATH:TAP:COUNT 2
SOURCEl:BB:GPS:SVID23:GALileo:MPATH:TAP1:POWER -3
SOURCEl:BB:GPS:SVID23:GALileo:MPATH:TAP2:POWER -5
SOURCEl:BB:GPS:SVID23:GALileo:MPATH:STATe ON
SOURCEl:BB:GPS:SATellite2:STATe ON
SOURCEl:BB:GPS:POWER:MODE AUTO
SOURCEl:BB:GPS:POWER:REFerence:SAT 1
SOURCEl:BB:GPS:POWER:REFerence:STANdard?
//Response: GPS
SOURCEl:BB:GPS:POWER:REFerence:SIGNal?
//Response: CACode
SOURCEl:BB:GPS:POWER:REFerence:DIStance?
//Response: 20720
SOURCEl:BB:GPS:POWER:REFerence:POWER -115
SOURCEl:BB:GPS:POWER:INTer:PZERO
SOURCEl:BB:GPS:STATe ON
SOURCEl:BB:GPS:SATellite2:POWER?

SOURCEl:BB:GPS:POWER:INTer:PSTandard
SOURCEl:BB:GPS:POWER:INTer:CAE1Def?
//Response: -1.25
SOURCEl:BB:GPS:SATellite2:POWER?

SOURCEl:BB:GPS:POWER -110
SOURCEl:BB:GPS:POWER:TOTal?

```

<subsystem>:POWER:MODE.....	330
<subsystem>:POWER:REFerence[:POWER].....	330
<subsystem>:POWER:REFerence:SATellite.....	331
<subsystem>:POWER:REFerence:STANdard.....	331
<subsystem>:POWER:REFerence:SIGNal?.....	331
<subsystem>:POWER:REFerence:DIStance?.....	331
<subsystem>:SATellite<st>:POWER.....	332
<subsystem>:SATellite<st>:POWER:RSIGNal?.....	332

<subsystem>:POWer:TOTal?.....	333
<subsystem>:POWer:INTer:PZERo.....	333
<subsystem>:POWer:INTer:PSTandard.....	333
<subsystem>:POWer:INTer:CABCAGeo.....	333
<subsystem>:POWer:INTer:CABCAlgo.....	333
<subsystem>:POWer:INTer:CABCAMEo.....	333
<subsystem>:POWer:INTer:CAQCA.....	333
<subsystem>:POWer:INTer:CAE1Def.....	333
<subsystem>:POWer:INTer:CARCA.....	333
<subsystem>:POWer:INTRa:GPS:PZERo.....	334
<subsystem>:POWer:INTRa:GPS:PSTandard.....	334
<subsystem>:POWer:INTRa:GPS:CAP.....	334

---

### <subsystem>:POWer:MODE <Mode>

Determines the whether the power is calculated automatically or is based on user defined settings.

#### Parameters:

<Mode> USER | AUTO

#### USER

Manual power configuration per satellite

#### AUTO

Automatic power calculation, based on the satellite-to-receiver distance and relative to the relative power of the reference satellite (<subsystem>:POWer:REFeRence:SATellite).

\*RST: USER

**Example:** See [example "Configuring the power settings "](#) on page 329.

**Manual operation:** See ["Power Mode"](#) on page 121

---

### <subsystem>:POWer:REFeRence[:POWer] <ReferencePower>

Sets the power level that is used as a reference for the calculation of the power level of the satellites.

#### Parameters:

<ReferencePower> float

Range: -145 to 20

Increment: 0.01

\*RST: -30

Default unit: dBm

**Example:** See [example "Configuring the power settings "](#) on page 329.

**Manual operation:** See ["Reference Power"](#) on page 121

---

**<subsystem>:POWER:REFERENCE:SATellite <Sat>**

Sets the satellite used as a reference for the calculation of the power levels of the satellites in auto power mode.

Value -1 corresponds to N.A.

**Parameters:**

<Sat> integer  
 Range: 1 to 24  
 \*RST: 1

**Example:** See [example "Configuring the power settings "](#) on page 329.

**Manual operation:** See ["Reference Satellite"](#) on page 122

---

**<subsystem>:POWER:REFERENCE:STANDARD <Standard>**

Queries/sets the reference standard.

**Parameters:**

<Standard> GPS | GALileo | GLONass | BEIDou | QZSS | SBAS  
 \*RST: GPS

**Example:** See [example "Configuring the power settings "](#) on page 329.

**Manual operation:** See ["Reference Standard"](#) on page 122

---

**<subsystem>:POWER:REFERENCE:SIGNAL?**

Queries the signal component of the current reference satellite used as reference for the power calculation.

**Return values:**

<SignalType> CACode | PCODE | CAPQ | CAPI | E1Def | RCA | B1CA | QCA | SCA  
 \*RST: CACode

**Example:** See [example "Configuring the power settings "](#) on page 329.

**Usage:** Query only

**Manual operation:** See ["Reference Signal/ Reference Orbital Distance"](#) on page 123

---

**<subsystem>:POWER:REFERENCE:DISTANCE?**

Queries the pseudorange of the reference satellite at the beginning of the simulation (t=t0).

**Return values:**

<Distance> float  
 Range: 0 to (0.2\*SPEED\_OF\_LIGHT)  
 Increment: 1E3  
 \*RST: 0

**Example:** See [example "Configuring the power settings"](#) on page 329.

**Usage:** Query only

**Manual operation:** See ["Reference Signal/ Reference Orbital Distance"](#) on page 123

**<subsystem>:SATellite<st>:POWER <Power>**

Sets/queries the power offset of the satellite in dB. The offset determines the power ratio of the activated satellites.

This setting command is only available for `<subsystem>:SMODEUSER`.

See [chapter 4.10.1, "Power Configuration"](#), on page 115 for information about the power calculation.

**Parameters:**

<Power> float  
 Range: -20 to 20 dB (for the query command) / 0 dB (for the settings command)  
 Increment: 0.01  
 \*RST: 0

**Example:** See [example "Configuring the power settings"](#) on page 329.

**Manual operation:** See ["Power"](#) on page 127

**<subsystem>:SATellite<st>:POWER:RSIGNAL? <RefSignal>**

For mixed signals like "C/A+P", queries the signal used as a reference by power calculation.

The power reference is fixed to "C/A" for mixed signals. For signals modulated only with the P code, the power reference is "P".

**Parameters:**

<RefSignal> CA | P  
 \*RST: CA

**Usage:** Query only

**Options:** R&S SMBV-K93

**Manual operation:** See ["Power Reference"](#) on page 129

**<subsystem>:POWER:TOTAL?**

Queries the total power of the GNSS signal.

**Return values:**

<Power> float  
 Range: -145 to 30  
 Increment: 0.01  
 \*RST: 0  
 Default unit: dBm

**Example:** See [example "Configuring the power settings "](#) on page 329.

**Usage:** Query only

**Manual operation:** See ["Total Power"](#) on page 122

**<subsystem>:POWER:INTER:PZERO**

Sets the Inter-Standard Power relations to 0 dB.

**Example:** See [example "Configuring the power settings "](#) on page 329.

**Usage:** Event

**Manual operation:** See ["Set to 0"](#) on page 139

**<subsystem>:POWER:INTER:PSTANDARD**

Sets the power relation between the signals belonging to the different navigation standard according to the relation determined in the specifications.

**Example:** See [example "Configuring the power settings "](#) on page 329.

**Usage:** Event

**Manual operation:** See ["Set to Standard"](#) on page 139

**<subsystem>:POWER:INTER:CABCAGEO <CaToGeo>**

**<subsystem>:POWER:INTER:CABCALGSO <CaToLgso>**

**<subsystem>:POWER:INTER:CABCAMEO <CaToBdsMeo>**

**<subsystem>:POWER:INTER:CAQCA <CaToQzssCa>**

**<subsystem>:POWER:INTER:CAE1DEF <CaToE1def>**

**<subsystem>:POWER:INTER:CARCA <CaToRca>**

Sets the power relation between the signals belonging to the different navigation standards. The power level of the GPS signal C/A is used as reference.

**Parameters:**

<CaToRca> float  
 Range: 0 to 6  
 Increment: 0.01  
 \*RST: 2.5  
 Default unit: dB

<CaToE1def> float  
 Range: -6 to 0  
 Increment: 0.01  
 \*RST: -1.5  
 Default unit: dB

<CaToGeo>,  
 <CaToIgs0>,  
 <CaToBdsMeo> float  
 Range: 0 to 6  
 Increment: 0.01  
 \*RST: 4.5  
 Default unit: dB

<CaToQzssCa> float  
 Range: 0 to 6  
 Increment: 0.01  
 \*RST: 0

**Example:** See [example "Configuring the power settings"](#) on page 329.

**Manual operation:** See ["GPS C/A-GALILEO E1-DEF, GPS C/A-GLONASS R-C/A, GPS C/A-BeiDou \(GEO/MEO/IGSO\) B-C/A, GPS C/A-QZSS C/A"](#) on page 140

#### <subsystem>:POWer:INTRa:GPS:PZERo

Sets the power relations between the signal components to 0 dB.

**Usage:** Event

**Options:** R&S SMBV-K93

**Manual operation:** See ["Set to 0"](#) on page 139

#### <subsystem>:POWer:INTRa:GPS:PSTandard

Sets the power relation between the signals belonging to the same navigation standard according to the relation determined in the specifications.

**Usage:** Event

**Options:** R&S SMBV-K93

**Manual operation:** See ["Set to Standard"](#) on page 139

#### <subsystem>:POWer:INTRa:GPS:CAP <CA\_P>

Sets the power relation between the signals belonging to the same navigation standard.

**Parameters:**

<CA\_P> float  
 Range: 0 to 6  
 Increment: 0.01  
 \*RST: 3

**Manual operation:** See "C/A-P" on page 139

## 6.18 Navigation Message Configuration

<subsystem>:SVID<ch>:<GNSS>:NMESsage:PAGE:COUNT.....	338
<subsystem>:SVID<ch>:QZSS:NMESsage:PAGE:COUNT.....	338
<subsystem>:SVID<ch>:BEIDou:NMESsage:PAGE:COUNT.....	338
<subsystem>:SVID<ch>:GALileo:NMESsage:PAGE:COUNT.....	338
<subsystem>:SVID<ch>:GLONass:NMESsage:PAGE:COUNT.....	339
<subsystem>:SVID<ch>:GPS:NMESsage:PAGE:COUNT.....	339
<subsystem>:SVID<ch>:<GNSS>:NMESsage:PRESet.....	339
<subsystem>:SVID<ch>:QZSS:NMESsage:PRESet.....	339
<subsystem>:SVID<ch>:BEIDou:NMESsage:PRESet.....	339
<subsystem>:SVID<ch>:GALileo:NMESsage:PRESet.....	339
<subsystem>:SVID<ch>:GLONass:NMESsage:PRESet.....	339
<subsystem>:SVID<ch>:GPS:NMESsage:PRESet.....	339
<subsystem>:SVID<ch>:<GNSS>:NMESsage:PROJect.....	339
<subsystem>:SVID<ch>:QZSS:NMESsage:PROJect.....	339
<subsystem>:SVID<ch>:BEIDou:NMESsage:PROJect.....	339
<subsystem>:SVID<ch>:GALileo:NMESsage:PROJect.....	339
<subsystem>:SVID<ch>:GLONass:NMESsage:PROJect.....	339
<subsystem>:SVID<ch>:GPS:NMESsage:PROJect.....	339
<subsystem>:SVID<ch>:<GNSS>:NMESsage:RTPRojection.....	339
<subsystem>:SVID<ch>:QZSS:NMESsage:RTPRojection.....	339
<subsystem>:SVID<ch>:BEIDou:NMESsage:RTPRojection.....	339
<subsystem>:SVID<ch>:GALileo:NMESsage:RTPRojection.....	340
<subsystem>:SVID<ch>:GLONass:NMESsage:RTPRojection.....	340
<subsystem>:SVID<ch>:GPS:NMESsage:RTPRojection.....	340
<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:CCORrection:AF<gr0>.....	340
<subsystem>:SVID<ch>:QZSS:NMESsage[:PAGE<us>]:CCORrection:AF<gr0>.....	340
<subsystem>:SVID<ch>:BEIDou:NMESsage[:PAGE<us>]:CCORrection:AF<gr0>.....	340
<subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:CCORrection:AF<gr0>.....	340
<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:CCORrection:TGD.....	340
<subsystem>:SVID<ch>:QZSS:NMESsage[:PAGE<us>]:CCORrection:TGD.....	340
<subsystem>:SVID<ch>:BEIDou:NMESsage[:PAGE<us>]:CCORrection:TGD<gr>.....	340
<subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:CCORrection:TGD.....	340
<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:CCORrection:TOC.....	341
<subsystem>:SVID<ch>:QZSS:NMESsage[:PAGE<us>]:CCORrection:TOC.....	341
<subsystem>:SVID<ch>:BEIDou:NMESsage[:PAGE<us>]:CCORrection:TOC.....	341
<subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:CCORrection:TOC.....	341
<subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:EPHemeris:AODO.....	341
<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:CIC.....	341

<subsystem>:SVID<ch>:QZSS:NMESSage[:PAGE<us>]:EPHemeris:CIC.....	341
<subsystem>:SVID<ch>:BEIDou:NMESSage[:PAGE<us>]:EPHemeris:CIC.....	341
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:CIC.....	341
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:CIC.....	341
<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:CIS.....	342
<subsystem>:SVID<ch>:QZSS:NMESSage[:PAGE<us>]:EPHemeris:CIS.....	342
<subsystem>:SVID<ch>:BEIDou:NMESSage[:PAGE<us>]:EPHemeris:CIS.....	342
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:CIS.....	342
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:CIS.....	342
<subsystem>:SVID<ch>:QZSS:NMESSage[:PAGE<us>]:EPHemeris:CLTMode.....	342
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:CLTMode.....	342
<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:CRC.....	342
<subsystem>:SVID<ch>:QZSS:NMESSage[:PAGE<us>]:EPHemeris:CRC.....	342
<subsystem>:SVID<ch>:BEIDou:NMESSage[:PAGE<us>]:EPHemeris:CRC.....	342
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:CRC.....	342
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:CRC.....	342
<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:CRS.....	343
<subsystem>:SVID<ch>:QZSS:NMESSage[:PAGE<us>]:EPHemeris:CRS.....	343
<subsystem>:SVID<ch>:BEIDou:NMESSage[:PAGE<us>]:EPHemeris:CRS.....	343
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:CRS.....	343
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:CRS.....	343
<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:CUC.....	343
<subsystem>:SVID<ch>:QZSS:NMESSage[:PAGE<us>]:EPHemeris:CUC.....	343
<subsystem>:SVID<ch>:BEIDou:NMESSage[:PAGE<us>]:EPHemeris:CUC.....	343
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:CUC.....	343
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:CUC.....	343
<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:CUS.....	343
<subsystem>:SVID<ch>:QZSS:NMESSage[:PAGE<us>]:EPHemeris:CUS.....	343
<subsystem>:SVID<ch>:BEIDou:NMESSage[:PAGE<us>]:EPHemeris:CUS.....	343
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:CUS.....	343
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:CUS.....	343
<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:ECCentricity.....	343
<subsystem>:SVID<ch>:QZSS:NMESSage[:PAGE<us>]:EPHemeris:ECCentricity.....	343
<subsystem>:SVID<ch>:BEIDou:NMESSage[:PAGE<us>]:EPHemeris:ECCentricity.....	344
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:ECCentricity.....	344
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:ECCentricity.....	344
<subsystem>:SVID<ch>:QZSS:NMESSage[:PAGE<us>]:EPHemeris:FIFLag.....	344
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:FIFLag.....	344
<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:HEALth.....	344
<subsystem>:SVID<ch>:QZSS:NMESSage[:PAGE<us>]:EPHemeris:HEALth.....	344
<subsystem>:SVID<ch>:BEIDou:NMESSage[:PAGE<us>]:EPHemeris:HEALth.....	344
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:HEALth.....	344
<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:IDOT.....	344
<subsystem>:SVID<ch>:QZSS:NMESSage[:PAGE<us>]:EPHemeris:IDOT.....	344
<subsystem>:SVID<ch>:BEIDou:NMESSage[:PAGE<us>]:EPHemeris:IDOT.....	344
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:IDOT.....	345
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:IDOT.....	345
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:IODA.....	345
<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:IDOC.....	345
<subsystem>:SVID<ch>:QZSS:NMESSage[:PAGE<us>]:EPHemeris:IODC.....	345



<subsystem>:SVID<ch>:BEIDou:NMEssage[:PAGE<us>]:EPHemeris:IODC.....	345
<subsystem>:SVID<ch>:GPS:NMEssage[:PAGE<us>]:EPHemeris:IODC.....	345
<subsystem>:SVID<ch>:<GNSS>:NMEssage[:PAGE<us>]:EPHemeris:IDOE.....	345
<subsystem>:SVID<ch>:QZSS:NMEssage[:PAGE<us>]:EPHemeris:IODE.....	345
<subsystem>:SVID<ch>:BEIDou:NMEssage[:PAGE<us>]:EPHemeris:IODE.....	345
<subsystem>:SVID<ch>:GPS:NMEssage[:PAGE<us>]:EPHemeris:IODE.....	345
<subsystem>:SVID<ch>:GALileo:NMEssage[:PAGE<us>]:EPHemeris:IODNav.....	346
<subsystem>:SVID<ch>:<GNSS>:NMEssage[:PAGE<us>]:EPHemeris:IZERo.....	346
<subsystem>:SVID<ch>:QZSS:NMEssage[:PAGE<us>]:EPHemeris:IZERo.....	346
<subsystem>:SVID<ch>:BEIDou:NMEssage[:PAGE<us>]:EPHemeris:IZERo.....	346
<subsystem>:SVID<ch>:GALileo:NMEssage[:PAGE<us>]:EPHemeris:IZERo.....	346
<subsystem>:SVID<ch>:GPS:NMEssage[:PAGE<us>]:EPHemeris:IZERo.....	346
<subsystem>:SVID<ch>:QZSS:NMEssage[:PAGE<us>]:EPHemeris:LTPData.....	346
<subsystem>:SVID<ch>:GPS:NMEssage[:PAGE<us>]:EPHemeris:LTPData.....	346
<subsystem>:SVID<ch>:<GNSS>:NMEssage[:PAGE<us>]:EPHemeris:MZERo.....	346
<subsystem>:SVID<ch>:QZSS:NMEssage[:PAGE<us>]:EPHemeris:MZERo.....	346
<subsystem>:SVID<ch>:BEIDou:NMEssage[:PAGE<us>]:EPHemeris:MZERo.....	346
<subsystem>:SVID<ch>:GALileo:NMEssage[:PAGE<us>]:EPHemeris:MZERo.....	347
<subsystem>:SVID<ch>:GPS:NMEssage[:PAGE<us>]:EPHemeris:MZERo.....	347
<subsystem>:SVID<ch>:<GNSS>:NMEssage[:PAGE<us>]:EPHemeris:NDELta.....	347
<subsystem>:SVID<ch>:QZSS:NMEssage[:PAGE<us>]:EPHemeris:NDELta.....	347
<subsystem>:SVID<ch>:BEIDou:NMEssage[:PAGE<us>]:EPHemeris:NDELta.....	347
<subsystem>:SVID<ch>:GALileo:NMEssage[:PAGE<us>]:EPHemeris:NDELta.....	347
<subsystem>:SVID<ch>:GPS:NMEssage[:PAGE<us>]:EPHemeris:NDELta.....	347
<subsystem>:SVID<ch>:<GNSS>:NMEssage[:PAGE<us>]:EPHemeris:ODOT.....	347
<subsystem>:SVID<ch>:QZSS:NMEssage[:PAGE<us>]:EPHemeris:ODOT.....	347
<subsystem>:SVID<ch>:BEIDou:NMEssage[:PAGE<us>]:EPHemeris:ODOT.....	347
<subsystem>:SVID<ch>:GALileo:NMEssage[:PAGE<us>]:EPHemeris:ODOT.....	347
<subsystem>:SVID<ch>:GPS:NMEssage[:PAGE<us>]:EPHemeris:ODOT.....	347
<subsystem>:SVID<ch>:<GNSS>:NMEssage[:PAGE<us>]:EPHemeris:OMEGa.....	347
<subsystem>:SVID<ch>:QZSS:NMEssage[:PAGE<us>]:EPHemeris:OMEGa.....	347
<subsystem>:SVID<ch>:BEIDou:NMEssage[:PAGE<us>]:EPHemeris:OMEGa.....	347
<subsystem>:SVID<ch>:GALileo:NMEssage[:PAGE<us>]:EPHemeris:OMEGa.....	348
<subsystem>:SVID<ch>:GPS:NMEssage[:PAGE<us>]:EPHemeris:OMEGa.....	348
<subsystem>:SVID<ch>:<GNSS>:NMEssage[:PAGE<us>]:EPHemeris:OZERo.....	348
<subsystem>:SVID<ch>:QZSS:NMEssage[:PAGE<us>]:EPHemeris:OZERo.....	348
<subsystem>:SVID<ch>:BEIDou:NMEssage[:PAGE<us>]:EPHemeris:OZERo.....	348
<subsystem>:SVID<ch>:GALileo:NMEssage[:PAGE<us>]:EPHemeris:OZERo.....	348
<subsystem>:SVID<ch>:GPS:NMEssage[:PAGE<us>]:EPHemeris:OZERo.....	348
<subsystem>:SVID<ch>:QZSS:NMEssage[:PAGE<us>]:EPHemeris:SF1Reserved<gr>.....	348
<subsystem>:SVID<ch>:GPS:NMEssage[:PAGE<us>]:EPHemeris:SF1Reserved<gr>.....	348
<subsystem>:SVID<ch>:GALileo:NMEssage[:PAGE<us>]:EPHemeris:SISA.....	348
<subsystem>:SVID<ch>:<GNSS>:NMEssage[:PAGE<us>]:EPHemeris:SQRA.....	349
<subsystem>:SVID<ch>:QZSS:NMEssage[:PAGE<us>]:EPHemeris:SQRA.....	349
<subsystem>:SVID<ch>:BEIDou:NMEssage[:PAGE<us>]:EPHemeris:SQRA.....	349
<subsystem>:SVID<ch>:GALileo:NMEssage[:PAGE<us>]:EPHemeris:SQRA.....	349
<subsystem>:SVID<ch>:GPS:NMEssage[:PAGE<us>]:EPHemeris:SQRA.....	349
<subsystem>:SVID<ch>:QZSS:NMEssage[:PAGE<us>]:EPHemeris:SVConfig.....	349
<subsystem>:SVID<ch>:GPS:NMEssage[:PAGE<us>]:EPHemeris:SVConfig.....	349
<subsystem>:SVID<ch>:<GNSS>:NMEssage[:PAGE<us>]:EPHemeris:TOE.....	349

<subsystem>:SVID<ch>:QZSS:NMESSage[:PAGE<us>]:EPHemeris:TOE.....	349
<subsystem>:SVID<ch>:BEIDou:NMESSage[:PAGE<us>]:EPHemeris:TOE.....	349
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:TOE.....	349
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:TOE.....	349
<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:URA.....	350
<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:URA.....	350
<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:URA.....	350
<subsystem>:SVID<ch>:QZSS:NMESSage[:PAGE<us>]:EPHemeris:URA.....	350
<subsystem>:SVID<ch>:BEIDou:NMESSage[:PAGE<us>]:EPHemeris:URA.....	350
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:URA.....	350
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:FNAV:AF<gr0>.....	350
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:FNAV:BGD.....	350
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:FNAV:E5ADVS.....	350
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:FNAV:E5AHS.....	351
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:FNAV:K.....	351
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:FNAV:TOC.....	351
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:INAV:AF<gr0>.....	351
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:INAV:BGD.....	352
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:INAV:E1BDVS.....	352
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:INAV:E1BHS.....	352
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:INAV:E5BDVS.....	352
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:INAV:E5BHS.....	353
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:INAV:TOC.....	353
<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:CCORrection:DTAU.....	353
<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:CCORrection:EN.....	353
<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:CCORrection:GAMN.....	354
<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:CCORrection:TAUN.....	354
<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:AOEP.....	354
<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:HEALth.....	355
<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:P.....	355
<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:SEType.....	355
<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:TALignment.....	356
<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:TINdex.....	356
<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:TINterval?.....	356
<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:TOE?.....	357
<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:XN.....	357
<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:YN.....	357
<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:ZN.....	357
<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:XDDN.....	357
<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:YDDN.....	357
<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:ZDDN.....	357
<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:XDN.....	358
<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:YDN.....	358
<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:ZDN.....	358

---

**<subsystem>:SVID<ch>:<GNSS>:NMESSage:PAGE:COUNT**

**<subsystem>:SVID<ch>:QZSS:NMESSage:PAGE:COUNT <NumberOfPages>**

**<subsystem>:SVID<ch>:BEIDou:NMESSage:PAGE:COUNT <NumberOfPages>**

**<subsystem>:SVID<ch>:GALileo:NMESSage:PAGE:COUNT <NumberOfPages>**

**<subsystem>:SVID<ch>:GLONass:NMESSage:PAGE:COUNT <NumberOfPages>**  
**<subsystem>:SVID<ch>:GPS:NMESSage:PAGE:COUNT <NumberOfPages>**

Number of navigation pages. Several navigation pages are available per satellite.

If a RINEX file is used, the value of this parameter is retrieved from the file. A RINEX file may contain ephemeris information for up to 24 hours. Since the ephemeris are updated every two hours, the RINEX file contains a maximum number of 12 navigation pages.

This setting is only available for `<subsystem>:SMODEUSER`.

**Parameters:**

`<NumberOfPages>` integer  
 Range: 1 to 12  
 \*RST: 1

**Options:** R&S SMBV-K65

**<subsystem>:SVID<ch>:<GNSS>:NMESSage:PRESet**  
**<subsystem>:SVID<ch>:QZSS:NMESSage:PRESet**  
**<subsystem>:SVID<ch>:BEIDou:NMESSage:PRESet**  
**<subsystem>:SVID<ch>:GALileo:NMESSage:PRESet**  
**<subsystem>:SVID<ch>:GLONass:NMESSage:PRESet**  
**<subsystem>:SVID<ch>:GPS:NMESSage:PRESet**

The navigation message's parameters are calculated according to the selected almanac.

This setting is only available for `<subsystem>:SMODEUSER`.

**Usage:** Event

**<subsystem>:SVID<ch>:<GNSS>:NMESSage:PROJect**  
**<subsystem>:SVID<ch>:QZSS:NMESSage:PROJect**  
**<subsystem>:SVID<ch>:BEIDou:NMESSage:PROJect**  
**<subsystem>:SVID<ch>:GALileo:NMESSage:PROJect**  
**<subsystem>:SVID<ch>:GLONass:NMESSage:PROJect**  
**<subsystem>:SVID<ch>:GPS:NMESSage:PROJect**

Triggers the projection of the parameters of the navigation message. The values of the TOE and TOC are calculated according to the selected current simulation time (for "System Time > UTC").

For details see "[Project Navigation Message](#)" on page 144

This setting is only available for `<subsystem>:SMODEUSER`.

**Usage:** Event

**<subsystem>:SVID<ch>:<GNSS>:NMESSage:RTPROjection**  
**<subsystem>:SVID<ch>:QZSS:NMESSage:RTPROjection <State>**  
**<subsystem>:SVID<ch>:BEIDou:NMESSage:RTPROjection <State>**

**<subsystem>:SVID<ch>:GALileo:NMEssage:RTPProjection <State>**  
**<subsystem>:SVID<ch>:GLONass:NMEssage:RTPProjection <State>**  
**<subsystem>:SVID<ch>:GPS:NMEssage:RTPProjection <State>**

Enables the instrument to internally perform a projection of the navigation message whenever this message is approaching its validity limit.

For details see "[Real-Time Projection](#)" on page 144.

This setting is only available for <subsystem>:SMODE USER and <subsystem>:SATellite:GRTPProjection OFF.

**Parameters:**

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

**Options:**            R&S SMBV-K65

**<subsystem>:SVID<ch>:<GNSS>:NMEssage[:PAGE<us>]:CCORrection:AF<gr0>**  
**<subsystem>:SVID<ch>:QZSS:NMEssage[:PAGE<us>]:CCORrection:AF<gr0>**  
                     <Af>  
**<subsystem>:SVID<ch>:BEIDou:NMEssage[:PAGE<us>]:CCORrection:AF<gr0>**  
                     <Af>  
**<subsystem>:SVID<ch>:GPS:NMEssage[:PAGE<us>]:CCORrection:AF<gr0>**  
                     <Af>

Defines the clock correction parameters a\_f2, a\_f1, a\_f0.

**Suffix:**

<gr0>                0 | 1 | 2

**Parameters:**

<Af>                integer  
                     Value range (GPS parameters):  
                     a\_f2 = -2<sup>7</sup> to 2<sup>7</sup>-1; a\_f1 = -2<sup>15</sup> to 2<sup>15</sup>-1; a\_f0 = -2<sup>21</sup> to 2<sup>21</sup>-1  
                     Value range (BeiDou parameters):  
                     a\_f2 = -2<sup>10</sup> to 2<sup>10</sup>-1; a\_f1 = -2<sup>21</sup> to 2<sup>21</sup>-1; a\_f0 = -2<sup>23</sup> to 2<sup>23</sup>-1  
                     \*RST:            0

**<subsystem>:SVID<ch>:<GNSS>:NMEssage[:PAGE<us>]:CCORrection:TGD**  
**<subsystem>:SVID<ch>:QZSS:NMEssage[:PAGE<us>]:CCORrection:TGD <Tgd>**  
**<subsystem>:SVID<ch>:BEIDou:NMEssage[:PAGE<us>]:CCORrection:TGD<gr>**  
                     <Tgd>  
**<subsystem>:SVID<ch>:GPS:NMEssage[:PAGE<us>]:CCORrection:TGD <Tgd>**

Defines the L1-L2 correction term.

**Parameters:**

<Tgd>                integer  
                     GPS parameter  
                     Range:            -128 to 127  
                     \*RST:            0

<Tgd> integer  
 BeiDou parameter  
 Range: -512 to 511  
 Increment: 1  
 \*RST: 0

**Example:** SOURce1:BB:GPS:SVID1:GPS:NMESSage:PAGE1:  
 CCORrection:TGD 10

---

<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:CCORrection:TOC  
 <subsystem>:SVID<ch>:QZSS:NMESSage[:PAGE<us>]:CCORrection:TOC <Toc>  
 <subsystem>:SVID<ch>:BEIDou:NMESSage[:PAGE<us>]:CCORrection:TOC  
 <Toc>  
 <subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:CCORrection:TOC <Toc>

Defines the Clock Correction Parameter.

This setting is only available for <subsystem>:SMODEUSER.

**Parameters:**

<Toc> integer  
 GPS parameter  
 Range: 0 to 65535  
 \*RST: 0

<Toc> integer  
 BeiDou parameter  
 Range: 0 to 131071  
 Increment: 1  
 \*RST: 0

**Options:** R&S SMBV-K65

---

<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:AODO <Aodo>

Age of Data Offset

**Parameters:**

<Aodo> integer  
 Range: 0 to 31  
 \*RST: 0

**Manual operation:** See "[GPS and QZSS Ephemeris Parameters](#)" on page 146

---

<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:CIC  
 <subsystem>:SVID<ch>:QZSS:NMESSage[:PAGE<us>]:EPHemeris:CIC <Cic>  
 <subsystem>:SVID<ch>:BEIDou:NMESSage[:PAGE<us>]:EPHemeris:CIC <Cic>  
 <subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:CIC <Cic>  
 <subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:CIC <Cic>

Amplitude of the Cosine Harmonic Correction Term to the Angle of Inclination

**Parameters:**

<Cic> integer  
 Range: -32768 to 32767  
 \*RST: 0

---

<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:CIS  
 <subsystem>:SVID<ch>:QZSS:NMESsage[:PAGE<us>]:EPHemeris:CIS <Cis>  
 <subsystem>:SVID<ch>:BEIDou:NMESsage[:PAGE<us>]:EPHemeris:CIS <Cis>  
 <subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:EPHemeris:CIS <Cis>  
 <subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:EPHemeris:CIS <Cis>

Amplitude of the Sine Harmonic Correction Term to the Angle of Inclination

**Parameters:**

<Cis> integer  
 Range: -32768 to 32767  
 \*RST: 0

---

<subsystem>:SVID<ch>:QZSS:NMESsage[:PAGE<us>]:EPHemeris:CLTMode  
 <CLTMode>  
 <subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:EPHemeris:CLTMode  
 <CLTMode>

Type of code for L2; This value does not have any impact on the actual used ranging code of the generated satellite.

**Parameters:**

<CLTMode> REServed | PCODE | CACode  
**REServed**  
 Reserved for future use.  
**PCODE**  
 Carrier L2 (f<sub>L2</sub>= 1.2276 GHz) is modulated by P-code (BPSK).  
**CACode**  
 Carrier L2 (f<sub>L2</sub>= 1.2276 GHz) is modulated by C/A-code (BPSK).  
 \*RST: PCODE

**Manual operation:** See ["GPS and QZSS Ephemeris Parameters"](#) on page 146

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<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:CRC  
 <subsystem>:SVID<ch>:QZSS:NMESsage[:PAGE<us>]:EPHemeris:CRC <Crc>  
 <subsystem>:SVID<ch>:BEIDou:NMESsage[:PAGE<us>]:EPHemeris:CRC <Crc>  
 <subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:EPHemeris:CRC <Crc>  
 <subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:EPHemeris:CRC <Crc>

Amplitude of the Cosine Harmonic Correction Term to the Orbit Radius

**Parameters:**

<Crc> integer  
 Range: -32768 to 32767  
 \*RST: 0

---

<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:CRS  
 <subsystem>:SVID<ch>:QZSS:NMESsage[:PAGE<us>]:EPHemeris:CRS <Crs>  
 <subsystem>:SVID<ch>:BEIDou:NMESsage[:PAGE<us>]:EPHemeris:CRS <Crs>  
 <subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:EPHemeris:CRS <Crs>  
 <subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:EPHemeris:CRS <Crs>

Amplitude of the Sine Harmonic Correction Term to the Orbit Radius

**Parameters:**

<Crs> integer  
 Range: -32768 to 32767  
 \*RST: 0

---

<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:CUC  
 <subsystem>:SVID<ch>:QZSS:NMESsage[:PAGE<us>]:EPHemeris:CUC <Cuc>  
 <subsystem>:SVID<ch>:BEIDou:NMESsage[:PAGE<us>]:EPHemeris:CUC <Cuc>  
 <subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:EPHemeris:CUC  
 <Cuc>

<subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:EPHemeris:CUC <Cuc>

Amplitude of the Cosine Harmonic Correction Term to the Argument of Latitude

**Parameters:**

<Cuc> integer  
 Range: -32768 to 32767  
 \*RST: 0

---

<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:CUS  
 <subsystem>:SVID<ch>:QZSS:NMESsage[:PAGE<us>]:EPHemeris:CUS <Cus>  
 <subsystem>:SVID<ch>:BEIDou:NMESsage[:PAGE<us>]:EPHemeris:CUS <Cus>  
 <subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:EPHemeris:CUS <Cus>  
 <subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:EPHemeris:CUS <Cus>

Amplitude of the Sine Harmonic Correction Term to the Argument of Latitude

**Parameters:**

<Cus> integer  
 Range: -32768 to 32767  
 \*RST: 0

---

<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:  
 ECCentricity  
 <subsystem>:SVID<ch>:QZSS:NMESsage[:PAGE<us>]:EPHemeris:ECCentricity  
 <Eccentricity>

**<subsystem>:SVID<ch>:BEIDou:NMESSage[:PAGE<us>]:EPHemeris:  
 ECCentricity <Eccentricity>**  
**<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:  
 ECCentricity <Eccentricity>**  
**<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:ECCentricity  
 <Eccentricity>**

Eccentricity

**Parameters:**

<Eccentricity>            integer  
                               Range:        0 to 4294967295  
                               \*RST:        0

**<subsystem>:SVID<ch>:QZSS:NMESSage[:PAGE<us>]:EPHemeris:FIFLag  
 <FiFlag>**  
**<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:FIFLag  
 <FiFlag>**

Indicates the curve-fit interval used by the CS (Control Segment) in determining the ephemeris parameters

**Parameters:**

<FiFlag>                    0 | 1 | OFF | ON  
                               \*RST:            0

**Manual operation:** See "[GPS and QZSS Ephemeris Parameters](#)" on page 146

**<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:HEALth**  
**<subsystem>:SVID<ch>:QZSS:NMESSage[:PAGE<us>]:EPHemeris:HEALth  
 <Health>**  
**<subsystem>:SVID<ch>:BEIDou:NMESSage[:PAGE<us>]:EPHemeris:HEALth  
 <Health>**  
**<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:HEALth  
 <Health>**

This value does not have an impact on the actual health status of the generated satellite.

**Parameters:**

<Health>                    integer  
                               Range:        0 to 31 (for GPS), 1 (for BeiDou)  
                               \*RST:        0

**<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:IDOT**  
**<subsystem>:SVID<ch>:QZSS:NMESSage[:PAGE<us>]:EPHemeris:IDOT <ldot>**  
**<subsystem>:SVID<ch>:BEIDou:NMESSage[:PAGE<us>]:EPHemeris:IDOT <ldot>**



**<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:EPHemeris:IDOT**  
 <ldot>

**<subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:EPHemeris:IDOT** <ldot>

Rate of Inclination Angle

**Parameters:**

<ldot> integer  
 Range: -8192 to 8191  
 \*RST: 0

**<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:EPHemeris:IODA**  
 <lode>

Issue Of Data (Almanacs)

**Parameters:**

<lode> integer  
 Range: 0 to 1023  
 \*RST: 0

**Manual operation:** See "[Common Ephemeris Parameters](#)" on page 146

**<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:IDOC**

**<subsystem>:SVID<ch>:QZSS:NMESsage[:PAGE<us>]:EPHemeris:IDOC** <lode>

**<subsystem>:SVID<ch>:BEIDou:NMESsage[:PAGE<us>]:EPHemeris:IDOC**  
 <lode>

**<subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:EPHemeris:IDOC** <lode>

Issue of Data, Clock

**Parameters:**

<lode> integer  
 Range: 0 to 1023 (for GPS), 31 (for BeiDou)  
 \*RST: 0

**<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:IDOE**

**<subsystem>:SVID<ch>:QZSS:NMESsage[:PAGE<us>]:EPHemeris:IDOE** <lode>

**<subsystem>:SVID<ch>:BEIDou:NMESsage[:PAGE<us>]:EPHemeris:IDOE**  
 <lode>

**<subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:EPHemeris:IDOE** <lode>

Issue of Data, Ephemeris

**Parameters:**

<lode> integer  
 Range: 0 to 255 (for GPS), 31 (for BeiDou)  
 \*RST: 0

---

```
<subsystem>:SVID<ch>:GALileo:NMEssage[:PAGE<us>]:EPHemeris:IODNav
<lode>
```

Issue Of Data (Ephemeris and Clock correction)

**Parameters:**

```
<lode>                integer
                        Range:    0 to 31
                        *RST:    0
```

**Manual operation:** See "[Common Ephemeris Parameters](#)" on page 146

---

```
<subsystem>:SVID<ch>:<GNSS>:NMEssage[:PAGE<us>]:EPHemeris:IZERo
<subsystem>:SVID<ch>:QZSS:NMEssage[:PAGE<us>]:EPHemeris:IZERo
<lzero>
<subsystem>:SVID<ch>:BEIDou:NMEssage[:PAGE<us>]:EPHemeris:IZERo
<lzero>
<subsystem>:SVID<ch>:GALileo:NMEssage[:PAGE<us>]:EPHemeris:IZERo
<lzero>
<subsystem>:SVID<ch>:GPS:NMEssage[:PAGE<us>]:EPHemeris:IZERo <lzero>
```

Inclination Angle at Reference Time

**Parameters:**

```
<lzero>                integer
                        Range:    -2147483648 to 2147483647
                        *RST:    0
```

---

```
<subsystem>:SVID<ch>:QZSS:NMEssage[:PAGE<us>]:EPHemeris:LTPData
<LtpData>
<subsystem>:SVID<ch>:GPS:NMEssage[:PAGE<us>]:EPHemeris:LTPData
<LtpData>
```

Use of carrier L2 P data flag

This value does not have an impact on whether data is really transmitted on the satellite's carrier L2 or not.

**Parameters:**

```
<LtpData>            0 | 1 | OFF | ON
                        *RST:    0
```

**Manual operation:** See "[GPS and QZSS Ephemeris Parameters](#)" on page 146

---

```
<subsystem>:SVID<ch>:<GNSS>:NMEssage[:PAGE<us>]:EPHemeris:MZERo
<subsystem>:SVID<ch>:QZSS:NMEssage[:PAGE<us>]:EPHemeris:MZERo
<MZero>
<subsystem>:SVID<ch>:BEIDou:NMEssage[:PAGE<us>]:EPHemeris:MZERo
<MZero>
```

<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:MZERO  
<MZero>

<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:MZERO  
<MZero>

Mean Anomaly at Reference Time

**Parameters:**

<MZero> integer  
Range: -2147483648 to 2147483647  
\*RST: 0

<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:NDELta

<subsystem>:SVID<ch>:QZSS:NMESSage[:PAGE<us>]:EPHemeris:NDELta  
<NDelta>

<subsystem>:SVID<ch>:BEIDou:NMESSage[:PAGE<us>]:EPHemeris:NDELta  
<NDelta>

<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:NDELta  
<NDelta>

<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:NDELta  
<NDelta>

Mean Motion Difference From Computed Value

**Parameters:**

<NDelta> integer  
Range: -32768 to 32767  
\*RST: 0

<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:ODOT

<subsystem>:SVID<ch>:QZSS:NMESSage[:PAGE<us>]:EPHemeris:ODOT  
<ODot>

<subsystem>:SVID<ch>:BEIDou:NMESSage[:PAGE<us>]:EPHemeris:ODOT  
<ODot>

<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:ODOT  
<ODot>

<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:ODOT <ODot>

Rate of Right Ascension

**Parameters:**

<ODot> integer  
Range: -8388608 to 8388607  
\*RST: 0

<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:OMEGa

<subsystem>:SVID<ch>:QZSS:NMESSage[:PAGE<us>]:EPHemeris:OMEGa  
<Omega>

<subsystem>:SVID<ch>:BEIDou:NMESSage[:PAGE<us>]:EPHemeris:OMEGa  
<Omega>

**<subsystem>:SVID<ch>:GALileo:NMEssage[:PAGE<us>]:EPHemeris:OMEGa**  
 <Omega>

**<subsystem>:SVID<ch>:GPS:NMEssage[:PAGE<us>]:EPHemeris:OMEGa**  
 <Omega>

Argument of Perigee

**Parameters:**

<Omega> integer  
 Range: -2147483648 to 2147483647  
 \*RST: 0

**<subsystem>:SVID<ch>:<GNSS>:NMEssage[:PAGE<us>]:EPHemeris:OZERO**  
**<subsystem>:SVID<ch>:QZSS:NMEssage[:PAGE<us>]:EPHemeris:OZERO**  
 <OZero>

**<subsystem>:SVID<ch>:BEIDou:NMEssage[:PAGE<us>]:EPHemeris:OZERO**  
 <OZero>

**<subsystem>:SVID<ch>:GALileo:NMEssage[:PAGE<us>]:EPHemeris:OZERO**  
 <OZero>

**<subsystem>:SVID<ch>:GPS:NMEssage[:PAGE<us>]:EPHemeris:OZERO**  
 <OZero>

Longitude of Ascending Node of Orbit Plane at Weekly Epoch

**Parameters:**

<OZero> integer  
 Range: -2147483648 to 2147483647  
 \*RST: 0

**<subsystem>:SVID<ch>:QZSS:NMEssage[:PAGE<us>]:EPHemeris:**  
**SF1Reserved<gr> <Reserved>**

**<subsystem>:SVID<ch>:GPS:NMEssage[:PAGE<us>]:EPHemeris:**  
**SF1Reserved<gr> <Reserved>**

SF1 Reserved 1/2/3/4

**Suffix:**

<gr> 1|2|3|4

**Parameters:**

<Reserved> integer  
 Range: 0 to 67108864  
 \*RST: 0

**Manual operation:** See ["GPS and QZSS Ephemeris Parameters"](#) on page 146

**<subsystem>:SVID<ch>:GALileo:NMEssage[:PAGE<us>]:EPHemeris:SISA**  
 <Ura>

Signal In Space Accuracy

**Parameters:**

<Ura> integer  
 Range: 0 to 15  
 \*RST: 0

**Manual operation:** See "[Common Ephemeris Parameters](#)" on page 146

<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:SQRA

<subsystem>:SVID<ch>:QZSS:NMESsage[:PAGE<us>]:EPHemeris:SQRA  
 <SqrA>

<subsystem>:SVID<ch>:BEIDou:NMESsage[:PAGE<us>]:EPHemeris:SQRA  
 <SqrA>

<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:EPHemeris:SQRA  
 <SqrA>

<subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:EPHemeris:SQRA <SqrA>

Square Root of the Semi-Major Axis

**Parameters:**

<SqrA> integer  
 Range: 100000 to 4294967295  
 \*RST: 100000

<subsystem>:SVID<ch>:QZSS:NMESsage[:PAGE<us>]:EPHemeris:SVConfig  
 <SvConfig>

<subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:EPHemeris:SVConfig  
 <SvConfig>

SV Configurations

**Parameters:**

<SvConfig> integer  
 Range: 0 to 15  
 \*RST: 0

**Manual operation:** See "[GPS and QZSS Ephemeris Parameters](#)" on page 146

<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:TOE

<subsystem>:SVID<ch>:QZSS:NMESsage[:PAGE<us>]:EPHemeris:TOE <ToE>

<subsystem>:SVID<ch>:BEIDou:NMESsage[:PAGE<us>]:EPHemeris:TOE <ToE>

<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:EPHemeris:TOE <ToE>

<subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:EPHemeris:TOE <ToE>

Time Of Ephemeris

**Parameters:**

<ToE> integer  
 Range: 0 to 65535  
 \*RST: 0

---

```

<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:URA
<subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris:URA
  <Ura>
<subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris:URA
  <SvAcc>
<subsystem>:SVID<ch>:QZSS:NMESsage[:PAGE<us>]:EPHemeris:URA <Ura>
<subsystem>:SVID<ch>:BEIDou:NMESsage[:PAGE<us>]:EPHemeris:URA <Ura>
<subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:EPHemeris:URA <Ura>

```

SV accuracy / URA Index

**Parameters:**

```

<Ura>                integer
                    Range:    0 to 15
                    *RST:    0

```

---

```

<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:FNAV:AF<gr0> <Af>

```

Defines the SV clock drift rate correction coefficients  $a_{f0}$ ,  $a_{f1}$ ,  $a_{f2}$ (E1,E5a) of the freely accessible navigation message F/NAV, provided by the E5a signal for Open Service.

**Suffix:**

```

<gr0>                0 | 1 | 2

```

**Parameters:**

```

<Af>                integer
                    Value range:
                    af2 = -2^5 ... 2^5-1
                    af1 = -2^20 ... 2^20-1
                    af0 = -2^30 ... 2^30-1
                    *RST:    0

```

**Manual operation:** See "[Galileo FNAV Parameters](#)" on page 151

---

```

<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:FNAV:BGD <B_GD>

```

Defines the E1-E5a Broadcast Group Delay parameters "BGD(E1,E5a)" of the freely accessible navigation message F/NAV, provided by the E5a signal for Open Service.

**Parameters:**

```

<B_GD>              integer
                    Range:    -512 to 511
                    *RST:    0

```

**Manual operation:** See "[Galileo FNAV Parameters](#)" on page 151

---

```

<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:FNAV:E5ADVS <Dvs>

```

Defines the Data Validity Satellite Status, transmitted on E5a ( $E5a_{DVS}$ ) of the freely accessible navigation message F/NAV.

**Parameters:**

<Dvs> integer  
 Range: 0 to 1  
 \*RST: 0

**Manual operation:** See "[Galileo FNAV Parameters](#)" on page 151

**<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:FNAV:E5AHS <Hs>**

Defines the Signal Health Status for E5a (E5a<sub>HS</sub>) of the freely accessible navigation message F/NAV, provided by the E5a signal for Open Service.

**Parameters:**

<Hs> integer  
 Range: 0 to 3  
 \*RST: 0

**Manual operation:** See "[Galileo FNAV Parameters](#)" on page 151

**<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:FNAV:K <K>**

Defines the F-NAV Almanac Scheduling start index of the freely accessible navigation message F/NAV, provided by the E5a signal for Open Service.

**Parameters:**

<K> integer  
 Range: 0 to 3  
 \*RST: 0

**Manual operation:** See "[Galileo FNAV Parameters](#)" on page 151

**<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:FNAV:TOC <Toc>**

Defines the Clock correction data reference Time of Week " $t_{oc}(E1,E5a)$ " of the freely accessible navigation message F/NAV, provided by the E5a signal for Open Service.

**Parameters:**

<Toc> integer  
 Range: 0 to 16383  
 \*RST: 0

**Manual operation:** See "[Galileo FNAV Parameters](#)" on page 151

**<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:INAV:AF<gr0> <Af>**

Defines the SV clock drift rate correction coefficients  $a_{f0}$ ,  $a_{f1}$ ,  $a_{f2}(E1,E5b)$  of the Integrity navigation message INAV.

**Suffix:**

<gr0> 0 | 1 | 2

**Parameters:**

<Af> integer  
 Value range:  
 af2 =  $-2^5 \dots 2^5-1$   
 af1 =  $-2^{20} \dots 2^{20}-1$   
 af0 =  $-2^{30} \dots 2^{30}-1$   
 \*RST: 0

**Manual operation:** See ["Galileo INAV Parameters"](#) on page 150

**<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:INAV:BGD <B\_GD>**

Defines the E1-E5b Broadcast Group Delay "BGD (E1,E5b)" parameter of the Integrity navigation message INAV.

**Parameters:**

<B\_GD> integer  
 Range: -512 to 511  
 \*RST: 0

**Manual operation:** See ["Galileo INAV Parameters"](#) on page 150

**<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:INAV:E1BDVS <Dvs>**

Defines the Data Validity Satellite Status, transmitted on E1-B ("E1-B<sub>DVS</sub>") of the Integrity navigation message I/NAV provided by E5b and E1-B signals.

**Parameters:**

<Dvs> integer  
 Range: 0 to 1  
 \*RST: 0

**Manual operation:** See ["Galileo INAV Parameters"](#) on page 150

**<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:INAV:E1BHS <HS>**

Defines the Signal Health Status for E1 ("E1-B<sub>HS</sub>") of the Integrity navigation message I/NAV provided by E5b and E1-B signals.

**Parameters:**

<HS> integer  
 Range: 0 to 3  
 \*RST: 0

**Manual operation:** See ["Galileo INAV Parameters"](#) on page 150

**<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:INAV:E5BDVS <Dvs>**

Defines the Data Validity Satellite Status, transmitted on E5b ("E5b<sub>DVS</sub>") of the Integrity navigation message I/NAV.



**Parameters:**

<Dvs> integer  
 Range: 0 to 1  
 \*RST: 0

**Manual operation:** See ["Galileo INAV Parameters"](#) on page 150

**<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:INAV:E5BHS <Hs>**

Defines the Signal Health Status for E5b ("E5b<sub>HS</sub>") of the Integrity navigation message I/NAV provided by E5b and E1-B signals.

**Parameters:**

<Hs> integer  
 Range: 0 to 3  
 \*RST: 0

**Manual operation:** See ["Galileo INAV Parameters"](#) on page 150

**<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:INAV:TOC <Toc>**

Defines the Clock correction data reference Time of Week "t<sub>oc</sub>(E1,E5b)" parameter of the Integrity navigation message INAV.

**Parameters:**

<Toc> integer  
 Range: 0 to 16383  
 \*RST: 0

**Manual operation:** See ["Galileo INAV Parameters"](#) on page 150

**<subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:CCORrection:DTAU  
 <Delta\_TAU\_n>**

Defines the time difference between navigation RF signal transmitted in L2 and navigation RF signal transmitted in L1 band.

**Parameters:**

<Delta\_TAU\_n> integer  
 Range: -16 to 15  
 \*RST: 0

**Manual operation:** See ["GLONASS Clock Correction Parameters"](#) on page 150

**<subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:CCORrection:EN  
 <E\_n>**

Sets the age of operation information.

**Parameters:**

<E\_n> integer  
 Range: 0 to 31  
 \*RST: 0

**Manual operation:** See ["GLONASS Clock Correction Parameters"](#) on page 150

**<subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:CCORrection:GAMN**  
 <GAMMA\_n>

Defines the SV Clock drift correction coefficient.

**Parameters:**

<GAMMA\_n> integer  
 Range: -1024 to 1023  
 \*RST: 0

**Manual operation:** See ["GLONASS Clock Correction Parameters"](#) on page 150

**<subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:CCORrection:TAUN**  
 <TAU\_n>

Defines the SV Clock bias correction coefficient.

**Parameters:**

<TAU\_n> integer  
 Range: -2097152 to 2097151  
 \*RST: 0

**Manual operation:** See ["GLONASS Clock Correction Parameters"](#) on page 150

**<subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris:AOEP**  
 <AgeOfEph>

Sets the time interval between 2 adjacent values of TOE. It defines hence the age of the current GLONASS Ephemeris page.

**Parameters:**

<AgeOfEph> A30M | A45M | A60M  
**A30M**  
 age of Ephemeris = 30 min  
**A45M**  
 age of Ephemeris = 45 min  
**A60M**  
 age of Ephemeris = 60 min  
 \*RST: A30M

**Manual operation:** See ["GLONASS Ephemeris Parameters"](#) on page 148

---

**<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:HEALTH**  
 <Health>

A health value. The user navigation equipment analyzes only the MSB of this word.

**Parameters:**

<Health> integer  
**B\_n[3] = 1\_n = 1**  
 Satellite is not healthy  
**B\_n[3] = 1\_n = 0**  
 Satellite is healthy  
 Range: 0 to 7  
 \*RST: 0

**Manual operation:** See "[GLONASS Ephemeris Parameters](#)" on page 148

---

**<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:P <P>**

Reliability measure of system time conversion parameters.

**Parameters:**

<P> integer  
**00**  
 TAU\_C and TAU\_GPS relayed from control segment.  
**01**  
 TAU\_C from control segment; TAU\_GPS calculated on board  
 GLONASS-M satellite.  
**10**  
 TAU\_C on board Glonass-M satellite and TAU\_GPS relayed  
 from CS.  
**11**  
 TAU\_C and TAU\_GPS calculated on board Glonass-M satel-  
 lites.  
 Range: 0 to 3  
 \*RST: 0

**Manual operation:** See "[GLONASS Ephemeris Parameters](#)" on page 148

---

**<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:SEType**  
 <Type>

Selects the satellite ephemeris type.

**Parameters:**

<Type> GLO | GLOM  
 \*RST: GLOM

**Manual operation:** See "[GLONASS Ephemeris Parameters](#)" on page 148

---

**<subsystem>:SVID<ch>:GLONass:NMEssage[:PAGE<us>]:EPHemeris:  
TAlign <TbAlign>**

Sets TOE to be aligned to an even or odd scale of 15 min for Age of Ephemeris = 30 or 60 min.

The parameters **Tb-Interval** (<subsystem>:SVID<ch>:GLONass:NMEssage[:PAGE<us>]:EPHemeris:TINterval?) and **TOE** (<subsystem>:SVID<ch>:GLONass:NMEssage[:PAGE<us>]:EPHemeris:TOE?) depend on this value.

**Note:** All Ephemeris pages of an SVID have the same Tb alignment (P2).

**Parameters:**

<TbAlign>                    EVEN | ODD  
\*RST:                        ODD

**Example:**                    SUR:BB:GLON:SVID:GLON:NMES:EPH:TAL EVEN

**Manual operation:**    See "GLONASS Ephemeris Parameters" on page 148

---

**<subsystem>:SVID<ch>:GLONass:NMEssage[:PAGE<us>]:EPHemeris:TINdex  
<TbIndex>**

Defines the index of the Tb-time interval.

To define the duration of the Tb-time interval, use the command <subsystem>:SVID<ch>:GLONass:NMEssage[:PAGE<us>]:EPHemeris:AOEP.

**Parameters:**

<TbIndex>                    integer  
Range:                        1 to 95  
\*RST:                        1

**Manual operation:**    See "GLONASS Ephemeris Parameters" on page 148

---

**<subsystem>:SVID<ch>:GLONass:NMEssage[:PAGE<us>]:EPHemeris:  
TINterval?**

Queries the Tb-Interval in the current day where the Ephemeris set page is valid.

**Return values:**

<TbInterval>                string

**Example:**

```
SUR:BB:GLON:SVID:GLON:NMES:EPH:TIND 0
set Tb_index to 0.
SOUR:BB:GLON:SVID:GLON:NMES:EPH:AOEP 30
set age of Ephemeris to 30 min.
SOUR:BB:GLON:SVID:GLON:NMES:EPH:TINT?
Response: Tb-Interval is the interval between 00:00:00 and
00:30:00 in the current day.
```

**Usage:**                        Query only

**Manual operation:**    See "GLONASS Ephemeris Parameters" on page 148

---

**<subsystem>:SVID<ch>:GLONass:NMEssage[:PAGE<us>]:EPHemeris:TOE?**

Queries the time of Ephemeris in the current day.

**Return values:**

<Hour>	integer	
	Range:	0 to 23
<Minute>	integer	
	Range:	0 to 59
<Second>	float	
	Range:	0 to 59
	Increment:	1

**Usage:** Query only

**Manual operation:** See "[GLONASS Ephemeris Parameters](#)" on page 148

---

**<subsystem>:SVID<ch>:GLONass:NMEssage[:PAGE<us>]:EPHemeris:XN <X\_n>**

**<subsystem>:SVID<ch>:GLONass:NMEssage[:PAGE<us>]:EPHemeris:YN <Y\_n>**

**<subsystem>:SVID<ch>:GLONass:NMEssage[:PAGE<us>]:EPHemeris:ZN <Z\_n>**

Sets the OX | OY | OZ **position** coordinates of the current satellite at TOE(tb), i.e. the middle of Tb-Interval.

The coordinates correspond to the PZ-90 coordinate system.

**Parameters:**

<Z_n>	integer	
	Range:	-67108864 to 67108863
	*RST:	0

**Manual operation:** See "[GLONASS Ephemeris Parameters](#)" on page 148

---

**<subsystem>:SVID<ch>:GLONass:NMEssage[:PAGE<us>]:EPHemeris:XDDN <XDDOT\_n>**

**<subsystem>:SVID<ch>:GLONass:NMEssage[:PAGE<us>]:EPHemeris:YDDN <YDDOT\_N>**

**<subsystem>:SVID<ch>:GLONass:NMEssage[:PAGE<us>]:EPHemeris:ZDDN <ZDDOT\_n>**

The OZ **acceleration** coordinate of the current satellite due to solar and lunar gravitational effects at TOE(tb), i.e. the middle of Tb-Interval.

The coordinates correspond to the PZ-90 coordinate system.

**Parameters:**

<ZDDOT_n>	integer	
	Range:	-16 to 15
	*RST:	0

**Manual operation:** See "[GLONASS Ephemeris Parameters](#)" on page 148

```

<subsystem>:SVID<ch>:GLONass:NMEssage[:PAGE<us>]:EPHemeris:XDN
  <XDOT_n>
<subsystem>:SVID<ch>:GLONass:NMEssage[:PAGE<us>]:EPHemeris:YDN
  <YDOT_n>
<subsystem>:SVID<ch>:GLONass:NMEssage[:PAGE<us>]:EPHemeris:ZDN
  <ZDOT_n>

```

Sets the OX | OY | OZ **velocity** coordinate of the current satellite at TOE(tb), i.e. the middle of Tb-Interval<sup>(1)</sup>.

The coordinates correspond to the PZ-90 coordinate system.

**Parameters:**

```

<ZDOT_n>          integer
                   Range:    -8388608 to 8388607
                   *RST:     0

```

**Manual operation:** See "[GLONASS Ephemeris Parameters](#)" on page 148

## 6.19 Atmospheric Configuration

### Example: Configuring the ionospheric model and ionospheric navigation parameters

The following example uses GPS entry standard and specifies a reference satellite.

```

SOURCE:BB:GPS:SMODE USER
SOURCE:BB:GPS:HYBRID:GPS:STATE 1
SOURCE:BB:GPS:HYBRID:GALileo:STATE 1
SOURCE:BB:GPS:NAVIGATION:SBAS:EGNOS:STATE 1
SOURCE:BB:GPS:NAVIGATION:SBAS:WAAS:STATE 1
SOURCE:BB:GPS:SIERRORS 0

SOURCE:BB:GPS:ATMOSPHERIC:IONOSPHERIC:MODEL KLOBuchar
SOURCE:BB:GPS:ATMOSPHERIC:IONOSPHERIC:KLOBuchar:ALPHA0 5
SOURCE:BB:GPS:ATMOSPHERIC:GPS:IONOSPHERIC:SYNC
SOURCE:BB:GPS:ATMOSPHERIC:GPS:IONOSPHERIC:ALPHA0?
// Response: 5
SOURCE:BB:GPS:ATMOSPHERIC:IONOSPHERIC:MODEL NEQuick
SOURCE:BB:GPS:ATMOSPHERIC:IONOSPHERIC:NEQuick:UMSN OFF
SOURCE:BB:GPS:ATMOSPHERIC:IONOSPHERIC:NEQuick:SUNSPOT 100
SOURCE:BB:GPS:ATMOSPHERIC:IONOSPHERIC:NEQuick:SFLUX 145.4
SOURCE:BB:GPS:ATMOSPHERIC:GPS:IONOSPHERIC:SYNC
SOURCE:BB:GPS:ATMOSPHERIC:GPS:IONOSPHERIC:ALPHA0?
// Response: 29

SOURCE:BB:GPS:ATMOSPHERIC:IONOSPHERIC:MODEL MOPS
// select a predefined file mixed iono grid file
SOURCE:BB:GPS:ATMOSPHERIC:IONOSPHERIC:MOPS:FILE "19_02_14_mixed.iono_grid"

```

```
SOURce:BB:GPS:NAVigation:SBAS:EGNOS:IGRID:FILE?
// Response: "../Lists/Gnss/Sbas/Correction/19_02_14_egnos.iono_grid"
SOURce:BB:GPS:ATMospheric:SBAS:IONospheric:IGSPeriod 3600
SOURce:BB:GPS:ATMospheric:SBAS:IONospheric:SYNC
SOURce:BB:GPS:NAVigation:SBAS:EGNOS:IGRID:FILE?
// Response: "..Gnss_Gen/sync_00_egnos.iono_grid"
```

- <subsystem>:ATMospheric:TROPospheric:MODEl..... 359
- <subsystem>:ATMospheric:IONospheric:MODEl..... 359
- <subsystem>:ATMospheric:IONospheric:NEQuick:SFLux..... 360
- <subsystem>:ATMospheric:IONospheric:NEQuick:SUNSpot..... 360
- <subsystem>:ATMospheric:IONospheric:NEQuick:UMSN..... 360
- <subsystem>:ATMospheric:IONospheric:MOPS:FILE..... 361
- <subsystem>:ATMospheric:SBAS:IONospheric:IGSPeriod..... 361
- <subsystem>:ATMospheric:GPS:IONospheric:SYNC..... 361
- <subsystem>:ATMospheric:GALileo:IONospheric:SYNC..... 361
- <subsystem>:ATMospheric:BEIDou:IONospheric:SYNC..... 361
- <subsystem>:ATMospheric:QZSS:IONospheric:SYNC..... 361
- <subsystem>:ATMospheric:SBAS:IONospheric:SYNC..... 361
- <subsystem>:ATMospheric:<GNSS>:IONospheric:ALPHa<ch0>..... 361
- <subsystem>:ATMospheric:IONospheric:KLOBuchar:ALPHa<ch0>..... 361
- <subsystem>:ATMospheric:BEIDou:IONospheric:ALPHa<ch0>..... 361
- <subsystem>:ATMospheric:QZSS:IONospheric:ALPHa<ch0>..... 362
- <subsystem>:ATMospheric:GPS:IONospheric:ALPHa<ch0>..... 362
- <subsystem>:ATMospheric:<GNSS>:IONospheric:BETA<ch0>..... 362
- <subsystem>:ATMospheric:IONospheric:KLOBuchar:BETA<ch0>..... 362
- <subsystem>:ATMospheric:BEIDou:IONospheric:BETA<ch0>..... 362
- <subsystem>:ATMospheric:QZSS:IONospheric:BETA<ch0>..... 362
- <subsystem>:ATMospheric:GPS:IONospheric:BETA<ch0>..... 362
- <subsystem>:ATMospheric:GALileo:IONospheric:AI<ch0>..... 362
- <subsystem>:ATMospheric:GALileo:IONospheric:SF<ch>..... 362

---

**<subsystem>:ATMospheric:TROPospheric:MODEl <Model>**

Determines the tropospheric model.

**Parameters:**

<Model> NONE | STANag | MOPS  
 \*RST: NONE

**Example:** SOURce:BB:GPS:ATMospheric:TROPospheric:MODEl  
 MOPS

**Manual operation:** See "[Tropospheric Model](#)" on page 156

---

**<subsystem>:ATMospheric:IONospheric:MODEl <Model>**

Determines the applied ionospheric model.

**Parameters:**

<Model> NONE | KLOBuchar | MOPS | NEQuick  
 \*RST: NONE

**Example:**

see [example "Configuring the ionospheric model and ionospheric navigation parameters"](#) on page 358

**Manual operation:**

See ["Ionospheric Model"](#) on page 156

<subsystem>:ATMospheric:IONospheric:NEQuick:SFLux <SolarFlux>

Sets the solar flux level.

**Parameters:**

<SolarFlux> float  
 Range: 0 to 300  
 Increment: 1E-3  
 \*RST: 0

**Example:**

see [example "Configuring the ionospheric model and ionospheric navigation parameters"](#) on page 358

**Manual operation:**

See ["NeQuick Parameters"](#) on page 159

<subsystem>:ATMospheric:IONospheric:NEQuick:SUNSpot <SunspotNumber>

Sets the sunspot number.

**Parameters:**

<SunspotNumber> float  
 Range: -99.636 to 248.870  
 Increment: 1E-3  
 \*RST: 100

**Example:**

see [example "Configuring the ionospheric model and ionospheric navigation parameters"](#) on page 358

**Manual operation:**

See ["NeQuick Parameters"](#) on page 159

<subsystem>:ATMospheric:IONospheric:NEQuick:UMSN <State>

Enables the instrument to use the measured sunspot number value.

**Parameters:**

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

**Example:**

see [example "Configuring the ionospheric model and ionospheric navigation parameters"](#) on page 358

**Manual operation:**

See ["NeQuick Parameters"](#) on page 159



---

**<subsystem>:ATMospheric:IONospheric:MOPS:FILE <Filename>**

Select an ionospheric grid file with mixed ionospheric information on the enabled GNSS systems.

**Parameters:**

<Filename>                    string  
                                   To load a predefined file, specify only the file name.  
                                   To load an used-defined file, specify the absolute file path with filename and extension (\*.iono\_grid)

**Example:**                    see [example "Configuring the ionospheric model and ionospheric navigation parameters"](#) on page 358

**Options:**                    R&S SMBV-K110

**Manual operation:**    See ["MOPS-DO-229D Parameters"](#) on page 157

---

**<subsystem>:ATMospheric:SBAS:IONospheric:IGSPeriod <SamplingPeriod>**

Sets the sampling period used by the generation of the iono grid file.

**Parameters:**

<SamplingPeriod>            integer  
                                   Range:        1 to 21600  
                                   \*RST:        960

**Example:**                    see [example "Configuring the ionospheric model and ionospheric navigation parameters"](#) on page 358

**Options:**                    R&S SMBV-K110

**Manual operation:**    See ["SBAS Ionospheric Navigation Parameters"](#) on page 162

---

**<subsystem>:ATMospheric:GPS:IONospheric:SYNC**

**<subsystem>:ATMospheric:GALileo:IONospheric:SYNC**

**<subsystem>:ATMospheric:BEIDou:IONospheric:SYNC**

**<subsystem>:ATMospheric:QZSS:IONospheric:SYNC**

**<subsystem>:ATMospheric:SBAS:IONospheric:SYNC**

Synchronizes the ionospheric navigation parameters of the GNSS standard with the parameters of the current ionospheric model.

**Example:**                    see [example "Configuring the ionospheric model and ionospheric navigation parameters"](#) on page 358

**Usage:**                    Event

**Manual operation:**    See ["Sync from Simulated Ionospheric Model"](#) on page 162

---

**<subsystem>:ATMospheric:<GNSS>:IONospheric:ALPHA<ch0>**

**<subsystem>:ATMospheric:IONospheric:KLOBuchar:ALPHA<ch0> <Alpha>**

**<subsystem>:ATMospheric:BEIDou:IONospheric:ALPHA<ch0> <Alpha>**

---

**<subsystem>:ATMospheric:QZSS:IONospheric:ALPHa<ch0>** <Alpha>

**<subsystem>:ATMospheric:GPS:IONospheric:ALPHa<ch0>** <Alpha>

Sets the parameter alpha\_0 .. alpha\_3 of the satellite's navigation message.

**Suffix:**

<ch0> 0 .. 3

**Parameters:**

<Alpha> integer  
 Range: -128 to 127  
 \*RST: 0

**<subsystem>:ATMospheric:<GNSS>:IONospheric:BETA<ch0>**

**<subsystem>:ATMospheric:IONospheric:KLOBuchar:BETA<ch0>** <Beta>

**<subsystem>:ATMospheric:BEIDou:IONospheric:BETA<ch0>** <Beta>

**<subsystem>:ATMospheric:QZSS:IONospheric:BETA<ch0>** <Beta>

**<subsystem>:ATMospheric:GPS:IONospheric:BETA<ch0>** <Beta>

Sets the parameter beta\_0 .. beta\_3 of the satellite's navigation message.

**Suffix:**

<ch0> 0 .. 3

**Parameters:**

<Beta> integer  
 Range: -128 to 127  
 \*RST: 0

**<subsystem>:ATMospheric:GALileo:IONospheric:AI<ch0>** <A\_j>

Sets the parameters effective Ionization level 1<sup>st</sup> .. 3<sup>rd</sup> order of the satellite's navigation message.

**Parameters:**

<A\_j> integer  
 Range: a\_i0 (0..2047), a\_i1 (-1024..1023), a\_i2 (-8192..8191)  
 \*RST: 0

**Manual operation:** See "[GALILEO Ionospheric Navigation Parameters](#)" on page 162

**<subsystem>:ATMospheric:GALileo:IONospheric:SF<ch>** <SF>

Sets the parameters ionospheric disturbance flag for region 1 to 5 of the satellite's navigation message.

**Suffix:**

<ch> 1 .. 5

**Parameters:**

<SF> integer  
 Range: 0 to 1  
 \*RST: 0

**Manual operation:** See "[GALILEO Ionospheric Navigation Parameters](#)" on page 162

## 6.20 Assistance Data Settings



The Assistance Data Settings are only configurable for instrument equipped with assistance option (R&S SMBV-K65/K67/K95) or the basic option R&S SMBV-K107 and in "User Localization" mode.

### Example: Generating of GPS assistance data

The following example uses GPS entry standard.

```
SOURcel:BB:GPS:SMODE USER
SOURcel:BB:GPS:ADGeneration:MODE GPS
SOURcel:BB:GPS:ADGeneration:GPS:SYNchronize
SOURcel:BB:GPS:ADGeneration:GPS:SVID15:STATE?
//Response:1
SOURcel:BB:GPS:ADGeneration:GPS:LOCation:COORDinates:RFRame WGS84
SOURcel:BB:GPS:ADGeneration:GPS:LOCation:COORDinates:DMS?
//Response:144,57,59.97,EAST,37,48,59.987,SOUT,100
SOURcel:BB:GPS:ADGeneration:GPS:LOCation:COORDinates:DECimal?
//Response:144.966658,-37.816663,100
SOURcel:BB:GPS:ADGeneration:GPS:LOCation:URADius 2500
SOURcel:BB:GPS:ADGeneration:GPS:TOAData:TBASis UTC
SOURcel:BB:GPS:ADGeneration:GPS:TOAData:DATE?
//Response:2010,11,7
SOURcel:BB:GPS:ADGeneration:GPS:TOAData:TIME?
//Response:17,4,0
SOURcel:BB:GPS:ADGeneration:GPS:TOAData:TBASis GPS
SOURcel:BB:GPS:ADGeneration:GPS:TOAData:WNUMBER?
//Response:1609
SOURcel:BB:GPS:ADGeneration:GPS:TOAData:TOWeek?
//Response:61455
SOURcel:BB:GPS:ADGeneration:GPS:TOAD:DURATION 10
SOURcel:BB:GPS:ADGeneration:GPS:TOAD:RES 0.001
SOURcel:BB:GPS:ADGeneration:ACQ:ISFormat GPS
SOURcel:BB:GPS:ADGeneration:ACQ:CREATE '/var/user/ADG/acquisition'
SOURcel:BB:GPS:ADGeneration:ALManac:CREATE '/var/user/ADG/almanac.rs_al'
SOURcel:BB:GPS:ADGeneration:ALManac:CREATE '/var/user/ADG/almanac.rs_yuma'
SOURcel:BB:GPS:ADGeneration:UTC:CREATE '/var/user/ADG/UTC'
SOURcel:BB:GPS:ADGeneration:NAVigation:CREATE '/var/user/ADG/navigation'
```

```

SOURCE1:BB:GPS:ADGeneration:NAVigation:CREate '/var/user/ADG/RINEX.110n'
SOURCE1:BB:GPS:ADGeneration:IONigation:CREate '/var/user/ADG/ionospheric'
MMEM:CAT? '/var/user/ADG'
//Response: 25301,43275001856,".,DIR,0",".,DIR,0","acquisition.rs_acq,BIN,525",
// "almanac.rs_al,BIN,5518","almanac.rs_yuma,BIN,18344","ion.rs_ion,BIN,70",
// "navigation.rs_nav,BIN,245","RINEX.10n,BIN,525","UTC.rs_utc,BIN,74"

<subsystem>:ADGeneration:BEIDou:SVID<ch>:ACQuisition:BLOCK?.....366
<subsystem>:ADGeneration:QZSS:SVID<ch>:ACQuisition:BLOCK?.....366
<subsystem>:ADGeneration:GPS:SVID<ch>:ACQuisition:BLOCK?.....366
<subsystem>:ADGeneration:GALileo:SVID<ch>:ACQuisition:BLOCK?.....367
<subsystem>:ADGeneration:GLONass:SVID<ch>:ACQuisition:BLOCK?.....367
<subsystem>:ADGeneration:BEIDou:SVID<ch>:SAData?.....368
<subsystem>:ADGeneration:QZSS:SVID<ch>:SAData?.....368
<subsystem>:ADGeneration:GALileo:SVID<ch>:SAData?.....368
<subsystem>:ADGeneration:GLONass:SVID<ch>:SAData?.....368
<subsystem>:ADGeneration:GPS:SVID<ch>:SAData?.....368
<subsystem>:ADGeneration:<GNSS>:SYNChronize.....369
<subsystem>:ADGeneration:BEIDou:SVID:SYNChronize.....369
<subsystem>:ADGeneration:BEIDou:LOCation:SYNChronize.....369
<subsystem>:ADGeneration:BEIDou:TOAData:SYNChronize.....370
<subsystem>:ADGeneration:BEIDou:SYNChronize.....370
<subsystem>:ADGeneration:QZSS:SVID:SYNChronize.....370
<subsystem>:ADGeneration:QZSS:LOCation:SYNChronize.....370
<subsystem>:ADGeneration:QZSS:TOAData:SYNChronize.....370
<subsystem>:ADGeneration:QZSS:SYNChronize.....370
<subsystem>:ADGeneration:GLONass:SVID:SYNChronize.....370
<subsystem>:ADGeneration:GLONass:LOCation:SYNChronize.....370
<subsystem>:ADGeneration:GLONass:TOAData:SYNChronize.....370
<subsystem>:ADGeneration:GLONass:SYNChronize.....370
<subsystem>:ADGeneration:GALileo:SVID:SYNChronize.....370
<subsystem>:ADGeneration:GALileo:LOCation:SYNChronize.....370
<subsystem>:ADGeneration:GALileo:TOAData:SYNChronize.....370
<subsystem>:ADGeneration:GALileo:SYNChronize.....370
<subsystem>:ADGeneration:GPS:SVID:SYNChronize.....370
<subsystem>:ADGeneration:GPS:LOCation:SYNChronize.....370
<subsystem>:ADGeneration:GPS:TOAData:SYNChronize.....370
<subsystem>:ADGeneration:GPS:SYNChronize.....370
<subsystem>:ADGeneration:MODE.....370
<subsystem>:ADGeneration:<GNSS>:SVID<ch>:STATe.....370
<subsystem>:ADGeneration:BEIDou:SVID<ch>:STATe.....370
<subsystem>:ADGeneration:QZSS:SVID<ch>:STATe.....370
<subsystem>:ADGeneration:GALileo:SVID<ch>:STATe.....370
<subsystem>:ADGeneration:GLONass:SVID<ch>:STATe.....370
<subsystem>:ADGeneration:GPS:SVID<ch>:STATe.....370
<subsystem>:ADGeneration:<GNSS>:LOCation:COORdinates:RFRame.....371
<subsystem>:ADGeneration:BEIDou:LOCation:COORdinates:RFRame.....371
<subsystem>:ADGeneration:QZSS:LOCation:COORdinates:RFRame.....371
<subsystem>:ADGeneration:GALileo:LOCation:COORdinates:RFRame.....371
<subsystem>:ADGeneration:GLONass:LOCation:COORdinates:RFRame.....371

```

<subsystem>:ADGeneration:GPS:LOCation:COORdinateS:RFRame.....	371
<subsystem>:ADGeneration:<GNSS>:LOCation:COORdinateS:DECimal:WGS PZ.....	371
<subsystem>:ADGeneration:BEIDou:LOCation:COORdinateS:DECimal:PZ.....	371
<subsystem>:ADGeneration:BEIDou:LOCation:COORdinateS:DECimal[:WGS].....	371
<subsystem>:ADGeneration:QZSS:LOCation:COORdinateS:DECimal:PZ.....	371
<subsystem>:ADGeneration:QZSS:LOCation:COORdinateS:DECimal[:WGS].....	371
<subsystem>:ADGeneration:GALileo:LOCation:COORdinateS:DECimal:PZ.....	371
<subsystem>:ADGeneration:GALileo:LOCation:COORdinateS:DECimal[:WGS].....	371
<subsystem>:ADGeneration:GLONass:LOCation:COORdinateS:DECimal:PZ.....	371
<subsystem>:ADGeneration:GLONass:LOCation:COORdinateS:DECimal[:WGS].....	371
<subsystem>:ADGeneration:GPS:LOCation:COORdinateS:DECimal:PZ.....	371
<subsystem>:ADGeneration:GPS:LOCation:COORdinateS:DECimal[:WGS].....	371
<subsystem>:ADGeneration:<GNSS>:LOCation:COORdinateS:DMS:WGS PZ.....	372
<subsystem>:ADGeneration:BEIDou:LOCation:COORdinateS:DMS:PZ.....	372
<subsystem>:ADGeneration:BEIDou:LOCation:COORdinateS:DMS[:WGS].....	372
<subsystem>:ADGeneration:QZSS:LOCation:COORdinateS:DMS:PZ.....	372
<subsystem>:ADGeneration:QZSS:LOCation:COORdinateS:DMS[:WGS].....	372
<subsystem>:ADGeneration:GALileo:LOCation:COORdinateS:DMS:PZ.....	372
<subsystem>:ADGeneration:GALileo:LOCation:COORdinateS:DMS[:WGS].....	372
<subsystem>:ADGeneration:GLONass:LOCation:COORdinateS:DECimal:PZ.....	372
<subsystem>:ADGeneration:GLONass:LOCation:COORdinateS:DECimal[:WGS].....	372
<subsystem>:ADGeneration:GPS:LOCation:COORdinateS:DMS:PZ.....	372
<subsystem>:ADGeneration:GPS:LOCation:COORdinateS:DMS[:WGS].....	372
<subsystem>:ADGeneration:<GNSS>:LOCation:URADius.....	374
<subsystem>:ADGeneration:BEIDou:LOCation:URADius.....	374
<subsystem>:ADGeneration:QZSS:LOCation:URADius.....	374
<subsystem>:ADGeneration:GALileo:LOCation:URADius.....	374
<subsystem>:ADGeneration:GLONass:LOCation:URADius.....	374
<subsystem>:ADGeneration:GPS:LOCation:URADius.....	374
<subsystem>:ADGeneration:<GNSS>:LOCation:URADius.....	374
<subsystem>:ADGeneration:BEIDou:TOAData:TBASis.....	374
<subsystem>:ADGeneration:QZSS:TOAData:TBASis.....	374
<subsystem>:ADGeneration:GALileo:TOAData:TBASis.....	374
<subsystem>:ADGeneration:GLONass:TOAData:TBASis.....	374
<subsystem>:ADGeneration:GPS:TOAData:TBASis.....	374
<subsystem>:ADGeneration:<GNSS>:TOAData:DATE.....	374
<subsystem>:ADGeneration:BEIDou:TOAData:DATE.....	374
<subsystem>:ADGeneration:QZSS:TOAData:DATE.....	374
<subsystem>:ADGeneration:GALileo:TOAData:DATE.....	374
<subsystem>:ADGeneration:GLONass:TOAData:DATE.....	374
<subsystem>:ADGeneration:GPS:TOAData:DATE.....	374
<subsystem>:ADGeneration:<GNSS>:TOAData:TIME.....	375
<subsystem>:ADGeneration:BEIDou:TOAData:TIME.....	375
<subsystem>:ADGeneration:QZSS:TOAData:TIME.....	375
<subsystem>:ADGeneration:GALileo:TOAData:TIME.....	375
<subsystem>:ADGeneration:GLONass:TOAData:TIME.....	375
<subsystem>:ADGeneration:GPS:TOAData:TIME.....	375
<subsystem>:ADGeneration:<GNSS>:TOAData:DURation.....	375
<subsystem>:ADGeneration:BEIDou:TOAData:DURation.....	375
<subsystem>:ADGeneration:QZSS:TOAData:DURation.....	375

<subsystem>:ADGeneration:GALileo:TOADData:DURation..... 375  
 <subsystem>:ADGeneration:GLONass:TOADData:DURation..... 375  
 <subsystem>:ADGeneration:GPS:TOADData:DURation..... 375  
 <subsystem>:ADGeneration:<GNSS>:TOADData:RESolution..... 376  
 <subsystem>:ADGeneration:BEIDou:TOADData:RESolution..... 376  
 <subsystem>:ADGeneration:QZSS:TOADData:RESolution..... 376  
 <subsystem>:ADGeneration:GALileo:TOADData:RESolution..... 376  
 <subsystem>:ADGeneration:GLONass:TOADData:RESolution..... 376  
 <subsystem>:ADGeneration:GPS:TOADData:RESolution..... 376  
 <subsystem>:ADGeneration:<GNSS>:TOADData:TOWeek..... 376  
 <subsystem>:ADGeneration:BEIDou:TOADData:TOWeek..... 376  
 <subsystem>:ADGeneration:QZSS:TOADData:TOWeek..... 376  
 <subsystem>:ADGeneration:GALileo:TOADData:TOWeek..... 376  
 <subsystem>:ADGeneration:GLONass:TOADData:TOWeek..... 376  
 <subsystem>:ADGeneration:GPS:TOADData:TOWeek..... 376  
 <subsystem>:ADGeneration:<GNSS>:TOADData:WNUmber..... 376  
 <subsystem>:ADGeneration:BEIDou:TOADData:WNUmber..... 376  
 <subsystem>:ADGeneration:QZSS:TOADData:WNUmber..... 376  
 <subsystem>:ADGeneration:GALileo:TOADData:WNUmber..... 376  
 <subsystem>:ADGeneration:GLONass:TOADData:WNUmber..... 376  
 <subsystem>:ADGeneration:GPS:TOADData:WNUmber..... 376  
 <subsystem>:ADGeneration:NAVigation:DFORmat..... 377  
 <subsystem>:ADGeneration[:ACQuisition]:DFORmat..... 377  
 <subsystem>:ADGeneration:ACQuisition:CREate..... 377  
 <subsystem>:ADGeneration:ALManac:CREate..... 378  
 <subsystem>:ADGeneration:UTC:CREate..... 378  
 <subsystem>:ADGeneration:NAVigation:CREate..... 378  
 <subsystem>:ADGeneration:IONospheric:CREate..... 379

---

**<subsystem>:ADGeneration:BEIDou:SVID<ch>:ACQuisition:BLOCK? <TimeOffset>**  
**<subsystem>:ADGeneration:QZSS:SVID<ch>:ACQuisition:BLOCK? <TimeOffset>**  
**<subsystem>:ADGeneration:GPS:SVID<ch>:ACQuisition:BLOCK? <TimeOffset>**

Queries part of the current assistance data settings.

**Query parameters:**

<TimeOffset>            Int  
 Sets the offset of time to the beginning of the acquisition data generation set with the command **<subsystem>:ADGeneration:GPS:TOADData:TIME** or the command **<subsystem>:ADGeneration:GPS:TOADData:TOWeek**.

**Return values:**

<Block> <Rx Time of Week>, <Satellite ID that corresponds to the record>, <Zero Order Doppler Term>, <1st order Doppler Term>, <Uncertainty Doppler>, <Code Phase (or half-Chip index at epoch Time of Transmission (GPS Sat Time))>, <Integer Code Phase (or ms unit index at epoch Time of Transmission (GPS Sat Time))>, <Corresponding Bit number (modulo 4) at epoch Time of Transmission (GPS Sat Time)>, <Correlator Code phase Search Radius>, <Azimuth Angle of the Satellite in ENU orthonormal coordinate System centered at reference point>, <Elevation Angle of the Satellite in ENU orthonormal coordinate System centered at reference point>

The returned value is exactly one row of the acquisition assistance data file (2G, 3G) that can be generated by the command `<subsystem>:ADGeneration:ACquisition:CREate`.

**Example:**

```
SOURce1:BB:GPS:ADGeneration:GPS:TOAData:TBASis
UTC
```

```
SOURce1:BB:GPS:ADGeneration:GPS:TOAData:TIME
17,04,00.000
```

sets the time of assistance data.

```
SOURce1:BB:GPS:ADGeneration:GPS:SVID2:
```

```
ACquisition:BLOCK? 0.1
```

queries the acquisition data for SV ID 2 and time offset of 0.1s, i.e. at UTC Time 17:04:00 + 0.1 s.

Response:

```
589925,5,3733.3371910282908,0,0,599,18,1,11,
225.32801752395233,11.17712126071662
```

**Usage:**

Query only

**Options:**

R&S SMBV-K65/K107

---

```
<subsystem>:ADGeneration:GALileo:SVID<ch>:ACquisition:BLOCK?
<TimeOffset>
```

```
<subsystem>:ADGeneration:GLONass:SVID<ch>:ACquisition:BLOCK?
<TimeOffset>
```

Queries part of the current assistance data settings.

**Query parameters:**

<TimeOffset>

Int

Sets the offset of time to the beginning of the acquisition data generation set with the command `<subsystem>:ADGeneration:GLONass:TOAData:TIME` or the command `<subsystem>:ADGeneration:GLONass:TOAData:TOWeek`.

**Return values:**

&lt;Block&gt;

<Rx Time of Week>, <Satellite ID that corresponds to the record>, <Zero Order Doppler Term>, <1st order Doppler Term>, <Uncertainty Doppler (m/s)>, <Code Phase (ms)>, <Integer Code Phase (ms)>, <Correlator Code phase Search Radius (ms)>, <Azimuth Angle of the Satellite in ENU orthonormal coordinate System centered at reference point>, <Elevation Angle of the Satellite in ENU orthonormal coordinate System centered at reference point>

The returned value is exactly one row of the acquisition assistance data file (2G, 3G) that can be generated by the command `<subsystem>:ADGeneration:ACquisition:CREate`.

**Example:**

```
SOURce1:BB:GPS:ADGeneration:GLONass:TOAData:
TBASis GLO
```

```
SOURce1:BB:GPS:ADGeneration:GLONass:TOAData:
DATE 2012,8,20
```

```
SOURce1:BB:GPS:ADGeneration:GLONass:TOAData:
TIME 19,00,00.000
```

sets the time of assistance data.

```
SOURce1:BB:GPS:ADGeneration:GLONass:SVID2:
ACquisition:BLOCK? 0.1
```

queries the acquisition data for SV ID 2 and time offset of 0.1s, i.e. at Glonass time 19:00:00 + 0.1 s.

Response:

```
154800.1,2,431.205775308508,0,0,0.987,68,
0.00764343745397626,151.707854408733,
55.6703598896116,0
```

**Usage:**

Query only

**Options:**

R&S SMBV-K67/K95

---

```
<subsystem>:ADGeneration:BEIDou:SVID<ch>:SAData? <TimeOffset>,
<NumberOfSymbols>
```

```
<subsystem>:ADGeneration:QZSS:SVID<ch>:SAData? <TimeOffset>,
<NumberOfSymbols>
```

```
<subsystem>:ADGeneration:GALileo:SVID<ch>:SAData? <TimeOffset>,
<NumberOfSymbols>
```

```
<subsystem>:ADGeneration:GLONass:SVID<ch>:SAData? <TimeOffset>,
<NumberOfSymbols>
```

```
<subsystem>:ADGeneration:GPS:SVID<ch>:SAData? <TimeOffset>,
<NumberOfSymbols>
```

Queries selected number of symbols from the sensitivity assistance message for a specific satellite (SV ID) and at given specific time.



**Query parameters:**

- <TimeOffset>** float  
Sets the offset of time to the beginning of the acquisition data generation set with the command `<subsystem>`:  
`ADGeneration:GPS:TOAData:TIME` or the command  
`<subsystem>:ADGeneration:GPS:TOAData:TOWeek`.
- <NumberOfSymbols>** Default unit: bits  
Determines the length of the sensitivity assistance data to be generated. The maximum length of the generated sensitivity assistance data is then 125 subframes, i.e. 25 pages or one complete navigation message.

**Return values:**

- <Data>** list of integers  
The R&S SMBV generates a sensitivity assistance message as a binary stream.  
The returned value of this query for a healthy satellite is a sequence of integer values. The first integer is the size of the message in bits to be returned. The remaining, each of which is a 32 bits long block, represents the expected data bits of the navigation message.  
The query returns 0, in case an unhealthy satellite has been selected.  
An error will only be reported if an out of range value for any of the arguments has been selected.

**Example:**

```
SOURce1:BB:GPS:ADGeneration:GPS:TOAData:TBASis
UTC
SOURce1:BB:GPS:ADGeneration:GPS:TOAData:TIME
17,04,00.000
SOURce1:BB:GPS:ADGeneration:GPS:SVID1:SADa?
1,300
queries the sensitivity assistance data for SV ID 1.
Response: 0
The selected satellite is unhealthy.
SOURce1:BB:GPS:ADGeneration:GPS:SVID2:SADa?
2,300
queries the sensitivity assistance data for SV ID 2.
Response:
300,-1962933360,78782016,68160383,-10752,43007,
-172032,681727,-1009778689,-1
The first bits of the sensitivity assistance message are 1000
1011 ...
```

- Usage:** Query only

---

`<subsystem>:ADGeneration:<GNSS>:SYNChronize`  
`<subsystem>:ADGeneration:BEIDou:SVID:SYNChronize`  
`<subsystem>:ADGeneration:BEIDou:LOCation:SYNChronize`

<subsystem>:ADGeneration:BEIDou:TOAData:SYNChronize  
 <subsystem>:ADGeneration:BEIDou:SYNChronize  
 <subsystem>:ADGeneration:QZSS:SVID:SYNChronize  
 <subsystem>:ADGeneration:QZSS:LOCation:SYNChronize  
 <subsystem>:ADGeneration:QZSS:TOAData:SYNChronize  
 <subsystem>:ADGeneration:QZSS:SYNChronize  
 <subsystem>:ADGeneration:GLONass:SVID:SYNChronize  
 <subsystem>:ADGeneration:GLONass:LOCation:SYNChronize  
 <subsystem>:ADGeneration:GLONass:TOAData:SYNChronize  
 <subsystem>:ADGeneration:GLONass:SYNChronize  
 <subsystem>:ADGeneration:GALileo:SVID:SYNChronize  
 <subsystem>:ADGeneration:GALileo:LOCation:SYNChronize  
 <subsystem>:ADGeneration:GALileo:TOAData:SYNChronize  
 <subsystem>:ADGeneration:GALileo:SYNChronize  
 <subsystem>:ADGeneration:GPS:SVID:SYNChronize  
 <subsystem>:ADGeneration:GPS:LOCation:SYNChronize  
 <subsystem>:ADGeneration:GPS:TOAData:SYNChronize  
 <subsystem>:ADGeneration:GPS:SYNChronize

Synchronizes the affected parameters.

**Example:** See [example "Generating of GPS assistance data"](#) on page 363.

**Usage:** Event

**Manual operation:** See ["Synchronize All/Synchronize"](#) on page 184

<subsystem>:ADGeneration:MODE <Mode>

Defines the type of assistance data to be loaded.

**Parameters:**

<Mode> GPS | GALileo | GLONass | BEIDou | QZSS  
 \*RST: GPS

**Example:** See [example "Generating of GPS assistance data"](#) on page 363.

**Options:** R&S SMBV-K65/K67/K95/K107

**Manual operation:** See ["Assistance Mode"](#) on page 183

<subsystem>:ADGeneration:<GNSS>:SVID<ch>:STATe  
 <subsystem>:ADGeneration:BEIDou:SVID<ch>:STATe <State>  
 <subsystem>:ADGeneration:QZSS:SVID<ch>:STATe <State>  
 <subsystem>:ADGeneration:GALileo:SVID<ch>:STATe <State>  
 <subsystem>:ADGeneration:GLONass:SVID<ch>:STATe <State>  
 <subsystem>:ADGeneration:GPS:SVID<ch>:STATe <State>

Enables/disables a space vehicle with the selected SV ID for generation of assistance data.

**Parameters:**

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

**Example:** See [example "Generating of GPS assistance data"](#) on page 363.

**Manual operation:** See ["Space Vehicle State"](#) on page 184

```
<subsystem>:ADGeneration:<GNSS>:LOCation:COORdinates:RFRame
<subsystem>:ADGeneration:BEIDou:LOCation:COORdinates:RFRame
  <ReferenceFrame>
<subsystem>:ADGeneration:QZSS:LOCation:COORdinates:RFRame
  <ReferenceFrame>
<subsystem>:ADGeneration:GALileo:LOCation:COORdinates:RFRame
  <ReferenceFrame>
<subsystem>:ADGeneration:GLONass:LOCation:COORdinates:RFRame
  <ReferenceFrame>
<subsystem>:ADGeneration:GPS:LOCation:COORdinates:RFRame
  <ReferenceFrame>
```

Sets the reference frame.

**Parameters:**

<ReferenceFrame> PZ90 | WGS84  
 \*RST: WGS84

**Example:** See [example "Generating of GPS assistance data"](#) on page 363.

```
<subsystem>:ADGeneration:<GNSS>:LOCation:COORdinates:DECimal:WGS|PZ
<subsystem>:ADGeneration:BEIDou:LOCation:COORdinates:DECimal:PZ
  <Longitude>, <Latitude>, <Altitude>
<subsystem>:ADGeneration:BEIDou:LOCation:COORdinates:DECimal[:WGS]
  <Longitude>, <Latitude>, <Altitude>
<subsystem>:ADGeneration:QZSS:LOCation:COORdinates:DECimal:PZ
  <Longitude>, <Latitude>, <Altitude>
<subsystem>:ADGeneration:QZSS:LOCation:COORdinates:DECimal[:WGS]
  <Longitude>, <Latitude>, <Altitude>
<subsystem>:ADGeneration:GALileo:LOCation:COORdinates:DECimal:PZ
  <Longitude>, <Latitude>, <Altitude>
<subsystem>:ADGeneration:GALileo:LOCation:COORdinates:DECimal[:WGS]
  <Longitude>, <Latitude>, <Altitude>
<subsystem>:ADGeneration:GLONass:LOCation:COORdinates:DECimal:PZ
  <Longitude>, <Latitude>, <Altitude>
<subsystem>:ADGeneration:GLONass:LOCation:COORdinates:DECimal[:WGS]
  <Longitude>, <Latitude>, <Altitude>
<subsystem>:ADGeneration:GPS:LOCation:COORdinates:DECimal:PZ
  <Longitude>, <Latitude>, <Altitude>
<subsystem>:ADGeneration:GPS:LOCation:COORdinates:DECimal[:WGS]
  <Longitude>, <Latitude>, <Altitude>
```

Sets the geographic reference location in decimal format.

**Parameters:**

<Longitude>	float
	Range: -180 to 180
	Increment: 1E-7
	*RST: 0
<Latitude>	float
	Range: -90 to 90
	Increment: 1E-7
	*RST: 0
<Altitude>	float
	Defines the altitude in meters above sea level.
	Range: -10E3 to 2500E3
	Increment: 0.01
	*RST: 0

**Example:** See [example "Generating of GPS assistance data"](#) on page 363.

---

```

<subsystem>:ADGeneration:<GNSS>:LOCation:COORDinates:DMS:WGS|PZ
<subsystem>:ADGeneration:BEIDou:LOCation:COORDinates:DMS:PZ
    <LongitudeDeg>, <LongitudeMin>, <LongitudeSec>, <LongitudeDir>,
    <LatitudeDeg>, <LatitudeMin>, <LatitudeSec>, <LatitudeDir>, <Altitude>
<subsystem>:ADGeneration:BEIDou:LOCation:COORDinates:DMS[:WGS]
    <LongitudeDeg>, <LongitudeMin>, <LongitudeSec>, <LongitudeDir>,
    <LatitudeDeg>, <LatitudeMin>, <LatitudeSec>, <LatitudeDir>, <Altitude>
<subsystem>:ADGeneration:QZSS:LOCation:COORDinates:DMS:PZ
    <LongitudeDeg>, <LongitudeMin>, <LongitudeSec>, <LongitudeDir>,
    <LatitudeDeg>, <LatitudeMin>, <LatitudeSec>, <LatitudeDir>, <Altitude>
<subsystem>:ADGeneration:QZSS:LOCation:COORDinates:DMS[:WGS]
    <LongitudeDeg>, <LongitudeMin>, <LongitudeSec>, <LongitudeDir>,
    <LatitudeDeg>, <LatitudeMin>, <LatitudeSec>, <LatitudeDir>, <Altitude>
<subsystem>:ADGeneration:GALileo:LOCation:COORDinates:DMS:PZ
    <LongitudeDeg>, <LongitudeMin>, <LongitudeSec>, <LongitudeDir>,
    <LatitudeDeg>, <LatitudeMin>, <LatitudeSec>, <LatitudeDir>, <Altitude>
<subsystem>:ADGeneration:GALileo:LOCation:COORDinates:DMS[:WGS]
    <LongitudeDeg>, <LongitudeMin>, <LongitudeSec>, <LongitudeDir>,
    <LatitudeDeg>, <LatitudeMin>, <LatitudeSec>, <LatitudeDir>, <Altitude>
<subsystem>:ADGeneration:GLONass:LOCation:COORDinates:DECimal:PZ
    <Longitude>, <Latitude>, <Altitude>
<subsystem>:ADGeneration:GLONass:LOCation:COORDinates:DECimal[:WGS]
    <Longitude>, <Latitude>, <Altitude>
<subsystem>:ADGeneration:GPS:LOCation:COORDinates:DMS:PZ
    <LongitudeDeg>, <LongitudeMin>, <LongitudeSec>, <LongitudeDir>,
    <LatitudeDeg>, <LatitudeMin>, <LatitudeSec>, <LatitudeDir>, <Altitude>
<subsystem>:ADGeneration:GPS:LOCation:COORDinates:DMS[:WGS]
    <LongitudeDeg>, <LongitudeMin>, <LongitudeSec>, <LongitudeDir>,
    <LatitudeDeg>, <LatitudeMin>, <LatitudeSec>, <LatitudeDir>, <Altitude>

```

Sets the geographic reference location in degrees, minutes and seconds.

**Parameters:**

<LongitudeDeg>	integer Defines the longitude degrees. 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: 1E-4 *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: 1E-4 *RST: 0
<LatitudeDir>	NORTH   SOUTH Defines the latitude direction. *RST: NORT
<Altitude>	float Defines the altitude in meters above sea level. Range: -10E3 to 2500E3 Increment: 0.01 *RST: 0

**Example:** See [example "Generating of GPS assistance data"](#) on page 363.

---

```

<subsystem>:ADGeneration:<GNSS>:LOCation:URADius
<subsystem>:ADGeneration:BEIDou:LOCation:URADius <Radius>
<subsystem>:ADGeneration:QZSS:LOCation:URADius <Radius>
<subsystem>:ADGeneration:GALileo:LOCation:URADius <Radius>
<subsystem>:ADGeneration:GLONass:LOCation:URADius <Radius>
<subsystem>:ADGeneration:GPS:LOCation:URADius <Radius>

```

Sets the Uncertainty Radius, i.e. sets the maximum radius of the area within which the two dimensional location of the UE is bounded.

**Parameters:**

```

<Radius>          integer
                   Range:    0 to 1.E6
                   *RST:     3.E3

```

**Example:** See [example "Generating of GPS assistance data"](#) on page 363.

---

```

<subsystem>:ADGeneration:<GNSS>:LOCation:URADius
<subsystem>:ADGeneration:BEIDou:TOAData:TBASis <TimeBasis>
<subsystem>:ADGeneration:QZSS:TOAData:TBASis <TimeBasis>
<subsystem>:ADGeneration:GALileo:TOAData:TBASis <TimeBasis>
<subsystem>:ADGeneration:GLONass:TOAData:TBASis <TimeBasis>
<subsystem>:ADGeneration:GPS:TOAData:TBASis <TimeBasis>

```

Determines the time basis used to enter the time of assistance data parameters.

**Parameters:**

```

<TimeBasis>      UTC | GPS | GST | GLO | BDT
                   *RST:    UTC

```

**Example:** See [example "Generating of GPS assistance data"](#) on page 363.

**Manual operation:** See ["Time Basis"](#) on page 185

---

```

<subsystem>:ADGeneration:<GNSS>:TOAData:DATE
<subsystem>:ADGeneration:BEIDou:TOAData:DATE <Year>, <Month>, <Day>
<subsystem>:ADGeneration:QZSS:TOAData:DATE <Year>, <Month>, <Day>
<subsystem>:ADGeneration:GALileo:TOAData:DATE <Year>, <Month>, <Day>
<subsystem>:ADGeneration:GLONass:TOAData:DATE <Year>, <Month>, <Day>
<subsystem>:ADGeneration:GPS:TOAData:DATE <Year>, <Month>, <Day>

```

Enabled for UTC or GLONASS time basis ([<subsystem>:ADGeneration:GPS:TOAData:TBASis](#)).

Enters the date for the assistance data in DMS format of the Gregorian calendar.

**Parameters:**

```

<Year>           integer
                   Range:    1980 to 9999

<Month>          integer
                   Range:    1 to 12

```

<Day> integer  
Range: 1 to 31

**Example:** See [example "Generating of GPS assistance data"](#) on page 363.

**Manual operation:** See ["Date \[dd.mm.yyyy\]"](#) on page 185

**<subsystem>:ADGeneration:<GNSS>:TOADData:TIME**

**<subsystem>:ADGeneration:BEIDou:TOADData:TIME** <Hour>, <Minute>, <Second>

**<subsystem>:ADGeneration:QZSS:TOADData:TIME** <Hour>, <Minute>, <Second>

**<subsystem>:ADGeneration:GALileo:TOADData:TIME** <Hour>, <Minute>, <Second>

**<subsystem>:ADGeneration:GLONass:TOADData:TIME** <Hour>, <Minute>, <Second>

**<subsystem>:ADGeneration:GPS:TOADData:TIME** <Hour>, <Minute>, <Second>

Enabled for UTC or GLONASS time basis ([<subsystem>:ADGeneration:GPS:TOADData:TBASis](#)).

Enters the exact start time for the assistance data in UTC time format.

**Parameters:**

<Hour> integer  
Range: 0 to 23

<Minute> integer  
Range: 0 to 59

<Second> float  
Range: 0 to 59.999  
Increment: 0.001

**Example:** See [example "Generating of GPS assistance data"](#) on page 363.

**Manual operation:** See ["Time \[hh:mm:ss\]"](#) on page 185

**<subsystem>:ADGeneration:<GNSS>:TOADData:DURation**

**<subsystem>:ADGeneration:BEIDou:TOADData:DURation** <Duration>

**<subsystem>:ADGeneration:QZSS:TOADData:DURation** <Duration>

**<subsystem>:ADGeneration:GALileo:TOADData:DURation** <Duration>

**<subsystem>:ADGeneration:GLONass:TOADData:DURation** <Duration>

**<subsystem>:ADGeneration:GPS:TOADData:DURation** <Duration>

Sets the duration of the assistance data.

**Parameters:**

<Duration> float  
Range: 1E-3 to 5E3  
Increment: 1E-3  
\*RST: 1E-3  
Default unit: s

**Example:** See [example "Generating of GPS assistance data"](#) on page 363.

**Manual operation:** See ["Duration"](#) on page 186

---

```
<subsystem>:ADGeneration:<GNSS>:TOAData:RESolution
<subsystem>:ADGeneration:BEIDou:TOAData:RESolution <Resolution>
<subsystem>:ADGeneration:QZSS:TOAData:RESolution <Resolution>
<subsystem>:ADGeneration:GALileo:TOAData:RESolution <Resolution>
<subsystem>:ADGeneration:GLONass:TOAData:RESolution <Resolution>
<subsystem>:ADGeneration:GPS:TOAData:RESolution <Resolution>
```

Sets the resolution of the assistance data.

**Parameters:**

```
<Resolution>      float
                   Range:    1E-3 to 5
                   Increment: 1E-3
                   *RST:     1E-3
                   Default unit: s
```

**Example:** See [example "Generating of GPS assistance data"](#) on page 363.

**Manual operation:** See ["Resolution"](#) on page 186

---

```
<subsystem>:ADGeneration:<GNSS>:TOAData:TOWeek
<subsystem>:ADGeneration:BEIDou:TOAData:TOWeek <TOW>
<subsystem>:ADGeneration:QZSS:TOAData:TOWeek <TOW>
<subsystem>:ADGeneration:GALileo:TOAData:TOWeek <TOW>
<subsystem>:ADGeneration:GLONass:TOAData:TOWeek <TOW>
<subsystem>:ADGeneration:GPS:TOAData:TOWeek <TOW>
```

Enabled for GPS time basis ([<subsystem>:ADGeneration:GPS:TOAData:TBASis](#)).

Determines the Time of Week (TOW) the assistance data is generated for.

**Parameters:**

```
<TOW>             integer
                   Range:    -604800 to 604800
                   *RST:     0
```

**Example:** See [example "Generating of GPS assistance data"](#) on page 363.

**Manual operation:** See ["Time of Week"](#) on page 186

---

```
<subsystem>:ADGeneration:<GNSS>:TOAData:WNUmber
<subsystem>:ADGeneration:BEIDou:TOAData:WNUmber <WeekNumber>
<subsystem>:ADGeneration:QZSS:TOAData:WNUmber <WeekNumber>
<subsystem>:ADGeneration:GALileo:TOAData:WNUmber <WeekNumber>
<subsystem>:ADGeneration:GLONass:TOAData:WNUmber <WeekNumber>
<subsystem>:ADGeneration:GPS:TOAData:WNUmber <WeekNumber>
```

Enabled for GPS time basis ([<subsystem>:ADGeneration:GPS:TOAData:TBASis](#)).



Sets the week number (WN) the assistance data is generated for.

**Parameters:**

<WeekNumber> integer  
 Range: 0 to 9999.0\*53  
 \*RST: 0

**Example:** See [example "Generating of GPS assistance data"](#) on page 363.

**Manual operation:** See ["Week Number"](#) on page 186

**<subsystem>:ADGeneration:NAVigation:DFORmat <DataFormat>**

Sets the format of the generated navigation data file.

**Parameters:**

<DataFormat> GPS  
 \*RST: GPS

**Example:** `SOURcel:BB:GPS:ADGeneration:MODE GPS`  
`SOURcel:BB:GPS:ADGeneration:NAVigation:DFORmat GPS`

**Manual operation:** See ["Navigation Data Format"](#) on page 186

**<subsystem>:ADGeneration[:ACQuisition]:DFORmat <DataFormat>**

Sets the format, GPS or GNSS, of the generated acquisition files.

**Parameters:**

<DataFormat> GNSS | GPS  
 \*RST: GNSS

**Example:** See [example "Generating of GPS assistance data"](#) on page 363.

**Manual operation:** See ["Data Format"](#) on page 186

**<subsystem>:ADGeneration:ACQuisition:CREate <Create>**

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

**Parameters:**

<Create> string

**Example:** See [example "Generating of GPS assistance data"](#) on page 363.

**Options:** R&S SMBV-K65/K67/K95/K107

**Manual operation:** See ["Generate Acquisition File ..."](#) on page 190

---

**<subsystem>:ADGeneration:ALManac:CREate <Filename>**

Stores the current assistance data settings into the selected almanac file. The directory is set using command `M MEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. Only the file name has to be entered. Assistance data settings are stored as almanac file with the specific file extensions `*.rs_al` or `*.rs_yuma`.

The default extension is `*.rs_al` and can be omitted in the file name.

To save an almanac file as file with extension `*.rs_yuma`, however, this extension has to be specified in the file name.

**Parameters:**

<Filename>            string

**Example:**            See [example "Generating of GPS assistance data"](#) on page 363.

**Options:**            R&S SMBV-K65/K67/K95

**Manual operation:** See ["Generate Almanac File ..."](#) on page 186

---

**<subsystem>:ADGeneration:UTC:CREate <Filename>**

Stores the current assistance data settings into the selected UTC file. The directory is set using command `M MEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. Only the file name has to be entered. Assistance data settings are stored as UTC file with the specific file extensions `*.rs_utc`.

**Parameters:**

<Filename>            string

**Example:**            See [example "Generating of GPS assistance data"](#) on page 363.

**Manual operation:** See ["Generate UTC File ..."](#) on page 189

---

**<subsystem>:ADGeneration:NAVigation:CREate <Filename>**

Stores the current assistance data settings into the selected navigation file. The directory is set using command `M MEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. Only the file name has to be entered. Assistance data settings are stored as navigation file with the specific file extensions `*.rs_nav` or into RINEX files with extension `.10n`.

**Parameters:**

<Filename>            string

**Example:**            See [example "Generating of GPS assistance data"](#) on page 363.

**Manual operation:** See ["Generate Navigation File ..."](#) on page 188

**<subsystem>:ADGeneration:IONospheric:CREate <Filename>**

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

**Parameters:**

<Filename>                    string

**Example:**                    See [example "Generating of GPS assistance data"](#) on page 363.

**Manual operation:**    See ["Generate Ionospheric File ..."](#) on page 187

## 6.21 S.P.O.T Configuration and Real-Time Commands

**Example: Retrieving real-time settings**

The following example uses GPS entry standard.

```
*RST

SOURCEl:BB:GPS:SMODE AUTO
SOURCEl:BB:GPS:HYBRId:GALileo:STATe 1
SOURCEl:BB:GPS:HYBRId:GLONass:STATe 1
SOURCEl:BB:GPS:HYBRId:BEIDou:STATe 1
SOURCEl:BB:GPS:SATEllite:COUNt?
// Response: 12
// constalation with 12 satellites

SOURCEl:BB:GPS:VEHicle:TYPE?
// LVEH
SOURCEl:BB:GPS:LOCation:SElect "Waypoints"
SOURCEl:BB:GPS:LOCation:WAYPoints:FILE "Melbourne_Car_Motion.xtd"

SOURCEl:BB:GPS:NAVigation:ALManac:GPS:FILE?
// ".../Lists/Gnss/Gps/Almanac/GPS_SEM678.txt"
SOURCEl:BB:GPS:NAVigation:SIMulation:WNUMBER?
// 1702
SOURCEl:BB:GPS:NAVigation:SIMulation:TOWeek?
// 144016
SOURCEl:BB:GPS:NAVigation:SIMulation:TBASis UTC
SOURCEl:BB:GPS:NAVigation:SIMulation:DATE?
// 2012,8,20
SOURCEl:BB:GPS:NAVigation:SIMulation:TIME?
// 16,0,0

SOURCEl:BB:GPS:STATe 1
```

```

SOURCE1:BB:GPS:SPOT:UPDate OFF

SOURCE1:BB:GPS:SPOT:DISPlay MAP
SOURCE1:BB:GPS:SPOT:MAP:DEVIation?
// 1500

SOURCE1:BB:GPS:RT:HWTTime?
// Response: 36.16 sec
// elapsed time since simulation start

SOURCE1:BB:GPS:SPOT:NHOTime?
// Response: 750 s
// 750 sec = 12 min 30 sec
// hence the next handover is expected at 12:30 min after 16:00:00 on 20.08.2012,
// that is, the Next Handover Time is 16:12:30

SOURCE1:BB:GPS:SPOT:DISPlay SKY
SOURCE1:BB:GPS:RT:SCONstellation? GPS,1702,144050
//Response: 12,G2,G4,G9,G27,E15,E16,E26,E27,R12,R22,B25,B34,716
// constalation with 12 satellites
SOURCE1:BB:GPS:RT:OCONstellation? GPS,1609,65455
//Response: 12,G9,E16,R12,E27,B25,R22,G2,G4,E26,G27,B34,E15
SOURCE1:BB:GPS:RT:RLOCation:COORdinateS:DMS? GPS,1702,144050
//Response: 144,57,59.195,EAST,37,48,37.615,SOUT,100.037
SOURCE1:BB:GPS:RT:RLOCation:COORdinateS:DECimal? GPS,1702,144050
//Response: 144.966443,-37.810449,100.037
SOURCE1:BB:GPS:RT:RATTitude?
// Response: 0,0,-1.54474
SOURCE1:BB:GPS:RT:GALileo:SVID27:TAP1:POWer:ABSolute? GST,1702,144100
//Response: -118.836975193809
SOURCE1:BB:GPS:RT:GALileo:SVID27:AZIMuth? GST,1702,144100
//Response: 37.5699690788219
SOURCE1:BB:GPS:RT:GALileo:SVID10:ELEVation? GST,1702,144100
//Response: 72.6122965557601

<subsystem>:SPOT:NHOTime?..... 381
<subsystem>:SPOT:DISPlay..... 381
<subsystem>:RT:HWTTime?..... 382
<subsystem>:SPOT:MAP:DEVIation..... 382
<subsystem>:RT:<GNSS>:SVID<ch>:AZIMuth..... 382
<subsystem>:RT:SBAS:SVID<ch>:AZIMuth?..... 382
<subsystem>:RT:QZSS:SVID<ch>:AZIMuth?..... 382
<subsystem>:RT:BEIDou:SVID<ch>:AZIMuth?..... 382
<subsystem>:RT:GALileo:SVID<ch>:AZIMuth?..... 382
<subsystem>:RT:GLONass:SVID<ch>:AZIMuth?..... 382
<subsystem>:RT:GPS:SVID<ch>:AZIMuth?..... 382
<subsystem>:RT:<GNSS>:SVID<ch>:ELEVation..... 383
<subsystem>:RT:SBAS:SVID<ch>:ELEVation?..... 383
<subsystem>:RT:QZSS:SVID<ch>:ELEVation?..... 383
<subsystem>:RT:BEIDou:SVID<ch>:ELEVation?..... 383

```

<subsystem>:RT:GALileo:SVID<ch>:ELEVation?	383
<subsystem>:RT:GLONass:SVID<ch>:ELEVation?	384
<subsystem>:RT:GPS:SVID<ch>:ELEVation?	384
<subsystem>:RT:<GNSS>:SVID<ch>:TAP<us>:POWER:ABSolute?	385
<subsystem>:RT:SBAS:SVID<ch>:TAP<us>:POWER:ABSolute?	385
<subsystem>:RT:QZSS:SVID<ch>:TAP<us>:POWER:ABSolute?	385
<subsystem>:RT:BEIDou:SVID<ch>:TAP<us>:POWER:ABSolute?	385
<subsystem>:RT:GALileo:SVID<ch>:TAP<us>:POWER:ABSolute?	385
<subsystem>:RT:GLONass:SVID<ch>:TAP<us>:POWER:ABSolute?	385
<subsystem>:RT:GPS:SVID<ch>:TAP<us>:POWER:ABSolute?	385
<subsystem>:RT:RLOCation:COORDinates:DECimal?	386
<subsystem>:RT:RLOCation:COORDinates:DMS?	388
<subsystem>:RT:SCONstellation?	389
<subsystem>:RT:OCONstellation?	391
<subsystem>:RT:RATTitude?	392

---

### <subsystem>:SPOT:NHOTime?

In <subsystem>:SMOD AUTO, queries the time period that will pass from the simulation start before the next handover will be executed.

The time of the upcoming handover is calculated as: "Next Handover Time" = simulation start "Time" + <NHoTime>.

#### Return values:

<NHoTime>            integer  
                           Default unit: seconds

**Example:**            See [example "Retrieving real-time settings"](#) on page 379.

**Example:**            SOURCE1:BB:GPS:NAVIGATION:SIMULATION:DATE?  
                           Response: 2012,8,20  
                           SOURCE1:BB:GPS:NAVIGATION:SIMULATION:TIME?  
                           Response: 16,0,0  
                           SOURCE1:BB:GPS:SPOT:NHOTime?  
                           Response: 750 s  
                           750 sec = 12 min 30 sec. Hence the next handover is expected  
                           at 12:30 min after 16:00:00 on 20.08.2012, that is, the Next  
                           Handover Time is 16:12:30

**Usage:**                Query only

**Manual operation:** See ["Next Constellation Change"](#) on page 168

---

### <subsystem>:SPOT:DISPlay <DisplayType>

Switches between the available views.

#### Parameters:

<DisplayType>        SKY | MAP | POWER | TRAjectory | ATTitude  
                           \*RST:            SKY

**Example:**            See [example "Retrieving real-time settings"](#) on page 379.

**Manual operation:** See ["Display Type"](#) on page 167

---

#### <subsystem>:RT:HWTTime?

Queries the time elapsed since the simulation start.

#### Return values:

<ElapsedTime> float  
 Range: 0 to INT\_MAX  
 Increment: 0.001  
 \*RST: 0

**Example:** See [example "Retrieving real-time settings"](#) on page 379

**Usage:** Query only

---

#### <subsystem>:SPOT:MAP:DEVIation <Deviation>

Queries the radius of the "" display.

#### Parameters:

<Deviation> integer  
 Range: 1 to 1E6  
 \*RST: 1E3

**Example:** See [example "Retrieving real-time settings"](#) on page 379

---

#### <subsystem>:RT:<GNSS>:SVID<ch>:AZIMuth

<subsystem>:RT:SBAS:SVID<ch>:AZIMuth? <TimeBasis>, <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>, <TimeOfWeek>

<subsystem>:RT:QZSS:SVID<ch>:AZIMuth? <TimeBasis>, <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>, <TimeOfWeek>

<subsystem>:RT:BEIDou:SVID<ch>:AZIMuth? <TimeBasis>, <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>, <TimeOfWeek>

<subsystem>:RT:GALileo:SVID<ch>:AZIMuth? <TimeBasis>, <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>, <TimeOfWeek>

<subsystem>:RT:GLONass:SVID<ch>:AZIMuth? <TimeBasis>, <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>, <TimeOfWeek>

<subsystem>:RT:GPS:SVID<ch>:AZIMuth? <TimeBasis>, <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>, <TimeOfWeek>

Queries the satellite azimuth in the selected moment of time. The required query parameters, depend on the selected time basis.

#### Query parameters:

<TimeBasis> UTC | GPS | GST | GLO | BDT  
 \*RST: UTC

<Year> integer  
 required for TimeBasis = UTC  
 Range: 1980 to 9999

<Month>	integer required for <code>TimeBasis = UTC</code> Range: 1 to 12
<Day>	integer required for <code>TimeBasis = UTC</code> Range: 1 to 31
<Hour>	integer required for <code>TimeBasis = UTC</code> Range: 0 to 23
<Minutes>	integer required for <code>TimeBasis = UTC</code> Range: 0 to 59
<Seconds>	float required for <code>TimeBasis = UTC</code> Range: 0 to 59.999 Increment: 0.001
<WeekNumber>	integer required for <code>TimeBasis = GPS GST BDT</code> Range: 0 to 529947
<TimeOfWeek>	float required for <code>TimeBasis = GPS GST BDT</code> Range: 0 to 604799.999 Increment: 0.001

**Return values:**

<Azimuth> float

**Example:** See [example "Retrieving real-time settings"](#) on page 379.

**Usage:** Query only

---

**<subsystem>:RT:<GNSS>:SVID<ch>:ELEVation**

**<subsystem>:RT:SBAS:SVID<ch>:ELEVation?** <TimeBasis>, <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>, <TimeOfWeek>

**<subsystem>:RT:QZSS:SVID<ch>:ELEVation?** <TimeBasis>, <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>, <TimeOfWeek>

**<subsystem>:RT:BEIDou:SVID<ch>:ELEVation?** <TimeBasis>, <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>, <TimeOfWeek>

**<subsystem>:RT:GALileo:SVID<ch>:ELEVation?** <TimeBasis>, <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>, <TimeOfWeek>

**<subsystem>:RT:GLONass:SVID<ch>:ELEVation?** <TimeBasis>, <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>, <TimeOfWeek>

**<subsystem>:RT:GPS:SVID<ch>:ELEVation?** <TimeBasis>, <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>, <TimeOfWeek>

Queries the satellite's elevation in the selected moment of time. The required query parameters, depend on the selected time basis.

**Query parameters:**

<TimeBasis>	UTC   GPS   GST   GLO   BDT *RST: UTC
<Year>	integer required for TimeBasis = UTC Range: 1980 to 9999
<Month>	integer required for TimeBasis = UTC Range: 1 to 12
<Day>	integer required for TimeBasis = UTC Range: 1 to 31
<Hour>	integer required for TimeBasis = UTC Range: 0 to 23
<Minutes>	integer required for TimeBasis = UTC Range: 0 to 59
<Seconds>	float required for TimeBasis = UTC Range: 0 to 59.999 Increment: 0.001
<WeekNumber>	integer required for TimeBasis = GPS GST BDT Range: 0 to 529947
<TimeOfWeek>	float required for TimeBasis = GPS GST BDT Range: 0 to 604799.999 Increment: 0.001

**Return values:**

<Elevation> float

**Example:** See [example "Retrieving real-time settings"](#) on page 379.



**Usage:** Query only

---

```

<subsystem>:RT:<GNSS>:SVID<ch>:TAP<us>:POWER:ABSolute
<subsystem>:RT:SBAS:SVID<ch>:TAP<us>:POWER:ABSolute? <TimeBasis>,
    <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>,
    <TimeOfWeek>
<subsystem>:RT:QZSS:SVID<ch>:TAP<us>:POWER:ABSolute? <TimeBasis>,
    <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>,
    <TimeOfWeek>
<subsystem>:RT:BEIDou:SVID<ch>:TAP<us>:POWER:ABSolute? <TimeBasis>,
    <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>,
    <TimeOfWeek>
<subsystem>:RT:GALileo:SVID<ch>:TAP<us>:POWER:ABSolute? <TimeBasis>,
    <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>,
    <TimeOfWeek>
<subsystem>:RT:GLONass:SVID<ch>:TAP<us>:POWER:ABSolute? <TimeBasis>,
    <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>,
    <TimeOfWeek>
<subsystem>:RT:GPS:SVID<ch>:TAP<us>:POWER:ABSolute? <TimeBasis>,
    <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>,
    <TimeOfWeek>

```

Queries the absolute power of a specified Tap of a specific satellite at a selected moment of time.

**Note:** The power refers to the reference signal component in case of many signals simulated with this specific satellite e.g. C/A when simulating a satellite with signals (C/A + P)Q.

**Suffix:**

<us> 1..10  
 Determines the tap number. The number of taps is set with the command `<subsystem>:SVID<ch>:GALileo:MPATH:TAP:COUNT`.

**Query parameters:**

<TimeBasis> UTC | GPS | GST | GLO | BDT  
 \*RST: UTC

<Year> integer  
 required for UTC time basis only  
 Range: 1980 to 9999

<Month> integer  
 required for TimeBasis = UTC  
 Range: 1 to 12

<Day> integer  
 required for TimeBasis = UTC  
 Range: 1 to 31

<Hour>	integer required for <code>TimeBasis = UTC</code> Range: 0 to 23
<Minutes>	integer required for <code>TimeBasis = UTC</code> Range: 0 to 59
<Seconds>	float required for <code>TimeBasis = UTC</code> Range: 0 to 59.999 Increment: 0.001
<WeekNumber>	integer required for <code>TimeBasis = GPS GST BDT</code> Range: 0 to 529947
<TimeOfWeek>	float required for <code>TimeBasis = GPS GST BDT</code> Range: 0 to 604799.999 Increment: 0.001

**Return values:**

<Power> float

**Example:** See [example "Retrieving real-time settings"](#) on page 379.

**Usage:** Query only

---

**<subsystem>:RT:RLOCation:COORDinates:DECimal?** <TimeBasis>, <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>, <TimeOfWeek>

Queries the coordinates of the receiver location in decimal format for the selected moment of time. The required query parameters depend on the selected time basis.

**Query parameters:**

<TimeBasis>	UTC   GPS   GST   GLO   BDT *RST: UTC
<Year>	integer required for <code>TimeBasis = UTC</code> Range: 1980 to 9999
<Month>	integer required for <code>TimeBasis = UTC</code> Range: 1 to 12

<Day>	integer required for <code>TimeBasis = UTC</code> Range: 1 to 31
<Hour>	integer required for <code>TimeBasis = UTC</code> Range: 0 to 23
<Minutes>	integer required for <code>TimeBasis = UTC</code> Range: 0 to 59
<Seconds>	float required for <code>TimeBasis = UTC</code> Range: 0 to 59.999 Increment: 0.001
<WeekNumber>	integer required for <code>TimeBasis = GPS GST BDT</code> Range: 0 to 529947
<TimeOfWeek>	float required for <code>TimeBasis = GPS GST BDT</code> Range: 0 to 604799.999 Increment: 0.001
<b>Return values:</b>	
<Longitude>	float Range: -180 to 180 Increment: 1E-7 *RST: 0
<Latitude>	float Range: -90 to 90 Increment: 1E-7 *RST: 0
<Altitude>	float Range: -10E3 to 2500E3 Increment: 0.01 *RST: 0
<b>Example:</b>	See <a href="#">example "Retrieving real-time settings"</a> on page 379.
<b>Usage:</b>	Query only

**<subsystem>:RT:RLOCation:COORDinates:DMS? <TimeBasis>, <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>, <TimeOfWeek>**

Queries the coordinates of the receiver location in DMS format for the selected moment of time. The required query parameters depend on the selected time basis.

**Query parameters:**

<TimeBasis>	UTC   GPS   GST   GLO   BDT *RST: UTC
<Year>	integer required for TimeBasis = UTC Range: 1980 to 9999
<Month>	integer required for TimeBasis = UTC Range: 1 to 12
<Day>	integer required for TimeBasis = UTC Range: 1 to 31
<Hour>	integer required for TimeBasis = UTC Range: 0 to 23
<Minutes>	integer required for TimeBasis = UTC Range: 0 to 59
<Seconds>	float required for TimeBasis = UTC Range: 0 to 59.999 Increment: 0.001
<WeekNumber>	integer required for TimeBasis = GPS GST BDT Range: 0 to 529947
<TimeOfWeek>	float required for TimeBasis = GPS GST BDT Range: 0 to 604799.999 Increment: 0.001
<b>Return values:</b>	
<LongitudeDeg>	integer Range: 0 to 180 *RST: 0

<LongitudeMin>	integer
	Range: 0 to 59
	*RST: 0
<LongitudeSec>	float
	Range: 0 to 59.999
	Increment: 1E-4
	*RST: 0
<LongitudeDir>	EAST   WEST
	*RST: EAST
<LatitudeDeg>	integer
	Range: 0 to 90
	*RST: 0
<LatitudeMin>	integer
	Range: 0 to 59
	*RST: 0
<LatitudeSec>	float
	Range: 0 to 59.999
	Increment: 1E-4
	*RST: 0
<LatitudeDir>	NORT   SOUT
	*RST: NORT
<Altitude>	float
	Range: -10E3 to 2500E3
	Increment: 0.01
	*RST: 0

**Example:** See [example "Retrieving real-time settings"](#) on page 379.

**Usage:** Query only

---

**<subsystem>:RT:SCONstellation?** <TimeBasis>, <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>, <TimeOfWeek>

Queries the constellation of the active satellites for the selected moment of time.

**Query parameters:**

<TimeBasis>	UTC   GPS   GST   GLO   BDT
	*RST: UTC
<Year>	integer
	required for TimeBasis = UTC
	Range: 1980 to 9999

<Month>	integer required for <code>TimeBasis = UTC</code> Range: 1 to 12
<Day>	integer required for <code>TimeBasis = UTC</code> Range: 1 to 31
<Hour>	integer required for <code>TimeBasis = UTC</code> Range: 0 to 23
<Minutes>	integer required for <code>TimeBasis = UTC</code> Range: 0 to 59
<Seconds>	float required for <code>TimeBasis = UTC</code> Range: 0 to 59.999 Increment: 0.001
<WeekNumber>	integer required for <code>TimeBasis = GPS GST BDT</code> Range: 0 to 529947
<TimeOfWeek>	float required for <code>TimeBasis = GPS GST BDT</code> Range: 0 to 604799.999 Increment: 0.001

**Return values:**

<Constellation> <Number of Sats>,<STD/SV ID of Sat1>,<STD/SV ID of Sat2>,...,<Remaining Time>

The query returns a string composed of the number of simulated satellites at the selected moment of time, standard/SV-ID of all the satellites in the active constellation and if applicable the remaining time to the next exchange of satellites in seconds.

The <Remaining Time> is returned as a valid positive integer in seconds only when working in a mode where exchange of satellites is predefined or made automatic at the beginning of the simulation, e.g while working in the auto localization mode (`<subsystem>:SMODE`); otherwise -1 is returned.

**Example:**

```
BB:GPS:SMOD AUTO
```

```
BB:GPS:RT:SCON? GPS,1609,61455
```

```
Response: 6,G24,G10,G32,E11,E25,E14,1525
```

The 6 active satellites G24,G10,G32,E11,E25,E14 build the satellite constellation. An exchange of satellites will be performed in 1525s.

**Example:** See also [example "Retrieving real-time settings"](#) on page 379.

**Usage:** Query only

---

**<subsystem>:RT:OCONstellation?** <TimeBasis>, <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>, <TimeOfWeek>

Queries the optimal constellation for the selected moment of time.

**Query parameters:**

<TimeBasis>	UTC   GPS   GST   GLO   BDT *RST: UTC
<Year>	integer required for TimeBasis = UTC Range: 1980 to 9999
<Month>	integer required for TimeBasis = UTC Range: 1 to 12
<Day>	integer required for TimeBasis = UTC Range: 1 to 31
<Hour>	integer required for TimeBasis = UTC Range: 0 to 23
<Minutes>	integer required for TimeBasis = UTC Range: 0 to 59
<Seconds>	float required for TimeBasis = UTC Range: 0 to 59.999 Increment: 0.001
<WeekNumber>	integer required for TimeBasis = GPS GST BDT Range: 0 to 529947
<TimeOfWeek>	float required for TimeBasis = GPS GST BDT Range: 0 to 604799.999 Increment: 0.001

**Return values:**

<Constellation> <Number of Sats>,<STD/SV ID of Sat1>,<STD/SV ID of Sat2>,...

The query returns a string composed of the number of satellites in the optimal constellation and the standard/SV-ID of the satellites.

Use this information as a basis for manually performed exchange of satellites.

**Example:**

```
BB:GPS:SMOD USER
BB:GPS:NAV:SIM:TBAS GPS
BB:GPS:NAV:SIM:WNUM 1609
BB:GPS:NAV:SIM:TOW 61455
BB:GPS:GOC
```

```
BB:GPS:RT:SCON? GPS,1609,61455
```

```
Response: 6,G11,E11,E19,E28,G19,G14,-1
```

The 6 active satellites G11,E11,E19,E28,G19,G14 build the satellite constellation.

```
BB:GPS:RT:OCON? GPS,1609,65455
```

```
Response: 6,G20,E20,E23,G4,G24,E31
```

The optimal constellation for the selected moment of time consists of 6 satellites G20,E20,E23,G4,G24,E31.

**Example:**

See also [example "Retrieving real-time settings"](#) on page 379.

**Usage:**

Query only

**Manual operation:**

See ["Get Optimal Constellation"](#) on page 124

**<subsystem>:RT:RATTitude?** <TimeBasis>, <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>, <TimeOfWeek>

Queries the receiver attitude parameters yaw, pitch, roll in degrees for the selected moment of time.

**Query parameters:**

<TimeBasis> UTC | GPS | GST | GLO | BDT  
\*RST: UTC

<Year> integer  
required for TimeBasis = UTC  
Range: 1980 to 9999

<Month> integer  
required for TimeBasis = UTC  
Range: 1 to 12

<Day> integer  
required for TimeBasis = UTC  
Range: 1 to 31



<Hour>	integer required for <code>TimeBasis = UTC</code> Range: 0 to 23
<Minutes>	integer required for <code>TimeBasis = UTC</code> Range: 0 to 59
<Seconds>	float required for <code>TimeBasis = UTC</code> Range: 0 to 59.999 Increment: 0.001
<WeekNumber>	integer required for <code>TimeBasis = GPS GST BDT</code> Range: 0 to 529947
<TimeOfWeek>	float required for <code>TimeBasis = GPS GST BDT</code> Range: 0 to 604799.999 Increment: 0.001

**Return values:**

<Yaw>	float Range: -3.14 to 3.14 Increment: 0.01 *RST: 0
<Pitch>	float Range: -3.14 to 3.14 Increment: 0.01 *RST: 0
<Roll>	float Range: -3.14 to 3.14 Increment: 0.01 *RST: 0

**Example:**

```
SOURce1:BB:GPS:SMODE AUTO
SOURce1:BB:GPS:RATTitude? GPS,1609,61455
Response: 0.10,0.00,1.00
The current receiver attitude parameters yaw (Y) = 0.1, pitch (P) = 0 and roll (R) = 1.0
```

**Usage:**

Query only

**Manual operation:** See "[Yaw/Heading, Pitch/Elevation, Roll/Bank](#)" on page 61

## 6.22 Data Logging

### Example: Enabling data logging

The following example uses GPS entry standard.

```

SOURCEl:BB:GPS:SMODE AUTO
SOURCEl:BB:GPS:HYBRid:GALileo[:STATe] 1
SOURCEl:BB:GPS:NAVigation:SIMulation:TBASis GPS
SOURCEl:BB:GPS:NAVigation:SIMulation:WNUMBER?
// 1780
SOURCEl:BB:GPS:NAVigation:SIMulation:TOWeek?
// 280816
SOURCEl:BB:GPS:SATellite:COUNT 4
SOURCEl:BB:GPS:RT:SCONstellation? GPS,1780,280816
// 4,G2,G29,E1,E30,630

SOURCEl:BB:GPS:LOCation:SElect "Waypoints"
SOURCEl:BB:GPS:LOCation:WAYPoints:FILE 'Melbourne_Car_Motion.xtd'
SOURCEl:BB:GPS:LOCation:WAYPoints:ROMode CYCLic
SOURCEl:BB:GPS:LOCation:COORdinates:DECimal?
// Response: 144.966658,-37.816663,100

SOURCEl:BB:GPS:STATe 1

SOURCEl:BB:GPS:LOGGing:MODE OFFLine
SOURCEl:BB:GPS:LOGGing:OFFLine:SYNChronize:TIME
SOURCEl:BB:GPS:LOGGing:OFFLine:TBASis UTC
SOURCEl:BB:GPS:LOGGing:OFFLine:DATE?
// 2014,2,19
SOURCEl:BB:GPS:LOGGing:OFFLine:TIME?
// 6,0,0

SOURCEl:BB:GPS:LOGGing:OFFLine:DURation 60
SOURCEl:BB:GPS:LOGGing:DESTination?
// File
SOURCEl:BB:GPS:LOGGing:DESTination:FILE:DIRectory "/var/user/logs"
SOURCEl:BB:GPS:LOGGing:DESTination:FILE:BNAME "gnss_log"
SOURCEl:BB:GPS:LOGGing:DESTination:FILE:TAPPend:STATe 1
SOURCEl:BB:GPS:LOGGing:CATegory:SATellite:FORMat CSV
SOURCEl:BB:GPS:LOGGing:CATegory:UMOTion:FORMat CSV
SOURCEl:BB:GPS:LOGGing:CATegory:SATellite:STEP R10S
SOURCEl:BB:GPS:LOGGing:CATegory:UMOTion:STEP R10S
SOURCEl:BB:GPS:LOGGing:CATegory:SATellite:STATe 1
SOURCEl:BB:GPS:LOGGing:CATegory:UMOTion:STATe 1
SOURCEl:BB:GPS:LOGGing:CATegory:SATellite:FILE?
// "gnss_log_offline_Satellite_.csv"
SOURCEl:BB:GPS:LOGGing:CATegory:UMOTion:FILE?
// "gnss_log_offline_UserMotion_.csv"

```

```

SOURCEl:BB:GPS:LOGGing:CATegory:SATellite:SVID:SYNChronize
SOURCEl:BB:GPS:LOGGing:CATegory:SATellite:GPS:SVID2?
// 1
SOURCEl:BB:GPS:LOGGing:CATegory:SATellite:AZIMuth 1
SOURCEl:BB:GPS:LOGGing:CATegory:SATellite:ELEVation 1
...

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<subsystem>:LOGGING:CATegory:UMOTion[CSV]:VDOP.....	403

---

#### <subsystem>:LOGGING:MODE <Mode>

Sets the logging mode.

#### Parameters:

<Mode>                    RT | OFFLine  
                              \*RST:        OFFLine

**Example:**                see [example "Enabling data logging"](#) on page 394.

**Manual operation:**    See ["Mode"](#) on page 173

---

#### <subsystem>:LOGGING:OFFLine:ABORt

#### <subsystem>:LOGGING:OFFLine:GENerate

Logging files are created and saved. Files with the same name are overwritten.

**Example:** see [example "Enabling data logging"](#) on page 394.

**Usage:** Event

**Manual operation:** See ["Generate, On/Off"](#) on page 173

**<subsystem>:LOGGING:RT:STATE <Status>**

Starts/stops data logging. Files with the same name are overwritten.

**Parameters:**

<Status> 0 | 1 | OFF | ON

\*RST: 0

**Example:** SOURCE1:BB:GPS:LOGGING:RT:STATE 1

**Manual operation:** See ["Generate, On/Off"](#) on page 173

**<subsystem>:LOGGING:DESTINATION?**

Queries that the logged data is stored into files.

**Return values:**

<Destination> FILE | STREAM

STREAM - reserved for future use

\*RST: FILE

**Example:** see [example "Enabling data logging"](#) on page 394.

**Usage:** Query only

**Manual operation:** See ["Logged Data Destination"](#) on page 175

**<subsystem>:LOGGING:OFFLINE:SYNCHRONIZE[:TIME]**

Sets the logging time to the simulation start time.

**Example:** see [example "Enabling data logging"](#) on page 394.

**Usage:** Event

**Manual operation:** See ["Synchronize"](#) on page 174

**<subsystem>:LOGGING:OFFLINE:TBASIS <TimeBasis>**

Sets the time basis.

**Parameters:**

<TimeBasis> UTC | GPS | GST | GLO | BDT

\*RST: UTC

**Example:** see [example "Enabling data logging"](#) on page 394.

**Manual operation:** See ["Logging Start Time"](#) on page 174

---

**<subsystem>:LOGGING:OFFLine:DATE** <Year>, <Month>, <Day>

Sets the logging start date.

**Parameters:**

<Year>	integer	
	Range:	1980 to 9999
<Month>	integer	
	Range:	1 to 12
<Day>	integer	
	Range:	1 to 31

**Example:** see [example "Enabling data logging"](#) on page 394.

**Manual operation:** See "[Logging Start Time](#)" on page 174

---

**<subsystem>:LOGGING:OFFLine:TIME** <Hour>, <Minute>, <Second>

Sets the logging start time.

**Parameters:**

<Hour>	integer	
	Range:	0 to 23
<Minute>	integer	
	Range:	0 to 59
<Second>	float	
	Range:	0 to 59.999
	Increment:	0.001

**Example:** see [example "Enabling data logging"](#) on page 394.

**Manual operation:** See "[Logging Start Time](#)" on page 174

---

**<subsystem>:LOGGING:OFFLine:WNUMBER** <Week>

Sets the logging start week number.

**Parameters:**

<Week>	integer	
	Range:	0 to 9999*53
	*RST:	0

**Example:** see [example "Enabling data logging"](#) on page 394.

**Manual operation:** See "[Logging Start Time](#)" on page 174

---

**<subsystem>:LOGGING:OFFLine:TOWeek** <TOW>

Sets the start time within the selected week number.

**Parameters:**

<TOW> float  
 Range: 0 to 604799.999  
 Increment: 0.001  
 \*RST: 0

**Example:** see [example "Enabling data logging"](#) on page 394.

**Manual operation:** See ["Logging Start Time"](#) on page 174

**<subsystem>:LOGGING:OFFLine:DURATION <Duration>**

Sets the logging duration.

**Parameters:**

<Duration> float  
 Range: 0 to 864000  
 Increment: 0.001  
 \*RST: 0

**Example:** see [example "Enabling data logging"](#) on page 394.

**Manual operation:** See ["Duration"](#) on page 175

**<subsystem>:LOGGING:OFFLine:PROGRESS?**

Queries the progress of the offline data logging generation.

**Return values:**

<Progress> integer  
 Range: 0 to 100  
 \*RST: 100

**Example:** see [example "Enabling data logging"](#) on page 394.

**Usage:** Query only

**<subsystem>:LOGGING:DESTINATION:FILE:DIRECTORY <Directory>**

Sets the storage place.

**Parameters:**

<Directory> string

**Example:** see [example "Enabling data logging"](#) on page 394.

**Manual operation:** See ["Logged Data Destination"](#) on page 175

**<subsystem>:LOGGING:DESTINATION:FILE:BNAMe <BaseName>**

Sets the file prefix.

**Parameters:**

<BaseName> string

**Example:** see [example "Enabling data logging"](#) on page 394.

**Manual operation:** See ["Logged Data Destination"](#) on page 175

---

**<subsystem>:LOGGING:DESTINATION:FILE:TAPPEND:STATE <Append>**

Adds a time stamp to the file name.

**Parameters:**

<Append> 0 | 1 | OFF | ON

\*RST: 1

**Example:** see [example "Enabling data logging"](#) on page 394.

**Manual operation:** See ["Logged Data Destination"](#) on page 175

---

**<subsystem>:LOGGING:CATEGORY:SATELLITE:FORMAT <Format>**

**<subsystem>:LOGGING:CATEGORY:UMOTION:FORMAT <Format>**

Sets the file format in that the logged data is stored.

**Parameters:**

<Format> CSV

\*RST: CSV

**Example:** see [example "Enabling data logging"](#) on page 394.

**Manual operation:** See ["Format"](#) on page 175

---

**<subsystem>:LOGGING:CATEGORY:UMOTION:STATE <State>**

**<subsystem>:LOGGING:CATEGORY:SATELLITE:STATE <State>**

Enables the logging of the selected category.

**Parameters:**

<State> 0 | 1 | OFF | ON

\*RST: 0

**Example:** see [example "Enabling data logging"](#) on page 394.

**Manual operation:** See ["State"](#) on page 175

---

**<subsystem>:LOGGING:CATEGORY:UMOTION:FILE?**

**<subsystem>:LOGGING:CATEGORY:SATELLITE:FILE?**

Queries the file name of the file with logged data.

**Return values:**

<Filename> string

**Example:** see [example "Enabling data logging"](#) on page 394.



**Usage:** Query only

**Manual operation:** See ["Filename"](#) on page 175

**<subsystem>:LOGGING:CATegory:UMOTion:STEP <Resolution>**

**<subsystem>:LOGGING:CATegory:SATellite:STEP <Resolution>**

Sets the logging step.

**Parameters:**

<Resolution> R1S | R2S | R5S | R10S | R02S | R04S | R08S

\*RST: R1S

**Example:** see [example "Enabling data logging"](#) on page 394.

**Manual operation:** See ["Log Step, s"](#) on page 175

**<subsystem>:LOGGING:CATegory:SATellite:SVID:SYNChronize**

Retrieves the SV ID of the current satellite constellation.

**Example:** see [example "Enabling data logging"](#) on page 394.

**Usage:** Event

**Manual operation:** See ["Space Vehicle Selection"](#) on page 177

**<subsystem>:LOGGING:CATegory:SATellite:BEIDou:SVID<ch> <State>**

**<subsystem>:LOGGING:CATegory:SATellite:GALileo:SVID<ch> <State>**

**<subsystem>:LOGGING:CATegory:SATellite:GLONass:SVID<ch> <State>**

**<subsystem>:LOGGING:CATegory:SATellite:QZSS:SVID<ch> <State>**

**<subsystem>:LOGGING:CATegory:SATellite:SBAS:SVID<ch> <State>**

**<subsystem>:LOGGING:CATegory:SATellite:GPS:SVID<ch> <State>**

Enables/disables a space vehicle with the selected SV ID for logging.

**Parameters:**

<State> 0 | 1 | OFF | ON

\*RST: 1

**Example:** see [example "Enabling data logging"](#) on page 394.

**Manual operation:** See ["Space Vehicle Selection"](#) on page 177

**<subsystem>:LOGGING:CATegory:UMOTion[:CSV]:SElect:ALL**

**<subsystem>:LOGGING:CATegory:UMOTion[:CSV]:SElect:NONE**

**<subsystem>:LOGGING:CATegory:SATellite:SVID:SElect:ALL**

**<subsystem>:LOGGING:CATegory:SATellite:SVID:SElect:NONE**

**<subsystem>:LOGGING:CATegory:SATellite:SElect:ALL**

**<subsystem>:LOGGING:CATegory:SATellite:SElect:NONE**

Enables or disables all of the available SV IDs.

**Usage:** Event

**Manual operation:** See ["Logged Satellite Parameters"](#) on page 178

---

```

<subsystem>:LOGGING:CATegory:SATellite:ACceleration:ECEF <State>
<subsystem>:LOGGING:CATegory:SATellite:AZIMuth <State>
<subsystem>:LOGGING:CATegory:SATellite:CBIas <State>
<subsystem>:LOGGING:CATegory:SATellite:CPHase <State>
<subsystem>:LOGGING:CATegory:SATellite:DSHift <State>
<subsystem>:LOGGING:CATegory:SATellite:ELEVation <State>
<subsystem>:LOGGING:CATegory:SATellite:IDELay <State>
<subsystem>:LOGGING:CATegory:SATellite:POSition:ECEF <State>
<subsystem>:LOGGING:CATegory:SATellite:PRANge <State>
<subsystem>:LOGGING:CATegory:SATellite:PRANge:BIAS <State>
<subsystem>:LOGGING:CATegory:SATellite:PRANge:BIAS:RATE <State>
<subsystem>:LOGGING:CATegory:SATellite:PRANge:RATE <State>
<subsystem>:LOGGING:CATegory:SATellite:RANGe <State>
<subsystem>:LOGGING:CATegory:SATellite:RANGe:RATE <State>
<subsystem>:LOGGING:CATegory:SATellite:RRATE <State>
<subsystem>:LOGGING:CATegory:SATellite:SLEVel <State>
<subsystem>:LOGGING:CATegory:SATellite:TDELay <State>
<subsystem>:LOGGING:CATegory:SATellite:VELocity:ECEF <State>

```

Enables the parameter for logging.

**Parameters:**

```

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

```

**Example:** see [example "Enabling data logging"](#) on page 394.

**Manual operation:** See ["Logged Satellite Parameters"](#) on page 178

---

```

<subsystem>:LOGGING:CATegory:UMOTION[:CSV]:ACceleration:ECEF <State>
<subsystem>:LOGGING:CATegory:UMOTION[:CSV]:ATTitude <State>
<subsystem>:LOGGING:CATegory:UMOTION[:CSV]:ATTitude:ACceleration
    <State>
<subsystem>:LOGGING:CATegory:UMOTION[:CSV]:ATTitude:JERK <State>
<subsystem>:LOGGING:CATegory:UMOTION[:CSV]:ATTitude:RATE <State>
<subsystem>:LOGGING:CATegory:UMOTION[:CSV]:GDOP <State>
<subsystem>:LOGGING:CATegory:UMOTION[:CSV]:GSPeed <State>
<subsystem>:LOGGING:CATegory:UMOTION[:CSV]:HDOP <State>
<subsystem>:LOGGING:CATegory:UMOTION[:CSV]:JERK:ECEF <State>
<subsystem>:LOGGING:CATegory:UMOTION[:CSV]:PDOP <State>
<subsystem>:LOGGING:CATegory:UMOTION[:CSV]:POSition:ECEF <State>
<subsystem>:LOGGING:CATegory:UMOTION[:CSV]:POSition:ENU <State>
<subsystem>:LOGGING:CATegory:UMOTION[:CSV]:POSition:LLA <State>
<subsystem>:LOGGING:CATegory:UMOTION[:CSV]:TDOP <State>
<subsystem>:LOGGING:CATegory:UMOTION[:CSV]:VDOP <State>
<subsystem>:LOGGING:CATegory:UMOTION[:CSV]:VELocity:ECEF <State>

```

**<subsystem>:LOGGing:CATegory:UMOTion[:CSV]:VELocity:LNEd <State>**  
**<subsystem>:LOGGing:CATegory:UMOTion[:CSV]:VDOP <State>**

**Parameters:**

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

**Manual operation:** See "Logged User Motion Parameters" on page 179

## 6.23 Trigger Settings

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---

**<subsystem>[:TRIGger]:SEQuence <Sequence>**

Selects the trigger mode.

**Parameters:**

**<Sequence>** AUTO | RETRigger | AAUTo | ARETRigger | SINGLE  
**\*RST:** AUTO

**Example:**

BB:GPS:SEQ AAUT  
 sets the "Armed\_auto" trigger mode; the device waits for the first trigger (e.g. with \*TRG) and then generates the signal continuously.

**Manual operation:** See "Trigger Mode" on page 192

---

**<subsystem>:TRIGger:SLENGth <SLength>**

Defines the length of the signal sequence to be output in the "Single" trigger mode (SOUR:BB:GPS:SEQ SING). The unit of the entry is defined under "Signal Duration Unit". The maximum value for the sequence length depends on the selected unit.

It is possible to output deliberately just part of the signal, an exact sequence of the signal, or a defined number of repetitions of the signal.

**Parameters:**

<SLength> integer  
 Range: 1 to 4294967295  
 \*RST: 1023

**Example:**

BB:GPS:SEQ SING  
 sets trigger mode Single.  
 BB:GPS:TRIG:SLEN 200  
 sets a sequence length of 200 chips. The first 200 chips of the current frame will be output after the next trigger event.

**Manual operation:** See ["Signal Duration"](#) on page 193

**<subsystem>:TRIGger:RMODe?**

Queries the current status of signal generation for all trigger modes with GPS modulation on.

**Return values:**

<RMode> STOP | RUN  
 \*RST: STOP

**Example:**

BB:GPS:TRIG:MODE ARET  
 selects the "Armed\_Retrigger" mode.  
 BB:GPS:TRIG:SOUR EXT  
 sets external triggering via the TRIGGER 1 connector.  
 BB:GPS:TRIG:RMODe?  
 queries the current status of signal generation.  
 Response: RUN  
 the signal is generated, an external trigger was executed.

**Usage:** Query only

**Manual operation:** See ["Running/Stopped"](#) on page 193

**<subsystem>:TRIGger:ARM:EXECute**

Stops signal generation for trigger modes "Armed\_Auto" and "Armed\_Retrigger". A subsequent internal or external trigger event restarts signal generation.

**Example:**

BB:GPS:TRIG:SOUR INT  
 sets internal triggering.  
 BB:GPS:TRIG:SEQ ARET  
 sets Armed\_Retrigger mode, i.e. every trigger event causes signal generation to restart.  
 BB:GPS:TRIG:EXEC  
 executes a trigger, signal generation is started.  
 BB:GPS:TRIG:ARM:EXEC  
 signal generation is stopped.  
 BB:GPS:TRIG:EXEC  
 executes a trigger, signal generation is started again.

**Usage:** Event  
**Manual operation:** See ["Arm"](#) on page 48

---

#### <subsystem>:TRIGger:EXECute

Executes a trigger. The internal trigger source must be selected using the command <subsystem>:TRIG:SOUR INT and a trigger mode other than AUTO must be selected using the command <subsystem>:TRIG:SEQ.

**Example:**

```
BB:GPS:TRIG:SOUR INT
sets internal triggering.
BB:GPS:TRIG:SEQ ARET
sets "Armed_Retrigger" mode, i.e. every trigger event causes
signal generation to restart.
BB:GPS:TRIG:EXEC
executes a trigger, signal generation is started.
BB:GPS:TRIG:ARM:EXEC
signal generation is stopped.
BB:GPS:TRIG:EXEC
executes a trigger, signal generation is started again.
```

**Usage:** Event  
**Manual operation:** See ["Execute Trigger"](#) on page 48

---

#### <subsystem>:TRIGger:SOURce <Source>

Selects the trigger source.

**Parameters:**  
 <Source> INTernal | EXTernal

**Example:**

```
SOURce1:BB:GPS:TRIGger:SOURce EXTernal
SOURce1:BB:GPS:TRIGger:DELay 50
```

**Manual operation:** See ["Trigger Source"](#) on page 194

---

#### <subsystem>:TRIGger:EXTernal:SYNChronize:OUTPut <Output>

(enabled for "Trigger Source" External)

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

**Parameters:**  
 <Output> 0 | 1 | OFF | ON  
 \*RST: 1

**Example:**

```
BB:GPS:TRIG:SOUR EXT
sets external triggering.
BB:GPS:TRIG:EXT:SYNC:OUTP ON
enables synchronous output to external trigger.
```

**Manual operation:** See ["Sync. Output to External Trigger"](#) on page 194

**<subsystem>:TRIGger:OUTPut<ch>:DELay <Delay>**

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

**Parameters:**

<Delay> float  
 Range: 0 to  $2^{32} - 1$  chips  
 Increment: 1 chip  
 \*RST: 0

**Example:**

`BB:GPS:TRIG:OUTP2:DEL 1600`  
 sets a delay of 1600 chips for the signal on connector MARKER 2.

**Manual operation:** See "[Marker x Delay](#)" on page 197

**<subsystem>:TRIGger:OUTPut<ch>:DELay:MINimum?****<subsystem>:TRIGger:OUTPut<ch>:DELay:MAXimum?**

Queries the maximum marker delay for setting `<subsystem>:TRIG:OUTP:DEL:FIX ON`.

**Return values:**

<Maximum> float  
 Range: 0 to max

**Example:**

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

**Usage:** Query only

**Manual operation:** See "[Marker x Delay](#)" on page 197

**<subsystem>:TRIGger:OUTPut:DELay:FIXed <Fixed>**

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

**Parameters:**

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

**Example:** `BB:GPS:TRIG:OUTP:DEL:FIX ON`  
 restricts the marker signal delay setting range to the dynamic range.

**Manual operation:** See "[Marker x Delay](#)" on page 197

**<subsystem>:TRIGger[:EXTernal<ch>]:DELay <Delay>**

Specifies the trigger delay (expressed as a number of chips) for external triggering.

**Parameters:**

<Delay> float  
 Range: 0 to 65535  
 Increment: 0.01  
 \*RST: 0

**Example:** see `<subsystem>:TRIGger:SOURce` on page 405

**Manual operation:** See "[External Delay](#)" on page 195

**<subsystem>:TRIGger[:EXTernal<ch>]:INHibit <Inhibit>**

Specifies the number of chips by which a restart is to be inhibited following a trigger event. Applies only in the case of external triggering.

**Parameters:**

<Inhibit> integer  
 Range: 0 to 67108863  
 Increment: 1 chip  
 \*RST: 0

**Example:** `BB:GPS:TRIG:SOUR EXT`  
 selects an external trigger via the TRIGGER 1 connector.  
`BB:GPS:TRIG:INH 200`  
 sets a restart inhibit for 200 chips following a trigger event.

**Manual operation:** See "[External Inhibit](#)" on page 195

## 6.24 Marker Settings

<a href="#">&lt;subsystem&gt;:TRIGger:OUTPut&lt;ch&gt;:MODE</a> .....	408
<a href="#">&lt;subsystem&gt;:TRIGger:OUTPut&lt;ch&gt;:ONTime</a> .....	408
<a href="#">&lt;subsystem&gt;:TRIGger:OUTPut&lt;ch&gt;:OFFTime</a> .....	408
<a href="#">&lt;subsystem&gt;:TRIGger:OUTPut&lt;ch&gt;:PATtern</a> .....	409
<a href="#">&lt;subsystem&gt;:TRIGger:OUTPut&lt;ch&gt;:PULSe:DIVider</a> .....	409
<a href="#">&lt;subsystem&gt;:TRIGger:OUTPut&lt;ch&gt;:PULSe:FREQuency?</a> .....	409
<a href="#">&lt;subsystem&gt;:TRIGger:OUTPut&lt;ch&gt;:PULSe:WIDTh</a> .....	410

---

**<subsystem>:TRIGger:OUTPut<ch>:MODE <Mode>**

Defines the signal for the selected marker output.

**Note:** In instruments equipped with option R&S SMBV-K96, disabled [<subsystem>:UMGPs](#) and enabled satellites constellation with more than 12 satellites, only one marker signal is available.

**Parameters:**

<Mode> PULSe | PATTeRn | RATio | PPS | PP2S | TRIGger | DISabled | PPS10

**PULSe|PATTeRn|RATio**

Regular marker signals

**PPS | PP2S | PPS10**

A marker signal is generated for every start of second, every second second or respectively every tenth second (GPS time). The pulse width is defined with the

[<subsystem>:TRIG:OUTP:PULSe:WIDTh](#) command

**TRIGger**

A marker signal is generated only when a trigger event occurs.

**DISabled**

Generation of a marker signal is deactivated.

\*RST: PPS

**Example:**

BB:GPS:TRIG:OUTP2:PA**T**T #B000000011111111,15  
sets a bit pattern.

BB:GPS:TRIG:OUTP1:MO**D**E PA**T**T

activates the marker signal according to a bit pattern on output MARKER 1.

**Manual operation:** See "[Marker Mode](#)" on page 196

---

**<subsystem>:TRIGger:OUTPut<ch>:ONTime <OnTime>**

**<subsystem>:TRIGger:OUTPut<ch>:OFFTime <OffTime>**

Sets the number of chips in a period (ON time + OFF time) during which the marker signal in setting [<subsystem>:TRIGger:OUTPut:MODE RATio](#) on the marker outputs is OFF.

**Parameters:**

<OffTime> integer  
Range: 1 to 2<sup>24</sup> - 1 chips  
Increment: 1 chip  
\*RST: 1

**Example:**

BB:GPS:TRIG:OUTP2:OFF**T** 200

sets an OFF time of 200 chips for marker signal 2.

**Manual operation:** See "[Marker Mode](#)" on page 196



**<subsystem>:TRIGger:OUTPut<ch>:PATTern <Pattern>**

Defines the bit pattern used to generate the marker signal in the setting  
 <subsystem>:TRIGger:OUTPut:MODE PATTern. 0 is marker off, 1 is marker on.

**Parameters:**

<Pattern>                    64 bit pattern  
 Range:            #B0,1 to #B111...1,64  
 \*RST:            #B0,1

**Example:**            BB:GPS:TRIG:OUTP2:PATT #B000000011111111,15  
 sets a bit pattern.  
 BB:GPS:TRIG:OUTP2:MODE PATT  
 activates the marker signal according to a bit pattern on output  
 MARKER 2.

**Manual operation:**    See "[Marker Mode](#)" on page 196

**<subsystem>:TRIGger:OUTPut<ch>:PULSe:DIVider <Divider>**

Sets the divider for Pulse marker mode (<subsystem>:TRIG:OUTP:MODE PULSe).  
 The resulting pulse frequency is derived by dividing the chip rate (1.023 MHz) by the  
 divider.

**Parameters:**

<Divider>                    integer  
 Range:            2 to 1024  
 \*RST:            2

**Example:**            BB:GPS:TRIG:OUTP2:PULS:DIV 2  
 sets the divider to 2 for the marker signal on output MARKER 2.  
 BB:GPS:TRIG:OUTP2:FREQ?  
 queries the resulting pulse frequency of the marker signal.  
 Response: 511511.038  
 the resulting pulse frequency is 511.511 kHz.

**Manual operation:**    See "[Marker Mode](#)" on page 196

**<subsystem>:TRIGger:OUTPut<ch>:PULSe:FREQuency?**

Queries the pulse frequency of the pulsed marker signal in the setting  
 <subsystem>:TRIGger:OUTPut:MODE PULSe. The pulse frequency is derived by  
 dividing the symbol rate by the divider.

**Return values:**

<Frequency>                float

**Example:** `BB:GPS:TRIG:OUTP2:PULS:DIV 2`  
 sets the divider for the marker signal on output MARKER 2 to the value 2.  
`BB:GPS:TRIG:OUTP2:MODE PULS`  
 enables the pulsed marker signal.  
`BB:GPS:TRIG:OUTP2:PULS:FREQ?`  
 queries the pulse frequency of the marker signal.  
 Response: 511511.038  
 the resulting pulse frequency is 511.511 kHz.

**Usage:** Query only

**Manual operation:** See "Marker Mode" on page 196

---

**<subsystem>:TRIGger:OUTPut<ch>:PULSe:WIDTh <Width>**

Sets the Pulse Width for 1PPS, 1PP2S and PPS10 marker mode.

**Parameters:**

<Width> integer  
 Range: 1 to 800  
 \*RST: 1

**Example:** `BB:GPS:TRIG:OUTP2:MODE PPS`  
 enables the 1PPS marker signal.  
`BB:GPS:TRIG:OUTP1:PULS:WIDT 2`  
 sets the pulse width for the marker signal on output MARKER 2 to the value 2.

**Manual operation:** See "Marker Mode" on page 196

## 6.25 Clock Settings

<code>&lt;subsystem&gt;:CLOCK:MODE</code> .....	410
<code>&lt;subsystem&gt;:CLOCK:MULTIplier</code> .....	411
<code>&lt;subsystem&gt;:CLOCK:SOURce</code> .....	411
<code>&lt;subsystem&gt;:CLOCK:SYNChronization:EXECute</code> .....	412
<code>&lt;subsystem&gt;:CLOCK:SYNChronization:MODE</code> .....	412

---

**<subsystem>:CLOCK:MODE <Mode>**

Enters the type of externally supplied clock (`<subsystem>:CLOCK:SOURce EXTERNAL`).

When `MCHIP` is used, a multiple of the chip clock is supplied via the `CLOCK` connector and the chip clock is derived internally from this. The multiplier is entered with the command `<subsystem>:CLOCK:MULTIplier`.

**Parameters:**

<Mode>           CHIP | MCHip  
 \*RST:            CHIP

**Example:**

BB:GPS:CLOC:MODE CHIP  
 selects clock type "Chip", i.e. the supplied clock is a chip clock.

**Manual operation:** See "[Clock Mode](#)" on page 198

**<subsystem>:CLOCK:MULTIplier <Multiplier>**

Specifies the multiplier for clock type "Multiplied" (<subsystem>:CLOCK:MODE MCHip) in the case of an external clock source.

**Parameters:**

<Multiplier>       integer  
 Range:            1 to 64  
 Increment:        1  
 \*RST:            4

**Example:**

BB:GPS:CLOC:SOUR EXT  
 selects the external clock source. The clock is supplied via the CLOCK connector.  
 BB:GPS:CLOC:MODE MCH  
 selects clock type "Multiplied", i.e. the supplied clock has a rate which is a multiple of the chip rate.  
 BB:GPS:CLOC:MULT 12  
 the multiplier for the external clock rate is 12.

**Manual operation:** See "[Clock Multiplier](#)" on page 199

**<subsystem>:CLOCK:SOURce <Source>**

Selects the clock source.

For two-path instruments, selecting EXTERNAL is only possible for path A, since the external clock source is permanently allocated to path A.

**Parameters:**

<Source>           INTERNAL | EXTERNAL | AINTERNAL  
**INTERNAL**  
 The internal clock reference is used to generate the chip clock (1.023 MHz).  
**EXTERNAL**  
 The external clock reference is supplied to the CLOCK connector.  
 \*RST:            INTERNAL

**Example:** `BB:GPS:CLOC:SOUR EXT`  
selects an external clock reference. The clock is supplied via the CLOCK connector.

`BB:GPS:CLOC:MODE CHIP`  
specifies that a chip clock is supplied via the CLOCK connector.

**Manual operation:** See ["Clock Source"](#) on page 198

#### <subsystem>:CLOCK:SYNChronization:EXECute

Performs automatic adjustment of the instrument's settings required for the selected synchronization mode.

**Usage:** Event

**Manual operation:** See ["Set Synchronization Settings"](#) on page 198

#### <subsystem>:CLOCK:SYNChronization:MODE <Mode>

Selects the synchronization mode.

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

**Note:** If several instruments are connected, the connecting cables from the master instrument to the slave 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 synchronizes all connected instruments, including the trigger and reference clock signals.

#### **SLAVe**

The instrument receives the synchronisation and reference clock signal from another instrument working in a master mode.

\*RST: NONE

**Example:** `BB:GPS:CLOC:SYNC:MODE MAST`  
Defines the current instrument as the master for synchronization of the connected instruments

**Manual operation:** See ["Sync. Mode"](#) on page 198

# A Annex

## A.1 User Environment Files

The R&S SMBV supports different file formats that describe a moving receiver. This section focus on:

- [Movement or Motion Files](#).....413
- [Vehicle Description Files \(Used for Smoothing\)](#).....421
- [Antenna Pattern / Body Mask Files](#).....423
- [Land Mobile Multipath \(LMM\) Files](#).....425

### A.1.1 Movement or Motion Files

#### A.1.1.1 Waypoint File Format

A waypoint file is a simple text file (\*.txt) that describes a trajectory as a sequence of positions called waypoints. The file contains a resolution [ms] that give the time between two consecutive waypoints and a list of waypoint coordinates, one row per waypoint.

Each waypoint is specified with its longitude [° (decimal format)], latitude [° (decimal format)], altitude [m], see [example "3GPP Performance Test Scenario#3 "Melbourne" \(WGS84 geodetic coordinates\)"](#) on page 413.

If the defined resolution is different than the internally used resolution of 10 ms, the waypoint file will be resampled and the waypoints linearly interpolated. For more information, see [chapter A.1.1.5, "Resampling Principle"](#), on page 420.

#### **Example: 3GPP Performance Test Scenario#3 "Melbourne" (WGS84 geodetic coordinates)**

The resolution command at the beginning of the file specifies the time (in ms) between two consecutive waypoints. In this example, it is 50 ms. The value is different than 10 ms; the waypoint file will be resampled.

```
RESOLUTION: 50
144.966666334601,-37.8166633061788,100.00000009313
144.966662392613,-37.8166632247233,100.00000039116
144.966658453002,-37.8166630889914,100.0000008475
144.966654516955,-37.8166628990241,100.00000149943
144.966650585658,-37.8166626548785,100.00000235625
144.966646660296,-37.8166623566284,100.00000339001
...
etc.
```

See also [chapter A.1.1.6, "Calculating the Maximum Time Duration of a Movement File"](#), on page 421.

### A.1.1.2 Vector Trajectory File Format

In the vector trajectory file format, motion is defined in an East North plane which is tangent to earth at the specified reference point. The curvature of the earth is not considered in the interpretation of the  $\bar{u}_p$  ( $\bar{U}$ ) coordinates' element when moving east or north.

The vector trajectory file format is suitable for description of city motion where the curvature of the earth is negligible. This file format is not intended for long distance simulations where the curvature of the earth is very significant.

This file format uses a script containing the commands defined in the following table:

Command	Description
REFERENCE: lon, Lat, alt	Specifies the Cartesian Reference of the ENU coordinates system. Given as a geodetic WGS84 point (longitude, Latitude, Altitude).
START: E, N, U, Velocity	Start location i.e., initial "current location" in the ENU Cartesian coordinate of center "REFERENCE". East, North and UP (ENU) coordinates are then provided (m). The last argument is the start velocity in (m/s).
ARC: E, N, Angle	Specifies a 2-Dimensional ARC (East, North) with the first two arguments representing the center of the ARC (m) in the Cartesian basis. The last argument specifies the angle in degrees ( $^{\circ}$ ) of the Arc Starting the "current location". Angle sign is significant since it indicates positive direction (against clock movement) or negative direction (same as clock movement). The end edge of the arc represents the new "current location". Velocity doesn't change when using an ARC command.
LINE: $\Delta E$ , $\Delta N$ , Acceleration	Specifies a 2-Dimensional Line starting the "current location" as the first edge and (Current loc E + $\Delta E$ , Current loc N + $\Delta N$ ) as the second edge (m). Constant acceleration/deceleration can be specified in the last argument e.g., (0 means constant velocity). Unit for acceleration is (m/s <sup>2</sup> ). The second edge is again used as the "current location" for the next command. The speed at this second edge is also used as the start speed for the next command.
STAY: Time	Stay at the current location for Time period (ms).

#### Example: Example of a Waypoint file

This example explains a waypoint file in the second format for the case of 3GPP Performance Test Scenario#3 "Melbourne", as described in 3GPP 34.108 v.8.0.0, 3GPP 34.171 v.7.0.1.

The GPS signals simulate the GPS-receiver moving on a rectangular trajectory of 940m by 1440m with rounded corners defined in [table 1-1](#) and [figure 1-1](#).

The initial reference is first defined followed by acceleration to final speed of 100 km/h in 250 m.

The UE then maintains the speed for 400 m. This is followed by deceleration to final speed of 25 km/h in 250 m. The UE then turn 90 degrees with turning radius of 20 m at 25 km/h. This is followed by acceleration to final speed of 100 km/h in 250 m.

The sequence is repeated to complete the rectangle.



```

%%In the current version, we will provide only EAST-NORTH Movement segments
%%"ARC", "Center EAST Coordinate", "Center NORTH Coordinate",
"ARC in degrees (pos or neg is necessary for orientation)"
ARC: 0, 20, -90
%%"LINE", "Second Edge EAST Coordinate, first edge is the current point
%% or last point of previous segment", "Second Edge NORTH Coordinate",
"Acceleration/Deceleration"
%%Acceleration is to be taken as the projection following the movement segment
LINE: 0, 250, 1.44675925925925926
LINE: 0, 400, 0
LINE: 0, 250, -1.44675925925925926
ARC: 0, 920, -90
LINE: 250, 0, 1.44675925925925926
LINE: 900, 0, 0
LINE: 250, 0, -1.44675925925925926
ARC: 1400, 920, -90
LINE: 0, -250, 1.44675925925925926
LINE: 0, -400, 0
LINE: 0, -250, -1.44675925925925926
ARC: 1400, 20, -90
LINE: -250, 0, 1.44675925925925926
LINE: -900, 0, 0
LINE: -250, 0, -1.44675925925925926
%%End of Trajectory description

```

### A.1.1.3 NMEA Files as Source for Movement Information

The NMEA movement information (receiver-fix location) extracted from a standard NMEA file can be used as a source for the generation of the movement file of interest.

Refer to [chapter A.3, "NMEA Scenarios"](#), on page 429 for detailed description of the NMEA file format.

### A.1.1.4 Trajectory Description Files

The trajectory description files are supported by instruments equipped with option R&S SMBV-K92. For some of the file contents (including attitude information), the option R&S SMBV-K103 is additionally required.

The trajectory description files use the file extension \*.xtd. See [example "Trajectory description files in <positiononly> waypoint format"](#) on page 418 for a simple example of the file format.

The [table 1-2](#) describes the used tags and parameters.



Table 1-2: Format of \*.xtd file

Container	Tag name	Parameter	Description
<general>	<property>	<waypointformat>	<p>Defines the format of the waypoint data. The possible values are:</p> <ul style="list-style-type: none"> <li>"positiononly" only waypoint data</li> <li>"position_attitude" waypoint and attitude data</li> <li>"position_velocitymagnitude" waypoints and velocity magnitude information per point</li> <li>"position_velocitymagnitude_attitude" waypoints, velocity magnitude and attitude data</li> <li>"position_velocityvector" waypoints and velocity vector per location</li> <li>"position_velocityvector_attitude" waypoints, velocity vector and attitude per point</li> </ul> <p>The three <code>&lt;property waypointformat="*_attitude"&gt;</code> formats require the option R&amp;S SMBV-K103. An instrument not equipped with this option discards files containing these formats and displays an error message.</p> <p>Smoothing is only possible with <code>&lt;property waypointformat=""positiononly"&gt;</code> as well as NMEA, waypoints and *.kml.</p> <p>The description of the waypoints has to follow the selected format, e.g.  <code>&lt;waypointvector data="0.05,144.966662392613,-37.8166632247233,100.00000039116"/&gt;</code> with <code>&lt;property waypointformat="positiononly"/&gt;</code> and <code>&lt;datavectorhastimestamp="yes"&gt;</code>.</p>
		<datavectorhastimestamp>	<p>Determines the way the time stamp (elapsed time starting start simulation time) is defined.</p> <ul style="list-style-type: none"> <li>With <code>&lt;datavectorhastimestamp="yes"&gt;</code> the time stamp of a waypoint is retrieved from the <code>&lt;waypointvector data&gt;</code>, as the first data vector parameter.</li> <li>With <code>&lt;datavectorhastimestamp="no"&gt;</code> the time stamp is internally calculated based on the following rule: <ul style="list-style-type: none"> <li>The time stamp of first waypoint is <math>T_1 = 0</math></li> <li>the time stamp of the waypoint<sub>N</sub> is <math>T_N = (N-1) \times \text{timeresolution}</math></li> </ul> </li> </ul>
		<coordsystem>	<p>Defines the coordinate system used by the definition of the <code>&lt;waypointvector data&gt;</code>.</p> <p>The possible values are: "enu", "cart ecef", "geod wgs84" or "geod pz90"</p>
		<timeresolution>	<p>If <code>&lt;datavectorhastimestamp="no"&gt;</code>, applies implicitly time stamps to waypoints. Otherwise, the time stamp is retrieved automatically, see <code>&lt;datavectorhastimestamp&gt;</code>.</p>
		<enurefpoint>	<p>Coordinates of the reference waypoint in ENU format</p>
		<endbehaviour>	<p>Determines the behavior of the moving object at the end of the trajectory. The possible values are: "jump", "return", "stop"</p>
		<attitudeunit>	<p>Defines the unit ("rad" or "deg") the attitude is expressed in</p>

Container	Tag name	Parameter	Description
		<noofwaypoints>	Number of the used waypoints vectors. Use the parameter to minimize the size of the waypoint without actually deleting the waypoints
		<attitudecontinuous>	If <attitudecontinuous="no">, the attitude angles to be read are bounded by $2\pi$ . The <attitudecontinuous="yes"> means that they are not bounded.
<waypoints>			Description of the trajectory as a list of waypoint vectors.
	<waypointvector>	<data>	Coordinates of the waypoint in the format selected by <coordsystem> <ul style="list-style-type: none"> <li>[time,]longitude,latitude,altitude (geod wgs84)</li> <li>[time,]X,Y,Z (cart ecef)</li> <li>[time,]EAST,NORTH,UPPER (enu)</li> </ul> Depending on the <datavectorhastimestamp>, 3 or 4 values are evaluated with <property waypointformat="positiononly"/> Depending on the <property waypointformat>, more information can be provided. The following is a list of the information appended to the coordinates of the waypoint mentioned above. <ul style="list-style-type: none"> <li>&lt;property waypointformat="positiononly"&gt; no additional information</li> <li>&lt;property waypointformat="position_attitude"&gt; <b>yaw/heading,pitch/elevation,roll/bank</b>, e.g. [time,]longitude,latitude,altitude,yaw,pitch,roll The vehicle attitude (yaw, pitch and roll) parameters are configured relative to the local horizon</li> <li>&lt;property waypointformat="position_velocitymagnitude"&gt; <b>vel</b>, e.g. [time,]X,Y,Z,vel</li> <li>&lt;property waypointformat="position_velocitymagnitude_attitude"&gt; <b>vel,yaw/heading,pitch/elevation,roll/bank</b>, e.g. [time,]EAST,NORTH,UPPER,vel,yaw,pitch,roll</li> <li>&lt;property waypointformat="position_velocityvector"&gt; <b>velocity vector Vx,Vy,Vz</b>, e.g. [time,]X,Y,Z,Vx,Vy,Vz</li> <li>&lt;property waypointformat="position_velocityvector_attitude"&gt; <b>yaw/heading,pitch/elevation,roll/bank,Vx,Vy,Vz</b>, e.g. [time,]longitude,latitude,altitude,yaw,pitch,roll,Vx,Vy,Vz.</li> </ul> <b>Note:</b> If the waypoints are in geod wgs84, velocity vector is assumed in Cartesian ECEF coordinate system.

### Example: Trajectory description files in <positiononly> waypoint format

The following are two examples in <property waypointformat="positiononly"> format. The examples emphasize on the different formats and explain the used time stamp principle.

- The <waypointvector data> parameters in the following example are vectors with size of 3, because of the tag <property datavectorhastimestamp="no">. Even if a fourth value have been defined, it would have been ignored.  
The time stamp is defined with the tag <property timeresolution="0.05">:  
 $T_1 = 0$ ,  $T_2 = (2-1)*0.05 = 0.05$ , etc.  $T_{12} = (12-1)*0.05 = 0.55$

```

<trajectory>
  <general>
    <property waypointformat="positiononly"/>
    <property datavectorhastimestamp="no"/>
    <property coordsystem="enu"/>
    <property timeresolution="0.05"/>
    <property enurefpoint="54.0,10.0,12"/>
    <property endbehaviour="return"/>
    <property noofwaypoints="12"/>
  </general>
  <waypoints>
    <waypointvector data="0,0,0"/>
    <waypointvector data="0,1,0"/>
    <waypointvector data="0,2,0"/>
    <waypointvector data="0,3,0"/>
    <waypointvector data="0,4,0"/>
    <waypointvector data="0,5,0"/>
    <waypointvector data="0,6,0"/>
    <waypointvector data="0,7,0"/>
    <waypointvector data="0,8,0"/>
    <waypointvector data="0,9,0"/>
    <waypointvector data="0,10,0"/>
    <waypointvector data="0,11,0"/>
  </waypoints>
</trajectory>

```

- In the following example the tag `<property datavectorhastimestamp="yes">` and all four value in the `<waypointvector data>` parameters are evaluated. The time stamp is retrieved automatically; the time stamp of a waypoint is the first value in the corresponding `<waypointvector data>` parameter:  
 $T_1 = 0$ ,  $T_2 = 0.05$ , etc.  $T_{12} = 0.55$ .

```

<trajectory>
  <general>
    <property waypointformat="positiononly"/>
    <property datavectorhastimestamp="yes"/>
    <property coordsystem="geod wgs84" />
    <property endbehaviour="return"/>
    <property duration="2.0"/>
  </general>
  <waypoints>
    <waypointvector data="0,144.966666334601,-37.8166633061788,100.000000009313"/>
    <waypointvector data="0.05,144.966662392613,-37.8166632247233,100.00000039116"/>
    <waypointvector data="0.10,144.966658453002,-37.8166630889914,100.0000008475"/>
    <waypointvector data="0.15,144.966654516955,-37.8166628990241,100.000000149943"/>
    <waypointvector data="0.20,144.966650585658,-37.8166626548785,100.000000235625"/>
    <waypointvector data="0.25,144.966646660296,-37.8166623566284,100.000000339001"/>
    <waypointvector data="0.30,144.966642742053,-37.8166620043635,100.000000461936"/>
    <waypointvector data="0.35,144.966638832109,-37.81666159819,100.000000603497"/>
  </waypoints>
</trajectory>

```

```

<waypointvector data="0.40,144.966634931642,-37.8166611382304,100.000000762753"/>
<waypointvector data="0.45,144.96663104183,-37.8166606246233,100.000000941567"/>
<waypointvector data="0.50,144.966627163843,-37.8166600575235,100.000001138076"/>
<waypointvector data="0.55,144.96662329885,-37.8166594371019,100.000001354143"/>
</waypoints>
</trajectory>
    
```

### A.1.1.5 Resampling Principle

The resampling principle is common to all movement or motion files. To explain the principle, we use the simple waypoint file text format described in [chapter A.1.1.1, "Waypoint File Format"](#), on page 413.

The 3GPP Performance Test Scenario#3 "Melbourne" file, that is used in the example there, uses a resolution of 50 ms.

This resolution is different than the internally used resolution of 10 ms. The waypoint file is resampled (in this case upsampled) and the waypoints linearly interpolated. Four samples are inserted between each two consecutive waypoints so that the sampling rate of 100 Hz (10ms) is achieved.

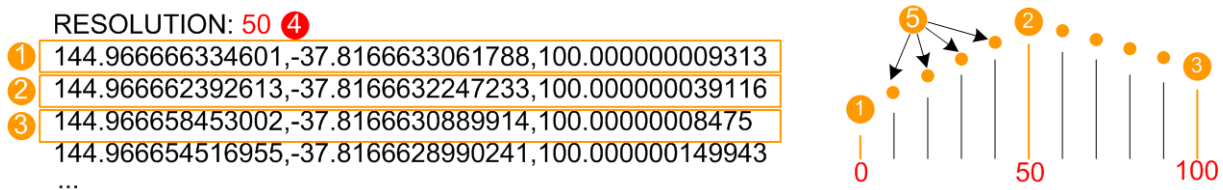


Fig. 1-2: Principle of waypoint file upsampling (extract of a waypoint file shown)

- 1, 2, 3 = Coordinates of the first three waypoints in the file
- 4 = Resolution
- 5 = Inserted waypoints

If a resolution of 5 ms is used in the same waypoint file, this file will be downsampled, i.e. each second waypoint will be discarded. This case is illustrated on [figure 1-3](#).

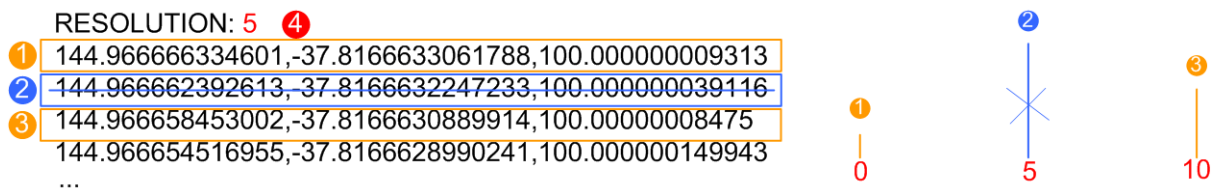


Fig. 1-3: Principle of waypoint file downsampling (extract of a waypoint file shown)

- 1, 2, 3 = Coordinates of the first three waypoints in the file
- 2 = Second waypoint removed
- 4 = Resolution

The described resampling principle applies also for resolutions that are not multiple of 10 ms.

For information on the impact of the used resolution on the number of possible waypoints, see [chapter A.1.1.6, "Calculating the Maximum Time Duration of a Movement File"](#), on page 421.

### A.1.1.6 Calculating the Maximum Time Duration of a Movement File

The R&S SMBV loads the movement and the motion files in the RAM memory. Hence, it is the available RAM memory that limits the duration of a simulated movement.

If a movement is described for example as a waypoint file, its duration is the product of the used resolution and the number of waypoints. Thus, the maximum possible number of waypoints in a waypoint file depends on the used resolution.

For a given available RAM memory, the maximum time duration a waypoint file may have is calculated as:

$\text{TimeDuration}_{\max} [\text{ms}] = (\text{RAM}_{\text{Size}} [\text{bytes}] / 6 \cdot 8 [\text{bytes}]) \cdot 10 [\text{ms}]$ , where:

- the  $\text{RAM}_{\text{Size}}$  is the available RAM memory size, e.g. 1 Gbyte;
- 10 ms is the internal resolution
- 6\*8 bytes are required to store one resampled waypoint; waypoints values are defined in double-precision floating point format (doubles) and a resampled waypoint requires 6 doubles with 8 bytes each.



If the time duration of the loaded waypoint file exceeds the maximum allowed value or the RAM memory is insufficient to process the file, a warning message is displayed.

#### Example:

If a waypoint file contains 4 waypoints and uses a resolution of 50 ms, then:

- $\#\text{Waypoints} \cdot \text{Resolution}_{\text{WaypointFile}} = \text{TimeDuration}_{\text{WaypointFile}}$ , i.e. the waypoint file is  $4 \cdot 50 = 200$  ms long.
- The file is resampled to the internal resolution of 10 ms (i.e. sampling rate of 100 Hz) and the resulting number of samples is:  
 $\#\text{Samples} = \text{TimeDuration}_{\text{WaypointFile}} [\text{ms}] / \text{Resolution}_{\text{Internal}} [\text{ms}] = 200 / 10 = 20$
- Storing these 20 samples requires a memory of  $\#\text{Samples} \cdot 6 \cdot 8 [\text{bytes}] = 20 \cdot 48 = 960$  bytes.

## A.1.2 Vehicle Description Files (Used for Smoothing)

The vehicle description files use the file extension \*.xvd. The following is a simple example of the file format.

```
<vehicle>
  <info name="Car"/>
  <limits>
    <property maxspeed="100.0"/>
    <property maxg="0.6"/>
    <property maxg_lateral="0.6"/>
```

```

    <property maxjerk="15"/>
    <property maxjerk_lateral="15"/>
    <property maxyawrate="0"/>
    <property maxyawacceleration="0"/>
    <property maxyawjerk="0"/>
    <property maxpitchangle="0"/>
    <property maxpitchrate="0"/>
    <property maxpitchacceleration="0"/>
    <property maxpitchjerk="0"/>
    <property maxrollangle="0"/>
    <property maxrollrate="0"/>
    <property maxrollacceleration="0"/>
    <property maxrolljerk="0"/>
    <property proximity="0"/>
  </limits>
</vehicle>

```

The [table 1-3](#) describes the used tags and parameters.

**Table 1-3: Format of \*.xvd file**

Container	Tag name	Parameter	Description
<info>	<name>		Vehicle name
	</info>		
<limits>	<property>	<maxspeed>	Maximal Speed (m/s)
		<maxg>	Maximum tangential acceleration in g unit
		<maxg_lateral>	Maximum radial acceleration (due to centrifugal force) in g unit
		<maxjerk>	Maximum tangential Jerk in m/s <sup>2</sup>
		<maxjerk_lateral>	Maximum radial Jerk in m/s <sup>2</sup>
		<maxyawrate>	Maximum rate of change of the yaw/heading (rad/s)
		<maxyawacceleration>	Maximum second rate of change (acceleration) of the yaw/heading (rad/s <sup>2</sup> )
		<maxyawjerk>	Maximum third rate of change (jerk) of the yaw/heading (rad/s <sup>3</sup> )
		<maxpitchangle>	Maximum pitch/elevation angle (rad)
		<maxpitchrate>	Maximum rate of change of the pitch/elevation (rad/s)
		<maxpitchacceleration>	Maximum second rate of change (acceleration) of the pitch/elevation (rad/s <sup>2</sup> )
		<maxpitchjerk>	Maximum third rate of change (jerk) of the pitch/elevation (rad/s <sup>3</sup> )
		<maxrollangle>	Maximum roll/bank angle (rad)
		<maxrollrate>	Maximum rate of change of the roll/bank (rad/s)

Container	Tag name	Parameter	Description
		<maxrollacceleration>	Maximum second rate of change (acceleration) of the roll/bank (rad/s <sup>2</sup> )
		<maxrolljerk>	Maximum third rate of change (jerk) of the roll/bank (rad/s <sup>3</sup> )
		<proximity>	Specifies the maximum allowed deviation from the way-points specified by the user (m)

### A.1.3 Antenna Pattern / Body Mask Files

The antenna patterns files are supported by instruments equipped with option R&S SMBV-K102/103. Some parameters additionally require option R&S SMBV-K92.

Two files describe an antenna, the antenna pattern \*.ant\_pat file and the phase response \*.phase file.

Both files must have the same file name and must be stored in the same directory. The \*.ant\_pat file describes the power response matrix of each antenna. The instrument retrieves the phase response matrix from the \*.phase file.

If the required \*.phase file does not exist, a zero phase response is assumed.

Both file \*.ant\_pat and \*.phase should have the same content but different data section <data> (see [table 1-4](#))

The following are two examples of the file format: an extract of the description of an antenna pattern with three antennas and description of an antenna with four sectors.

#### Example: Antenna pattern with three antennas (Space\_Vehicle\_3\_antennas.ant\_pat)

The following is an extract of the description.

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<antenna_pattern>
  <antenna_descr count="3" use_same_pattern="no">
    <antenna id="1" RollAxis_X_offset="0" PitchAxis_Y_offset=" 0.0000"
      YawAxis_Z_offset=" 0.2000" Yaw_offset="0" Pitch_offset="0"
      Roll_offset="0" />
    <antenna id="2" RollAxis_X_offset="0" PitchAxis_Y_offset="-0.1414"
      YawAxis_Z_offset="-0.1414" Yaw_offset="0" Pitch_offset="0"
      Roll_offset="120"/>
    <antenna id="3" RollAxis_X_offset="0" PitchAxis_Y_offset=" 0.1414"
      YawAxis_Z_offset="-0.1414" Yaw_offset="0" Pitch_offset="0"
      Roll_offset="240" />
  </antenna_descr>
  <az_res> 1.00000000e+000 </az_res>
  <elev_res> 1.00000000e+000 </elev_res>
  <data>
    -179.5,-178.5,-177.5,-176.5,-175.5,-174.5,-173.5,-172.5,-171.5,-170.5,-169.5,-168.5,
    -167.5,-166.5,-165.5,-164.5,-163.5,-162.5,-161.5,-160.5,-159.5,-158.5,-157.5,-156.5,
```

```

-155.5,-154.5,-153.5,-152.5,-151.5,-150.5,-149.5,-148.5,-147.5,-146.5,-145.5,-144.5,
-143.5,-142.5,-141.5,-140.5,-139.5,-138.5,-137.5,-136.5,-135.5,-134.5,-133.5,-132.5,
...
</data>
</antenna_pattern>
    
```

**Example: Antenna with four sectors**

The following is a file describing an antenna with four sectors.

```

<?xml version="1.0" encoding="ISO-8859-1"?>
<antenna_pattern>
  <antenna_descr count="1" use_same_pattern="no">
    <antenna id="1" YawAxis_Z_offset="0" PitchAxis_Y_offset="0"
      RollAxis_X_offset="0" Yaw_offset="0" Pitch_offset="90"
      Roll_offset="0" />
  </antenna_descr>
  <az_res> 90.00000000e+000 </az_res>
  <elev_res> 90.00000000e+000 </elev_res>
  <data>
    -135.0,-45.0,45.0,135,45.0,0.0,3.0,6.0,9.0,-45.0,0.0,3.0,6.0,9.0
  </data>
</antenna_pattern>
    
```

The [table 1-4](#) describes the used tags and parameters.

**Table 1-4: Format of \*.ant\_pat and \*.phase file**

Container	Tag name	Parameter	Description
<antenna_pattern>			Defines antenna pattern File
<antenna_descr>			Contains the descriptions of the antennas
		<count>	Number of antenna patterns. Value range = 1 to 4.
		<use_same_pattern>	Specify whether the same data section is used for all the antennas or not. <ul style="list-style-type: none"> <li>• "yes": the data section will be used for all antennas</li> <li>• "no": the data section has to be augmented with the data of all antennas consecutively</li> </ul>
	<antenna>		Descriptions of the individual antenna
		<id>	Antenna identification number
		<YawAxis_Z_offset> <PitchAxis_Y_offset> <RollAxis_X_offset>	Position shift of the antenna along the X/Y/Z axis with respect to the center of gravity of the body Value in meters
		<Yaw_offset> <Pitch_offset> <Roll_offset>	Angular shift of the antenna along the X/Y/Z axis of the to the body Value in degrees
<az_res>			Resolution of the columns in the data section value in degrees integer divider of 360



Container	Tag name	Parameter	Description
<elev_res>			Resolution of the rows in the data section value in degrees integer divider of 180
<data>			<p>The file has to contain for every pattern:</p> <ul style="list-style-type: none"> <li>• [1 + 360/&lt;az_res&gt;] columns</li> <li>• [1 + 180/&lt;elev_res&gt;] rows</li> </ul> <p>Title column and row are disregarded</p> <p>If the &lt;use_same_pattern="yes"&gt; only one pattern is sufficient, otherwise the other patterns must be appended after each others inside this section</p> <p>If the data represents the power response of the antenna (*.ant_pat file), the power loss values are in dB (between 0 and 40)</p> <p>If the data represents the phase response of the antenna (*.phase file), the phase values are in degrees</p>

#### A.1.4 Land Mobile Multipath (LMM) Files

The land mobile multipath (LMM) files are supported by instruments equipped with option R&S SMBV-K01.

The LMM files use the file extension \*.lmm. The following is a an extract of an LMM files.

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<LAND_MOBILE_MULTIPATH>
<az_res> 5.00000000e+000 </az_res>
<elev_res> 5.00000000e+000 </elev_res>
<Category>
  <data>
    -177.5   -172.5   -167.5   -162.5   -157.5   ...
  87.5      2       2       2       2       2       ...
  82.5      2       2       2       2       2       ...
  77.5      2       2       2       2       2       ...
  67.5      3       2       2       2       2       ...
  62.5      3       3       2       2       3       ...
  ...
  </data>
</Category>
<NrOfTaps>
  <data>
    -177.5   -172.5   -167.5   -162.5   -157.5
  87.5      1       1       1       1       1       ...
  82.5      1       1       1       1       1       ...
  77.5      1       1       1       1       1       ...
  67.5      2       1       1       1       2       ...
  62.5      2       2       1       1       2       ...
  ....
```

```

</data>
</NrOfTaps>
<TAP1>
  <data>
    -177.5          -172.5          -167.5          ...
87.5  00.0,000.0,0.000,0.000  00.0,000.0,0.000,0.000  00.0,000.0,0.000,0.000 ...
...
  </data>
</TAP1>
<TAP2>
  <data>
    -177.5          -172.5          -167.5          ...
...
  67.5  -14.3,000.9,0.011,0.866          0,0,0,0          0,0,0,0 ...
  62.5  -11.4,000.4,0.003,3.933  -11.4,000.4,0.003,3.933          0,0,0,0 ...
...
</data>
</TAP2>
...
</LAND_MOBILE_MULTIPATH>

```

The [table 1-5](#) describes the used tags and parameters.

**Table 1-5: Format of \*.Imm file**

Container	Tag name	Description
<LAND_MOBILE_MULTIPATH>		Defines the LMM File
<az_res>		Resolution of the columns in the data sections value in degrees and integer divider of 360
<elev_res>		Resolution of the rows in the data sections value in degrees and integer divider of 180
<Category>		Channel state information per segment
	<data>	Channel state: <ul style="list-style-type: none"> <li>• 1 = Obscuration (i.e. fully blocked)</li> <li>• 2 = LOS</li> <li>• 3 = LOS + Echos</li> <li>• 4 = Echos only</li> </ul>
<NrOfTaps>		Number of taps per segment
	<data>	Number of multipath taps
<TAP1> -- <TAP4>		Values of the additional parameters describing the multipath per segment and per tap
	<data>	<Range Offset, m>, <Power, dB>, <Doppler Shift, Hz>, <Carrier Phase, rad>

## A.2 RINEX Files

The RINEX file format consists of three ASCII file types: observation data file, navigation message file and meteorological data file. The navigation RINEX files comprises the Ephemeris information of all visible satellites at a control station or a commercial receiver.

Each file type consists of a header section and a data section. The header section contains global information for the entire file and is placed at the beginning of the file. The format of the data records of the RINEX navigation message files may contain navigation messages of more than one satellite system (GPS, GLONASS, Galileo, etc.). See [RINEX Format Description](#) for description of the RINEX file format.



RINEX Navigation Files can be downloaded from [http://cddis.gsfc.nasa.gov/gnss\\_data-sum.html#brdc](http://cddis.gsfc.nasa.gov/gnss_data-sum.html#brdc).

### A.2.1 RINEX Format Description

Records marked with \* are optional

**Table 1-6: Navigation message file - header section description**

	HEADER LABEL (Columns 61-80)	DESCRIPTION	FORMAT
	RINEX VERSION / TYPE	<ul style="list-style-type: none"> <li>Format version (2)</li> <li>File type ('N' for Navigation data)</li> </ul>	I6,14X, A1,19X
	PGM / RUN BY / DATE	<ul style="list-style-type: none"> <li>Name of program creating current file</li> <li>Name of agency creating current file</li> <li>Date of file creation</li> </ul>	A20, A20 A20
*	COMMENT	Comment line(s)	A60
*	ION ALPHA	Ionosphere parameters A0-A3 of almanac (page 18 of subframe 4)	2X,4D12.4
*	ION BETA	Ionosphere parameters B0-B3 of almanac	2X,4D12.4
*	DELTA-UTC: A0,A1,T,W	Almanac parameters to compute time in UTC (page 18 of subframe 4) A0,A1: terms of polynomial T : reference time for UTC data W : UTC reference week number. Continuous number, not mod(1024)!	3X,2D19.12, 2I9
*	LEAP SECONDS	Delta time due to leap seconds	I6
	END OF HEADER	Last record in the header section.	60X

Table 1-7: Navigation message file - data record description

	HEADER LABEL (Columns 61-80 )	DESCRIPTION	FORMAT
	PRN / EPOCH / SV CLK	<ul style="list-style-type: none"> <li>• Satellite PRN number</li> <li>• Epoch: Toc - Time of Clock <ul style="list-style-type: none"> <li>– year (2 digits)</li> <li>– month</li> <li>– day</li> <li>– hour</li> <li>– minute</li> <li>– second</li> </ul> </li> <li>• SV clock bias (seconds)</li> <li>• SV clock drift (sec/sec)</li> <li>• SV clock drift rate (sec/sec<sup>2</sup>)</li> </ul>	I2, 5I3, F5.1, 3D19.12
	BROADCAST ORBIT - 1	<ul style="list-style-type: none"> <li>• IODE Issue of Data, Ephemeris</li> <li>• Crs (meters)</li> <li>• Delta n (radians/sec)</li> <li>• M0 (radians)</li> </ul>	3X,4D19.12
	BROADCAST ORBIT - 2	<ul style="list-style-type: none"> <li>• Cuc (radians)</li> <li>• e Eccentricity</li> <li>• Cus (radians)</li> <li>• sqrt(A) (sqrt(m))</li> </ul>	3X,4D19.12
	BROADCAST ORBIT - 3	<ul style="list-style-type: none"> <li>• Toe Time of Ephemeris (sec of GPS week)</li> <li>• Cic (radians)</li> <li>• OMEGA (radians)</li> <li>• CIS (radians)</li> </ul>	3X,4D19.12
	BROADCAST ORBIT - 4	<ul style="list-style-type: none"> <li>• i0 (radians)</li> <li>• Crs (meters)</li> <li>• omega (radians)</li> <li>• OMEGA DOT (radians/sec)</li> </ul>	3X,4D19.12
	BROADCAST ORBIT - 5	<ul style="list-style-type: none"> <li>• IDOT (radians/sec)</li> <li>• Codes on L2 channel</li> <li>• GPS Week # (to go with TOE) Continuous number, not mod(1024)!</li> <li>• L2 P data flag</li> </ul>	3X,4D19.12
	BROADCAST ORBIT - 6	<ul style="list-style-type: none"> <li>• SV accuracy (meters)</li> <li>• SV health (MSB only)</li> <li>• TGD (seconds)</li> <li>• IODC Issue of Data, Clock</li> </ul>	3X,4D19.12
	BROADCAST ORBIT - 7	<ul style="list-style-type: none"> <li>• Transmission time of message (sec of GPS week, derived e.g. from Z-count in Hand Over Word (HOW))</li> <li>• spare</li> <li>• spare</li> <li>• spare</li> </ul>	3X,4D19.12

## A.2.2 Example of a RINEX File

The following part of a script has the ephemeris info of satellites 4 and 9 at toc = toe = 352800.

```
2.10          N: GPS NAV DATA          RINEX VERSION / TYPE
teqc 2002Mar14  Lisa McCormick  20090501 01:40:41UTCPGM / RUN BY / DATE
```

```

Solaris 2.7|Ultra 2|cc SC5.0|+-*Sparc COMMENT
rnw Dataflow Processing 04/30/2009 00:00:21 COMMENT
END OF HEADER

4 09 4 30 2 0 0.0-7.157493382690D-05-1.523403625470D-11 0.000000000000D+00
5.100000000000D+01 9.125000000000D+00 5.024495004670D-09-3.085066632770D+00
3.930181264880D-07 8.587007410820D-03 7.828697562220D-06 5.153723627090D+03
3.528000000000D+05 3.725290298460D-09 1.098217239560D-01-1.024454832080D-07
9.410577584670D-01 2.186875000000D+02 4.847291251310D-01-8.071407635100D-09
-3.571577341960D-10 1.000000000000D+00 1.529000000000D+03 0.000000000000D+00
2.400000000000D+00 0.000000000000D+00-6.053596735000D-09 5.100000000000D+01
3.456060000000D+05 4.000000000000D+00

9 09 4 30 2 0 0.0 5.332380533220D-05 1.932676241270D-12 0.000000000000D+00
1.070000000000D+02-7.959375000000D+01 4.243748197720D-09-2.353512095310D+00
-4.012137651440D-06 2.042865683320D-02 3.149732947350D-06 5.153640602110D+03
3.528000000000D+05 2.738088369370D-07-3.071164751940D+00 9.499490261080D-08
9.762633443270D-01 3.201250000000D+02 1.469759572200D+00-7.773895242510D-09
1.046472161190D-10 1.000000000000D+00 1.529000000000D+03 0.000000000000D+00
2.400000000000D+00 0.000000000000D+00-5.587935447690D-09 1.070000000000D+02
3.456060000000D+05 4.000000000000D+00
    
```

### A.3 NMEA Scenarios

The National Marine Electronic Association (NMEA) is a broadcasting standard supported by all navigation receivers. The NMEA files comprise information about common parameters related to the satellite constellation, navigation parameters, time, receiver location and dynamics. The [table 1-8](#) defines the starting acronym for a NMEA command of a specific navigation standard. In the moment this firmware is released, the Galileo NMEA acronym has not been defined yet.

**Table 1-8: Overview of the starting acronyms for the NMEA command**

ID	Meaning
AG	Autopilot - General
AP	Autopilot - Magnetic
CC	Computer - Programmed Calculator (outdated)
CD	Communications - Digital Selective Calling (DSC)
CM	Computer - Memory Data (outdated)
CS	Communications - Satellite
CT	Communications - Radio-Telephone (MF/HF)
CV	Communications - Radio-Telephone (VHF)
CX	Communications - Scanning Receiver

ID	Meaning
DE	DECCA Navigation
DF	Direction Finder
EP	Emergency Position Indicating Beacon (EPIRB)
ER	Engine Room Monitoring Systems
GP	Global Positioning System (GPS)
GL	GLONASS
HC	Heading - Magnetic Compass
HE	Heading - North Seeking Gyro
HN	Heading - Non North Seeking Gyro
II	Integrated Instrumentation
IN	Integrated Navigation
LA	Loran A
LC	Loran C
MP	Microwave Positioning System (outdated)
OM	OMEGA Navigation System

**Example of NMEA File**

```
$GPVTG,,T,,M,0.000,N,0.000,K,A*23
$GPGGA,215810.00,3540.00066,N,13944.99611,E,1,04,1.61,6.8,M,39.4,M,,*5E
$GPGSA,A,3,06,09,04,10,,,,,,,,,2.47,1.61,1.87*01
$GPGSV,4,1,14,29,48,312,,26,47,312,,06,35,302,47,09,18,238,47*71
$GPGSV,4,2,14,27,47,312,,13,50,118,,04,72,181,47,30,48,312,*76
$GPGSV,4,3,14,14,39,070,,10,12,050,47,31,48,312,,07,64,349,*72
$GPGSV,4,4,14,25,47,312,,28,48,312,*7E
$GPGLL,3540.00066,N,13944.99611,E,215810.00,A,A*69
$GPZDA,215810.00,28,04,2023,00,00*64
$GPRMC,215811.00,A,3540.00066,N,13944.99611,E,0.000,,280423,,,A*7E
```

## A.4 SBAS Message Files Format

The R&S SMBV supports the SBAS message files, listed in [table 1-9](#).

**Table 1-9: SBAS message files**

SBAS Service	File	Extension	Format	Content
Navigation data	Almanac	*.alm	CSV	position and velocity information on all satellites Data ID, PRN Number, Health and Status, XG (ECEF), YG (ECEF), ZG (ECEF), XG (RoC), YG (RoC), ZG (RoC), t0 (ToD), WN
	RINEX	*.14n	RINEX	see <a href="#">chapter A.2, "RINEX Files"</a> , on page 427

SBAS Service	File	Extension	Format	Content
Correction data	Ionospheric correction data	*.iono_grid	XML*	Vertical Delay, GIVEI value pairs with 5° and 15 minutes resolution
	PRN Mask	*.prn_mask	XML*	List of PRN numbers used from the specified time until the next PRN list
	Fast correction data	*.f_corr	XML*	List of corrections (PRC, UDREI) per PRN and at a specific time
	Long term correction data	*.lt_corr	XML*	List of corrections (XLC, YLC, ZLC, CLKL, IODE) per PRN and at a specific time
	Fast correction degradation factor	*.fc_deg	XML*	List of degradation values (System Latency, IODP, Deg Factor) at a specific time
	Clock-Ephemeris Covariance Matrix	*.covar	XML*	List of clock-ephemeris covariance matrix elements (PRN, Scale Exp, E11 .. E34) per IOPD and at a specific time
	Service	*.serv	XML*	List of service messages (UDREI_IN, UDREI_OUT, LAT, LONG, SHAPE) per region at a specific time
	Degradation factors	*.deg_fact	XML*	List of degradation factors per region at a specific time

\*) Rohde & Schwarz proprietary file format

A subset of predefined SBAS message files is delivered with the firmware. For an overview, see [chapter A.8, "List of the Provided Predefined Files"](#), on page 441.

This section lists extracts of the predefined SBAS message files to illustrate the used XML Rohde & Schwarz proprietary file format.

#### A.4.1 SBAS Message Files Extracts

##### 19\_02\_14\_egnos.alm

```
Data ID,PRN Number,Health,XG (ECEF), YG (ECEF), ZG (ECEF), XG (RoC), YG (RoC), ZG (RoC), t0 (ToD), WN
      0,      120,      16,40638000,-11245000,      0,      0,      0,      0,      64,1780
      0,      126,      16,38160200, 17945200,      0,      0,      0,      0,      64,1780
```

##### 19\_02\_14\_egnos.14n

```
3.00          N: GNSS NAV DATA      S: SBAS          RINEX VERSION / TYPE
GNSS Simulator      R&S          20150325 022541 LCL PGM / RUN BY / DATE
ROHDE & SCHWARZ GNSS          COMMENT
ROHDE & SCHWARZ GNSS SIMULATOR RINEX3 NAV OUTPUT FILE      COMMENT
SBUT .7450580597D-08 -.147970525D-11 258048 1780 egnos 3 TIME SYSTEM CORR
      16          LEAP SECONDS
This file contains navigation message data from      COMMENT
SBAS (geostationary) satellites, generated      COMMENT
using R&S GNSS Data Conversion Wizard      COMMENT
          END OF HEADER
S20 2014 02 19 00 02 08 .000000000000D+00 .000000000000D+00 .259338000000D+06
```

```

        .406367200000D+05 .000000000000D+00 .000000000000D+00 .000000000000D+00
    -.112459160000D+05 .000000000000D+00 .000000000000D+00 .150000000000D+02
        .000000000000D+00 .000000000000D+00 .000000000000D+00 .191000000000D+03
S26 2014 02 19 00 02 24 .000000000000D+00 .000000000000D+00 .259348000000D+06
        .381590000000D+05 .000000000000D+00 .000000000000D+00 .000000000000D+00
        .179460000000D+05 .000000000000D+00 .000000000000D+00 .150000000000D+02
        .000000000000D+00 .000000000000D+00 .000000000000D+00 .226000000000D+03
S20 2014 02 19 00 04 48 .000000000000D+00 .000000000000D+00 .259496000000D+06
        .406367200000D+05 .000000000000D+00 .000000000000D+00 .000000000000D+00
        -.112459160000D+05 .000000000000D+00 .000000000000D+00 .150000000000D+02
        .000000000000D+00 .000000000000D+00 .000000000000D+00 .192000000000D+03
S26 2014 02 19 00 05 04 .000000000000D+00 .000000000000D+00 .259508000000D+06
        .381590000000D+05 .000000000000D+00 .000000000000D+00 .000000000000D+00
        .179460000000D+05 .000000000000D+00 .000000000000D+00 .150000000000D+02
        .000000000000D+00 .000000000000D+00 .000000000000D+00 .227000000000D+03
    ...

```

### 19\_02\_14\_egnos.covar

```

<?xml version="1.0" encoding="ISO-8859-1"?>
<REGION sys = "EGNOS">

<COVAR_MATRIX_ENTRY DateTime = "14-02-19 06:00:00" IODP = "0" PRN = " 1"
SCALE_EXP = "5" E11 = " 1" E22 = " 1" E33 = " 1" E44 = " 1" E12 = " 0"
E13 = " 0" E14 = " 0" E23 = " 0" E24 = " 0" E34 = " 0"/>
<COVAR_MATRIX_ENTRY DateTime = "14-02-19 06:00:00" IODP = "0" PRN = " 2"
SCALE_EXP = "5" E11 = " 1" E22 = " 1" E33 = " 1" E44 = " 1" E12 = " 0"
E13 = " 0" E14 = " 0" E23 = " 0" E24 = " 0" E34 = " 0"/>
<COVAR_MATRIX_ENTRY DateTime = "14-02-19 06:00:00" IODP = "0" PRN = " 3"
SCALE_EXP = "5" E11 = " 1" E22 = " 1" E33 = " 1" E44 = " 1" E12 = " 0"
E13 = " 0" E14 = " 0" E23 = " 0" E24 = " 0" E34 = " 0"/>
..
</REGION>

```

### 19\_02\_14\_egnos.deg\_fact

```

<?xml version="1.0" encoding="ISO-8859-1"?>
<REGION sys = "EGNOS">
<DEG_FACT_ENTRY DateTime = "14-02-19 06:00:35" B_RCC = "0.000" C_LTC_LSB = "0.358"
C_LTC_V1 = "0.00780" I_LTC_V1 = "120" C_LTC_V0 = "0.958" I_LTC_V0 = "120"
C_GEO_LSB = "0.1770" C_GEO_V = "0.02000" I_GEO = "120" C_ER = " 0.0"
C_IONO_STEP = "0.657" I_IONO = "300" C_IONO_RAMP = "0.000000" RSS_UDRE = "0"
RSS_IONO = "0" C_COVARIANCE = " 0.0"/>
<DEG_FACT_ENTRY DateTime = "14-02-19 06:59:59" B_RCC = "0.000" C_LTC_LSB = "0.358"
C_LTC_V1 = "0.00780" I_LTC_V1 = "120" C_LTC_V0 = "0.958" I_LTC_V0 = "120"
C_GEO_LSB = "0.1770" C_GEO_V = "0.02000" I_GEO = "120" C_ER = " 0.0"
C_IONO_STEP = "0.657" I_IONO = "300" C_IONO_RAMP = "0.000000" RSS_UDRE = "0"
RSS_IONO = "0" C_COVARIANCE = " 0.0"/>
</REGION>

```





```

      85      none      none      none      none ... none      none
...
     -85      none      none      none      none ... none      none
</data>
</IGP_GRID>
</REGION>

```

### 19\_02\_14\_egnos.lt\_corr

```

<?xml version="1.0" encoding="ISO-8859-1"?>
<REGION sys = "EGNOS">
<VELOCITY_CODE val = "0"/>

<LT_CORR_ENTRY DateTime = "14-02-19 06:00:43" PRN = " 32" XLC="  1.625"
YLC="  1.500" ZLC="  3.125" CLKL="  .186264514923D-08" IODE="59"/>
<LT_CORR_ENTRY DateTime = "14-02-19 06:00:43" PRN = "  3" XLC=" -1.125"
YLC="  0.125" ZLC="  0.250" CLKL=" -.512227416039D-08" IODE="74"/>
...
</REGION>

```

### 19\_02\_14\_egnos.prn\_mask

```

<?xml version="1.0" encoding="ISO-8859-1"?>
<REGION sys = "EGNOS">
<IODP init_val="0"/>

<PRN_MASK DateTime = "14-02-19 06:00:27" PRN = "1,2,3,4,5,6,7,8,9,10,11,
12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,31,32,120,126"/>
<PRN_MASK DateTime = "14-02-19 06:59:59" PRN = "1,2,3,4,5,6,7,8,9,10,11,
12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,31,32,120,126"/>
</REGION>

```

### 19\_02\_14\_egnos.serv

```

<?xml version="1.0" encoding="ISO-8859-1"?>
<REGION sys = "EGNOS">
<IODS init_val="0"/>

<SERVICE_ENTRY DateTime = "14-02-19 06:00:31" NO_OF_SERV_MSG = "1"
SERV_MSG_NO = "1" NO_OF_REG = "1" PRIOR_CODE = "0" UDREI_IN = " 0"
UDREI_OUT = "15" R0_LAT1 = " 70" R0_LONG1 = " -40" R0_LAT2 = " 20"
R0_LONG2 = "  40" R0_SHAPE = "1"/>
<SERVICE_ENTRY DateTime = "14-02-19 06:59:59" NO_OF_SERV_MSG = "1"
SERV_MSG_NO = "1" NO_OF_REG = "1" PRIOR_CODE = "0" UDREI_IN = " 0"
UDREI_OUT = "15" R0_LAT1 = " 70" R0_LONG1 = " -40" R0_LAT2 = " 20"
R0_LONG2 = "  40" R0_SHAPE = "1"/>
</REGION>

```

### A.4.2 Interpolation and Correction Data Sampling Principle

Correction data is sampled with the time period specified with the parameter "Period" (see "SBAS message files table" on page 92).

The illustration on figure 1-4 for example shows the sampling of the fast correction message file. The example uses an EGNOS fast correction file and the default "Period".

A

```

1 <F_CORR_ENTRY DateTime = "14-02-19 06:30:00" PRN = " 16" PRC = " 0.000" UDREI = " 3.75"/>
2 <F_CORR_ENTRY DateTime = "14-02-19 06:30:04" PRN = " 16" PRC = " 0.125" UDREI = " 3.75"/>
3 <F_CORR_ENTRY DateTime = "14-02-19 06:30:16" PRN = " 16" PRC = " 0.250" UDREI = " 3.75"/>
4 <F_CORR_ENTRY DateTime = "14-02-19 06:30:20" PRN = " 16" PRC = " 0.750" UDREI = " 3.75"/>
5 <F_CORR_ENTRY DateTime = "14-02-19 06:30:28" PRN = " 16" PRC = " 0.500" UDREI = " 3.75"/>
    
```

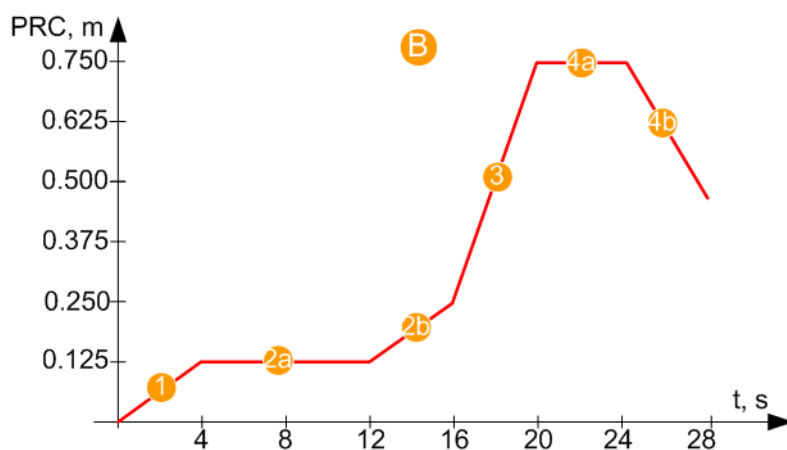


Fig. 1-4: Principle of interpolation and resampling (example extract of a SBAS fast correction file, "Period = 4s")

- A = Extract of an example SBAS fast correction file
- B = PRC time plot of PRN = 16
- 1, 3 = Time interval between the two consecutive corrections is  $\leq 4$  sec; the PRC is interpolated, a linear ramp function is used
- 2, 4 = Time interval between the two consecutive corrections is  $> 4$  sec; the PRC is held constant (2a, 4a), a linear ramp is applied for the last 4 sec of the time interval (2b, 4b)
- 1, 3, 2b, 4b = Interpolated linear ramps
- 2b, 4b = PRC constant

Per default, EGNOS fast corrections are updated every 4 sec; the way the pseudo random corrections (PRC) values are interpreted depends on the time interval between two consecutive correction:

- If this interval is shorter than the period of 4 sec, the pseudo random corrections (PRC) are linearly interpolated
- If this interval is longer than the period of 4 sec, the first PRC value is used and the PRC value is linearly interpolated in the last 4 sec to the second value.

The same principle applies for the other corrections. For example, the EGNOS long term corrections clock and satellite positions ("δaf0" and "δx/δy/δz") are updated per default every 30 sec.

See also:

- ["To vary and apply pseudorange corrections \(PRC\) that follow a linear ramp function"](#) on page 236
- ["To configure clock or satellite position errors"](#) on page 238

## A.5 Channel Budget

Depending on the installed option, the R&S SMBV can generate the signal of up to 24 satellites. For information on the required options, see [chapter 3.4, "Extension to 12 / 24 Satellites \(R&S SMBV-K91/-K96\)"](#), on page 26.

This section explains how the maximum number of simulated satellites depends on whether P code signal and BeiDou satellites are enabled in the GNSS system configuration or not.

### Without satellites using position accuracy (P-Code) signals

The generation of up to 24-GPS C/A, Galileo E1 and/or GLONASS satellites hybrid signal is possible when no P-Code signals are activated. For the [Use Position Accuracy \(P-Code\) GPS= Off](#) case the following rules apply:

- If  $a$  corresponds to resource units that can be either data or pilot and  $b$  to the resource units that can do both, data and pilot, than:
  - Any of the GPS C/A, QZSS C/A, Glonass R-C/A and BeiDou B-C/A satellite/multipath tap channel consumes  $1a$  or  $1b$  resource units.
  - A Galileo E1 satellite/multipath tap consumes  $1a$  or  $2b$  resource units.
- The total number of available resource units depends on the ["Activate Systems > BeiDou"](#) state as follows:
  - $14a + 10b$ , if "BeiDou = Off"
  - $24b$ , if "BeiDou = On"

### Example:

The [table 1-10](#) lists some of the GNSS constellations with 24 satellites that can be achieved.

**Table 1-10: Possible GNSS hybrid configurations with 24 satellites**

GPS C/A signal	QZSS C/A signal	Galileo E1 signal	GLONASS R-C/A signal	BeiDou B-C/A
24	0	0	0	0
23	1	0	0	0
12	0	0	12	0
8	0	8	8	0
12	0	0	0	12

GPS C/A signal	QZSS C/A signal	Galileo E1 signal	GLONASS R-C/A signal	BeiDou B-C/A
0	0	0	0	24
8	0	0	8	8
5	0	2	5	10
0	0	19	0	0
0	0	11	0	1
etc.				

### With activated P-code in the GNSS system configuration

For enabled [Use Position Accuracy \(P-Code\) GPS](#) or [Maximum Number of Satellites](#) is less or equal to 24, only a subset of hybrid GNSS configurations are possible (see [table 1-12](#)).

Let  $c$  corresponds to the civilian (C/A) resource units and  $p$  to the military (P-Code) resource units. The [table 1-11](#) lists the number of resource units needed per signal when both the C/A GPS and position accuracy P-Code GPS signals are activated in GNSS system configuration.

**Table 1-11: Number of resource units required per signal**

Standard	"Signal"	c C/A resource units	p P-code resource units
GPS	C/A	1	0
		0	1
	P	0	1
	(C/A+P)Q	1	1
0		2	
Galileo	E1	2	0
		1	1
		0	2
GLONASS	R-C/A	1	0
		0	1
BeiDou	B-C/A	1	0
		0	1
QZSS	C/A	1	0
		0	1
SBAS	C/A	1	0

**Example:**

According to the table, the GPS (C/A+P)Q signal requires 1c + 1p or 2p units. The total available budget when GPS and P-code signals are activated in a hybrid GNSS system configuration is 12c + 12p.



Instruments equipped with R&S SMBV-K92 can generate multipath signal. The generation of multipath satellite signal with *n* taps requires *n* times more resource units.

**Example:**

The [table 1-12](#) lists some of the GNSS constellations that can be achieved based on the information listed in [table 1-11](#).

*Table 1-12: Possible GNSS hybrid configurations*

GPS (C/A +P)Q signal	GPS P signal	GPS C/A signal	QZSS C/A signal	Galileo E1 signal	GLONASS R-C/A signal
12	0	0	0	0	0
11	0	0	0	0	2
10	0	0	0	1	2
9	0	0	1	1	2
9	0	0	0	2	2
8	4	4	0	0	0
8	4	2	0	0	2
8	0	8	0	0	0
8	0	4	0	0	4
8	0	0	0	0	8
8	0	0	0	4	0
8	0	3	0	2	1
8	0	0	0	3	2
8	0	0	0	2	4
8	0	0	0	1	6
7	0	0	0	3	4
6	0	0	0	4	4
5	0	0	0	3	8

## A.6 QZSS Navigation Message Scheduling

The table on [figure 1-5](#) shows the structure of the QZSS navigation message, as it is implemented in the R&S SMBV.

## List of the Supported Predefined Test Scenarios

#	Time	Subframe 4			Subframe 5		
		Content	Data ID	SVID		Data ID	SVID
1	00:00:00	1 Almanac	11	1	1 Almanac	00	1
2	00:00:30	Health of QZSS	11	51	1 Almanac	00	2
3	00:01:00	IONO	11	56	1 Almanac	00	3
4	00:01:30	1 Almanac	00	25	1 Almanac	00	4
5	00:02:00	IONO	11	56	IONO	00	56
6	00:02:30	1 Almanac	11	2	1 Almanac	00	5
7	00:03:00	Health of QZSS	11	51	1 Almanac	00	6
8	00:03:30	IONO	11	56	1 Almanac	00	7
9	00:04:00	1 Almanac	00	26	1 Almanac	00	8
10	00:04:30	NMCT of GPS	11	52	NMCT QZSS and GPS	11	53
11	00:05:00	1 Almanac	11	3	1 Almanac	00	9
12	00:05:30	Health of QZSS	11	51	1 Almanac	00	10
13	00:06:00	1 Almanac	00	27	1 Almanac	00	11
14	00:06:30	1 Almanac	00	28	1 Almanac	00	12
15	00:07:00	Health of GPS	11	49	Health of GPS	11	50
16	00:07:30	1 Almanac	11	1	1 Almanac	00	13
17	00:08:00	Health of QZSS	11	51	1 Almanac	00	14
18	00:08:30	IONO	11	56	1 Almanac	00	15
19	00:09:00	1 Almanac	00	29	1 Almanac	00	16
20	00:09:30	IONO	11	56	IONO	00	56
21	00:10:00	1 Almanac	11	2	1 Almanac	00	17
22	00:10:30	Health of QZSS	11	51	1 Almanac	00	18
23	00:11:00	IONO	11	56	1 Almanac	00	19
24	00:11:30	Health of GPS	00	51	1 Almanac	00	20
25	00:12:00	NMCT of GPS	11	52	NMCT QZSS and GPS	11	53
26	00:12:30	1 Almanac	11	3	1 Almanac	00	21
27	00:13:00	Health of QZSS	11	51	1 Almanac	00	22
28	00:13:30	1 Almanac	00	31	1 Almanac	00	23
29	00:14:00	1 Almanac	00	32	1 Almanac	00	24
30	00:14:30	Health of GPS	11	49	Health of GPS	11	50

Fig. 1-5: QZSS navigation message structure



The QZSS navigation message structure used in R&S SMBV deliberately deviates from the QZSS navigation message scheduling published on the Jaxa web page:

[http://qz-vision.jaxa.jp/USE/is-qzss/pattern/pattern\\_L1CA\\_N\\_e.html](http://qz-vision.jaxa.jp/USE/is-qzss/pattern/pattern_L1CA_N_e.html)

The reason for this deviation is that the R&S SMBV can simulate the signal of up to three QZSS satellites, while the published information applies for the only one available QZSS satellite.

## A.7 List of the Supported Predefined Test Scenarios

R&S SMBV equipped with the assisted options supports test scenarios as basis for A-GPS/A-GLONASS/A-GNSS Protocol and Conformance Test cases.

This section lists the supported predefined test scenarios:

- for A-GPS test scenarios, see [table 1-13](#)
- for A-GLONASS test scenarios, see [table 1-14](#)
- for A-GNSS test scenarios, see [table 1-15](#).

## List of the Supported Predefined Test Scenarios

Table 1-13: A-GPS test scenarios overview

Test Scenario	Required for Test Case	Required SW Option
<b>GSM</b>		
3GPP TS 51.010: 10.9 Signaling	3GPP TS 51.010-1 v.7.7.0 10.9: A-GPS Signaling scenario	R&S SMBV-K44/-K65
3GPP TS 51.010: 10.10 Performance 1	3GPP TS 51.010-1 v.7.7.0 10.10: A-GPS Performance Test Scenario 1	R&S SMBV-K44/-K65
3GPP TS 51.010: 10.10 Performance 2	3GPP TS 51.010-1 v.7.7.0 10.10: A-GPS Performance Test Scenario 2	R&S SMBV-K44/-K65
3GPP TS 51.010: 10.10 Performance 3	3GPP TS 51.010-1 v.7.7.0 10.10: A-GPS Performance Test Scenario 3	R&S SMBV-K44/-K65/-K92
<b>3GPP FDD</b>		
3GPP TS 34.108: 10.7 Signaling	3GPP TS 34.108 v.8.0.0 10.7: A-GPS Signaling scenario	R&S SMBV-K44/-K65
3GPP TS 34.108: 10.1.2 Performance 1	3GPP TS 34.108 v.8.0.0 10.1.2: A-GPS Performance scenario 1	R&S SMBV-K44/-K65
3GPP TS 34.108: 10.1.2 Performance 2	3GPP TS 34.108 v.8.0.0 10.1.2: A-GPS Performance scenario 2	R&S SMBV-K44/-K65
3GPP TS 34.108: 10.1.2 Performance 3	3GPP TS 34.108 v.8.0.0 10.1.2: A-GPS Performance scenario 3	R&S SMBV-K44/-K65/-K92
<b>3GPP2</b>		
3GPP2 C.S0036: 2.1.1 Stationary	3GPP2 C.S0036-0 V1.0 2.1.1: A-GPS Stationary	R&S SMBV-K44/-K65
3GPP2 C.S0036: 2.1.2 Moving	3GPP2 C.S0036-0 V1.0 2.1.2: A-GPS Moving	R&S SMBV-K44/-K65/-K91/-K92
<b>EUTRA/LTE</b>		
3GPP TS 37.571-2: S7 Signaling ST1	3GPP TS 37.571-2 v.10.0.0 subclause 7: A-GPS Signaling scenario, Subtest 1	R&S SMBV-K44/-K65
3GPP TS 37.571-1: S7 Performance 1 ST1	3GPP TS 37.571-1 v.10.0.0 subclause 7: A-GPS Performance scenario 1, Subtest 1	R&S SMBV-K44/-K65
3GPP TS 37.571-1: S7 Performance 2 ST1	3GPP TS 37.571-1 v.10.0.0 subclause 7: A-GPS Performance scenario 2, Subtest 1	R&S SMBV-K44/-K65
3GPP TS 37.571-1: S7 Performance 5 ST1	3GPP TS 37.571-1 v.10.0.0 subclause 7: A-GPS Performance scenario 5, Subtest 1	R&S SMBV-K44/-K65/-K92

Table 1-14: A-GLONASS test scenarios overview

Test Scenario	Required for Test Case	Required SW Option
<b>3GPP FDD</b>		
3GPP TS 37.571-2: S6 Signaling ST1	3GPP TS 37.571-2 v.10.0.0 subclause 6: A-Glonass Signaling scenario, Subtest 1	R&S SMBV-K94/-K95
3GPP TS 37.571-1: S6 Performance 1	3GPP TS 37.571-1 v.10.0.0 subclause 6: A-Glonass Performance scenario 1, Subtest 1	R&S SMBV-K94/-K95
3GPP TS 37.571-1: S6 Performance 2	3GPP TS 37.571-1 v.10.0.0 subclause 6: A-Glonass Performance scenario 2, Subtest 1	R&S SMBV-K94/-K95



Test Scenario	Required for Test Case	Required SW Option
3GPP TS 37.571-1: S6 Performance 5	3GPP TS 37.571-1 v.10.0.0 subclause 6: A-Glonass Performance scenario 5, Subtest 1	R&S SMBV-K94/-K95/-K92
<b>EUTRA/LTE</b>		
3GPP TS 37.571-2: S7 Signaling ST2	3GPP TS 37.571-2 v.10.0.0 subclause 7: A-Glonass Signaling scenario, Subtest 2	R&S SMBV-K44/-K95
3GPP TS 37.571-1: S7 Performance 1 ST2	3GPP TS 37.571-1 v.10.0.0 subclause 7: A-Glonass Performance scenario 1, Subtest 2	R&S SMBV-K44/-K95
3GPP TS 37.571-1: S7 Performance 2 ST2	3GPP TS 37.571-1 v.10.0.0 subclause 7: A-Glonass Performance scenario 2, Subtest 2	R&S SMBV-K44/-K95
3GPP TS 37.571-1: S7 Performance 5 ST2	3GPP TS 37.571-1 v.10.0.0 subclause 7: A-Glonass Performance scenario 5, Subtest 2	R&S SMBV-K44/-K95/-K92

Table 1-15: A-GNSS test scenarios overview

Test Scenario	Required for Test Case	Required SW Option
<b>3GPP FDD</b>		
3GPP TS 37.571-2: S6 Signaling ST4	3GPP TS 37.571-2 v.10.0.0 subclause 6: A-GNSS Signaling scenario, Subtest 4	R&S SMBV-K44/-K65/-K95
3GPP TS 37.571-1: S6 Performance 1 ST4	3GPP TS 37.571-1 v.10.0.0 subclause 6: A-GNSS Performance scenario 1, Subtest 4	R&S SMBV-K44/-K65/-K95
3GPP TS 37.571-1: S6 Performance 2 ST4	3GPP TS 37.571-1 v.10.0.0 subclause 6: A-GNSS Performance scenario 2, Subtest 4	R&S SMBV-K44/-K65/-K95
3GPP TS 37.571-1: S6 Performance 5 ST4	3GPP TS 37.571-1 v.10.0.0 subclause 6: A-GNSS Performance scenario 5, Subtest 4	R&S SMBV-K44/-K65/-K92/-K95
<b>EUTRA/LTE</b>		
3GPP TS 37.571-2: S7 Signaling ST4	3GPP TS 37.571-2 v.10.0.0 subclause 7: A-GNSS Signaling scenario, Subtest 4	R&S SMBV-K44/-K65/-K95
3GPP TS 37.571-1: S7 Performance 1 ST5	3GPP TS 37.571-1 v.10.0.0 subclause 7: A-GNSS Performance scenario 1, Subtest 5	R&S SMBV-K44/-K65/-K95
3GPP TS 37.571-1: S7 Performance 2 ST5	3GPP TS 37.571-1 v.10.0.0 subclause 7: A-GNSS Performance scenario 2, Subtest 5	R&S SMBV-K44/-K65/-K95
3GPP TS 37.571-1: S7 Performance 5 ST5	3GPP TS 37.571-1 v.10.0.0 subclause 7: A-GNSS Performance scenario 5, Subtest 5	R&S SMBV-K44/-K65/-K92/-K95

## A.8 List of the Provided Predefined Files

If the required options are installed, the firmware provides the following predefined files:

## List of the Provided Predefined Files

Description	File Type	File extension	File Name
BeiDou Almanac files	Almanac	*.txt	19_02_2014_bds.txt Beidou_Yuma678.txt Beidou_Yuma752.txt Beidou_Yuma772.txt
BeiDou RINEX files	RINEX	*.14n *.12n	19_02_2014_bds.14n Beidou_Week678_Day1.12n
Galileo Almanac files	Almanac	*.txt	19_02_2014_gal.txt GAL_Yuma581.txt GAL_Yuma582.txt GAL_Yuma583.txt GAL_Yuma584.txt GAL_Yuma585.txt GAL_Yuma678.txt GAL_Yuma683.txt
Galileo RINEX files	RINEX	*.14n *.10n *.12n	19_02_2014_gal.14n GAL_Week585_Day0.10n GAL_Week678_Day1.12n GAL_Week683_Day1.12n
GLONASS Almanac files	Almanac	*.agl	19_02_2014_glo.agl GLO_03_10_2011.agl GLO_581.agl GLO_582.agl GLO_583.agl GLO_584.agl GLO_585.agl GLO_678.agl GLO_683.agl GLONASS_LTE_Sunnyvale_Yuma.agl GLONASS_LTE_Tokyo_Yuma.agl
GLONASS RINEX files	RINEX	*.14g *.12g *.10n	19_02_2014_glo.14g GLO_LTE_PER1_SIG.12g GLO_LTE_PER2.12g GLO_Week585_Day0.10n GLO_Week678_Day1.12g GLO_Week683_Day1.12g
GLONASS test scenario files	Test scenarios	*.gpstmd	EUTRA_PER1_ST5.gpstmd EUTRA_PER2_ST2.gpstmd EUTRA_PER2_ST5.gpstmd EUTRA_PER5_ST2.gpstmd EUTRA_PER5_ST5.gpstmd EUTRA_SIG_PER1_ST2.gpstmd EUTRA_SIG_ST4.gpstmd

## List of the Provided Predefined Files

Description	File Type	File extension	File Name
GPS Almanac files	Almanac	*.txt	3GPP2_Yuma.txt 19_02_2014_gps.txt GPS_LTE_Sunnyvale_Yuma.txt GPS_LTE_Tokyo_Yuma.txt GPS_SEM581.txt GPS_SEM582.txt GPS_SEM583.txt GPS_SEM584.txt GPS_SEM585.txt GPS_SEM678.txt GPS_SEM683.txt GPS1_Yuma.txt GPS2_Yuma.txt GPS3_Yuma.txt SEM269.txt SEM385.txt SEM464.txt SEM482.txt SEM483.txt SEM484.txt SEM485.txt Tokyo_Yuma.txt
GPS RINEX files	RINEX	*.14g *.12g *.10n	19_02_2014_gps.14n 3gpp2.10n GPS_LTE_Per1.12n GPS_LTE_Per2.12n GPS_LTE_SIG.12n GPS_Week581_Day0.10n GPS_Week582_Day0.10n GPS_Week583_Day0.10n GPS_Week584_Day0.10n GPS_Week585_Day0.10n GPS_Week678_Day1.12n GPS_Week683_Day1.12n gsm_3gpp_per_1.10n gsm_3gpp_per_2and3.10n gsm_3gpp_signaling.10n

## List of the Provided Predefined Files

Description	File Type	File extension	File Name
GPS test scenario files	Test scenarios	*.gpstmd	3GPP_PER1.gpstmd 3GPP_PER2.gpstmd 3GPP_PER3.gpstmd 3GPP_SIG.gpstmd 3GPP2_moving.gpstmd 3GPP2_static.gpstmd EUTRA_PER1_ST1.gpstmd EUTRA_PER1_ST1.gpstmd EUTRA_PER2_ST1.gpstmd EUTRA_PER2_ST5.gpstmd EUTRA_PER5_ST1.gpstmd EUTRA_PER5_ST5.gpstmd EUTRA_SIG_ST1.gpstmd EUTRA_SIG_ST4.gpstmd
Land Mobile Multipath files		*.lmm	EUTRA_SIG_ST4.gpstmd Offenburg_Suburban.lmm
Obstacles		*.rs_obst	City_Block.rs_obst Urban_Canyon_1.rs_obst
		*.rs_buil	Cutting.rs_buil Highway.rs_buil Suburban_1.rs_buil
Antenna Patterns	Body Mask files	*.ant_pat	Bus.ant_pat Car_Medium.ant_pat Car_Medium_OpenRoof.ant_pat Car_Small.ant_pat Car_Small_OpenRoof.ant_pat Isotropic.ant_pat Jet.ant_pat Jet_Big.ant_pat Plane.ant_pat Ship_Big.ant_pat Ship_Medium.ant_pat Space_Vehicle_3_antennas.ant_pat SUV.ant_pat Van.ant_pat Yacht_Small.ant_pat
QZSS Almanac files	Almanac	*.txt	QZSS_Yuma678.txt 19_02_2014_qzss.txt
QZSS RINEX files	RINEX	*.14q	19_02_2014_qzss.14q
		*.12q	QZSS_Week678_Day1.12q

## List of the Provided Predefined Files

Description	File Type	File extension	File Name
SBAS Almanac files	Almanac	*.alm	19_02_14_egnos.alm 19_02_14_msas.alm 19_02_14_waas.alm 20_08_12_egnos.alm
SBAS correction data		*.covar *.deg_fact *.f_corr *.fc_deg *.iono_grid *.lt_corr *.prn_mask *.serv	19_02_14_egnos.covar 19_02_14_egnos.deg_fact 19_02_14_egnos.f_corr 19_02_14_egnos.fc_deg 19_02_14_egnos.iono_grid 19_02_14_egnos.lt_corr 19_02_14_egnos.prn_mask 19_02_14_egnos.serv 19_02_14_mixed.iono_grid 19_02_14_msas.covar 19_02_14_msas.deg_fact 19_02_14_msas.f_corr 19_02_14_msas.fc_deg 19_02_14_msas.iono_grid 19_02_14_msas.lt_corr 19_02_14_msas.prn_mask 19_02_14_msas.serv 19_02_14_waas.covar 19_02_14_waas.deg_fact 19_02_14_waas.f_corr 19_02_14_waas.fc_deg 19_02_14_waas.iono_grid 19_02_14_waas.lt_corr 19_02_14_waas.prn_mask 19_02_14_waas.serv 20_08_12_egnos.covar 20_08_12_egnos.deg_fact 20_08_12_egnos.f_corr 20_08_12_egnos.fc_deg 20_08_12_egnos.iono_grid 20_08_12_egnos.lt_corr 20_08_12_egnos.prn_mask 20_08_12_egnos.serv
SBAS Raw data		*.nsth *.ems	Eko_Oem4_1830_1780_03.nsth PRN120_19_02_14.ems PRN120_20_08_12.ems PRN126_19_02_14.ems

## List of the Provided Predefined Files

Description	File Type	File extension	File Name		
SBAS RINEX files	RINEX	*.14n *.12n	19_02_14_egnos.14n 19_02_14_msas.14n 19_02_14_waas.14n 20_08_12_egnos.12n		
Vehicle description files	XVD	*.xvd	Aircraft1.xvd LandVehicle1.xvd Pedestrian1.xvd Ship1.xvd Small_Jet.xvd Spacecraft1.xvd Speed_Boat.xvd Sports_Car.xvd Truck.xvd		
Motion description files	Waypoint files	*.txt	3gpp_eutra_per5.txt 3gpp2.txt Melbourne.txt Melbourne_Movement.txt Misc_Tokyo_GPS_Moving.txt Misc_Tokyo_GPS_Moving_2012.txt Misc_Tokyo_SUPL_AreaEvent.txt Misc_Tokyo_SUPL_AreaEvent_2012.txt Scen_Circle_5km.txt Scen_City_Block.txt Scen_Parking_10min.txt Scen_Parking_1h.txt Scen_Parking_1min.txt Scen_Urban_Canyon_1.txt		
			XTD	*.xtd	Circle_Motion_VMag.xtd Barcelona_Ship_Cruise.xtd Melbourne_Car_Motion.xtd Munich_Flight.xtd NewYork_City_Walk.xtd Nuerburgring_Race_VelComp.xtd Nuerburgring_Race_VelMag.xtd Small_Jet_Flight.xtd Spacecraft_Motion.xtd
			KML	*.kml	Nuerburgring_Race.kml
			NMEA	*.nmea	Melbourne_nmea.nmea

# Glossary: List of Publications with Further or Reference Information

## Symbols

[1]: <http://www.navipedia.net>

**1GP67:** Rohde & Schwarz Application Note [1GP67](#) "Phase Adjustment of Two MIMO Signal Sources with Option B90 (Phase Coherence)"

**1GP84:** Rohde & Schwarz Application Note [1GP84](#) "Time Synchronous Signals with Multiple R&S SMBV100A Vector Signal Generators"

**1GP86:** Rohde & Schwarz Application Note [1GP86](#) "GPS, Glonass, Galileo, BeiDou Receiver Testing Using a GNSS Signal Simulator"

**1GP101:** Rohde & Schwarz Application Note [1GP101](#) "Simulating Automatic Obscuration and Multipath for Realistic GNSS Receiver Testing"

**1GP102:** Rohde & Schwarz Application Note [1GP102](#) "Hardware in the Loop (HIL) Testing with a GNSS Simulator"

## D

**Di Giovanni and Radicella, 1990:** Di Giovanni, G. and Radicella, S. M., 1990. An analytical model of the electron density profile in the ionosphere. *Advances in Space Research*

## J

**JAXA:** The Japan Aerospace Exploration Agency

## R

**RTCA MOPS DO-229:** "Minimum Operational Performance Standards for Global Positioning System/Wide Area Augmentation System Airborne Equipment", 13 Dec 2006

## S

**STANAG:** NATO Standard Agreement STANAG 4294 Issue 1

## List of Commands

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[:SOURCE<hw>]:BB:GLONass:ATSCenario	251
[:SOURCE<hw>]:BB:GLONass:SETTING:CATalog?	252
[:SOURCE<hw>]:BB:GPS:ATSCenario	250
[:SOURCE<hw>]:BB:GPS:SETTING:CATalog?	252
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