Satellite Navigation Digital Standard for R&S®WinIQSIM2™

User Manual

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User Manual

Version 01

ROHDE&SCHWARZ

This document describes the software options for satellite navigation: GPS, Galileo, GLONASS, COMPASS/BeiDou
Described are the following software options:

- R&S®SMW-K244/-K266/-K294/-K298/-K407
  1413.4880.xx, 1413.7015.xx, 1413.7067.xx, 1414.3171.xx, 1413.7115.xx
- R&S®SMBVB-K244/-K266/-K294/-K298/-K407
  1423.8195.xx, 1423.8320.xx, 1423.8395.xx, 1423.8408.xx, 1423.8489.xx
- R&S®SGT-K244/-K266/-K294/-K298/-K407
  1419.6104.xx, 1419.7000.xx, 1419.7400.xx, 1419.5766.xx, 1419.7452.xx
- R&S®SMBV-K244/-K266/-K294/-K407
  1415.8260.02, 1415.8590.02, 1415.8690.02, 1419.2721.xx
- R&S®CMW-KW620/-KW621/-KW622/-KW623
  1203.6008.02, 1207.8305.02, 1207.8357.02, 1208.8280.02
- R&S®WV-K1144
  2114.8302.02

This manual version corresponds to software version 4.60.162.xx.x64 and later of the R&S®WinIQSIM2™.

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1179.0080.02 | Version 01 | Satellite Navigation

The following abbreviations are used throughout this manual: R&S®WinIQSIM2™ is abbreviated as R&S WinIQSIM2, R&S®SMW200A is abbreviated as R&S SMW, R&S®SMBV100B is abbreviated as R&S SMBVB, R&S®SGT100A is abbreviated as R&S SGT, R&S®SMBV100A is abbreviated as R&S SMBV, R&S®CMW500, R&S®CMW280, R&S®CMW270 and R&S®CMW100 are abbreviated as R&S CMW, R&S®SFU is abbreviated as R&S SFU, R&S®BTC is abbreviated as R&S BTC; the license types 02/03/07/11/13/16/12 are abbreviated as xx.

Contents

1 Preface

1.1 About This Manual

This user 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 WinIQSIM2 user 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 Sxx-K244/-K266/-K294/-K298/-K407**
  Introduction to and getting familiar with the options
- **About the GNSS options**
  Background information on basic terms and principles in the context of GNSS 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 generate and play a waveform with the GNSS options**
  The basic procedure to perform signal generation tasks and step-by-step instructions for more complex tasks or alternative methods
  And 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 WinIQSIM2 user manual)
  Programming examples demonstrate the use of many commands and can usually be executed directly for test purposes
- **List of remote commands**
  Alphabetical list of all remote commands described in the manual
- **Index**

Contents and scope

This description assumes R&S WinIQSIM2 equipped with all available options. Depending on your model and the installed options, some of the functions may not be available on your instrument.

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 usage scenarios.

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

1.2 Documentation Overview

This section provides an overview of the R&S WinIQSIM2 user documentation. Unless specified otherwise, you find the documents on the R&S WinIQSIM2 product page at:

www.rohde-schwarz.com/manual/winiqsim2

1.2.1 Getting Started Manual

Introduces the R&S WinIQSIM2 and describes how to set up and start working with the product. Includes basic operations, typical measurement examples, and general information, e.g. safety instructions, etc. A printed version is delivered with the instrument.

1.2.2 User Manual and Help

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

- Base unit manual
  Contains the description of all instrument modes and functions. It also provides an introduction to remote control, a complete description of the remote control commands with programming examples, and information on maintenance, instrument interfaces and error messages. Includes the contents of the getting started manual.
- Software option manual
  Contains the description of the specific functions of an option. Basic information on operating the R&S WinIQSIM2 is not included.

The contents of the user manuals are available as help in the R&S WinIQSIM2. The help offers quick, context-sensitive access to the complete information for the base unit and the software options.

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

1.2.3 Service Manual

Describes the performance test for checking the rated specifications, module replacement and repair, firmware update, troubleshooting and fault elimination, and contains mechanical drawings and spare part lists.

The service manual is available for registered users on the global Rohde & Schwarz information system (GLORIS, https://gloris.rohde-schwarz.com).

1.2.4 Instrument Security Procedures

Deals with security issues when working with the R&S WinIQSIM2 in secure areas. It is available for download on the Internet.

1.2.5 Basic Safety Instructions

Contains safety instructions, operating conditions and further important information. The printed document is delivered with the instrument.

1.2.6 Data Sheets and Brochures

The data sheet contains the technical specifications of the R&S WinIQSIM2. It also lists the options and their order numbers and optional accessories.

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

See www.rohde-schwarz.com/brochure-datasheet/winiqsim2

1.2.7 Release Notes and Open Source Acknowledgment (OSA)

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

The open source acknowledgment document provides verbatim license texts of the used open source software.

See www.rohde-schwarz.com/software/winiqsim2

1.2.8 Application Notes, Application Cards, White Papers, etc.

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

See www.rohde-schwarz.com/application/winiqsim2.

2 Welcome to the GNSS Options

The R&S WinIQSIM2-K244/-K266/-K294/-K298/-K407 are firmware applications that add functionality to generate signals in accordance with the GPS, Galileo, GLONASS and COMPASS/BeiDou navigation systems.

GNSS key features

- Support of single GNSS systems and signals (Table 2-1)
- Configuring the state of a particular signal component individually
- Waveform generation for tracking tests

Table 2-1: Supported single GNSS systems and signals

GNSS system	GPS	Glonass	Galileo	BeiDou
RF band (signal)	L1 (C/A) L2 (C/A, L2C) L5	L1 (C/A) L2 (C/A)	L1 (E1) L5 (E5a, E5b)	L1 (B1I) L5 (B2I)

Differences between implementation in GNSS simulator and R&S WinIQSIM2

The GNSS implementation in the R&S WinIQSIM2 allows you to generate waveform files. You can load the waveform files to Rohde & Schwarz current and discontinued instruments listed in the table below:

Current instruments	**Discontinued instruments**
R&S SMW, R&S SMBVB, R&S SGT, R&S SMBV, R&S AFQ, R&S CMW, R&S BTC	R&S SMU, R&S SMJ, R&S AMU, R&S SFU

To play back a waveform file created by the simulation software R&S WinIQSIM2, the signal generator must be equipped with the corresponding digital standard options for using R&S WinIQSIM2.

Depending on the availability of the respective options, e.g. R&S®SMW-K244/-K266/-K294/-K407, you can simulate **one** GPS, Galileo, GLONASS or BeiDou satellite respectively on the instrument, e.g. R&S SMW.

As a major difference to the real-time solution of the GNSS simulator, the satellite signal generated with the R&S WinIQSIM2 is limited to a certain time period. It depends on the ARB capacity of the signal generator and the user configurable sample rate of the satellite signal.

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

All functions not discussed in this manual, are described in the R&S WinIQSIM2 user manual. The latest version is available at:

http://www.rohde-schwarz.com/product/WinIQSIM2.html

2.1 Accessing the GNSS Dialog

To open the dialog with GNSS settings

► In the block diagram of the R&S WinIQSIM2, 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, it includes:

- Managing settings and data lists, like storing and loading settings, creating and accessing data lists, or accessing files in a particular directory.
- Information on marker signals and 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 WinIQSIM2 user manual.

3 About the GNSS Options

Global navigation satellite system (GNSS) employs the radio signals of several navigation standards, like GPS, Galileo, GLONASS, and BeiDou. 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 new. In the foreseeable future, several more GNSS satellites utilizing more signals and new frequencies are available.

The GNSS implementation in the R&S WinIQSIM2 enables you to generate the signal of GNSS satellites, depending on the installed options. Signal generation is performed in real time and thus not limited to a certain time period.

The following chapters provide background information on required options, basic terms and principles in the context of GNSS signal generation. For detailed information on the GNSS standards, see the corresponding specifications.

3.1 Required Options

To play back a waveform file created by the simulation software R&S WinIQSIM2, the signal generator must be equipped with the corresponding digital standard options for using R&S WinIQSIM2.

For more information, see data sheet.

3.2 GNSS Overview

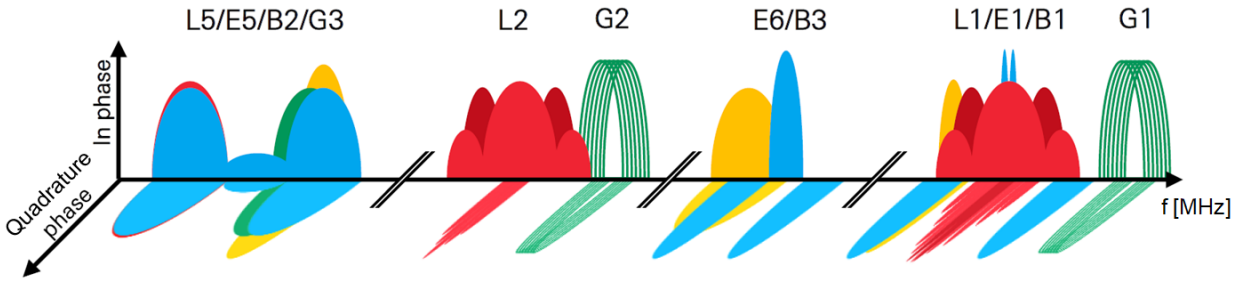


Figure 3-1: Power spectral density and center frequencies of most important GNSS signals

Red = GPS L1, L2 and L5 signals, details in GPS signal plan
Blue = Galileo E1, E5 and E6 signals, details in Galileo signal plan
Green = Glonass G1, G2 and G3 signals, details in GLONASS signal plan
Yellow = BeiDou B1, B2 and B3 signals, details in BeiDou signal plan

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 correlation (gold) codes. These ranging codes are used as spreading codes for the navigation message which is transmitted at a rate of 50 bauds. The C/A codes are used to provide standard positioning service (SPS), the P(Y) codes to provide precise positioning service (PPS).

Table 3-1: GPS signal plan

Service name	C/A	P(Y)	L1C[1)]	L2C	MCode[1)]	L5I, L5Q
Frequency band	L1	L1 L2	L1	L2	L1 L2	L5
Center frequency, MHz	1575.42	1575.42 1227.6	1575.42	1227.6	1575.42 1227.6	1176.45
Modulation	BPSK(1)	BPSK(10)	TMBOC (6,1,1/11)	BPSK(1)	BOC(10,5)	QPSK(10)

Where:

- [1)] GPS L1C and M code signals are not supported with the GNSS firmware.

Galileo

Galileo is the European global navigation satellite system that provides global positioning service under civilian control. It is planed 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 subdivided into two signals denoted E5a and E5b (see Figure 3-1). The Galileo system provides open service (OS), public regulated service (PRS) to authorized, commercial service (CS) and search and rescue (SAR) service.

Table 3-2: Galileo signal plan

Service name	E1 OS	PRS[1)]		E5a OS	E5b OS	E6 CS[1)]
Frequency band	E1	E1	E6	E5		E6
Center frequency, MHz	1575.42	1575.42	1278.75	1176.45	1207.14	1278.75
Modulation	CBOC (6,1,1/11)	BOC (15,2.5)	BOC(10,5)	AltBOC (15,10)		BPSK(5)

Where:

- [1)] Galileo E1 PRS and E6 signals are not supported with the GNSS firmware.

GLONASS

Glonass 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 improves the availability and therefore the navigation performance in high urban areas.

Table 3-3: GLONASS signal plan

Service name	C/A		P[1)]		G3I , G3Q[1)]
Frequency band	G1	G2	G1	G2	G3
Center frequency, MHz	1602 ± k*0.5625[2)]	1246 ± k*0.5625[2)]	1602 ± k*0.5625[2)]	1246 ± k*0.5625[2)]	1202.025
Modulation	BPSK(0.5)		BPSK(5)		QPSK(10)

Where:

- [1)] Glonass G1/2 P code and G3I/Q signals are not supported in the GNSS firmware.
- [2)] k is the frequency number (FDMA), with -7 ≤ k ≤ 13.

COMPASS/BeiDou

The fully deployed BeiDou navigation satellite system (BDS) is a Chinese satellite navigation system. This navigation system is also referred as BeiDou-2 and is expected in 2020. The BDS is a global satellite navigation system 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 providing open service (OS) and authorized service (AS).

Table 3-4: BeiDou signal plan

Service name	B1I OS, B1Q AS[1)]	B2I OS	B2Q AS[1)]	B3I[1)], B3Q[1)]
Frequency band	B1	B2		B3
Center frequency, MHz	1561.098	1207.14		1268.52
Modulation	QPSK(2)	BPSK(2)	BPSK(10)	QPSK(10)

Where:

- [1)] BeiDou B1/2/3Q and B3I signals are not supported in the GNSS firmware.

3.3 Single-satellite GNSS Signal

This section gives an overview of the basic offline options GPS (R&S Sxx-K244 and R&S Sxx-K298), Galileo (R&S Sxx-K266), GLONASS (R&S Sxx-K294) and BeiDou (R&S Sxx-K407).

R&S WinIQSIM2 calculates a single satellite GNSS signal, where static satellites with constant Doppler shifts are provided for simple receiver tests, like receiver sensitivity, acquisition, tracking and production tests. Selection and configuration of any localization data, such as receiver location for instance, is not enabled.

A generic workflow is described in Chapter 6, "Generating and Playing GNSS Waveforms", on page 57.

3.4 GNSS Components Overview

The GNSS system comprises of three main components: the space segment, the ground segment and the user segment.

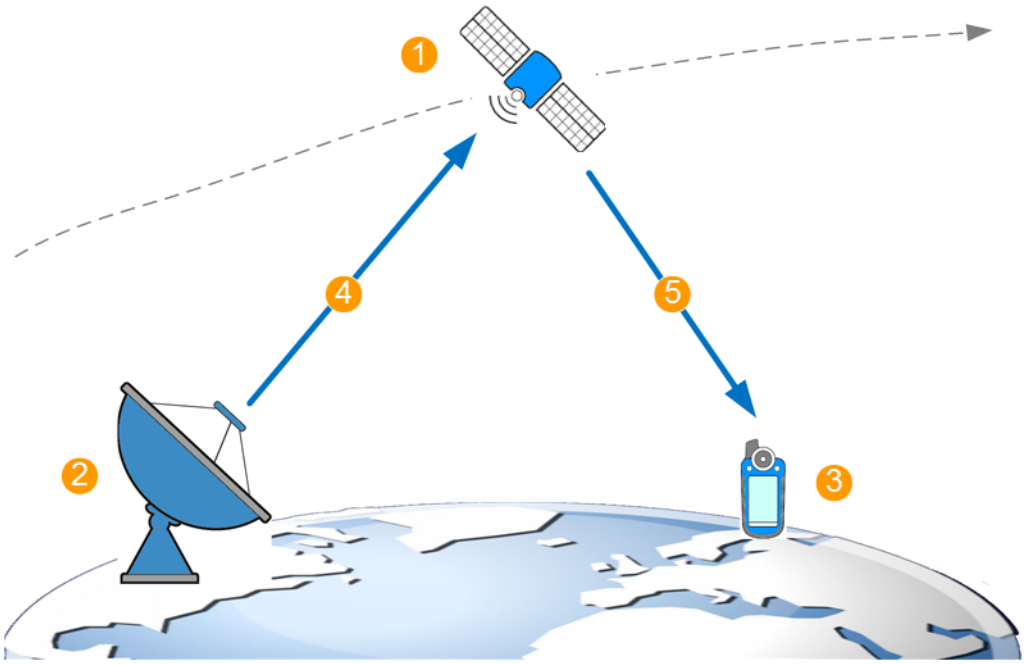


Figure 3-2: GNSS system components (simplified)

1 = Space segment or satellites
2 = Ground segment or ground stations
3 = User segment or receivers
4 = Ephemeris (broadcasted satellites orbit and clock)
5 = Broadcasted navigation message

Space segment

The space segment consists of the **satellites** that orbit the earth on their individual orbits. Satellites broadcast signals at specific frequency in the L band and spread by predefined codes. For the GPS satellites using L1 frequency band, for instance, the predefined codes are the coarse/acquisition (C/A) or the precision (P) codes.

The transmitted signal carries the **navigation message**, on which each satellite broadcasts its major characteristics, its clock offsets and precise orbit description, where the latter is called **ephemeris**. The navigation message contains also satellites status information, ionospheric and time-related parameters, UTC information and orbit data with reduced accuracy for all other satellites, commonly referred as **almanac**.

Ground segment

The ground segment is a network of **ground stations** whose primary goal is to measure constantly the satellites' location, altitude and velocity, and the satellites signals. The ground stations also estimate the influence of the ionosphere. They calculate the **precise orbit (and orbit perturbation)** parameters and **clock drifts** parameters of each satellite. This corrected highly accurate information is regularly broadcasted back to the satellites so that their navigation messages can be updated.

User segment

Finally, the **receiver** decodes the navigation message (ephemeris and almanac) broadcasted by the GNSS satellites, obtains information regarding the satellites orbit, clock, health etc. and calculates the satellites coordinates. The receiver also measures the signal propagation time (i.e. the pseudorange) of at least four satellites and estimates its own position.

4 GNSS Configuration and Settings

Access:

► Select "Baseband > Satellite Navigation > GNSS"

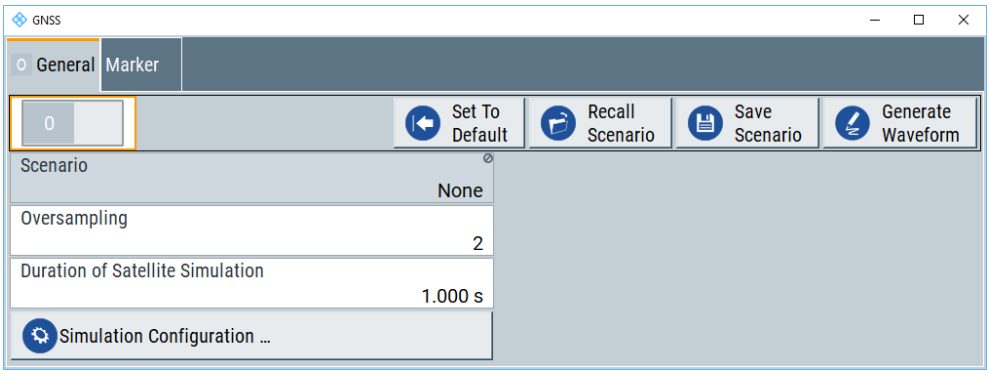
The R&S WinIQSIM2 generates a single GNSS signal that is suitable for testing the receiver capabilities to track the signal and to estimate its position based.

The receiver tests focus on testing if the receiver is capable to acquire and decode the GNSS signal; navigation and thus position estimation is not necessary. For such tests or for receivers' sensitivity tests in zero Doppler conditions or under varying signal dynamics conditions, the R&S WinIQSIM2 provides the tracking mode.

4.1 General Settings

Access:

► Select "Baseband > Satellite Navigation > GNSS".



This dialog comprises the standard general settings.
The remote commands required to define these settings are described in Chapter 7.2, "General Settings", on page 61.

Settings:

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

Remote command:
`[:SOURce<hw>]:BB:GNSS:STATe` on page 62

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

Parameter	Value
"State"	Not affected by "Set to default"
"Scenario"	"None"
"Simulation Configuration"	L1/GPS C/A only
"Oversampling"	"2"
"Duration of Satellite Simulation"	"1.000 s"
"GNSS System"	"GPS"
"Band"	"L1"
"Signal"	"C/A"

Remote command:
`[:SOURce<hw>]:BB:GNSS:PRESet` on page 62

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

The filename and the directory, in which the settings are stored, are user-definable; the file extension is however predefined.

To ensure repeatable test situation, the save/recall file contains all settings and includes all files used in the simulation, like for example waypoints files or vehicle description files.

When a save/recall file is loaded, the instrument checks the installed options and the used system configuration. If there is a mismatch, the file is loaded, settings adapted as far as possible and a warning message is displayed to indicate this situation.

Remote command:
`[:SOURce<hw>]:BB:GNSS:SETTing:CATalog?` on page 67
`[:SOURce<hw>]:BB:GNSS:SETTing:STORe` on page 67
`[:SOURce<hw>]:BB:GNSS:SETTing:LOAD` on page 68
`[:SOURce<hw>]:BB:GNSS:SETTing:DELete` on page 68

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

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

See also:
- Chapter 6.1, "To Generate a Single Satellite GNSS Waveform", on page 57
- Chapter 6.2, "To Play a GNSS Waveform with Rohde & Schwarz Signal Generator", on page 58

Remote command:
`[:SOURce<hw>]:BB:GNSS:WAVeform:CREate` on page 69

Scenario
Indicates one of the following:
- None: preset (default) configuration, see Set to Default.
- Filename: if saved settings configuration is loaded, see Save/Recall Scenario.
- "User-defined" indicates that at least one parameter is changed after a configuration or predefined scenario is loaded.

Remote command:
`[:SOURce<hw>]:BB:GPS:ATSCenario` on page 65
(etc. for the other GNSS systems)

Oversampling
Determines the upsampling factor.

A higher upsampling factor improves the filtering but increases the waveform size proportionally and hence limits the maximum Duration Of Satellite Simulation.

The sampling rate is increased/decreased automatically, depending on the modulation, i.e. the GNSS system and signal.

Remote command:
`[:SOURce<hw>]:BB:GNSS:OSAMpling` on page 66

Duration Of Satellite Simulation
Determines the duration of the satellite simulation.

The resulting duration of the simulation is calculated as follows:

$$Duration\ of\ Simulation = \frac{Duration\ of\ Satellite\ Simulation}{1 + \frac{Doppler\ Shift}{F_{Carrier}}}$$

$F_{Carrier}$ is the frequency selected with the parameter L# Band.

The maximum duration of satellite simulation depends on the Oversampling and the ARB memory size of the connected instrument.

Remote command:
`[:SOURce<hw>]:BB:GNSS:DURation` on page 67

Simulation Configuration
Access the "Simulation Configuration" dialog for defining the active navigation system, used bands and configure the satellites.

A summary of the current configuration is displayed.

See:
- Chapter 4.3.1, "Systems and Signals Settings", on page 22
- Chapter 4.2.1, "Time Configuration Settings", on page 18
- Chapter 4.3.2, "Satellites Settings", on page 24

4.2 Simulation Time

The default system time in this simulation is given in the UTC (Universal Time Coordinates) time base. The simulation start time is thus defined as date and time and is set to 19.02.2014 at 06:00:00 am.

Simulation start time

You can change the simulation start time as you can change the time basis at any time. The time is then automatically recalculated and displayed in the selected time format.

The satellite constellation can comprise SVs from different navigation systems. You can observe the current simulation time converted into the time basis of each of the enabled GNSS systems at a glance.

Time conversion parameters and leap second

Time conversion parameters are zero and first order system clock drift parameters and the current leap second.

The leap second describes the difference between the GPS, Galileo, GLONASS or BeiDou system time and UTC system time. The simulation requires only the date and sign of the next leap second, further calculations are performed automatically.

Simulating time conversion errors

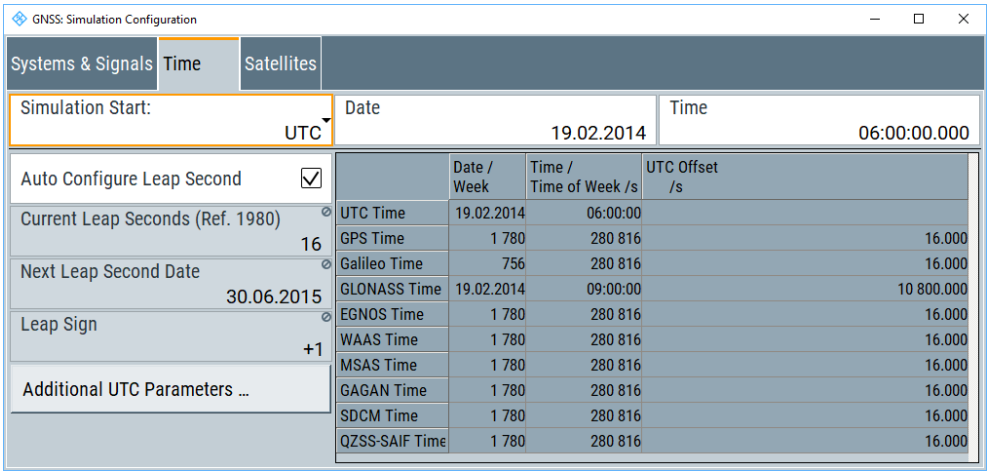
Per default, the time conversion between the time basis excludes conversion errors and drifts between the time basis of the GNSS systems. We recommend that you use the default configuration, without system time offset or time drift.

If you aim to simulate deliberate errors and change the time conversion settings, see:
- "Additional UTC Parameters" on page 21
- Chapter 4.5.5, "Time Conversion Errors Settings", on page 47

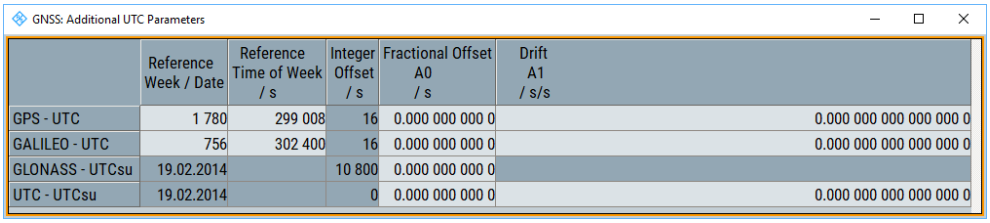
4.2.1 Time Configuration Settings

Access:

1. Select "GNSS > Simulation Configuration > Time".



2. Select "Additional UTC Parameters".



These dialogs contain 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 timebase to another.

Settings:

Simulation Start
Sets the simulation start data and time in the selected format.

"Format" Per default, the UTC format used. If different format is selected, the time is automatically recalculated.

Note: Use the Additional UTC Parameters dialog to configure the parameters, necessary for time conversion between the proprietary time of the navigation standard and the UTC.

Remote command:
`[:SOURce<hw>]:BB:GNSS:TIME:STARt:TBASis` on page 75

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

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.

Remote command:

`[:SOURce<hw>]:BB:GNSS:TIME:STARt:DATE` on page 74

`[:SOURce<hw>]:BB:GNSS:TIME:STARt:TIME` on page 75

"Week Number, Time of Week (TOW)"

The satellite clocks in the GPS and Galileo navigation systems are not synchronized to the UTC. They use a proprietary time, the GPS and the Galileo system time. The format used for these systems is week number (WN) and time of week (TOW), that is the simulation start time within this 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 time point (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

Remote command:

`[:SOURce<hw>]:BB:GNSS:TIME:STARt:WNUMber` on page 76

`[:SOURce<hw>]:BB:GNSS:TIME:STARt:TOWeek` on page 75

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.

Auto Configure Leap Seconds ← Leap Second Configuration

Sets the leap second value according to the simulation time.

Remote command:

`[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:LEAP:AUTO` on page 76

Current Leap Seconds (Ref. 1980) ← Leap Second Configuration

Displays the currently used leap second.

Remote command:

`[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:LEAP:SECond`s on page 76

Date/WN, Tome/TOW, UTC Offset

Displays overview information on the parameters used for the time conversion between the different navigation standards.

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.

For in-depth configuration, use the "Additional UTC Parameters" on page 21 dialog.

Remote command:
[:SOURce<hw>]:BB:GNSS:TIME:STARt:UTC:DATE? on page 76
[:SOURce<hw>]:BB:GNSS:TIME:STARt:UTC:TIME? on page 77
[:SOURce<hw>]:BB:GNSS:TIME:STARt:UTC:OFFSet? on page 78
[:SOURce<hw>]:BB:GNSS:TIME:STARt:GPS:WNUMber? on page 77
[:SOURce<hw>]:BB:GNSS:TIME:STARt:GPS:TOWeek? on page 78
[:SOURce<hw>]:BB:GNSS:TIME:STARt:GPS:OFFSet? on page 78
(etc. for the other GNSS systems)

Additional UTC Parameters
Sets the time conversion parameters required for switching from one timebase to another, for example GPS to UTC. The time conversion is performed according to the following equation:

$t_{UTC} = (t_E - delta\_t_{UTC})$ *modulo 86400*, where:
- $delta\_t_{UTC} = delta\_t_{LS}+A_0+A_1 (t_E-T_{ot}+604800(WN-WN_{ot}))$
- $t_E = t_{GPS}$ or $t_{Galileo}$

Reference Week/Date, Reference Time of Week ← Additional UTC Parameters
Sets the reference data and time per navigation standard.

Remote command:
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GPS:UTC:WNOT on page 78
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GPS:UTC:TOT on page 79
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GPS:UTC:TOT:UNSCaled on page 79
(etc. for the other GNSS systems)

UTC-UTC(SU) ← Additional UTC Parameters
For Glonass satellites, indicates the UTC-UTC (SU) time conversion reference date.

Remote command:
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:UTCSu:UTC:DATE? on page 79

Integer Offset ← Additional UTC Parameters
Indicates the integer offset.

Remote command:
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GPS:UTC:IOFFset? on page 80
(etc. for the other GNSS systems)

Fractional Offset A0, Drift A1 ← Additional UTC Parameters
Sets the time parameters constant term of polynomial, A_0 and 1st order term of polynomial, A_1.

Remote command:
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GPS:UTC:AZERo on page 80
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GPS:UTC:AZERo:UNSCaled on page 80
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GPS:UTC:AONE on page 81

[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GPS:UTC:AONE:UNSCaled
on page 81
(etc. for the other GNSS systems)

4.3 Satellite's Constellation

Single-satellite GNSS signal

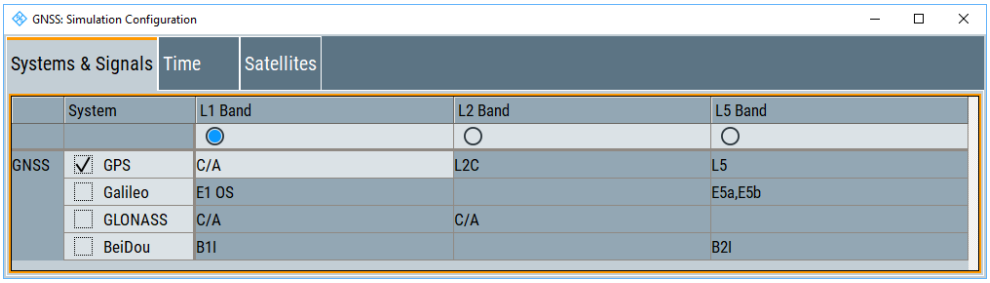
R&S WinIQSIM2 calculates a single satellite GNSS signal, where static satellites with constant Doppler shifts are provided for simple receiver tests, like receiver sensitivity, acquisition, tracking and production tests. Selection and configuration of any localization data, such as receiver location for instance, is not enabled.

A generic workflow is described in Chapter 6, "Generating and Playing GNSS Waveforms", on page 57.

4.3.1 Systems and Signals Settings

Access:

► Select "GNSS > Simulation Configuration > Systems & Signals"



In this dialog, you select which global, regional and augmentation GNSS systems are simulated, which signals they transmit and the frequency band they use.

Settings:

Systems
Defines the navigation standards that are part of the GNSS system configuration, see Chapter 4.3.2, "Satellites Settings", on page 24.

The available global, regional and augmentation GNSS systems depend on the installed options.

Note: At least one GNSS system is always enabled. If switching off the only enabled system, a warning message is displayed to indicate the situation.

Remote command:
`[:SOURce<hw>]:BB:GNSS:SYSTem:GPS[:STATe]` on page 71
(etc. for the other GNSS systems)

L# Band
Defines the used frequency band "L1/2/5 Band". The satellite signals are modulated on the respective standard carrier frequencies, defined for the corresponding frequency band.

Table 4-1: Carrier frequencies

System	RF band	Carrier frequency, GHz	Required option
GPS	L1 L2 L5	1.57542 1.2276 1.17645	R&S Sxx-K244 R&S Sxx-K298 R&S Sxx-K298
GALILEO	E1 E5 (E5a) E5 (E5b)	1.57542 1.17645 1.20714	R&S Sxx-K266 R&S Sxx-K266 R&S Sxx-K266
GLONASS	L1 L2	1.602 1.246	R&S Sxx-K294 R&S Sxx-K294
BeiDou	L1 L5	1.561098 1.20714	R&S Sxx-K407 R&S Sxx-K407

Note: One frequency band is always enabled. If switching off the only enabled frequency band, a warning message is displayed to indicate the situation.

Remote command:
`[:SOURce<hw>]:BB:GNSS:L1Band[:STATe]` on page 71
`[:SOURce<hw>]:BB:GNSS:L2Band[:STATe]` on page 71
`[:SOURce<hw>]:BB:GNSS:L5Band[:STATe]` on page 71

Signals
Enables the signals per system.

The enabled signals are activated automatically for each SV belonging to the GNSS system. To redefine the signals used by a particular satellite (SV), select "Simulation Configuration > Satellites > GNSS System > SV ID# > SV Config > Signal" > Signal State.

Note: At least one signal is always enabled for active frequency bands and GNSS systems . If switching off the only enabled signal, a warning message is displayed to indicate the situation.

"None" All signals of a GNSS system are disabled assuming, that the GNSS system itself is disabled. All parameters of the GNSS system are disabled, too.
"Signals = None" implies Systems > "State = Off".

"C/A, E1 OS, B1I, L2C, B2I, L5, E5a, E5b"

Table 4-2: Overview of the supported signals

Band	System	Signal	Minimum required option
L1	GPS	C/A	R&S Sxx-K244
	Galileo	E1 OS	R&S Sxx-K266
	GLONASS	C/A	R&S Sxx-K294
	BeiDou	B1I	R&S Sxx-K407
L2	GPS	C/A L2C	R&S Sxx-K244 R&S Sxx-K298
	GLONASS	C/A	R&S Sxx-K294
L5	GPS	L5	R&S Sxx-K298
	Galileo	E5a, E5b	R&S Sxx-K266
	BeiDou	B2I	R&S Sxx-K407

Remote command:
`[:SOURce<hw>]:BB:GNSS:SYSTem:GPS:SIGNal:L1Band:CA[:STATe]`
on page 72
(etc. for the other GNSS systems)

4.3.2 Satellites Settings

Access:

1. Select "GNSS > Simulation Configuration" > **"Satellites"**.

   In the "Satellite" dialog, you configure the satellites (SV ID) constellation for each enabled GNSS system.

2. In the "Satellites" dialog, select the GNSS system for that you want to configure satellites constellation.

3. To configure individual settings per SV, like power offset, used signals and the content of the navigation message each satellites transmitts, select "SV# > SV Config". For description, see Chapter 4.4, "Space Vehicle Configuration", on page 26.

   In the "Satellite" dialog, you configure the satellite constellation.

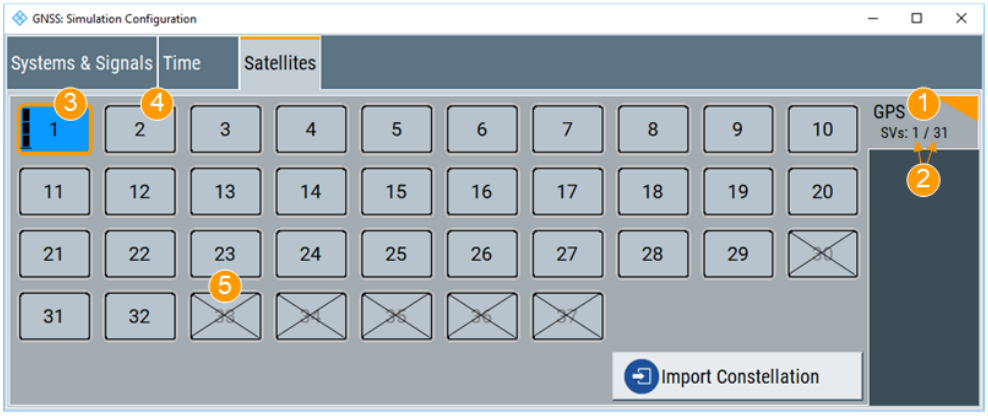


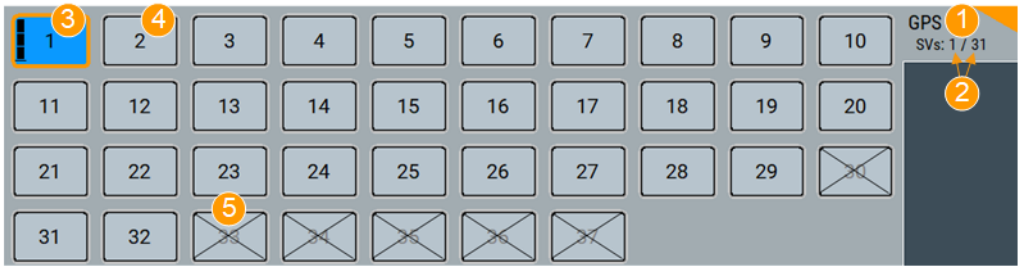
Figure 4-1: Satellites constellation: Understanding the displayed information

1 = Enabled GNSS system
2 = Number of active and available SVs of the GNSS system
3 = Visible and active SV, full power level
4 = Not visible and inactive SV
5 = Excluded from the constellation (Present in Constellation = "Off")

The dialog consists of several tabs, one per activated GNSS Systems ("Systems&Signals > System > On").
An active and visible satellite is indicated with blue color.

Settings:

Satellite's Constellation, SV ID
Indicates the SV IDs included in the current constellation.

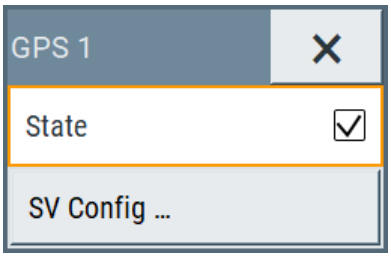


1 = Enabled GNSS system
2 = Number of active and available SVs of the GNSS system
3 = Visible and active SV, full power level
4 = Not visible and inactive SV
5 = Excluded from the constellation (Present in Constellation = "Off")

The information is color-coded. Icons provide further information:
- Blue: active SV ID
- Gray: Inactive SV ID

- Cross out: SV ID is excluded from the constellation, for example if "SV ID > SV Config" > Present in Constellation > "Off"
- Power bar: Reduced height indicates that the signal of the SV ID is transmitted with less power than the value indicated as "Configurable Nav. Message".
  The height of the power bar reflects enabled "Power Offset", "Power Path-Loss" and "Power Offset" of the echoes.

The blocks are interactive. Select an SV ID to access further settings for changing its state, enabling power offset of configuring the orbit simulation and navigation message parameters.



Remote command:
`[:SOURce<hw>]:BB:GNSS:SVID:GPS:LIST?` on page 85
`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:HEALthy` on page 85
`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:VISibility:STATe?` on page 86
(etc. for the other GNSS systems)

State (SV ID) ← Satellite's Constellation, SV ID
Changes the SV ID state on-the-fly.

Per default, only visible satellites can be included in the constellation. SV ID for that Present in Constellation > "Off" cannot be activated.

Remote command:
`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:STATe` on page 92
(etc. for the other GNSS systems)

SV Config ← Satellite's Constellation, SV ID
Access a dialog with further settings for configuring the orbit simulation and navigation message parameters.

See:
- Chapter 4.4, "Space Vehicle Configuration", on page 26
- Chapter 4.5, "Perturbations and Errors Simulation", on page 33

Import Constellation
Opens the "Import Constellation" dialog.

4.4 Space Vehicle Configuration

In this section, configure individual settings and modulation control settings for signals and navigation message of a single-satellite system.

Access:

1. Select "GNSS > Simulation Configuration > Satellites".
2. Select "SV# > SV Config".

   The "SV Configuration" dialog of the selected satellite opens.

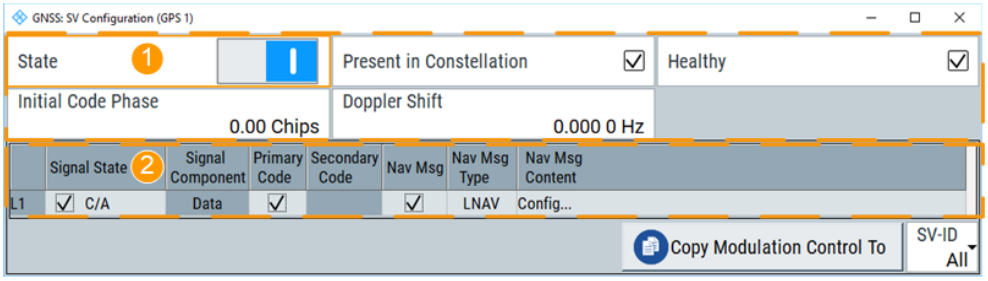


Figure 4-2: SV configuration settings

1 = Individual satellite settings
2 = Modulation control settings

Settings

4.4.1 Individual Satellite Settings

Comprises the settings of the selected satellite.

Settings

State (SV ID)
Changes the SV ID state on-the-fly.

Per default, only visible satellites can be included in the constellation. SV ID for that Present in Constellation > "Off" cannot be activated.

Remote command:
`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:STATe` on page 92
(etc. for the other GNSS systems)

Present in Constellation
If disabled, the SV ID is excluded from the currents constellation. The SV ID is automatically deactivated ("SV ID > State = Off").

In the "Satellites" dialog, SV IDs that are excluded from the constellation are displayed in gray color and are crossed out.

To reactivate such satellite, set "Present in Constellation > On" and activate it ("State > On")

Remote command:
`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:PRESent` on page 92
(etc. for the other GNSS systems)

Healthy
Defines if the SV ID is healthy or not. A warning symbol indicates an unhealthy satellite.

The healthy state reflects the value of the corresponding healthy flag in the navigation message. The healthy flag and the healthy state are interdependent; changing one of them changes the other.

See:
- GPS > Additional Data > "SV Health" and "L1/L2/L5 Health"
- GLONASS > Additional Data > "SV Health"
- Galileo > Additional Data > "$E1B_{DVS}$/$E5b_{DVS}$/$E1B_{HS}$/$E5b_{HS}$"
- BeiDou > Additional Data > "SV Health"

Remote command:
`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:HEALthy` on page 85
(etc. for the other GNSS systems)

Initial Code Phase
Sets the initial code phase. In R&S WinIQSIM2, the actual simulated resolution for initial code phase depends on the sample rate.

To increase the sample rate, use the Oversampling function.

Remote command:
`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:ICPHase` on page 94
(etc. for the other GNSS systems)

Doppler Shift
Sets the Doppler shift for a constant signal profile of the simulated signal of the satellite. The simulation of Doppler shifted signals can be used to check the receiver characteristics under more realistic conditions than with zero Doppler.

Remote command:
`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:DSHift` on page 93
(etc. for the other GNSS systems)

Frequency Number
For GLONASS satellites, indicates the frequency number of the subcarrier used to modulate the GLONASS satellite.

If "Nav Msg Type = NAV", the frequency number is retrieved from the imported configuration file.

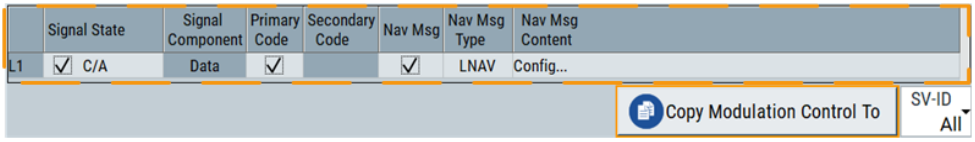
The value is configurable, if arbitrary data is used, e.g. "Nav Msg Content > Config" and "Nav Msg Type > All 0".

Remote command:
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:FNUMber on page 92

4.4.2 Modulation Control Settings

Access:

1. Select "GNSS > Simulation Configuration > Signals&Systems".
2. Enable the GNSS system for that you want to control the signal modulation, for example:
   "System > GLONASS > On"
3. Select "GNSS > Simulation Configuration > Satellites".
4. Select "GLONASS > SV# > SV Config".
5. To generate a **continuous wave** signal, sent on the GLONASS frequency, select:
   a) "Primary Code > Off"
   b) "Nav Msg > Off"
   c) "Meander Sequence > Off"
   d) "Time Sequence > Off"
6. To apply the modulation control settings of the current satellite to other SV ID, select for example "SV-ID = All" and "Copy Modulation Control To"



Available modulation control settings depend on the GNSS system and selected RF band.
The remote commands required to define these settings are described in Chapter 7.6, "Signals per Satellite", on page 88.

Settings:

SV signal configuration table
Table with one or more rows, one row per enabled signal ("Simulation Configuration > Systems&Signals" > Signals).

Signal State ← SV signal configuration table
Activates the selected signal.

The available signals depend on GNSS system and the configuration in the Systems&Signals dialog.

At least one signal has to be activated per satellite. Activate another signal to deactivate a particular signal, if it is the only one active at that moment.

Remote command:
`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L1Band:CA[:STATe]`
on page 93
(etc. for the other GNSS systems)

Signal Component ← SV signal configuration table
Indicates the signal content (data only or data and pilot).

The information is retrieved automatically from the selected simulation data source file. Signal components depend on the signal, the frequency band and the GNSS system.

Remote command:
n.a.

Primary Code ← SV signal configuration table
Defines if the primary code is used to spread the data and pilot components.

If your interference tests require the generation of a continuous wave signal send on the same frequency as a specific SV, set "Primary Code > Off" and "Nav Msg Control > Off".

Remote command:
`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L1Band:CA:DATA:PCODe[:STATe]` on page 96
`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L1Band:CA:PILot:PCODe[:STATe]` on page 96
(etc. for the other GNSS systems)

Secondary Code ← SV signal configuration table
Enables the secondary code in the pilot and data channel of GPS, Galileo or in the D1 navigation message for BeiDou.

Remote command:
`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L5Band:L5S:DATA:SCODe[:STATe]` on page 96
`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L5Band:L5S:PILot:SCODe[:STATe]` on page 96
(etc. for the other GNSS systems)

Nav Msg ← SV signal configuration table
Defines whether the navigation message parameters can be changed or not.

"On" Enables configuration of the navigation message parameters.

"Off" Navigation message is disabled.

Remote command:
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L1Band:CA:DATA:NMESsage[:STATe] on page 94
(etc. for the other GNSS systems)

Nav Msg Type, Pattern, Data List ← SV signal configuration table
Sets the data source used for the generation of the navigation message.

"LNAV/CNAV/FNAV/INAV/DNAV/NAV"
The navigation message parameters are "real" since they are retrieved from the loaded simulation data source file, see Import Constellation.

To change the automatically filled in values, select:
- Nav Msg Content > Config

"PRBSxx/Data List/Pattern"
Selects a configurable data source.
The data symbols from the data source are transmitted in the navigation message. The signal is sufficient for simple functional tests and sensitivity 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 section "Custom Digital Modulation > Data Source" in the R&S WinIQSIM2 user manual.

"Zero Navigation Data"
Sets the broadcasted orbit and clock correction parameters in the navigation message to zero. Frame structure, timing and channel coding of the navigation message are retained.

Remote command:
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L1Band:CA:DATA:NMESsage:TYPE on page 98
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L1Band:CA:DATA:NMESsage:DSELect on page 99

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L1Band:CA:DATA:NMESsage:PATTern on page 99
(etc. for the other GNSS systems)

Nav Msg Content, Config ← SV signal configuration table
Opens the "Navigation Message" dialog, where you can observe the navigation message parameter and if enabled, change them.

See Chapter 4.5, "Perturbations and Errors Simulation", on page 33.

Meander Sequence ← SV signal configuration table
Enables meandering, i.e. doubling the data rate of a GLONASS satellite navigation signal.

Remote command:
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:SIGNal:L1Band:CA:DATA:MEANdering[:STATe] on page 100
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:SIGNal:L2Band:CA:DATA:MEANdering[:STATe] on page 100

Time Sequence ← SV signal configuration table
Enables the time signal component of GLONASS signals.

Remote command:
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:SIGNal:L1Band:CA:DATA:TSEQuence[:STATe] on page 100
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:SIGNal:L2Band:CA:DATA:TSEQuence[:STATe] on page 100

Copy Modulation Control Settings to,SV-ID
Applies the power settings of the current satellite to the selected or to all SV-IDs of the same GNSS system.

The following settings are considered:
- Signal State
- Primary Code
- Secondary Code
- Nav Msg
- Nav Msg Type, Pattern, Data List
- Meander Sequence
- Time Sequence

Remote command:
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:MCONtrol:COPY:SVID on page 100
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:MCONtrol:COPY:EXECute on page 101
(etc. for the other GNSS systems)

4.5 Perturbations and Errors Simulation

Real receivers experience also signal errors caused by satellite orbit and clock errors, that remain non-corrected despite the corrections in the broadcasted navigation message. To simulate even more challenging conditions, you can add deliberate signal errors by manipulating the navigation messages of the satellites.

Signal errors of any kind have a direct impact on the receiver's positioning accuracy.

4.5.1 About the Errors Sources

You can observe the effect of the following common error sources on the receiver's positioning accuracy:

- Atmospheric (ionospheric and tropospheric) errors

  See:

  – Chapter 4.5.1.1, "About the Atmospheric Effects", on page 33.
- Difference between the atmospheric condition at the ground station and the receiver, simulated as difference in the simulated ionospheric model and the broadcasted ionospheric parameters in the navigation message
  See "Errors are deviations between the simulated and broadcasted navigation message parameters" on page 36
- Satellite orbit and orbit perturbation errors (ephemeris errors)

  See:

  – Chapter 4.5.1.2, "About Orbit and Orbit Perturbation Parameters and Errors", on page 34.
  – Chapter 4.5.3, "Orbit and Orbit Perturbation Errors Settings", on page 38.
- Satellite clock and time conversion errors, like system time drifts due to difference in the time conversion sets

  See:

  – Chapter 4.5.1.3, "About Clock and Time Conversion Parameters and Errors", on page 35.
  – Chapter 4.5.5, "Time Conversion Errors Settings", on page 47.

4.5.1.1 About the Atmospheric Effects

When traveling thought the atmosphere, the satellite signal experiences changes in speed and direction. While the increased travel time due to signal refraction is insignificant, the variation in the signal propagation speed causes pseudorange measurement errors.

Tropospheric effects

The troposphere is the lower atmosphere layer that comprises rain, snow, clouds, etc. and affects the GNSS signals' propagation. GNSS signals experience a variable path delay, caused mainly by the dry atmosphere. The magnitude of this delay depends on the pressure, humidity, temperature and the location of the receiver and the satellite.

Ionospheric effects

The magnitude of ionospheric effects depends geographical location of the receiver, the hour of day and the solar activity.

Ionospheric effects are frequency-dependent and can be counteracted by frequency measurements. For single frequency receivers, the navigation message contains a set of parameters that describes an ionospheric prediction model with the goal to remove the ionospheric effect.

Tropospheric and ionospheric models

The simulation of atmospheric effects based on tropospheric and ionospheric models is not performed by R&S WinIQSIM2. Use a GNSS simulator for this purpose, e.g. the R&S SMW200A. However, R&S WinIQSIM2 offers configuration of ionospheric parameters within the navigation message.

Ionospheric model vs. ionospheric parameters in the navigation message

The ionospheric model defines the satellite to receiver channel, whereas the ionospheric navigation parameters define what the satellites are transmitting (broadcasting) as ionospheric correction parameters.

See also Chapter 4.5.2, "Ionospheric Errors Settings", on page 37.

4.5.1.2 About Orbit and Orbit Perturbation Parameters and Errors

The different GNSS systems use specific approach to describe the satellite's orbit and orbit perturbations.

In GPS, Galileo, BeiDou and QZSS systems, the orbit description is based on the first approximation of 16 Keplerian parameters. The navigation message of a GPS satellite thus carries the reference time of ephemeris t_{0e}, six orbit elements and three rate parameters describing the linear time-dependent changes [1].

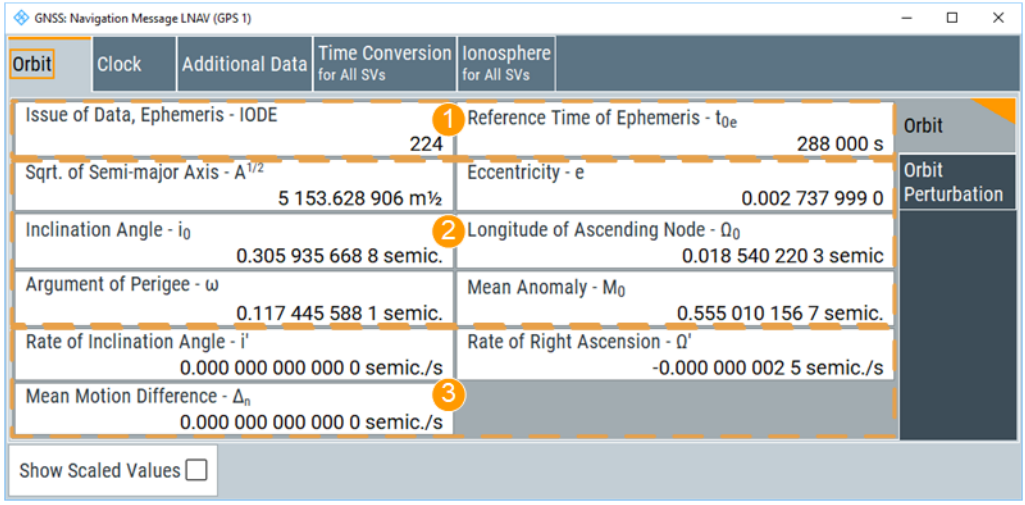


Figure 4-3: Satellite orbit (GPS): Understanding the displayed information

1 = Issue of data, IODE and reference time, t_{0e}
2 = Orbit elements
3 = Rate parameters

In GPS, Galileo, BeiDou and QZSS, the perturbations are seen as variations of the orbital elements. In the navigation message, they are described by three pairs of sinusoidal (cosine and sine) corrections C_C and C_S. Each pair describes the difference in latitude C_U, orbital radius C_r and inclination C_i.

GLONASS satellites broadcast their PZ coordinates and velocity at reference epoch time t_b as well as the moon and sun acceleration components [1].

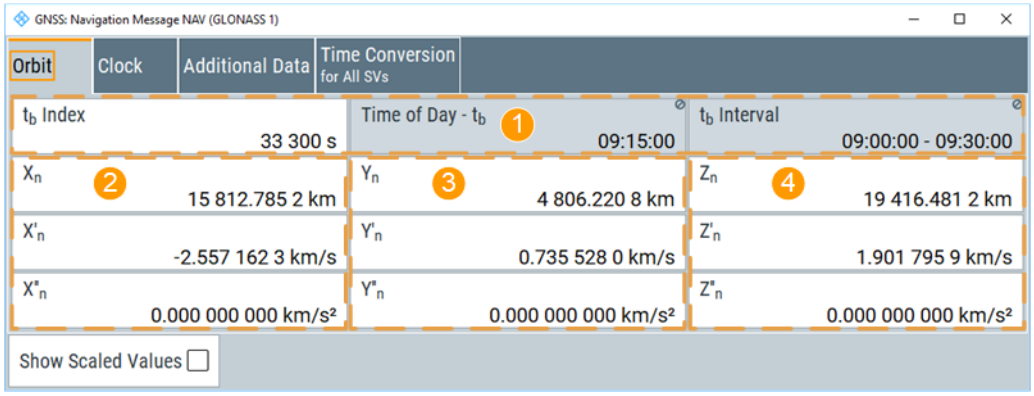


Figure 4-4: Satellite orbit (GLONASS): Understanding the displayed information

1 = Reference epoch, t_b; orbit parameters are given at t_b
2 = Coordinates in PZ-90
3 = Velocity component
4 = Moon and sun acceleration

4.5.1.3 About Clock and Time Conversion Parameters and Errors

Clock and time conversion errors

Satellites and receivers can suffer from timing errors. Although satellites are equipped with atomic clocks, there is always a clock offset due to:

- Clock drift between the different SVs.
- Misalignment in the time bases of the different GNSS systems.

The clock in the receiver is usually less precise and is hence a prone to an additional drift.

To counteract the drifts in the satellites and GNSS systems time, the navigation message contains satellite clock offset and time conversion parameters, see "Satellite clock parameters" on page 36.

The receiver clock synchronization errors are estimated and compensated during the positioning measurements, because the receiver clock offset is a constant value present in the measurements of all satellites.

Satellite clock parameters

Satellite clock offset $\Delta Clock_{SV}$ is described by a second order polynomial given as follows:

$\Delta Clock_{SV} = a_{f0} + a_{f1}(t - t_{0c}) + a_{f2}(t - t_{0c})^2$, where:

- t_{0c} is the reference time of clock
- a_{f0}, a_{f1} and a_{f2} are three coefficients that are broadcasted in the navigation message.

Polynomial coefficients

In GPS, Galileo, BeiDou and QZSS, polynomial coefficients are:

- a_{f0}: SV clock offset
- a_{f1}: SV clock drift
- a_{f2}: SV clock drift rate

GLONASS considers the first order version of the polynomial (i.e. $a_{f2} = 0$) and transmits only two clock parameters:

- T_n: SV clock offset, where:
  $a_{f0} = -T_n$
- Γ_n: SV relative frequency offset
  $a_{f1} = \Gamma_n$

4.5.1.4 Simulating Errors

Per default, the broadcasted navigation message parameters per SV are set automatically to match the simulated orbit, clock and pseudorange parameters. For example, the clock parameters in the navigation message of GPS SV ID #1 resemble the simulated clock values for this satellite.

Errors are deviations between the simulated and broadcasted navigation message parameters

Changing the default navigation message values leads to deviation between the simulated and the broadcasted navigation information and thus deliberated errors. To simulate clock errors, change for example, the parameter a_{f0} in the broadcasted navigation message of SV#1 but maintain the a_{f0} value of the simulated clock.

You can also simulate unusual stations, like, for example, the wrongly broadcasted clock bias between UTC and GPS system clocks. Such situations are simulated by configuring different time conversion sets for the UTC-GPS conversion parameters in the broadcasted navigation message and in the simulated UTC time parameters.

4.5.2 Ionospheric Errors Settings

Access:

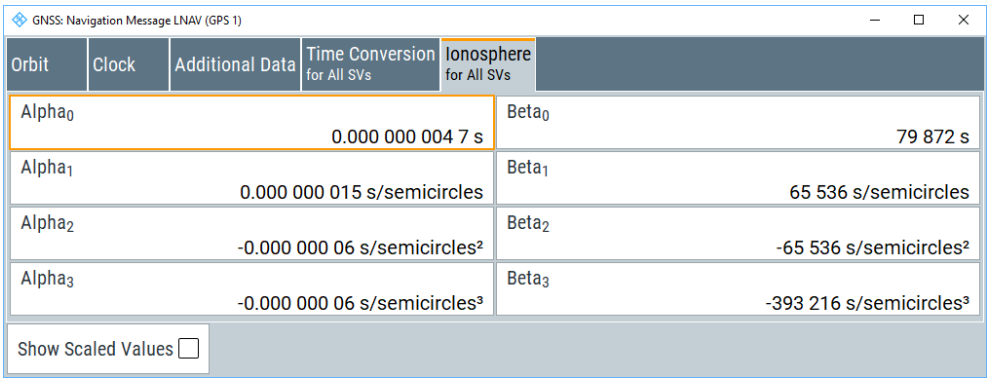
1. Select "GNSS > Simulation Configuration > Satellites".

   In the "Satellites" dialog, the single satellite constellation of the GNSS system is displayed.

2. To configure the ionospheric navigation parameters that define what the satellites are transmitting as **ionospheric correction parameters**, set the ionospheric parameters on the navigation message of the particular GNSS system:

   a) Select "SV# > SV Config > Signals Configuration".
   Ionospheric parameters are common for all SV of one GNSS system. To change them, apply the same configuration to all SVs.
   b) Select "SV# > SV Config" > **"Copy Modulation Control to SVI-ID = All"**.
   c) Select **"Nav Msg Content > Config > Ionosphere"**.

   Per default, the navigation message parameters are set to values corresponding to the values retrieved from the single constellation data source.



   Changing these values leads to deviation between the simulated and the broadcasted navigation message and thus deliberated errors.

   Available navigation message parameters depend on the GNSS system and selected navigation message type.
   - The ionospheric model for GLONASS is not yet specified; its satellites transmit no data on the atmosphere.
   - GPS, Galileo and BeiDou assume specific ionospheric models. These systems transmit different atmospheric navigation parameters.

Settings:

GPS > Ionosphere
Comprises the parameters of the GPS satellites.

Table 4-3: LNAV and CNAV

Parameter	Remote command:
"Alpha$_0$" to "Alpha$_3$"	`[:SOURce<hw>]:BB:GNSS:ATMospheric:GPS[:NMESsage:LNAV]:IONospheric:ALPHa<ch0>` on page 148
"Beta$_0$" to "Beta$_3$"	`[:SOURce<hw>]:BB:GNSS:ATMospheric:GPS[:NMESsage:LNAV]:IONospheric:BETA<ch0>` on page 148

Galileo > Ionosphere
Comprises the parameters of the Galileo satellites.

Table 4-4: INAV and FNAV

Parameter	Remote command:
"a_{i0}" to "a_{i2}"	`[:SOURce<hw>]:BB:GNSS:ATMospheric:GALileo[:NMESsage:INAV]:IONospheric:AI<ch0>` on page 148
"SF_1" to "SF_5"	`[:SOURce<hw>]:BB:GNSS:ATMospheric:GALileo[:NMESsage:INAV]:IONospheric:SF<ch>` on page 149

BeiDou > Ionosphere
Comprises the parameters of the BeiDou satellites.

Parameter	Remote command:
"Alpha$_0$ - Alpha$_3$"	`[:SOURce<hw>]:BB:GNSS:ATMospheric:BEIDou[:NMESsage:DNAV]:IONospheric:ALPHa<ch0>` on page 147
"Beta$_0$ - Beta$_3$"	`[:SOURce<hw>]:BB:GNSS:ATMospheric:BEIDou[:NMESsage:DNAV]:IONospheric:BETA<ch0>` on page 148

Show Scaled Values
Switches between scaled and unscaled values representation.

Navigation message values are recalculated automatically.

Remote command:
`[:SOURce<hw>]:BB:GNSS:SSValues` on page 114

4.5.3 Orbit and Orbit Perturbation Errors Settings

Access:

1. Select "Simulation Configuration > Satellites".
2. Select the GNSS system for that you want simulate system errors, for example GPS.
3. Select "SV# > SV Config > Signals Configuration".
4. Select real navigation data as data source.
   For example, for a GPS SV ID, select **"Nav Msg Type > LNAV"**.

5. Select **"Nav Msg Content > Config > Orbit"**.

   Per default, the navigation message parameters are set to values corresponding to the values retrieved from the constellation data source.

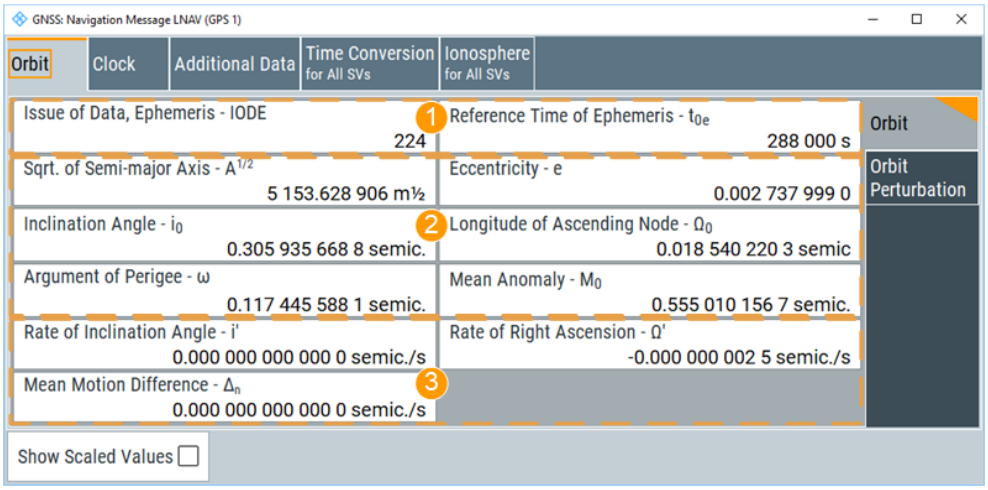


Figure 4-5: Satellite orbit: Understanding the displayed information

1 = Issue of data, IODE and reference time, t_{0e}
2 = Orbit elements
3 = Rate parameters

Changing these values leads to deviation between the simulated and the broadcasted navigation message and thus deliberated errors. The generated signal can be used for testing the receiver's ability to cope with errors.
Available navigation message parameters depend GNSS system and selected navigation message type, see Chapter 4.5.1.2, "About Orbit and Orbit Perturbation Parameters and Errors", on page 34.

Settings:

GPS > Orbit
Comprises the orbit parameters of the GPS satellites.

Table 4-5: LNAV and CNAV

Parameter	Remote command:
"Reference Time of Ephemeris - t_{0e}"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:TOE on page 115
"Square Root of Semi-Major Axis - $A^{1/2}$"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:SQRA on page 116
"Eccentricity - e"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:ECCentricity on page 116
"Inclination Angle - i_0"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:IZERo on page 117
"Longitude of Ascending Node - Ω_0"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:OZERo on page 118
"Argument of Perigee - ω"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:OMEGa on page 118
"Mean Anomaly - M_0"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:MZERo on page 119
"Rate of Inclination Angle - i'"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:IDOT on page 119
"Rate of Right Ascension - Ω'"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:ODOT on page 120

Table 4-6: LNAV

Parameter	Remote command:
"Issue of Data, Ephemeris - IODE"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:IODE on page 115
"Mean Motion Difference - Δ_n"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:NDELta on page 121

Table 4-7: CNAV

Parameter	Remote command:
"Rate of Right Ascension Diff. - ΔΩ'"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:DODot on page 120
"Mean Motion Difference - Δ_{n0}"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:NDELta on page 121
"Rate of Mean Motion Diff. - Δ_{n0}'"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:DNDot on page 121
"Change Rate in Semi-major Axis - A'"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:ADOT on page 121
"Semi-Major Axis Difference - ΔA"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:ADELta on page 122

GPS > Orbit Perturbation

Comprises the parameters of the GPS satellites.

Table 4-8: LNAV and CNAV

Parameter	Remote command:
"Cosine Difference of Latitude - C_{uc}"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:CUC on page 124
"Sine Difference of Latitude - C_{us}"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:CUS on page 125
"Cosine Difference of Orbital Radius - C_{rc}"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:CRC on page 126
"Sine Difference of Orbital Radius - C_{rs}"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:CRS on page 126
"Cosine Difference of Inclination - C_{ic}"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:CIC on page 127
"Sine Difference of Inclination - C_{is}"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:CIS on page 127

Galileo > Orbit

Comprises the parameters of the Galileo satellites.

Table 4-9: INAV and FNAV

Parameter	Remote command:
"IODnav"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:IODNav on page 114
"Reference Time of Ephemeris - t_{0e}"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:TOE on page 115
"Square Root of Semi-Major Axis - $A^{1/2}$"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:SQRA on page 116
"Eccentricity - e"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:ECCentricity on page 116
"Inclination Angle - i_0"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:IZERo on page 117
"Longitude of Ascending Node - Ω_0"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:OZERo on page 117
"Argument of Perigee - ω"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:OMEGa on page 118
"Mean Anomaly - M_0"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:MZERo on page 118
"Rate of Inclination Angle - i'"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:IDOT on page 119
"Rate of Right Ascension - Ω'"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:ODOT on page 120
"Mean Motion Difference - Δ_n"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:NDELta on page 120

Galileo > Orbit Perturbation

Comprises the parameters of the Galileo satellites.

Table 4-10: INAV and FNAV

Parameter	Remote command:
"Cosine Difference of Latitude - C_{uc}"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:CUC on page 124
"Sine Difference of Latitude - C_{us}"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:CUS on page 125
"Cosine Difference of Orbital Radius - C_{rc}"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:CRC on page 125
"Sine Difference of Orbital Radius - C_{rs}"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:CRS on page 126
"Cosine Difference of Inclination - C_{ic}"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:CIC on page 126
"Sine Difference of Inclination - C_{is}"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:CIS on page 127

GLONASS > Orbit

Comprises the parameters of the GLONASS satellites.

See also Chapter 4.5.1.2, "About Orbit and Orbit Perturbation Parameters and Errors", on page 34.

Parameter	Remote command:
"t_b Index"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:TINDex on page 122
"Time of Day - t_b / t_b Interval"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:TOE? on page 122 [:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:TINTerval? on page 122
"X_n"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:XN on page 123
"Y_n"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:YN on page 123
"Z_n"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:ZN on page 123
"X'_n"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:XDN on page 123
"Y'_n"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:YDN on page 123
"Z'_n"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:ZDN on page 123
"X''_n"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:XDDN on page 124

Parameter	Remote command:
"Y'_n"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:YDDN on page 124
"Z'_n"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:ZDDN on page 124

BeiDou > Orbit

Comprises the parameters of the BeiDou satellites.

Parameter	Remote command:
"AODE"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:IODE on page 115
"Reference Time of Ephemeris - t_{0e}"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:TOE on page 115
"Square Root of Semi-Major Axis - $A^{1/2}$"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:SQRA on page 116
"Eccentricity - e"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:ECCentricity on page 116
"Inclination Angle - i_0"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:IZERo on page 117
"Longitude of Ascending Node - Ω_0"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:OZERo on page 117
"Argument of Perigee - ω"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:OMEGa on page 118
"Mean Anomaly - M_0"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:MZERo on page 119
"Rate of Inclination Angle - i'"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:IDOT on page 119
"Rate of Right Ascension - Ω'"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:ODOT on page 120
"Mean Motion Difference - Δ_n"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:NDELta on page 121

BeiDou > Orbit Perturbation

Comprises the parameters of the BeiDou satellites.

Parameter	Remote command:
"Cosine Difference of Latitude - C_{uc}"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:CUC on page 124
"Sine Difference of Latitude - C_{us}"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:CUS on page 125
"Cosine Difference of Orbital Radius - C_{rc}"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:CRC on page 125

Parameter	Remote command:
"Sine Difference of Orbital Radius - C_{rs}"	`[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:CRS` on page 126
"Cosine Difference of Inclination - C_{ic}"	`[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:CIC` on page 127
"Sine Difference of Inclination - C_{is}"	`[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:CIS` on page 127

Show Scaled Values
Switches between scaled and unscaled values representation.

Navigation message values are recalculated automatically.

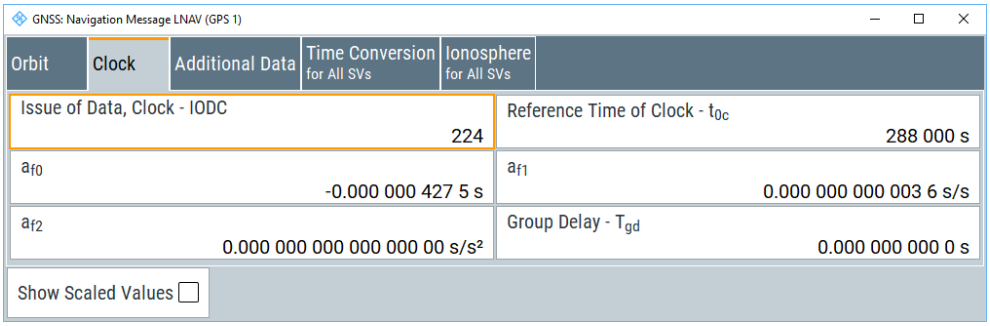
Remote command:
`[:SOURce<hw>]:BB:GNSS:SSValues` on page 114

4.5.4 Clock Errors Settings

Access:

1. Select "Simulation Configuration > Satellites > GNSS system > SV# > SV Config > Signals Configuration".
2. Select **"Nav Msg Content > Config > Clock"**.

   Per default, the navigation message parameters are set to values corresponding to the values retrieved from the constellation data source.



   Changing these values leads to deviation between the simulated and the broadcasted navigation message and thus deliberated errors. The generated signal can be used for testing the receiver's ability to cope with errors.
   Available navigation message parameters depend GNSS system and selected navigation message type, see Chapter 4.5.1.3, "About Clock and Time Conversion Parameters and Errors", on page 35.

Settings:

GPS > Clock

Comprises the parameters of the GPS satellites.

Table 4-11: LNAV and CNAV

Parameter	Remote command:
"Reference Time of Clock - t_{0c}"	`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:CCORrection:TOC` on page 128
"a_{f0}" to "a_{f2}"	`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:CCORrection:AF<s2us0>` on page 129
"Group Delay - T_{gd}"	`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:CCORrection:TGD` on page 129

Table 4-12: LNAV

Parameter	Remote command:
"Issue of Data, Clock - IODC"	`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:IODC` on page 128

Table 4-13: CNAV

Parameter	Remote command:
"$ISC_{L1C/A}$"	`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:CCORection:ISC:L1CA` on page 130
"ISC_{L2C}"	`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:CCORection:ISC:L2C` on page 130
"ISC_{L5I5}"	`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:CCORection:ISC:L5I` on page 130
"ISC_{L5Q5}"	`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:CCORection:ISC:L5Q` on page 130

Galileo > Clock

Comprises the parameters of the Galileo satellites.

Table 4-14: INAV and FNAV

Parameter	Remote command:
[Time of Clock - t_{0c} (E1-E5A)]	`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:CCORrection:TOC` on page 128
"a_{f0} (E1-E5A)" to "a_{f2} (E1-E5A)"	`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:CCORrection:AF<s2us0>` on page 129
"Broadcast Group Delay - BGD (E1-E5A)"	`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:CCORrection:BGD` on page 130

GLONASS > Clock

Comprises the parameters of the GLONASS satellites.

Parameter	Remote command:
"Time of Day - t_b / t_b Interval"	`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:TOE?` on page 122 `[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:TINTerval?` on page 122
"T_n (~ -a_{f0})"	`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:CCORrection:TAUN` on page 130
"Γ_n (~a_{f1})"	`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:CCORrection:GAMN` on page 131
"ΔT_n (~T_{gd})"	`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:CCORrection:DTAU` on page 131

BeiDou > Clock

Comprises the parameters of the BeiDou satellites.

Parameter	Remote command:
"AODC"	`[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:IODC` on page 128
"ReferenceTime of Clock - t_{0c}"	`[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:CCORrection:TOC` on page 128
"a_{f0}" to "a_{f2}"	`[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:CCORrection:AF<s2us0>` on page 129
"Group Delay B1| - T_{GD1}", "Group Delay B2| - T_{GD2}"	`[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:CCORrection:TGD<s2us>` on page 129

Show Scaled Values

Switches between scaled and unscaled values representation.

Navigation message values are recalculated automatically.

Remote command:
`[:SOURce<hw>]:BB:GNSS:SSValues` on page 114

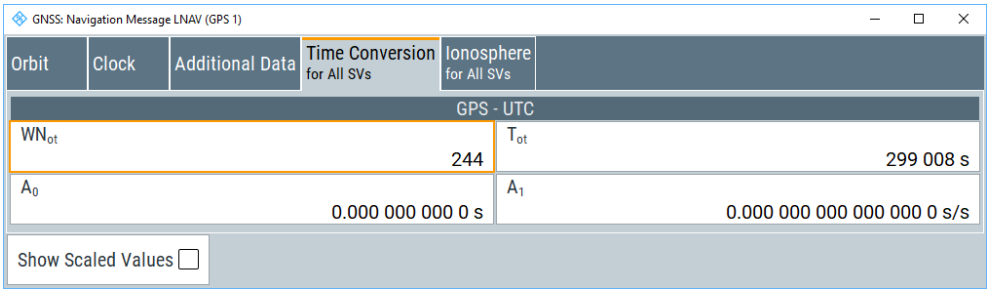
4.5.5 Time Conversion Errors Settings

Access:

1. Select "Simulation Configuration > Satellites > GNSS system > SV# > SV Config > Signals Configuration".
2. Select **"Nav Msg Content > Config > Time Conversion"**.

   Time conversion parameters are read-only and common for all SV of one GNSS system.
3. To change the time conversion parameters of all GPS SVs for example, select "SV# > SV Config" > **"Copy Modulation Control to SV-ID = All"**.

   Per default, the navigation message parameters are set to values corresponding to the values retrieved from the constellation data source.



   Changing these values leads to deviation between the simulated and the broadcasted navigation message and thus deliberated errors.
   Available navigation message parameters depend GNSS system and selected navigation message type.

Settings:

GPS > Time Conversion
Comprises the parameters of the GPS satellites.

Table 4-15: GPS - UTC (LNAV and CNAV)

Parameter	Remote command:
"W_{Not}"	`[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:LNAV:TIME:CONVersion:UTC:WNOT` on page 140
"T_{ot}"	`[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:LNAV:TIME:CONVersion:UTC:TOT` on page 141

Parameter	Remote command:
"A_0"	[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:LNAV:TIME:CONVersion:UTC:AZERo on page 142
"A_1"	[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:LNAV:TIME:CONVersion:UTC:AONE on page 142

Table 4-16: GPS - UTC (CNAV)

Parameter	Remote command:
"A_2"	[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:UTC:ATWO on page 141

Table 4-17: GPS - Galileo (CNAV)

Parameter	Remote command:
"W_{Not}"	[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:GALileo:WNOT on page 144
"T_{ot}"	[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:GALileo:TOT on page 145
"A_0"	[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:GALileo:AZERo on page 145
"A_1"	[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:GALileo:AONE on page 145
"A_2"	[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:GALileo:ATWO on page 146

Table 4-18: GPS - GLONASS (CNAV)

Parameter	Remote command:
W_{Not}	[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:GLONass:WNOT on page 146
T_{ot}	[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:GLONass:TOT on page 146
A_0	[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:GLONass:AZERo on page 147
A_1	[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:GLONass:AONE on page 147
A_2	[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:GLONass:ATWO on page 147

Galileo > Time Conversion

Comprises the parameters of the Galileo satellites.

Table 4-19: Galileo - UTC (INAV and FNAV)

Parameter	Remote command:
"W_{Not}"	[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:INAV:TIME:CONVersion:UTC:WNOT on page 140
"T_{ot}"	[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:INAV:TIME:CONVersion:UTC:TOT on page 140
"A_0"	[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:INAV:TIME:CONVersion:UTC:AZERo on page 142
"A_1"	[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:INAV:TIME:CONVersion:UTC:AONE on page 141

Table 4-20: Galileo - GPS (INAV and FNAV)

Parameter	Remote command:
"W_{Not}"	[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:INAV:TIME:CONVersion:GPS:WNOT on page 143
"T_{ot}"	[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:INAV:TIME:CONVersion:GPS:TOT on page 143
"A_0"	[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:INAV:TIME:CONVersion:GPS:AZERo on page 143
"A_1"	[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:INAV:TIME:CONVersion:GPS:AONE on page 144

GLONASS > Time Conversion

Comprises the parameters of the GLONASS satellites.

Parameter	Remote command:
"T_c (~A_0)"	[:SOURce<hw>]:BB:GNSS:SV:GLONass:NMESsage:NAV:TIME:CONVersion:UTC:AZERo on page 142
"Γ_n (~A_1)"	[:SOURce<hw>]:BB:GNSS:SV:GLONass:NMESsage:NAV:TIME:CONVersion:UTC:AONE on page 141
"T_{GPS} (~A_0)"	[:SOURce<hw>]:BB:GNSS:SV:GLONass:NMESsage:NAV:TIME:CONVersion:GPS:AZERo on page 143

BeiDou > Time Conversion

Comprises the parameters of the BeiDou satellites.

Table 4-21: BeiDou - UTC

Parameter	Remote command:
"W_{Not}"	[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:UTC:WNOT on page 140
"T_{ot}"	[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:UTC:TOT on page 140

Parameter	Remote command:
"A_0"	[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:UTC:AZERo on page 142
"A_1"	[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:UTC:AONE on page 141

Table 4-22: BeiDou - GPS

Parameter	Remote command:
"A_0"	[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:GPS:AZERo on page 144
"A_1"	[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:GPS:AONE on page 144

Table 4-23: BeiDou - Galileo

Parameter	Remote command:
"A_0"	[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:GALileo:AZERo on page 145
"A_1"	[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:GALileo:AONE on page 145

Table 4-24: BeiDou - GLONASS

Parameter	Remote command:
"A_0"	[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:GLONass:AZERo on page 146
"A_1"	[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:GLONass:AONE on page 147

Show Scaled Values
Switches between scaled and unscaled values representation.

Navigation message values are recalculated automatically.

Remote command:
[:SOURce<hw>]:BB:GNSS:SSValues on page 114

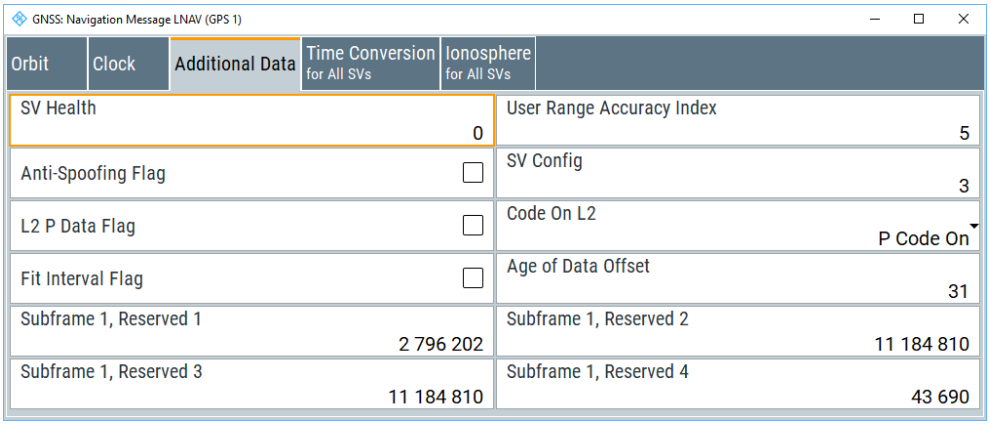
4.5.6 System Errors Settings

Access:

1. Select "Simulation Configuration > Satellites > GNSS system > SV# > SV Config > Signals Configuration".
2. Select real navigation data as data source.
   For example, for a GPS SV ID, select **"Nav Msg Type > LNAV"**.
3. Select **"Nav Msg Content > Config"**

4. Select **"Nav Msg Content > Config > Additional Data"**.

   Per default, the navigation message parameters are set to values corresponding to the values retrieved from the constellation data source.



   Available navigation message parameters depend GNSS system and selected navigation message type.

5. To simulate errors, change the values.
   For example, set "User Range Accuracy Index (URA) = 12".

   With this URA index, the selected SV is set to unvisible.

   Changing any navigation message value leads to deviation between the simulated and the broadcasted navigation message and thus to a deliberated error.
   The generated signal can be used for testing the receiver's ability to cope with errors.

Settings:

GPS > Additional Data

Comprises the parameters of the GPS satellites.

Table 4-25: LNAV

Parameter	Remote command:
"SV Health"	`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:HEALth` on page 134
"User Range Accuracy Index"	`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:URA` on page 134
"Anti-Spoofing Flag"	`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:ASFLag` on page 134
"SV Config"	`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:SVConfig` on page 134

Parameter	Remote command:
"Code On L2"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:CLTMode on page 135
"L2 P Data Flag"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:LTPData on page 135
"Fit Interval Flag"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:FIFLag on page 135
"Age of Date Offset"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:AODO on page 135
"Subframe 1, Reserved 1" to "Subframe 1, Reserved 4"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:SF1Reserved<s2us> on page 136

Table 4-26: CNAV

Parameter	Remote command:
"Alert Flag"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:ALERt on page 131
"L1 Health"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:L1Health on page 131
"L2 Health"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:L2Health on page 132
"L5 Health"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:L5Health on page 132
"ED Accuracy Index"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:URA on page 132
"NED Accuracy Index"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:NED0 on page 132
"NED Accuracy Change Index"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:NED1 on page 132
"NED Accuracy Change Rate Index"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:NED2 on page 132
"Data Predict Week Number -WN_{op}"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:WNOP on page 133
"Data Predict Time of Week - t_{op}"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:TOP on page 133
"Integrity Status Flag"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:ISFLag on page 133
"L2C Phasing"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:L2CPhasing on page 133

Galileo > Additional Data
Comprises the parameters of the Galileo satellites.

Table 4-27: INAV

Parameter	Remote command:
"Signal in Space Accuracy Index"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:SISA on page 136
"Data Validity Status - $E1B_{DVS}$"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:E1BDVS on page 136
"Data Validity Status - $E5b_{DVS}$"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:E5BDVS on page 137
"Signal Health Status - $E1B_{HS}$"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:E1BHS on page 136
"Signal Health Status - $E5b_{HS}$"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:E5BHS on page 137
SAR configuration	
"Mode"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:SAR:MODE on page 137
"RLM Data 1" to "RLM Data 4/8" (requires "Mode > Short/Long RLM)"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:SAR:RLM<s2us> on page 138
"Spare Data" (requires "Mode > Spare)"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:SAR:SPARe on page 138

Table 4-28: FNAV

Parameter	Remote command:
"Data Validity Status - $E5a_{DVS}$"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:E5ADVS on page 138
"Signal Health Status - $E5a_{HS}$ "	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:E5AHS on page 139

GLONASS > Additional Data

Comprises the parameters of the GLONASS satellites.

Parameter	Remote command:
"SV Health - $B_n(l_n)$"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:HEALth on page 134
"User Range Accuracy - F_T"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:URA on page 134
"Satellite Ephemeris Type - M"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:SEType on page 139
"Satellite Operation mode - P"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:P on page 139
"Age of Ephemeris Page - P1"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:AOEP on page 139

Parameter	Remote command:
"t_b Alignment - P2"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:TALignment on page 139
"E_n"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:CCORrection:EN on page 140

BeiDou > Additional Data
Comprises the parameters of the BeiDou satellites.

Parameter	Remote command:
"SV Health"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:HEALth on page 134
"User Range Accuracy Index"	[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:URA on page 134

Show Scaled Values
Switches between scaled and unscaled values representation.

Navigation message values are recalculated automatically.

Remote command:
[:SOURce<hw>]:BB:GNSS:SSValues on page 114

5 Signal Generation Control

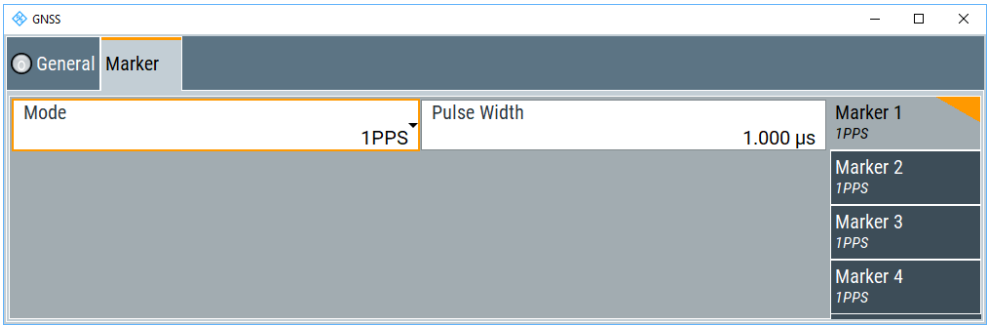
This section lists settings provided for defining the signal generation start and for generating signals necessary for synchronization with other instruments.

It covers the following topics:

5.1 Marker Settings

Access:

1. Select "GNSS > Marker".



This tab provides access to the settings necessary to select and configure the marker output signal for a single marker, like the marker mode or marker delay settings. By default, the settings for "Marker 1" are displayed. The set "Marker Mode" is also displayed for each marker on the "Marker x" side tabs.

2. To configure another marker, select e.g. the "Marker 2" side tab.

   Maximum four markers can be mapped in the GNSS firmware.

This section focuses on the available settings.

For information on how these settings affect the signal, refer to section "Basics on ..." in the R&S WinIQSIM2 user manual.

Settings:

Marker x Mode
Marker configuration for up to 4 markers. The settings are used to select the marker mode defining the shape and periodicity of the markers. The contents of the dialog change with the selected marker mode; the settings are self-explanatory.

"Restart" A marker signal is generated at each restart of the waveform.
Use the mode to trigger and monitor restarts of the signal generation, i.e. replays of the waveform.

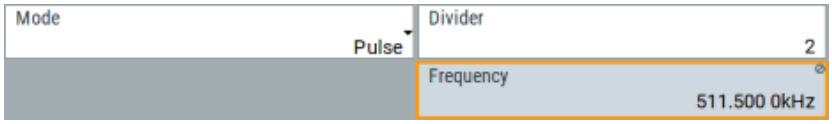
"1PPS/10PPS/1PP2S" A marker signal is generated at:

- The start of every second
- 10 times per second or once every 100 ms
- Once every two seconds

Set the "Pulse Width" in the corresponding field.

Remote command:
`[:SOURce<hw>]:BB:GNSS:TRIGger:OUTPut<ch>:PULSe:WIDTh` on page 152

"Pulse" Regular marker signal.
To define the pulse frequency, set the divider. The pulse frequency is derived by dividing the chip rate by the divider; the resulting "Frequency" value is displayed.

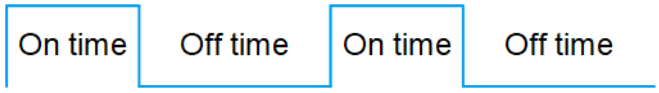


Remote command:
`[:SOURce<hw>]:BB:GNSS:TRIGger:OUTPut<ch>:PULSe:DIVider` on page 151
`[:SOURce<hw>]:BB:GNSS:TRIGger:OUTPut<ch>:PULSe:FREQuency?` on page 151

"Pattern" Marker signal that is defined by a bit pattern. The pattern has a maximum length of 64 bits.

Remote command:
`[:SOURce<hw>]:BB:GNSS:TRIGger:OUTPut<ch>:PATTern` on page 151

"On/Off Ratio"
Regular marker signal that is defined as on-time and off-time; a period lasts one on and off cycle.



Remote command:
`[:SOURce<hw>]:BB:GNSS:TRIGger:OUTPut<ch>:ONTime` on page 151
`[:SOURce<hw>]:BB:GNSS:TRIGger:OUTPut<ch>:OFFTime` on page 151

Remote command:
`[:SOURce<hw>]:BB:GNSS:TRIGger:OUTPut<ch>:MODE` on page 150

6 Generating and Playing GNSS Waveforms

This section provides some examples of typical workflow by working with one of the basic offline options.

The generated single satellite static GNSS signal is suitable for basic tests.

6.1 To Generate a Single Satellite GNSS Waveform

To generate a GNSS satellite signal (GPS, Galileo, GLONASS or BeiDou) with R&S WinIQSIM2 and save it as a waveform follow the following general steps:

1. Select "Baseband > GNSS > Set To Default" to call the default settings.
2. Access "GNSS > Simulation Configuration > System & Signals" to select the GNSS system, RF band and signal.
   a) Select the GNSS system, e.g. "GPS".
   b) Select the RF band, e.g. "L1 Band".
   c) Select the signal. With the settings above only "C/A" can be selected.

   Note: Only one GNSS system, frequency band and signal can be selected at a time.
3. In the satellite constellation ("GNSS > Simulation Configuration > Satellites"), select the space vehicle (SV), that you want to simulate.

   By default, the first GPS satellite "SV1" is selected.
4. Optionally, configure individual and modulation control settings of the space vehicle.
   a) Set "Initial Code Phase".
   b) For constant signal dynamics, set the "Doppler Shift".
   c) Select the navigation data type.
   d) For real navigation message types, e.g. "LNAV" for GPS, configure parameters for Perturbations and Errors Simulation.
5. Set general parameters.
   a) Adjust the "Oversampling" parameter to increase/decrease the sample rate.
   b) Adjust the "Duration of Satellites Simulation".
6. Select "GNSS > Simulation Configuration > Time" to adjust the simulation date and the simulation time (GNSS mean time).
7. Set "State > On" to enable the GNSS satellite signal generation.
8. Select the "Generate Waveform File" to save the GNSS satellite signal to a waveform file.

6.2 To Play a GNSS Waveform with Rohde & Schwarz Signal Generator

1. Generate a waveform file.
2. Connect the R&S WinIQSIM2 to the signal generator, on that you want to play the waveform.
3. Transfer the waveform file.
   For detailed description, see to the R&S WinIQSIM2 user manual.
4. On the instrument, select "Baseband > ARB" to load the waveform.
5. Find out, what frequency value you set on the instrument:
   a) In the dialog "Baseband > ARB > General", click the "Waveform Info" button.
   b) In the waveform "Info" dialog (Waveform Info dialog), look for "Comment" line.
   c) Set the RF "Frequency" as requested in the "Comment" line.

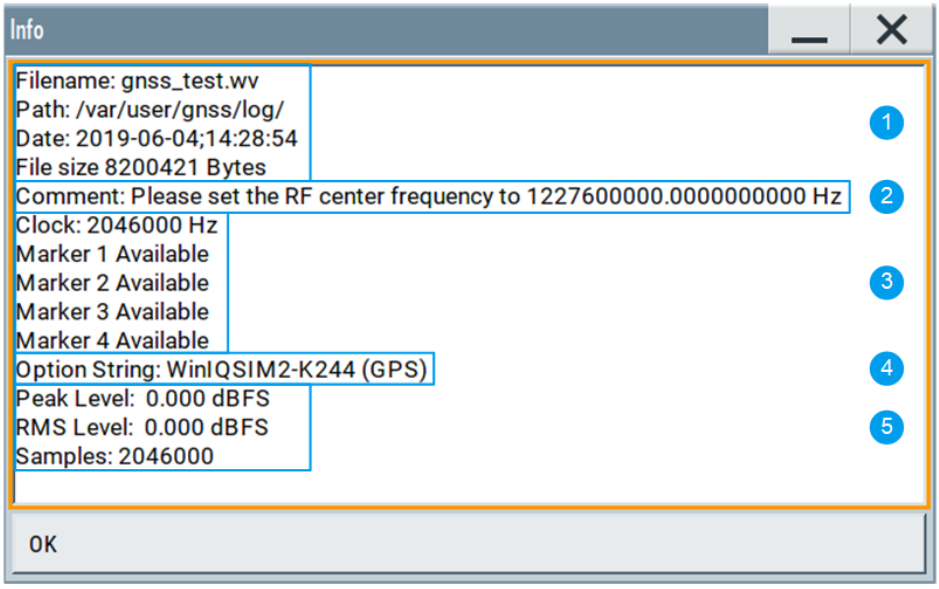


Figure 6-1: Waveform Info dialog

1 = General waveform file properties
2 = RF frequency to set on the instrument
3 = Signal generation and signal control parameters
4 = Required option to play the waveform
5 = General waveform signal properties

6. Select the "FREQ" key to set the frequency in the header of the instrument to the resulting frequency of the generated waveform.
7. Set the "ARB State > On" to enable signal processing.

   The signal generator processes the GNSS signal generated by the R&S WinIQSIM2.

7 Remote-Control Commands

The following commands are required for signal generation with the satellite navigation options in a remote environment. We assume that the R&S WinIQSIM2 has already been set up for remote operation in a network as described in the R&S WinIQSIM2 documentation. A knowledge about the remote control operation and the SCPI command syntax is assumed.

Conventions used in SCPI command descriptions

For a description of the conventions used in the remote command descriptions, see section "Remote Control Commands" in the R&S WinIQSIM2 user manual.

The `SOURce:BB:GPS|GALileo|GLONass|BEIDou` subsystem contains commands for configuring the GNSS standards.

Common suffixes

The following common suffixes are used in remote commands:

Suffix	Value range	Description
`SOURce<hw>`	[1]	available baseband signals
`OUTPut<ch>`	1 .. 4	available markers
`SVID<ch>`	1 to 37 for GPS satellites 1 to 50 for Galileo satellite	distinguishes between the SV IDs
`ECHO<s2us0>`	1 to 9	echoes in the multipath configuration

Required options

SCPI command contains	Required option

`SYSTem:GPS`
`TIME:STARt:GPS`
`TIME:CONVersion:GPS`
`SVID<ch>:GPS`
`SVID:GPS`
`SV:SELection:GPS`
`SV:IMPOrt:GPS`
	R&S Sxx-K244

`L2C` `L5S`	R&S Sxx-K298

SCPI command contains	Required option
SYSTem:GALileo TIME:STARt:GALileo TIME:CONVersion:GALileo SVID<ch>:GALileo SVID:GALileo SV:SELection:GALileo SV:IMPort:GALileo E1OS E5A E5B	R&S Sxx-K266
SYSTem:GLONnas TIME:STARt:GLONnas TIME:CONVersion:GLONnas SVID<ch>:GLONnas SVID:GLONnas SV:SELection:GLONnas SV:IMPOrt:GLONnas	R&S Sxx-K294
SYSTem:BEIDou TIME:STARt:BEIDou TIME:CONVersion:BEIDou SVID<ch>:BEIDou SVID:BEIDou SV:SELection:BEIDou SV:IMPOrt:BEIDou	R&S Sxx-K407

The following commands specific to the GNSS options are described here:

7.1 Programming Examples

The following sections provide simple programming examples for the R&S WinIQSIM2. 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 preset/reset is recommended to set the R&S WinIQSIM2 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.

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.

7.2 General Settings

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'
SOURce1:BB:GNSS:SETTing:CATalog?
// Response: gnss_settings,settings
SOURce1:BB:GNSS:SETTing:STORe '/var/user/settings/gnss'
SOURce1:BB:GNSS:SETTing:LOAD '/var/user/settings/gnss_settings'
SOURce1:BB:GNSS:SETTing:DELete '/var/user/settings/settings'
// Deletes the file settings.gnss
SOURce1:BB:GNSS:SETTing:CATalog?
// Response: gnss_settings,gnss
```

Example: Selecting a predefined test scenario

This example shows how to enable a predefined scenario.

```
*********************************
// Select and enable the predefined  test scenario
// 3GPP FDD Signaling Test Scenario 2
// ***************************************
SOURce1:BB:GNSS:PRESet
SOURce1:BB:GNSS:SETTing:CATalog:PREDefined?

// Assisted GNSS+EUTRA/LTE+3GPP TS 37.571-2:  S7  Signaling ST1;
// 3GPP TS 37.571-2:  S7  Signaling ST2;...
SOURce1:BB:GNSS:SETTing:LOAD:PREDefined "3GPP TS 37.571-2:  S7  Signaling ST2"
SOURce1:BB:GPS:ATSCENario?
// "Predefined: 3GPP TS 37.571-2:  S7  Signaling ST2"
SOURce1:BB:GNSS:SIMulation:INFO?
// "L1 / GLONASS only"
SOURce1:BB:GNSS:STATe ON
```

[:SOURce<hw>]:BB:GNSS: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: See Example "Selecting a predefined test scenario" on page 61.

Usage: Event

Manual operation: See "Set to Default" on page 16

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

Enables/disables the GNSS signal simulation.

Parameters:

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

Example: See Example "Selecting a predefined test scenario" on page 61.

Manual operation: See "State" on page 16

[:SOURce<hw>]:BB:BEIDou:ATSCenario <Scenario>

Selects the file with the predefined A-BeiDou/A-GNSS test scenario.

Table 7-1: A-BeiDou test scenarios

Test Scenario	SCPI
3GPP TS 37.571-2: S6 Signaling ST9	`W3GSIGST9`
3GPP TS 37.571-1: S6 Performance 1/2/5 ST9	`W3GPER1ST9|W3GPER2ST9|W3GPER5ST9`

Test Scenario	SCPI
3GPP TS 37.571-2: S7 Signaling ST9	LTESIGST9
3GPP TS 37.571-1: S7 Performance 1/2/5 ST9	LTEPER1ST9|LTEPER2ST9|LTEPER5ST9

Table 7-2: A-GNSS test scenarios

Test Scenario	SCPI
3GPP TS 37.571-2: S6 Signaling ST10	W3GSIGST10
3GPP TS 37.571-1: S6 Performance 1/2/5 ST10	W3GPER1ST10|W3GPER2ST10|W3GPER5ST10
3GPP TS 37.571-2: S7 Signaling ST10	LTESIGST10
3GPP TS 37.571-1: S7 Performance 1/2/5 ST10	LTEPER1ST10|LTEPER2ST10|LTEPER5ST10
3GPP TS 37.571-1: S7 Performance 1/2/5 ST11	LTEPER1ST11|LTEPER2ST11|LTEPER5ST11
3GPP TS 37.571-1: S7 Performance 1/2/5 ST13	LTEPER1ST13|LTEPER2ST13|LTEPER5ST13

Parameters:

<Scenario> W3GSIGST9 | W3GSIGST10 | W3GPER1ST9 | W3GPER1ST10 | W3GPER2ST9 | W3GPER2ST10 | W3GPER5ST9 | W3GPER5ST10 | LTESIGST9 | LTESIGST10 | LTEPER1ST9 | LTEPER1ST10 | LTEPER2ST9 | LTEPER2ST10 | LTEPER5ST9 | LTEPER5ST10 | USER | LTEPER1ST11 | LTEPER2ST11 | LTEPER5ST11 | LTEPER5ST13 | LTEPER2ST13 | LTEPER1ST13

User
No predefined test scenario is selected.

*RST: USER

Example: For a GPS example, see Example "Selecting a predefined test scenario" on page 61.

[:SOURce<hw>]:BB:GALileo:ATSCenario <Scenario>

Selects the file with the predefined A-Galileo/A-GNSS test scenario.

Table 7-3: A-Galileo test scenarios

Test Scenario	SCPI
3GPP TS 37.571-2: S6 Signaling ST2	W3GSIGST2
3GPP TS 37.571-1: S6 Performance 1/2/5 ST2	W3GPER1ST2|W3GPER2ST2|W3GPER5ST2
3GPP TS 37.571-2: S7 Signaling ST3	LTESIGST3
3GPP TS 37.571-1: S7 Performance 1/2/5 ST3	LTEPER1ST3|LTEPER2ST3|LTEPER5ST3

Table 7-4: A-GNSS test scenarios

Test Scenario	SCPI
3GPP TS 37.571-2: S6 Signaling ST8	W3GSIGST8
3GPP TS 37.571-1: S6 Performance 1/2/5 ST8	W3GPER1ST8|W3GPER2ST8|W3GPER5ST8
3GPP TS 37.571-2: S7 Signaling ST8	LTESIGST8
3GPP TS 37.571-1: S7 Performance 1/2/5 ST8	LTEPER1ST8|LTEPER2ST8|LTEPER5ST8
3GPP TS 37.571-1: S7 Performance 1/2/5 ST12	LTEPER1ST12|LTEPER2ST12|LTEPER5ST12
3GPP TS 37.571-1: S7 Performance 1/2/5 ST13	LTEPER1ST13|LTEPER2ST13|LTEPER5ST13

Parameters:

<Scenario> W3GSIGST2 | W3GSIGST8 | W3GPER1ST2 | W3GPER1ST8 | W3GPER2ST2 | W3GPER2ST8 | W3GPER5ST2 | W3GPER5ST8 | LTESIGST3 | LTESIGST8 | LTEPER1ST3 | LTEPER1ST8 | LTEPER2ST3 | LTEPER2ST8 | LTEPER5ST3 | LTEPER5ST8 | USER | LTEPER1ST12 | LTEPER2ST12 | LTEPER5ST12 | LTEPER1ST13 | LTEPER2ST13 | LTEPER5ST13

User

No predefined test scenario is selected.

*RST: USER

Example: For a GPS example, see Example "Selecting a predefined test scenario" on page 61.

[:SOURce<hw>]:BB:GLONass:ATSCenario <Scenario>

Selects the file with the predefined A-GLONASS/A-GNSS test scenario.

Table 7-5: 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 ST1	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 7-6: 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

Test Scenario	SCPI
3GPP TS 37.571-1: S7 Performance 1/2/5 ST11	LTEPER1ST11|LTEPER2ST11|LTEPER5ST11
3GPP TS 37.571-1: S7 Performance 1/2/5 ST12	LTEPER1ST12|LTEPER2ST12|LTEPER5ST12

Parameters:

<Scenario> USER | W3GSIGST1 | W3GSIGST4 | W3GPER1ST1 | W3GPER5ST4 | W3GPER5ST1 | W3GPER2ST4 | W3GPER2ST1 | W3GPER1ST4 | LTESIGST2 | LTESIGST4 | LTEPER1ST2 | LTEPER1ST5 | LTEPER2ST2 | LTEPER2ST5 | LTEPER5ST2 | LTEPER5ST5 | LTEPER1ST11 | LTEPER2ST11 | LTEPER5ST11 | LTEPER1ST12 | LTEPER2ST12 | LTEPER5ST12

User
No predefined test scenario is selected.

*RST: USER

Example: For a GPS example, see Example "Selecting a predefined test scenario" on page 61.

[:SOURce<hw>]:BB:GPS:ATSCenario <Scenario>

Selects the file with the predefined A-GPS/A-GNSS test scenario.

Table 7-7: 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	GSMPER1|GSMPER2|GSMPER3
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 7-8: A-GNSS test scenarios

Test Scenario	SCPI
3GPP TS 37.571-2: S6 Signaling ST4/ST8/ST10	W3GSIGST4|W3GSIGST8|W3GSIGST10
3GPP TS 37.571-1: S6 Performance 1/2/5 ST4	W3GPER1ST4|W3GPER2ST4|W3GPER5ST4
3GPP TS 37.571-1: S6 Performance 1/2/5 ST8	W3GPER1ST8|W3GPER2ST8|W3GPER5ST8
3GPP TS 37.571-1: S6 Performance 1/2/5 ST10	W3GPER1ST10|W3GPER2ST10|W3GPER5ST10
3GPP TS 37.571-2: S7 Signaling ST4/ST8/ST10	LTESIGST4|LTESIGST8|LTESIGST10

Test Scenario	SCPI
3GPP TS 37.571-1: S7 Performance 1/2/5 ST5	LTEPER1ST5|LTEPER2ST5|LTEPER5ST5
3GPP TS 37.571-1: S7 Performance 1/2/5 ST8	LTEPER1ST8|LTEPER2ST8|LTEPER5ST8
3GPP TS 37.571-1: S7 Performance 1/2/5 ST10	LTEPER1ST10|LTEPER2ST10|LTEPER5ST10
3GPP TS 37.571-1: S7 Performance 1/2/5 ST11	LTEPER1ST11|LTEPER2ST11|LTEPER5ST11
3GPP TS 37.571-1: S7 Performance 1/2/5 ST12	LTEPER1ST12|LTEPER2ST12|LTEPER5ST12
3GPP TS 37.571-1: S7 Performance 1/2/5 ST13	LTEPER1ST13|LTEPER2ST13|LTEPER5ST13

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 | W3GSIGST8 | W3GSIGST10 | W3GPER1ST8 | W3GPER1ST10 | W3GPER2ST8 | W3GPER2ST10 | W3GPER5ST8 | W3GPER5ST10 | LTESIGST8 | LTESIGST10 | LTEPER1ST8 | LTEPER1ST10 | LTEPER2ST8 | LTEPER2ST10 | LTEPER5ST8 | LTEPER5ST10 | LTEPER1ST11 | LTEPER2ST11 | LTEPER5ST11 | LTEPER1ST12 | LTEPER2ST12 | LTEPER5ST12 | LTEPER1ST13 | LTEPER2ST13 | LTEPER5ST13

User
No predefined test scenario is selected.

*RST: USER

Example: See Example "Selecting a predefined test scenario" on page 61.

Manual operation: See "Scenario" on page 17

[:SOURce<hw>]:BB:GNSS:SIMulation:INFO?

Queries information on the current enabled RF bands, signals and GNSS standards.

Return values:

<SimConfigInfo> string

Example: See Example "Selecting a predefined test scenario" on page 61.

Usage: Query only

[:SOURce<hw>]:BB:GNSS:OSAMpling <OSampling>

Sets the upsampling factor.

A higher upsampling factor improves the filtering but increases the waveform size proportionally. This leads to limitation for the maximum "Duration Of Satellite Simulation".

Parameters:

<OSampling> integer

Range: 2 to 32
*RST: 2

Example: `SOURce1:BB:GNSS:OSAMpling 2`
Sets an upsampling factor of 2.

Manual operation: See "Oversampling" on page 17

[:SOURce<hw>]:BB:GNSS:DURation <Duration>

Sets the duration of the satellite simulation.

The resulting duration of the simulation is calculated as follow:

$$Duration\ of\ Simulation = \frac{Duration\ of\ Satellite\ Simulation}{1 + \frac{Doppler\ Shift}{F_{Carrier}}}$$

where $F_{Carrier}$ is the frequency selected with the parameter RF Band.

The maximum duration of satellite simulation depends on the Oversampling factor and the ARB memory size of the connected instrument.

Parameters:

<Duration> float

Range: 20E-3 to 64
Increment: 1E-3
*RST: 1

Example: `SOUR:BB:GPS:DUR 20`
Sets 20 s duration of the satellite simulation.

Manual operation: See "Duration Of Satellite Simulation" on page 17

[:SOURce<hw>]:BB:GNSS:SETTing:CATalog?

Queries the files with settings in the default directory. Listed are files with the file extension `*.gnss`.

Example: See Example "Save/Recall files with user settings" on page 61.

Usage: Query only

Manual operation: See "Save/Recall Scenario" on page 16

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

Saves the current settings into the selected file; the file extension (`*.gnss`) is assigned automatically.

Setting parameters:

<Filename> "<filename>"

Filename or complete file path

Example: See Example "Save/Recall files with user settings" on page 61.

Usage: Setting only

Manual operation: See "Save/Recall Scenario" on page 16

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

Loads the selected file from the default or the specified directory. Loaded are files with extension `*.gnss`.

Setting parameters:

<Filename> "<filename>"

Filename or complete file path; file extension can be omitted
Query the existing files with the command `[:SOURce<hw>]:BB:GNSS:SETTing:CATalog?`.

Example: See Example "Save/Recall files with user settings" on page 61.

Usage: Setting only

Manual operation: See "Save/Recall Scenario" on page 16

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

Deletes the selected file from the default or the specified directory.

Setting parameters:

<Filename> "<filename>"

Filename or complete file path; file extension can be omitted

Example: See Example "Save/Recall files with user settings" on page 61.

Usage: Setting only

Manual operation: See "Save/Recall Scenario" on page 16

[:SOURce<hw>]:BB:GNSS:SETTing:CATalog:PREDefined?

Queries the files with predefined settings.

Example: See Example "Selecting a predefined test scenario" on page 61.

Usage: Query only

[:SOURce<hw>]:BB:GNSS:SETTing:LOAD:PREDefined <Scenario>

Loads the selected scenario file.

Setting parameters:

<Scenario> "<ScenarioName>"

Name of a predefined scenario, as queried with the command `[:SOURce<hw>]:BB:GNSS:SETTing:CATalog:PREDefined?`.

Example: See Example "Selecting a predefined test scenario" on page 61.

Usage: Setting only

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

Stores the current settings as an ARB signal in a waveform file (`*.wv`).

Setting parameters:

<Filename> string

Filename or complete file path; file extension is assigned automatically

Example:

```
MMEM:CDIR D:\gnss
SOURce1:BB:GNSS:STATe 1
SOURce1:BB:GNSS:WAVeform:CREate "gnss_test"
```

Usage: Setting only

Manual operation: See "Generate Waveform" on page 17

7.3 Systems and Signals

Example: Configuration example

```
//------------------------------------------------------------------------------
// Enable an RF band. Only one RF band can be enabled at a time.
//------------------------------------------------------------------------------
SOURce1:BB:GNSS:L1Band:STATe 1
SOURce1:BB:GNSS:L2Band:STATe? 0
SOURce1:BB:GNSS:L5Band:STATe? 0

//------------------------------------------------------------------------------
// Enable a GNSS system. Only one GNSS system can be enabled at a time.
//------------------------------------------------------------------------------
SOURce1:BB:GNSS:SYSTem:GPS:STATe 1
SOURce1:BB:GNSS:SYSTem:BEIDou:STATe? 0
SOURce1:BB:GNSS:SYSTem:GALileo:STATe? 0
SOURce1:BB:GNSS:SYSTem:GLONass:STATe? 0

//------------------------------------------------------------------------------
// Enable signals within a GNSS system and RF band.
//------------------------------------------------------------------------------
SOURce1:BB:GNSS:SYSTem:GPS:SIGNal:L2Band:CA:STATe 1
SOURce1:BB:GNSS:SYSTem:GPS:SIGNal:L2Band:L2C:STATe 1
SOURce1:BB:GNSS:SYSTem:GPS:SIGNal:L1Band:CA:STATe? 0
SOURce1:BB:GNSS:SYSTem:GPS:SIGNal:L5Band:L5S:STATe? 0
SOURce1:BB:GNSS:SYSTem:BEIDou:SIGNal:L1Band:B1I:STATe? 0
SOURce1:BB:GNSS:SYSTem:BEIDou:SIGNal:L5Band:B2I:STATe? 0
SOURce1:BB:GNSS:SYSTem:GALileo:SIGNal:L1Band:E1OS:STATe? 0
SOURce1:BB:GNSS:SYSTem:GALileo:SIGNal:L5Band:E5A:STATe? 0
SOURce1:BB:GNSS:SYSTem:GALileo:SIGNal:L5Band:E5B:STATe? 0
SOURce1:BB:GNSS:SYSTem:GLONass:SIGNal:L1Band:CA:STATe? 0
SOURce1:BB:GNSS:SYSTem:GLONass:SIGNal:L2Band:CA:STATe? 0


//------------------------------------------------------------------------------
// Query information about active RF bands and GNSS systems.
//------------------------------------------------------------------------------
SOURce1:BB:GNSS:SIMulation:INFO? "L2 / GPS only"
```

[:SOURce<hw>]:BB:GNSS:L5Band[:STATe] <L5BandState>
[:SOURce<hw>]:BB:GNSS:L2Band[:STATe] <L2BandState>
[:SOURce<hw>]:BB:GNSS:L1Band[:STATe] <L1BandState>

Activates the RF band.

Parameters:

<L1BandState> 0 | 1 | OFF | ON

*RST: 0

Manual operation: See "L# Band" on page 23

[:SOURce<hw>]:BB:GNSS:SYSTem:BEIDou[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SYSTem:GALileo[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SYSTem:GLONass[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SYSTem:GPS[:STATe] <State>

Defines if satellites from the selected GNSS system are included in the simulated satellites constellation.

Parameters:

<State> 0 | 1 | OFF | ON

Disabling a GNSS system deactivates all SVID and signals from this system.

*RST: 0

Example: See Example "Configuration example" on page 70.

Manual operation: See "Systems" on page 22

[:SOURce<hw>]:BB:GNSS:SYSTem:BEIDou:SIGNal:L1Band:B1I[:STATe]
<SignalState>
[:SOURce<hw>]:BB:GNSS:SYSTem:BEIDou:SIGNal:L5Band:B2I[:STATe]
<SignalState>
[:SOURce<hw>]:BB:GNSS:SYSTem:GALileo:SIGNal:L5Band:E5B[:STATe]
<SignalState>
[:SOURce<hw>]:BB:GNSS:SYSTem:GALileo:SIGNal:L5Band:E5A[:STATe]
<SignalState>
[:SOURce<hw>]:BB:GNSS:SYSTem:GALileo:SIGNal:L1Band:E1OS[:STATe]
<SignalState>
[:SOURce<hw>]:BB:GNSS:SYSTem:GLONass:SIGNal:L1Band:CA[:STATe]
<SignalState>

[:SOURce<hw>]:BB:GNSS:SYSTem:GLONass:SIGNal:L2Band:CA[:STATe]
<SignalState>
[:SOURce<hw>]:BB:GNSS:SYSTem:GPS:SIGNal:L5Band:L5S[:STATe]
<SignalState>
[:SOURce<hw>]:BB:GNSS:SYSTem:GPS:SIGNal:L2Band:L2C[:STATe]
<SignalState>
[:SOURce<hw>]:BB:GNSS:SYSTem:GPS:SIGNal:L2Band:CA[:STATe]
<SignalState>
[:SOURce<hw>]:BB:GNSS:SYSTem:GPS:SIGNal:L1Band:CA[:STATe]
<SignalState>

Enables the corresponding signal from the GNSS system in the corresponding RF band.

Parameters:

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

Example: See Example "Configuration example" on page 70.

Manual operation: See "Signals" on page 23

7.4 Time Conversion Configuration

Example: Configuring the time conversion and leap seconds settings

```
SOURce1:BB:GNSS:SYSTem:GPS:STATe 1

// set simulation start date and time in UTC format
SOURce1:BB:GNSS:TIME:STARt:TBASis UTC
SOURce1:BB:GNSS:TIME:STARt:DATE 2016,2,19
SOURce1:BB:GNSS:TIME:STARt:TIME 7,0,0
// query the simulation start in GPS format
SOURce1:BB:GNSS:TIME:STARt:TBASis GPS
SOURce1:BB:GNSS:TIME:STARt:WNUMber?
// 1884
SOURce1:BB:GNSS:TIME:STARt:TOWeek?
// 457216.3154372

// query the simulation start date and time or week number
// and time of week for the active GNSS systems
SOURce1:BB:GNSS:TIME:STARt:GPS:WNUMber?
// 1884
SOURce1:BB:GNSS:TIME:STARt:GPS:TOWeek?
// 457216.3154372

// activate automatic leap second calculation
SOURce1:BB:GNSS:TIME:CONVersion:LEAP:AUTO 1
```

```
SOURce1:BB:GNSS:TIME:CONVersion:LEAP:SEConds?
// 17

// set the time conversion parameters
//  used for the automatic time conversion
SOURce1:BB:GNSS:TIME:CONVersion:GPS:UTC:WNOT 244
SOURce1:BB:GNSS:TIME:CONVersion:GPS:UTC:TOT:UNSCaled 475200
SOURce1:BB:GNSS:TIME:CONVersion:GPS:UTC:AONE:UNSCaled 0
SOURce1:BB:GNSS:TIME:CONVersion:GPS:UTC:AZERo:UNSCaled 0
SOURce1:BB:GNSS:TIME:CONVersion:GPS:UTC:IOFFset?
// 16

SOURce1:BB:GNSS:TIME:CONVersion:UTCSu:UTC:DATE?
// 2014,2,19
SOURce1:BB:GNSS:TIME:CONVersion:GLONass:UTC:AZERo:UNSCaled 0
SOURce1:BB:GNSS:TIME:CONVersion:UTCSu:UTC:AZERo:UNSCaled 0
SOURce1:BB:GNSS:TIME:CONVersion:UTCSu:UTC:AONE:UNSCaled 0
// etc. for each GNSS system
```

[:SOURce<hw>]:BB:GNSS:TIME:STARt:DATE <Year>, <Month>, <Day>

If the time base is UTC, defines the date for the simulation in `DD.MM.YYYY` 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 "Configuring the time conversion and leap seconds settings" on page 72.

Manual operation: See "Simulation Start" on page 19

[:SOURce<hw>]:BB:GNSS:TIME:STARt: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 "Configuring the time conversion and leap seconds settings" on page 72.

Manual operation: See "Simulation Start" on page 19

[:SOURce<hw>]:BB:GNSS:TIME:STARt:TIME <Hour>, <Minute>, <Second>

If the time base is UTC, sets the simulation start time 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 "Configuring the time conversion and leap seconds settings" on page 72.

Manual operation: See "Simulation Start" on page 19

[:SOURce<hw>]:BB:GNSS:TIME:STARt:TOWeek <TOW>

If time base is GPS or GST, sets the simulation start time within week set with the command `[:SOURce<hw>]:BB:GNSS:TIME:STARt:WNUMber`.

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 "Configuring the time conversion and leap seconds settings" on page 72.

Manual operation: See "Simulation Start" on page 19

[:SOURce<hw>]:BB:GNSS:TIME:STARt:WNUMber <Week>

If time base is GPS or GST, sets the week number (WN).

Parameters:

<Week> integer

The weeks are numbered starting from a reference time point (WN_REF=0), that depends on the navigation standard.

Range: 0 to 9999*53
*RST: 0

Example: See Example "Configuring the time conversion and leap seconds settings" on page 72.

Manual operation: See "Simulation Start" on page 19

[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:LEAP:AUTO <AutoConfigure>

Enables the simulation of the leap second transition.

Parameters:

<AutoConfigure> 0 | 1 | OFF | ON

*RST: 1

Example: See Example "Configuring the time conversion and leap seconds settings" on page 72.

Manual operation: See "Auto Configure Leap Seconds" on page 20

[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:LEAP:SEConds <LeapSeconds>

Sets 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 72.

Manual operation: See "Current Leap Seconds (Ref. 1980)" on page 20

[:SOURce<hw>]:BB:GNSS:TIME:STARt:UTC:DATE?
[:SOURce<hw>]:BB:GNSS:TIME:STARt:GLONass:DATE?

Queries the date at the simulation start time of the selected navigation standard.

Return values:

<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 72.

Usage: Query only

[:SOURce<hw>]:BB:GNSS:TIME:STARt:UTC:TIME?
[:SOURce<hw>]:BB:GNSS:TIME:STARt:GLONass:TIME?

Queries the simulation start time of the selected navigation standard.

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: See Example "Configuring the time conversion and leap seconds settings" on page 72.

Usage: Query only

[:SOURce<hw>]:BB:GNSS:TIME:STARt:BEIDou:WNUMber?
[:SOURce<hw>]:BB:GNSS:TIME:STARt:GALileo:WNUMber?
[:SOURce<hw>]:BB:GNSS:TIME:STARt:GPS:WNUMber?

Queries the week number at the simulation start of the selected navigation standard.

Return values:

<SystemWeekNumb> integer
Range: 0 to 10000
*RST: 0

Example: See Example "Configuring the time conversion and leap seconds settings" on page 72.

Usage: Query only

Manual operation: See "Date/WN, Tome/TOW, UTC Offset" on page 20

[:SOURce<hw>]:BB:GNSS:TIME:STARt:BEIDou:TOWeek?
[:SOURce<hw>]:BB:GNSS:TIME:STARt:GALileo:TOWeek?
[:SOURce<hw>]:BB:GNSS:TIME:STARt:GPS:TOWeek?

Queries the time of week at the simulation start of the selected navigation standard.

Return values:

<TOW> float

Range: 0 to 604799.999
Increment: 0.001
*RST: 0

Example: See Example "Configuring the time conversion and leap seconds settings" on page 72.

Usage: Query only

Manual operation: See "Date/WN, Tome/TOW, UTC Offset" on page 20

[:SOURce<hw>]:BB:GNSS:TIME:STARt:BEIDou:OFFSet?
[:SOURce<hw>]:BB:GNSS:TIME:STARt:GALileo:OFFSet?
[:SOURce<hw>]:BB:GNSS:TIME:STARt:GLONass:OFFSet?
[:SOURce<hw>]:BB:GNSS:TIME:STARt:UTC:OFFSet?
[:SOURce<hw>]:BB:GNSS:TIME:STARt:GPS:OFFSet?

Queries the time offset between the time in the navigation standard and UTC.

Return values:

<UtcOffset> float

Range: -1E6 to 1E6
Increment: 0.001
*RST: 0

Example: See Example "Configuring the time conversion and leap seconds settings" on page 72.

Usage: Query only

Manual operation: See "Date/WN, Tome/TOW, UTC Offset" on page 20

[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:BEIDou:UTC:WNOT <Wnot>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GALileo:UTC:WNOT <Wnot>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GLONass:UTC:WNOT <Wnot>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GLONass:UTCSu:WNOT <Wnot>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:UTCSu:UTC:WNOT <Wnot>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GPS:UTC:WNOT <Wnot>

Sets 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 72.

Manual operation: See "Reference Week/Date, Reference Time of Week" on page 21

[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:UTCSu:UTC: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

Example: See Example "Configuring the time conversion and leap seconds settings" on page 72.

Usage: Query only

Manual operation: See "UTC-UTC(SU)" on page 21

[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:BEIDou:UTC:TOT:UNSCaled <Tot>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:BEIDou:UTC:TOT <Tot>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GALileo:UTC:TOT:UNSCaled <Tot>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GALileo:UTC:TOT <Tot>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GLONass:UTC:TOT:UNSCaled <Tot>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GLONass:UTC:TOT <Tot>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GLONass:UTCSu:TOT:UNSCaled <Tot>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GLONass:UTCSu:TOT <Tot>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:UTCSu:UTC:TOT:UNSCaled <Tot>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:UTCSu:UTC:TOT <Tot>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GPS:UTC:TOT:UNSCaled <Tot>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GPS:UTC:TOT <Tot>

Sets 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 72.

Manual operation: See "Reference Week/Date, Reference Time of Week" on page 21

[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:BEIDou:UTC:IOFFset?
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GALileo:UTC:IOFFset?
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GLONass:UTCSu:IOFFset?
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:UTCSu:UTC:IOFFset?
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GPS:UTC:IOFFset?

Queries the integer offset.

Return values:
<IntegerOffset> integer
Range: 0 to 604800
*RST: 0

Example: See Example "Configuring the time conversion and leap seconds settings" on page 72.

Usage: Query only

Manual operation: See "Integer Offset" on page 21

[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:BEIDou:UTC:AZERo:UNSCaled <A0>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:BEIDou:UTC:AZERo <AZero>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GALileo:UTC:AZERo:UNSCaled <A0>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GALileo:UTC:AZERo <AZero>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GLONass:UTC:AZERo:UNSCaled <A0>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GLONass:UTC:AZERo <AZero>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GLONass:UTCSu:AZERo:UNSCaled <A0>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GLONass:UTCSu:AZERo <AZero>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:UTCSu:UTC:AZERo:UNSCaled <A0>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:UTCSu:UTC:AZERo <AZero>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GPS:UTC:AZERo:UNSCaled <A0>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GPS:UTC:AZERo <AZero>

Sets 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 72.

Manual operation: See "Fractional Offset A0, Drift A1" on page 21

[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:BEIDou:UTC:AONE:UNSCaled <A1>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:BEIDou:UTC:AONE <AOne>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GALileo:UTC:AONE:UNSCaled <A1>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GALileo:UTC:AONE <AOne>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GLONass:UTC:AONE:UNSCaled <A1>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GLONass:UTC:AONE <AOne>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GLONass:UTCSu:AONE:UNSCaled <A1>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GLONass:UTCSu:AONE <AOne>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:UTCSu:UTC:AONE:UNSCaled <A1>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:UTCSu:UTC:AONE <AOne>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GPS:UTC:AONE:UNSCaled <A1>
[:SOURce<hw>]:BB:GNSS:TIME:CONVersion:GPS:UTC:AONE <AOne>

Sets the first 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 72.

Manual operation: See "Fractional Offset A0, Drift A1" on page 21

7.5 Satellites Constellation

Example: Configuring the satellite's constellation

```
SOURce1:BB:GNSS:PRESet

SOURce1:BB:GNSS:SYSTem:GPS:STATe 1
SOURce1:BB:GNSS:SYSTem:GALileo:STATe 1

SOURce1:BB:GNSS:SV:SELection:MODE ELEV
SOURce1:BB:GNSS:SV:SELection:EOBScuration:REFerence LHOR
SOURce1:BB:GNSS:SV:SELection:EOBScuration:ANGLe 5
// query the number of satellites available
SOURce1:BB:GNSS:SV:SELection:GPS:AVAilable?
// 37
SOURce1:BB:GNSS:SV:SELection:GALileo:AVAilable?
// 29
SOURce1:BB:GNSS:SV:SELection:GPS:MIN 1
SOURce1:BB:GNSS:SV:SELection:GPS:MAX 24
SOURce1:BB:GNSS:SV:SELection:GALileo:MIN 1
```

```
SOURce1:BB:GNSS:SV:SELection:GALileo:MAX 15
// query the number of active statellites in the constellation
SOURce1:BB:GNSS:SV:SELection:GPS:ACTive?
// 10
SOURce1:BB:GNSS:SV:SELection:GALileo:ACTive?
// 8

// query the valid SV IDs per GNSS system
SOURce1:BB:GNSS:SVID:GPS:LIST?
// 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,
// 28,29,30,31,32,33,34,35,36,37
// query if a SV ID is healhy or not
SOURce1:BB:GNSS:SVID1:GPS:HEALthy?
// 1
SOURce1:BB:GNSS:SVID30:GPS:HEALthy?
// 0
// query if a SV ID is visible or not
SOURce1:BB:GNSS:SVID1:GPS:VISibility:STATe?
// 1
SOURce1:BB:GNSS:SVID30:GPS:VISibility:STATe?
// 0

SOURce1:BB:GNSS:SVID1:GPS:STATe 1
SOURce1:BB:GNSS:SVID1:GPS:POWer:OFFSet -10
```

Example: Loading historical data

```
SOURce1:BB:GNSS:SYSTem:GPS:STATe 1
SOURce1:BB:GNSS:SYSTem:GALileo:STATe 1

SOURce1:BB:GNSS:SV:IMPort:GPS:FILE:CONStellation
"/var/user/19_02_2014_gps.txt"
SOURce1:BB:GNSS:SV:IMPort:GPS:UDSource 1
SOURce1:BB:GNSS:SV:IMPort:GPS:FILE:NMESsage
"/var/user/19_02_2014_gps.14n"
SOURce1:BB:GNSS:SV:IMPort:GPS:EXECute
```

[:SOURce<hw>]:BB:GNSS:SV:SELection:MODE <SelectionMode>

Sets the criteria used to define the initial satellite constellation.

Parameters:

<SelectionMode> MANual | ELEVation | VISibility

*RST: VISibility

Example: See Example "Configuring the satellite's constellation" on page 81.

[:SOURce<hw>]:BB:GNSS:SV:SELection:EOBScuration:REFerence <Type>

Selects how the behavior of earth obscuration is defined.

Parameters:

<Type> ETANgent | LHORizon

*RST: ETANgent

Example: See Example "Configuring the satellite's constellation" on page 81.

[:SOURce<hw>]:BB:GNSS:SV:SELection:EOBScuration:ANGLe <ElevMaskAngle>

Sets the satellite's elevation mask angle. The angle is applied relative to the selected horizon.

Parameters:

<ElevMaskAngle> float

Range: -10 to 90
Increment: 0.1
*RST: 5

Example: See Example "Configuring the satellite's constellation" on page 81.

[:SOURce<hw>]:BB:GNSS:SV:SELection:BEIDou:MIN <MinimumSVs>
[:SOURce<hw>]:BB:GNSS:SV:SELection:BEIDou:MAX <MaximumSVs>
[:SOURce<hw>]:BB:GNSS:SV:SELection:GALileo:MIN <MinimumSVs>
[:SOURce<hw>]:BB:GNSS:SV:SELection:GALileo:MAX <MaximumSVs>
[:SOURce<hw>]:BB:GNSS:SV:SELection:GLONass:MIN <MinimumSVs>
[:SOURce<hw>]:BB:GNSS:SV:SELection:GLONass:MAX <MaximumSVs>
[:SOURce<hw>]:BB:GNSS:SV:SELection:GPS:MIN <MinimumSVs>
[:SOURce<hw>]:BB:GNSS:SV:SELection:GPS:MAX <MaximumSVs>

Sets the minimum and maximum number of satellites per GNSS system that can be included in the satellite constellation.

Parameters:

<MaximumSVs> integer

Range: 0 to 24
*RST: 24

Example: See Example "Configuring the satellite's constellation" on page 81.

[:SOURce<hw>]:BB:GNSS:SV:SELection:BEIDou:ACTive?
[:SOURce<hw>]:BB:GNSS:SV:SELection:GALileo:ACTive?
[:SOURce<hw>]:BB:GNSS:SV:SELection:GLONass:ACTive?
[:SOURce<hw>]:BB:GNSS:SV:SELection:GPS:ACTive?

Queries the number of active satellites per GNSS system that are currently part of the satellite's constellation.

Return values:
<ActiveSVs> integer
Range: 0 to 24
*RST: 0

Example: See Example "Configuring the satellite's constellation" on page 81.

Usage: Query only

[:SOURce<hw>]:BB:GNSS:SV:SELection:BEIDou:AVAilable?
[:SOURce<hw>]:BB:GNSS:SV:SELection:GALileo:AVAilable?
[:SOURce<hw>]:BB:GNSS:SV:SELection:GLONass:AVAilable?
[:SOURce<hw>]:BB:GNSS:SV:SELection:GPS:AVAilable?

Queries the number of available satellites per GNSS system.

Return values:
<AvailableSVs> integer
Range: 0 to 40
*RST: 0

Example: See Example "Configuring the satellite's constellation" on page 81.

Usage: Query only

[:SOURce<hw>]:BB:GNSS:SVID:BEIDou:LIST?
[:SOURce<hw>]:BB:GNSS:SVID:GALileo:LIST?
[:SOURce<hw>]:BB:GNSS:SVID:GLONass:LIST?
[:SOURce<hw>]:BB:GNSS:SVID:GPS:LIST?

Queries the SV IDs of all valid satellites for the GNSS system.

Example: See Example "Configuring the satellite's constellation" on page 81.

Usage: Query only

Manual operation: See "Satellite's Constellation, SV ID" on page 25

[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:HEALthy <HealthyState>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:HEALthy <HealthyState>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:HEALthy <HealthyState>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:HEALthy <HealthyState>

Indicates if the selected SV ID is healthy or not.

Parameters:
<HealthyState> 0 | 1 | OFF | ON
1 = healthy satellite
The healthy state reflects the value of the corresponding healthy flag in the navigation message:

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:HEALth on page 134
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:L1Health on page 131
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:L2Health on page 132
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:L5Health on page 132
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:E1BDVS on page 136
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:E1BHS on page 136
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:E5BHS on page 137
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:HEALth on page 134
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:HEALth on page 134
The values are interdependent; changing one of them changes the other.

*RST: 1

Example: See Example "Configuring the satellite's constellation" on page 81.

Example:

```
SOURce1:BB:GNSS:SVID1:GPS:NMESsage:LNAV:EPHemeris:HEALth 0
SOURce1:BB:GNSS:SVID1:GPS:HEALthy?
// 1
SOURce1:BB:GNSS:SVID1:GPS:HEALthy 0
SOURce1:BB:GNSS:SVID1:GPS:NMESsage:LNAV:EPHemeris:HEALth?
// 63
```

Manual operation: See "Satellite's Constellation, SV ID" on page 25

[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:VISibility:STATe?
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:VISibility:STATe?
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:VISibility:STATe?
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:VISibility:STATe?

Queries if the selected SV ID is visible in the satellite constellation.

Return values:

<VisibilityState> 0 | 1 | OFF | ON

*RST: 0

Example: See Example "Configuring the satellite's constellation" on page 81.

Usage: Query only

Manual operation: See "Satellite's Constellation, SV ID" on page 25

[:SOURce<hw>]:BB:GNSS:SV:IMPort:BEIDou:FILE:CONStellation <Filename>
[:SOURce<hw>]:BB:GNSS:SV:IMPort:GALileo:FILE:CONStellation <Filename>
[:SOURce<hw>]:BB:GNSS:SV:IMPort:GLONass:FILE:CONStellation <Filename>
[:SOURce<hw>]:BB:GNSS:SV:IMPort:GPS:FILE:CONStellation <Filename>

Selects the file from that the satellites constellation and navigation data are extracted.

Table 7-9: Supported file types per GNSS system

GNSS system	*.txt	*.alm	*.al3	*.xml	*.alg	*.rnx	*.<xx>n
GPS	x	x	x			x	x
Galileo	x	x	x	x		x	x
GLONASS					x	x	x
BeiDou	x					x	x

Parameters:
<Filename> string
Filename, incl. file path and file extension.

Example: See Example "Loading historical data" on page 82.

[:SOURce<hw>]:BB:GNSS:SV:IMPort:BEIDou:UDSource <UseDiffSrcState>
[:SOURce<hw>]:BB:GNSS:SV:IMPort:GALileo:UDSource <UseDiffSrcState>
[:SOURce<hw>]:BB:GNSS:SV:IMPort:GLONass:UDSource <UseDiffSrcState>
[:SOURce<hw>]:BB:GNSS:SV:IMPort:GPS:UDSource <UseDiffSrcState>

Enables loading the dedicated files as source for the navigation data.

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

Example: See Example "Loading historical data" on page 82.

[:SOURce<hw>]:BB:GNSS:SV:IMPort:BEIDou:FILE:NMESsage <Filename>
[:SOURce<hw>]:BB:GNSS:SV:IMPort:GALileo:FILE:NMESsage <Filename>
[:SOURce<hw>]:BB:GNSS:SV:IMPort:GLONass:FILE:NMESsage <Filename>
[:SOURce<hw>]:BB:GNSS:SV:IMPort:GPS:FILE:NMESsage <Filename>

Selects the file from that the navigation data is extracted.

For overview of hte supported file types, see Table 7-9.

Parameters:
<Filename> string
Filename, incl. file path and file extension.

Example: See Example "Loading historical data" on page 82.

[:SOURce<hw>]:BB:GNSS:SV:IMPort:BEIDou:EXECute
[:SOURce<hw>]:BB:GNSS:SV:IMPort:GALileo:EXECute
[:SOURce<hw>]:BB:GNSS:SV:IMPort:GLONass:EXECute
[:SOURce<hw>]:BB:GNSS:SV:IMPort:GPS:EXECute

Triggers the import of constellation and navigation data from the selected files.

Example: See Example "Loading historical data" on page 82.

Usage: Event

7.6 Signals per Satellite

Example: Configuring the SV modulation control settings

```
SOURce1:BB:GNSS:PRESet
// Activate C/A code in L2 band.
SOURce1:BB:GNSS:L2Band:STATe 1
SOURce1:BB:GNSS:SYSTem:GPS:SIGNal:L2Band:CA:STATe 1
// Activate GPS SVID#11
SOURce1:BB:GNSS:SVID11:GPS:STATe 1
SOURce1:BB:GNSS:SVID11:GPS:PRESent 1


// Set Doppler shift [Hz] and initital code phase.
SOURce1:BB:GNSS:SVID1:GPS:DSHift 1146.05
SOURce1:BB:GNSS:SVID1:GPS:ICPHase 20459.99

// Set modulation control settings.
SOURce1:BB:GNSS:SVID1:GPS:SIGNal:L1Band:CA:DATA:PCODe:STATe 1
SOURce1:BB:GNSS:SVID1:GPS:SIGNal:L1Band:CA:DATA:NMESsage:STATe 1
SOURce1:BB:GNSS:SVID1:GPS:SIGNal:L1Band:CA:DATA:NMESsage:TYPE RND
SOURce1:BB:GNSS:SVID1:GPS:MCONtrol:COPY:SVID 5
SOURce1:BB:GNSS:SVID1:GPS:MCONtrol:COPY:EXECute

// Use a data pattern as the navigation message data source.
SOURce1:BB:GNSS:SVID1:GPS:SIGNal:L1Band:CA:DATA:NMESsage:TYPE PATT
SOURce1:BB:GNSS:SVID1:GPS:SIGNal:L1Band:CA:DATA:NMESsage:PATTern #H6,4
SOURce1:BB:GNSS:SVID1:GPS:SIGNal:L1Band:CA:DATA:NMESsage:TYPE DLIS
// Select the file gps_dl.dm_iqd.

// It is required, that the file is stored in the directory below.
SOUR:BB:GNSS:SVID1:GPS:SIGN:L1Band:CA:DATA:NMES:DSEL "C:\Users\gps_dl.dm_iqd"
```

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:STATe <SvState>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:STATe <SvState>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:STATe <SvState>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:STATe <SvState>

Activates the SV ID.

Parameters:

<SvState> 0 | 1 | OFF | ON

*RST: 0

Example: See Example "Configuring the SV modulation control settings" on page 88.

Manual operation: See "State (SV ID)" on page 26

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:PRESent <PresentInConst>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:PRESent <PresentInConst>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:PRESent <PresentInConst>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:PRESent <PresentInConst>

Includes the SV ID in the currents constellation.

Parameters:

<PresentInConst> 0 | 1 | OFF | ON

*RST: 1

Example: See Example "Configuring the SV modulation control settings" on page 88.

Manual operation: See "Present in Constellation" on page 27

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:FNUMber <FreqNum>

Queries the frequency number of the subcarrier.

Parameters:

<FreqNum> integer

Range: -7 to 13
*RST: 0

Example: `SOURce1:BB:GNSS:SVID15:GLONass:FNUMber?`

Manual operation: See "Frequency Number" on page 28

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:SIGNal:L5Band:E5B[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:SIGNal:L5Band:E5A[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:SIGNal:L1Band:E1OS[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:SIGNal:L2Band:CA[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:SIGNal:L1Band:CA[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:SIGNal:L5Band:B2I[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:SIGNal:L1Band:B1I[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L5Band:L5S[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L2Band:CA[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L2Band:L2C[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L1Band:CA[:STATe] <State>

Activates the selected signal.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: See Example "Configuring the SV modulation control settings" on page 88.

Manual operation: See "Signal State" on page 30

[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:DSHift <DopplerShift>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:DSHift <DopplerShift>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:DSHift <DopplerShift>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:DSHift <DopplerShift>

Sets the Doppler shift of the simulated signal of the selected satellite.

Parameters:

<DopplerShift> float

Range: -100E3 to 100E3
Increment: 1E-4
*RST: 0

Example: See Example "Configuring the SV modulation control settings" on page 88.

Manual operation: See "Doppler Shift" on page 28

[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:ICPHase <InitCodePhase>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:ICPHase <InitCodePhase>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:ICPHase <InitCodePhase>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:ICPHase <InitCodePhase>

Require arbitrary navigation data source.

Sets the initial code phase in chips.

Parameters:
<InitCodePhase> float

Range: 0 to 20459.99
Increment: 0.01
*RST: 0

Example: See Example "Configuring the SV modulation control settings" on page 88.

Manual operation: See "Initial Code Phase" on page 28

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:SIGNal:L5Band:E5B:DATA:NMESsage[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:SIGNal:L5Band:E5A:DATA:NMESsage[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:SIGNal:L1Band:E1OS:DATA:NMESsage[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:SIGNal:L2Band:CA:DATA:NMESsage[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:SIGNal:L1Band:CA:DATA:NMESsage[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:SIGNal:L5Band:B2I:DATA:NMESsage[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:SIGNal:L1Band:B1I:DATA:NMESsage[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L5Band:L5S:DATA:NMESsage[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L2Band:L2C:DATA:NMESsage[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L2Band:CA:DATA:NMESsage[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L1Band:CA:DATA:NMESsage[:STATe] <State>

In tracking mode, enables configuration of the navigation message parameters.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 1

Example: See Example "Configuring the SV modulation control settings" on page 88.

Manual operation: See "Nav Msg" on page 30

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:SIGNal:L5Band:E5B:PILot:PCODe[:STATe] <State>

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:SIGNal:L5Band:E5B:DATA:PCODe[:STATe] <State>

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:SIGNal:L5Band:E5A:PILot:PCODe[:STATe] <State>

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:SIGNal:L5Band:E5A:DATA:PCODe[:STATe] <State>

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:SIGNal:L1Band:E1OS:PILot:PCODe[:STATe] <State>

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:SIGNal:L1Band:E1OS:DATA:PCODe[:STATe] <State>

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:SIGNal:L2Band:CA:PILot:PCODe[:STATe] <State>

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:SIGNal:L2Band:CA:DATA:PCODe[:STATe] <State>

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:SIGNal:L1Band:CA:PILot:PCODe[:STATe] <State>

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:SIGNal:L1Band:CA:DATA:PCODe[:STATe] <State>

[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:SIGNal:L5Band:B2I:DATA:PCODe[:STATe] <State>

[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:SIGNal:L1Band:B1I:PILot:PCODe[:STATe] <State>

[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:SIGNal:L1Band:B1I:DATA:PCODe[:STATe] <State>

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L5Band:L5S:PILot:PCODe[:STATe] <State>

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L5Band:L5S:DATA:PCODe[:STATe] <State>

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L2Band:CA:PILot:PCODe[:STATe] <State>

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L2Band:CA:DATA:PCODe[:STATe] <State>

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L2Band:L2C:PILot:PCODe[:STATe] <State>

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L2Band:L2C:DATA:PCODe[:STATe] <State>

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L1Band:CA:PILot:PCODe[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L1Band:CA:DATA:PCODe[:STATe] <State>

Activates spreading by using the primary code.

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

Example: See Example "Configuring the SV modulation control settings" on page 88.

Manual operation: See "Primary Code" on page 30

[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:SIGNal:L5Band:B2I:DATA:SCODe[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:SIGNal:L1Band:B1I:PILot:SCODe[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:SIGNal:L1Band:B1I:DATA:SCODe[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:SIGNal:L5Band:E5B:PILot:SCODe[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:SIGNal:L5Band:E5B:DATA:SCODe[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:SIGNal:L5Band:E5A:PILot:SCODe[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:SIGNal:L5Band:E5A:DATA:SCODe[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:SIGNal:L1Band:E1OS:PILot:SCODe[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:SIGNal:L1Band:E1OS:DATA:SCODe[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L5Band:L5S:PILot:SCODe[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L5Band:L5S:DATA:SCODe[:STATe] <State>

Activates the secondary code in the data/pilot channel.

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

Example:
```
:SOURce1:BB:GNSS:SYSTem:GPS:STATe 1
:SOURce1:BB:GNSS:SVID1:GPS:SIGNal:L5Band:L5S 1
:SOURce1:BB:GNSS:SVID1:GPS:SIGNal:L5Band:L5S:PILot:SCODE 1
:SOURce1:BB:GNSS:SVID1:GPS:SIGNal:L5Band:L5S:DATA:SCODE 1
```

Example: See Example "Configuring the SV modulation control settings" on page 88.

Manual operation: See "Secondary Code" on page 30

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:SIGNal:L5Band:E5B:DATA:NMESsage:CONTrol <NavMsgControl>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:SIGNal:L5Band:E5A:DATA:NMESsage:CONTrol <NavMsgControl>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:SIGNal:L1Band:E1OS:DATA:NMESsage:CONTrol <NavMsgControl>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:SIGNal:L2Band:CA:DATA:NMESsage:CONTrol <NavMsgControl>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:SIGNal:L1Band:CA:DATA:NMESsage:CONTrol <NavMsgControl>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:SIGNal:L5Band:B2I:DATA:NMESsage:CONTrol <NavMsgControl>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:SIGNal:L1Band:B1I:DATA:NMESsage:CONTrol <NavMsgControl>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L5Band:L5S:DATA:NMESsage:CONTrol <NavMsgControl>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L2Band:CA:DATA:NMESsage:CONTrol <NavMsgControl>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L2Band:L2C:DATA:NMESsage:CONTrol <NavMsgControl>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L1Band:CA:DATA:NMESsage:CONTrol <NavMsgControl>

Defines whether the navigation message parameters can be changed or not.

Parameters:

<NavMsgControl> OFF | EDIT | AUTO | OFF | ON

OFF
Disables sending the navigation message.

ON
Enables configuration of the navigation message.

*RST: AUTO

Example: See Example "Configuring the SV modulation control settings" on page 88.

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:SIGNal:L5Band:E5B:DATA:NMESsage:TYPE <Data>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:SIGNal:L5Band:E5A:DATA:NMESsage:TYPE <Data>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:SIGNal:L1Band:E1OS:DATA:NMESsage:TYPE <Data>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:SIGNal:L2Band:CA:DATA:NMESsage:TYPE <Data>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:SIGNal:L1Band:CA:DATA:NMESsage:TYPE <Data>

[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:SIGNal:L5Band:B2I:DATA:NMESsage:TYPE <Data>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:SIGNal:L1Band:B1I:DATA:NMESsage:TYPE <Data>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L5Band:L5S:DATA:NMESsage:TYPE <Data>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L2Band:CA:DATA:NMESsage:TYPE <Data>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L2Band:L2C:DATA:NMESsage:TYPE <Data>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L1Band:CA:DATA:NMESsage:TYPE <Data>

Sets the data source used for the generation of the navigation message.

Parameters:

<Data> RNData

ZERO|ONE|PATTern|PN9|PN11|PN15|PN16|PN20|PN21|PN23|DLISt
Arbitrary data source.
Define the pattern and load an existing data list file with the commands:
`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L1Band:CA:DATA:NMESsage:PATTern`
`[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L1Band:CA:DATA:NMESsage:DSELect`

RNData
Summary indication for real navigation data.
Current navigation message type depends on the GNSS system and the RF band, e.g. for GPS in L1 RNData means LNAV.

ZNData
Zero navigation data
Sets the orbit and clock correction parameters in the broadcasted navigation message to zero.

*RST: RNData

Example: See Example "Configuring the SV modulation control settings" on page 88.

Manual operation: See "Nav Msg Type, Pattern, Data List" on page 31

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:SIGNal:L5Band:E5B:DATA:NMESsage:DSELect <DSelect>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:SIGNal:L5Band:E5A:DATA:NMESsage:DSELect <DSelect>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:SIGNal:L1Band:E1OS:DATA:NMESsage:DSELect <DSelect>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:SIGNal:L2Band:CA:DATA:NMESsage:DSELect <DSelect>

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:SIGNal:L1Band:CA:DATA:NMESsage:DSELect <DSelect>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:SIGNal:L5Band:B2I:DATA:NMESsage:DSELect <DSelect>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:SIGNal:L1Band:B1I:DATA:NMESsage:DSELect <DSelect>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L5Band:L5S:DATA:NMESsage:DSELect <DSelect>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L2Band:CA:DATA:NMESsage:DSELect <DSelect>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L2Band:L2C:DATA:NMESsage:DSELect <DSelect>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L1Band:CA:DATA:NMESsage:DSELect <DSelect>

Selects an existing data list file from the default directory or from the specific directory.

Parameters:

<DSelect> string

Filename incl. file extension or complete file path

Example: See Example "Configuring the SV modulation control settings" on page 88.

Manual operation: See "Nav Msg Type, Pattern, Data List" on page 31

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:SIGNal:L5Band:E5B:DATA:NMESsage:PATTern <Pattern>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:SIGNal:L5Band:E5A:DATA:NMESsage:PATTern <Pattern>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:SIGNal:L1Band:E1OS:DATA:NMESsage:PATTern <Pattern>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:SIGNal:L2Band:CA:DATA:NMESsage:PATTern <Pattern>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:SIGNal:L1Band:CA:DATA:NMESsage:PATTern <Pattern>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:SIGNal:L5Band:B2I:DATA:NMESsage:PATTern <Pattern>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:SIGNal:L1Band:B1I:DATA:NMESsage:PATTern <Pattern>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L5Band:L5S:DATA:NMESsage:PATTern <Pattern>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L2Band:CA:DATA:NMESsage:PATTern <Pattern>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L2Band:L2C:DATA:NMESsage:PATTern <Pattern>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:SIGNal:L1Band:CA:DATA:NMESsage:PATTern <Pattern>

Sets a bit pattern as data source.

Parameters:
<Pattern> 64 bits

Example: See Example "Configuring the SV modulation control settings" on page 88.

Manual operation: See "Nav Msg Type, Pattern, Data List" on page 31

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:SIGNal:L2Band:CA:DATA:MEANdering[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:SIGNal:L1Band:CA:DATA:MEANdering[:STATe] <State>

Enables meandering, i.e. doubling the data rate of a GLONASS satellite navigation signal.

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

Example: See `[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:SIGNal:L1Band:CA:DATA:TSEQuence[:STATe]` on page 100.

Manual operation: See "Meander Sequence" on page 32

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:SIGNal:L2Band:CA:DATA:TSEQuence[:STATe] <State>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:SIGNal:L1Band:CA:DATA:TSEQuence[:STATe] <State>

Enables the time signal component of GLONASS signals.

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

Example:
```
:SOURce1:BB:GNSS:SYSTem:GLONass:STATe 1
:SOURce1:BB:GNSS:SVID2:GLONass:SIGNal:L1Band:CA:DATA:MEANdering:STATe 1
:SOURce1:BB:GNSS:SVID2:GLONass:SIGNal:L1Band:CA:DATA:TSEQuence:STATe 1
```

Manual operation: See "Time Sequence" on page 32

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:MCONtrol:COPY:SVID <Svid>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:MCONtrol:COPY:SVID <Svid>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:MCONtrol:COPY:SVID <Svid>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:MCONtrol:COPY:SVID <Svid>

Sets the SV ID to that the configuration form the current satellite (`SVID<ch>`) is applied.

Both SV IDs belong to the same GNSS system.

Parameters:

<Svid> 1 | 2 | 3 | 5 | 4 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 19 | 18 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 124 | 125 | 126 | 127 | 128 | 129 | 130 | 131 | 132 | 133 | 134 | 135 | 136 | 137 | 138 | 139 | 140 | 141 | 142 | 143 | 144 | 145 | 146 | 147 | 148 | 149 | 150 | 151 | 152 | 153 | 154 | 155 | 156 | 157 | 158 | 159 | 160 | 161 | 162 | 163 | 164 | 165 | 166 | 167 | 168 | 169 | 170 | 171 | 172 | 173 | 174 | 175 | 176 | 177 | 178 | 179 | 180 | 181 | 182 | 183 | 184 | 185 | 186 | 187 | 188 | 189 | 190 | 191 | 192 | 193 | 194 | 195 | 196 | 197 | 198 | 199 | 200 | ALL

*RST: 1

Example: See Example "Configuring the SV modulation control settings" on page 88.

Manual operation: See "Copy Modulation Control Settings to,SV-ID" on page 32

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:MCONtrol:COPY:EXECute
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:MCONtrol:COPY:EXECute
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:MCONtrol:COPY:EXECute
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:MCONtrol:COPY:EXECute

Applies the configuration of the current satellite (`SVID<ch>:<GNSS system>`) to the satellite defined with the command `[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:MCONtrol:COPY:SVID`.

Both SV IDs belong to the same GNSS system.

Example: See Example "Configuring the SV modulation control settings" on page 88.

Usage: Event

Manual operation: See "Copy Modulation Control Settings to,SV-ID" on page 32

7.7 Navigation Message Configuration

Example: Setting the navigation message parameters as scaled and unscaled values

```
// using unscaled values
// commands with mnemonic UNSCaled apply
SOURce1:BB:GNSS:SSValues 0
SOURce1:BB:GNSS:SVID1:GPS:NMESsage:LNAV:EPHemeris:TOE:UNSCaled 28800

// using scaled values
// commands without mnemonic UNSCaled apply
SOURce1:BB:GNSS:SSValues 1
SOURce1:BB:GNSS:SVID1:GPS:NMESsage:LNAV:EPHemeris:TOE  1800
```

Example: Configuring Galileo Search-and-Rescue (SAR) data

```
********************************************************************************
Enable Galileo system and nav. message configuration of, e.g., space vehicle 6.
********************************************************************************
SOURce1:BB:GNSS:SYSTem:GALileo:STATe 1
SOURce1:BB:GNSS:SVID6:GALileo:SIGNal:L1Band:E1OS:DATA:NMESsage:CONTrol EDIT
********************************************************************************
Configure long return link message (RLM) data.
********************************************************************************
// Set for long RLM data SAR mode.
SOUR1:BB:GNSS:SVID6:GAL:NMES:INAV:EPH:SAR:MODE LRLM
// Set data bits of RLM parts 1 to 8.
SOUR1:BB:GNSS:SVID6:GAL:NMES:INAV:EPH:SAR:RLM1 0
SOUR1:BB:GNSS:SVID6:GAL:NMES:INAV:EPH:SAR:RLM2 1
SOUR1:BB:GNSS:SVID6:GAL:NMES:INAV:EPH:SAR:RLM3 2
SOUR1:BB:GNSS:SVID6:GAL:NMES:INAV:EPH:SAR:RLM4 3
SOUR1:BB:GNSS:SVID6:GAL:NMES:INAV:EPH:SAR:RLM5 4
SOUR1:BB:GNSS:SVID6:GAL:NMES:INAV:EPH:SAR:RLM6 5
SOUR1:BB:GNSS:SVID6:GAL:NMES:INAV:EPH:SAR:RLM7 6
SOUR1:BB:GNSS:SVID6:GAL:NMES:INAV:EPH:SAR:RLM8 1048575

********************************************************************************
Configure spare data.
********************************************************************************
// Set for spare data SAR mode.
SOUR1:BB:GNSS:SVID6:GAL:NMES:INAV:EPH:SAR:MODE SPARe
// Set the 21 bits of spare SAR data.
SOUR1:BB:GNSS:SVID6:GAL:NMES:INAV:EPH:SAR:SPARe 699050
```

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7.7.1 Orbit, Clock, System, Time Conversion and Ionospheric Errors

[:SOURce<hw>]:BB:GNSS:SSValues <ShowScaledValue>

Defines if the navigation message parameters are set as scaled or unscaled values and thus which subset of remote-control commands is used.

Parameters:

<ShowScaledValue> 0 | 1 | OFF | ON

0
Used are unscaled values
The `SOURce<hw>:BB:GNSS:...:UNSCaled` commands apply.

1
Used are scaled values
Commands without the mnemonic `UNSCaled` apply.

*RST: 0

Example:

```
SOURce1:BB:GNSS:SSValues 0
SOURce1:BB:GNSS:SVID1:GPS:NMESsage:LNAV:EPHemeris:TOE:UNSCaled
// 28800
SOURce1:BB:GNSS:SSValues 1
SOURce1:BB:GNSS:SVID1:GPS:NMESsage:LNAV:EPHemeris:TOE?
// 1800
```

Manual operation: See "Show Scaled Values" on page 38

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:IODNav <IODnav>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:IODNav <IODnav>

Sets the IODnav parameter.

Parameters:

<IODnav> integer

Range: 0 to 1023
*RST: 0

Manual operation: See "Galileo > Orbit" on page 41

[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:IODE <IODe>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:IODE <IODe>

Sets the issue of data, emphemeris.

Parameters:
<IODe> integer
Range: 0 to 255
*RST: 0

Manual operation: See "GPS > Orbit" on page 39

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:TOE:UNSCaled <Toe>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:TOE <Toe>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:TOE:UNSCaled <Toe>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:TOE <Toe>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:TOE:UNSCaled <Toe>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:TOE <Toe>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:TOE:UNSCaled <Toe>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:TOE <Toe>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:TOE:UNSCaled <Toe>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:TOE <Toe>

Sets the reference time of ephemeris.

Parameters:
<Toe> integer
*RST: 0

Manual operation: See "GPS > Orbit" on page 39

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:SQRA:UNSCaled <SqrtA>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:SQRA <SqrtA>

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:SQRA:UNSCaled <SqrtA>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:SQRA <SqrtA>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:SQRA:UNSCaled <SqrtA>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:SQRA <SqrtA>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:SQRA:UNSCaled <SqrtA>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:SQRA <SqrtA>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:SQRA:UNSCaled <SqrtA>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:SQRA <SqrtA>

Sets the square root of semi-major axis.

Parameters:
<SqrtA> integer
*RST: 0

Manual operation: See "GPS > Orbit" on page 39

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:ECCentricity:UNSCaled <Eccentricity>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:ECCentricity <Eccentricity>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:ECCentricity:UNSCaled <Eccentricity>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:ECCentricity <Eccentricity>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:ECCentricity:UNSCaled <Eccentricity>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:ECCentricity <Eccentricity>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:ECCentricity:UNSCaled <Eccentricity>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:ECCentricity <Eccentricity>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:ECCentricity:UNSCaled <Eccentricity>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:ECCentricity <Eccentricity>

Sets the eccentricity.

Parameters:
<Eccentricity> integer
*RST: 0

Manual operation: See "GPS > Orbit" on page 39

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:IZERo:UNSCaled <I0>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:IZERo <I0>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:IZERo:UNSCaled <I0>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:IZERo <I0>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:IZERo:UNSCaled <I0>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:IZERo <I0>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:IZERo:UNSCaled <I0>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:IZERo <I0>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:IZERo:UNSCaled <I0>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:IZERo <I0>

Sets the inclination angle.

Parameters:

<I0> integer

*RST: 0

Manual operation: See "GPS > Orbit" on page 39

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:OZERo:UNSCaled <Omega0>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:OZERo <Omega0>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:OZERo:UNSCaled <Omega0>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:OZERo <Omega0>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:OZERo:UNSCaled <Omega0>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:OZERo <Omega0>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:OZERo:UNSCaled <Omega0>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:OZERo <Omega0>

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:OZERo:UNSCaled <Omega0>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:OZERo <Omega0>

Sets the longitude of ascending node.

Parameters:
<Omega0> integer
*RST: 0

Manual operation: See "GPS > Orbit" on page 39

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:OMEGa:UNSCaled <Omega>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:OMEGa <Omega>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:OMEGa:UNSCaled <Omega>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:OMEGa <Omega>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:OMEGa:UNSCaled <Omega>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:OMEGa <Omega>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:OMEGa:UNSCaled <Omega>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:OMEGa <Omega>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:OMEGa:UNSCaled <Omega>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:OMEGa <Omega>

Sets the argument of perigee.

Parameters:
<Omega> integer
*RST: 0

Manual operation: See "GPS > Orbit" on page 39

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:MZERo:UNSCaled <M0>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:MZERo <M0>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:MZERo:UNSCaled <M0>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:MZERo <M0>

[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:MZERo:UNSCaled <M0>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:MZERo <M0>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:MZERo:UNSCaled <M0>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:MZERo <M0>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:MZERo:UNSCaled <M0>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:MZERo <M0>

Sets the mean anomaly.

Parameters:
<M0> integer
*RST: 0

Manual operation: See "GPS > Orbit" on page 39

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:IDOT:UNSCaled <Idot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:IDOT <Idot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:IDOT:UNSCaled <Idot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:IDOT <Idot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:IDOT:UNSCaled <Idot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:IDOT <Idot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:IDOT:UNSCaled <Idot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:IDOT <Idot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:IDOT:UNSCaled <Idot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:IDOT <Idot>

Sets the rate of inclination angle.

Parameters:
<Idot> integer
*RST: 0

Manual operation: See "GPS > Orbit" on page 39

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:ODOT:UNSCaled <OmegaDot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:ODOT <OmegaDot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:ODOT:UNSCaled <OmegaDot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:ODOT <OmegaDot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:ODOT:UNSCaled <OmegaDot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:ODOT <OmegaDot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:ODOT:UNSCaled <OmegaDot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:ODOT <OmegaDot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:ODOT:UNSCaled <OmegaDot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:ODOT <OmegaDot>

Sets the rate of right ascension.

Parameters:
<OmegaDot> integer
*RST: 0

Manual operation: See "GPS > Orbit" on page 39

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:DODot:UNSCaled <DeltaOmegaDot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:DODot <DeltaOmegaDot>

Sets the Rate of right ascension difference.

Parameters:
<DeltaOmegaDot> integer
*RST: 0

Manual operation: See "GPS > Orbit" on page 39

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:NDELta:UNSCaled <DeltaN>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:NDELta <DeltaN>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:NDELta:UNSCaled <DeltaN>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:NDELta <DeltaN>

[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:NDELta:UNSCaled <DeltaN>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:NDELta <DeltaN>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:NDELta:UNSCaled <DeltaN>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:NDELta <DeltaN>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:NDELta:UNSCaled <DeltaN>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:NDELta <DeltaN>

Sets the mean motion difference delta.

Parameters:
<DeltaN> integer
*RST: 0

Manual operation: See "GPS > Orbit" on page 39

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:DNDot:UNSCaled <DeltaNDot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:DNDot <DeltaNDot>

Sets the rate of mean motion difference delta.

Parameters:
<DeltaNDot> integer
*RST: 0

Manual operation: See "GPS > Orbit" on page 39

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:ADOT:UNSCaled <ADot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:ADOT <ADot>

Sets the change rate in semi-major axis.

Parameters:
<ADot> integer
*RST: 0

Manual operation: See "GPS > Orbit" on page 39

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:ADELta:UNSCaled <DeltaA>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:ADELta <DeltaA>

Sets the semi-major axis difference.

Parameters:
<DeltaA> integer
*RST: 0

Manual operation: See "GPS > Orbit" on page 39

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:TINTerval?

Queries the T_b-interval.

Return values:
<TbInterval> string

Usage: Query only

Manual operation: See "GLONASS > Orbit" on page 42

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:TOE?

Queries the reference epoch time t_b.

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 > Orbit" on page 42

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:TINDex:UNSCaled <TbIndex>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:TINDex <TbIndex>

Sets the t_b Index parameter.

Parameters:
<TblIndex> integer
*RST: 0

Manual operation: See "GLONASS > Orbit" on page 42

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:YN:UNSCaled <Yn>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:YN <Yn>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:ZN:UNSCaled <Zn>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:ZN <Zn>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:XN:UNSCaled <Xn>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:XN <Xn>

Sets the X_n, Y_n and Z_n coordinates in PZ-90.

Parameters:
<Xn> integer
*RST: 0

Manual operation: See "GLONASS > Orbit" on page 42

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:ZDN <ZnDot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:ZDN:UNSCaled <ZnDot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:YDN <YnDot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:YDN:UNSCaled <YnDot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:XDN:UNSCaled <XnDot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:XDN <XnDot>

Sets the velocity components X'_n, Y'_n and Z'_n.

Parameters:
<XnDot> integer
*RST: 0

Manual operation: See "GLONASS > Orbit" on page 42

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:YDDN:UNSCaled <YnDotDot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:YDDN <YnDotDot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:ZDDN:UNSCaled <ZnDotDot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:ZDDN <ZnDotDot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:XDDN:UNSCaled <XnDotDot>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:XDDN <XnDotDot>

Sets the moon and sun acceleration parameters X''_n, Y''_n and Z''_n.

Parameters:
<XnDotDot> integer
*RST: 0

Manual operation: See "GLONASS > Orbit" on page 42

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:CUC:UNSCaled <Cuc>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:CUC <Cuc>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:CUC:UNSCaled <Cuc>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:CUC <Cuc>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:CUC:UNSCaled <Cuc>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:CUC <Cuc>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:CUC:UNSCaled <Cuc>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:CUC <Cuc>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:CUC:UNSCaled <Cuc>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:CUC <Cuc>

Sets the cosine difference of latitude.

Parameters:
<Cuc> integer
*RST: 0

Manual operation: See "GPS > Orbit Perturbation" on page 40

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:CUS:UNSCaled <Cus>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:CUS <Cus>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:CUS:UNSCaled <Cus>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:CUS <Cus>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:CUS:UNSCaled <Cus>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:CUS <Cus>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:CUS:UNSCaled <Cus>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:CUS <Cus>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:CUS:UNSCaled <Cus>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:CUS <Cus>

Sets the sine difference of latitude.

Parameters:

<Cus> integer

*RST: 0

Manual operation: See "GPS > Orbit Perturbation" on page 40

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:CRC:UNSCaled <Crc>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:CRC <Crc>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:CRC:UNSCaled <Crc>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:CRC <Crc>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:CRC:UNSCaled <Crc>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:CRC <Crc>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:CRC:UNSCaled <Crc>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:CRC <Crc>

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:CRC:UNSCaled <Crc>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:CRC <Crc>

Sets the cosine difference of orbital radius.

Parameters:
<Crc> integer
*RST: 0

Manual operation: See "GPS > Orbit Perturbation" on page 40

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:CRS:UNSCaled <Crs>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:CRS <Crs>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:CRS:UNSCaled <Crs>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:CRS <Crs>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:CRS:UNSCaled <Crs>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:CRS <Crs>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:CRS:UNSCaled <Crs>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:CRS <Crs>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:CRS:UNSCaled <Crs>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:CRS <Crs>

Sets the sine difference of orbital radius.

Parameters:
<Crs> integer
*RST: 0

Manual operation: See "GPS > Orbit Perturbation" on page 40

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:CIC:UNSCaled <Cic>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:CIC <Cic>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:CIC:UNSCaled <Cic>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:CIC <Cic>

[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:CIC:UNSCaled <Cic>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:CIC <Cic>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:CIC:UNSCaled <Cic>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:CIC <Cic>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:CIC:UNSCaled <Cic>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:CIC <Cic>

Sets the sine difference of orbital radius.

Parameters:
<Cic> integer
*RST: 0

Manual operation: See "GPS > Orbit Perturbation" on page 40

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:CIS:UNSCaled <Cis>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:CIS <Cis>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:CIS:UNSCaled <Cis>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:CIS <Cis>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:CIS:UNSCaled <Cis>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:CIS <Cis>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:CIS:UNSCaled <Cis>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:CIS <Cis>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:CIS:UNSCaled <Cis>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:CIS <Cis>

Sets the sine difference of inclination.

Parameters:
<Cis> integer
*RST: 0

Manual operation: See "GPS > Orbit Perturbation" on page 40

[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:IODC <Iodc>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:IODC <Iodc>

Sets the issue of data, clock (IODC).

Parameters:

<Iodc> integer
Range: 0 to 1023
*RST: 0

Manual operation: See "GPS > Clock" on page 45

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:CCORrection:TOC:UNSCaled <Toc>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:CCORrection:TOC <Toc>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:CCORrection:TOC:UNSCaled <Toc>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:CCORrection:TOC <Toc>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:CCORrection:TOC:UNSCaled <Toc>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:CCORrection:TOC <Toc>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:CCORrection:TOC:UNSCaled <Toc>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:CCORrection:TOC <Toc>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:CCORrection:TOC:UNSCaled <Toc>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:CCORrection:TOC <Toc>

Sets the reference time of clock.

Parameters:

<Toc> integer
*RST: 0

Manual operation: See "GPS > Clock" on page 45

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:CCORrection:AF<s2us0>:UNSCaled <Af>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:CCORrection:AF<s2us0> <Af>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:CCORrection:AF<s2us0>:UNSCaled <Af>

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:CCORrection:AF<s2us0> <Af>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:CCORrection:AF<s2us0>:UNSCaled <Af>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:CCORrection:AF<s2us0> <Af>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:CCORrection:AF<s2us0>:UNSCaled <Af>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:CCORrection:AF<s2us0> <Af>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:CCORrection:AF<s2us0>:UNSCaled <Af>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:CCORrection:AF<s2us0> <Af>

Sets the parameter AF 0 to 2.

Suffix:
AF<s2us0> 0 to 2 (GPS, Galileo, BeiDou)

Parameters:
<Af> integer
*RST: 0

Manual operation: See "GPS > Clock" on page 45

[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:CCORrection:TGD<s2us>:UNSCaled <Tgd>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:CCORrection:TGD<s2us> <Tgd>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:CCORrection:TGD:UNSCaled <Tgd>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:CCORrection:TGD <Tgd>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:CCORrection:TGD:UNSCaled <Tgd>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:CCORrection:TGD <Tgd>

Sets the group delay.

Parameters:
<Tgd> integer
Range: -128 to 127
*RST: 0

Manual operation: See "GPS > Clock" on page 45

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:CCORection:ISC:L2C <IscL2C>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:CCORection:ISC:L2C:UNSCaled <IscL2C>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:CCORection:ISC:L5I <IscL5I5>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:CCORection:ISC:L5I:UNSCaled <IscL5I5>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:CCORection:ISC:L5Q <IscL5Q5>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:CCORection:ISC:L5Q:UNSCaled <IscL5Q5>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:CCORection:ISC:L1CA:UNSCaled <IscL1CA>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:CCORection:ISC:L1CA <IscL1CA>

Sets the inter-signal corrections (ISC) parameters of the GPS CNAV message.

Parameters:

<IscL1CA> integer

Range: -4096 to 4095
*RST: 0

Manual operation: See "GPS > Clock" on page 45

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:CCORrection:BGD:UNSCaled <Tgd>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:CCORrection:BGD <Tgd>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:CCORrection:BGD:UNSCaled <Tgd>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:CCORrection:BGD <Tgd>

Sets the broadcast group delay.

Parameters:

<Tgd> integer

Range: -128 to 127
*RST: 0

Manual operation: See "Galileo > Clock" on page 45

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:CCORrection:TAUN:UNScaled <Tau>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:CCORrection:TAUN <Tau>

Sets the parameter T_n (~ $-a_{f0}$)

Parameters:
<Tau> integer
*RST: 0

Manual operation: See "GLONASS > Clock" on page 46

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:CCORrection:GAMN:UNSCaled <GammaN>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:CCORrection:GAMN <GammaN>

Sets the parameter Γ_n ($\sim a_{f1}$).

Parameters:
<GammaN> integer
*RST: 0

Manual operation: See "GLONASS > Clock" on page 46

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:CCORrection:DTAU:UNSCaled <Tgd>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:CCORrection:DTAU <Tgd>

Sets the DELTA T_n ($\sim T_{gd}$).

Parameters:
<Tgd> integer
Range: -128 to 127
*RST: 0

Manual operation: See "GLONASS > Clock" on page 46

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:ALERt <AlertFlag>

Sets the alert flag.

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

Manual operation: See "GPS > Additional Data" on page 51

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:L1Health <L1Health>

Sets the L1 health flag.

Parameters:
<L1Health> 0 | 1 | OFF | ON
*RST: 0

Manual operation: See "GPS > Additional Data" on page 51

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:L2Health <L2Health>

Sets the L2 health flag.

Parameters:
<L2Health> 0 | 1 | OFF | ON
*RST: 0

Manual operation: See "GPS > Additional Data" on page 51

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:L5Health <L5Health>

Sets the L5 health flag.

Parameters:
<L5Health> 0 | 1 | OFF | ON
*RST: 0

Manual operation: See "GPS > Additional Data" on page 51

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:URA <URA>

Sets the ED accuracy index.

Parameters:
<URA> integer
Range: 0 to 15
*RST: 0

Manual operation: See "GPS > Additional Data" on page 51

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:NED0 <NED0>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:NED1 <NED1>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:NED2 <NED0>

Sets the NED accuracy index (`NED0`), accuracy change indexs (`NED1`) and accuracy change rate index (`NED2`).

Parameters:
<NED0> integer
Range: 0 to 7
*RST: 0

Manual operation: See "GPS > Additional Data" on page 51

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:WNOP <WNOP>

Sets the data predict week number.

Parameters:
<WNOP> integer
Range: 0 to 8191
*RST: 0

Manual operation: See "GPS > Additional Data" on page 51

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:TOP:UNSCaled <Top>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:TOP <Top>

Sets the data predict time of week.

Parameters:
<Top> integer
*RST: 0

Manual operation: See "GPS > Additional Data" on page 51

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:ISFLag <IsFlag>

Sets the integrity status flag.

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

Manual operation: See "GPS > Additional Data" on page 51

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:CNAV:EPHemeris:L2CPhasing <L2CPhasing>

Sets the L2C phasing.

Parameters:
<L2CPhasing> 0 | 1 | OFF | ON
*RST: 0

Manual operation: See "GPS > Additional Data" on page 51

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:HEALth <SvHealt>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:HEALth <SvHealt>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:HEALth <SvHealt>

Sets the SV health.

See also `[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:HEALthy` on page 85.

Parameters:

<SvHealt> integer

Range: 0 to 63
*RST: 0

Manual operation: See "GPS > Additional Data" on page 51

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:URA <URA>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:BEIDou:NMESsage:DNAV:EPHemeris:URA <URA>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:URA <URA>

Sets the user range accuracy index.

Parameters:

<URA> integer

Range: 0 to 15
*RST: 0

Manual operation: See "GPS > Additional Data" on page 51

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:ASFLag <AntiSpoofFlag>

Parameters:

<AntiSpoofFlag> 0 | 1 | OFF | ON

*RST: 0

Manual operation: See "GPS > Additional Data" on page 51

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:SVConfig <AsFlag>

Sets the SV config.

Parameters:
<AsFlag> integer
Range: 0 to 7
*RST: 0

Manual operation: See "GPS > Additional Data" on page 51

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:CLTMode <CodeOnL2Mode>

Sets the code on L2.

Parameters:
<CodeOnL2Mode> REServed | PCODe | CACode
*RST: PCODe

Manual operation: See "GPS > Additional Data" on page 51

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:LTPData <L2P>

Sets the L2 P data flag.

Parameters:
<L2P> 0 | 1 | OFF | ON
*RST: 0

Manual operation: See "GPS > Additional Data" on page 51

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:FIFLag <FitInterval>

Sets the fit interval flag.

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

Manual operation: See "GPS > Additional Data" on page 51

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:AODO <Aodo>

Sets the age of date offset.

Parameters:
<Aodo> integer
Range: 0 to 31
*RST: 0

Manual operation: See "GPS > Additional Data" on page 51

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GPS:NMESsage:LNAV:EPHemeris:SF1Reserved<s2us> <Subfr1Reserved>

Sets the subframe 1 (reserved 1 to 4).

Parameters:

<Subfr1Reserved> integer

Range: 0 to 67108864
*RST: 0

Manual operation: See "GPS > Additional Data" on page 51

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:EPHemeris:SISA <URA>
[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:SISA <URA>

Sets the signal in space accuracy index.

Parameters:

<URA> integer

Range: 0 to 15
*RST: 0

Manual operation: See "Galileo > Additional Data" on page 52

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:E1BDVS <DvsE1b>

Sets the data validity status - $E1B_{DVS}$.

Parameters:

<DvsE1b> integer

Range: -1 to 1
*RST: 0

Manual operation: See "Galileo > Additional Data" on page 52

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:E1BHS <HsE1b>

Sets the signal health status - $E1B_{HS}$ parameter.

Parameters:

<HsE1b> integer

Range: -1 to 1
*RST: 0

Manual operation: See "Galileo > Additional Data" on page 52

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:E5BDVS <DvsE5b>

Sets the data validity status - $E5b_{DVS}$ parameter.

Parameters:

<DvsE5b> integer

Range: -1 to 1
*RST: 0

Manual operation: See "Galileo > Additional Data" on page 52

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:E5BHS <HsE5b>

Sets the signal health status - $E5b_{HS}$ parameter.

Parameters:

<HsE5b> integer

Range: -1 to 1
*RST: 0

Manual operation: See "Galileo > Additional Data" on page 52

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:SAR:MODE <SarMode>

Sets the Search-and-Rescue Service (SAR) mode for SAR message generation. SAR messages are specified by the 22-bit SAR field in the I/NAV navigation message.

For more information, refer to specification Galileo OS SIS ICD.

Parameters:

<SarMode> SPARe | SRLM | LRLM

SPARe
Generates spare SAR data.
The start bit is set to one. SAR receivers interpret the following 21 spare bits as SAR non-relevant data.

SRLM/LRLM
Generates SAR data for nominal mode operation in the Galileo E1-B component. For the SAR message format, you can select between short return link message (SRLM) and long return link message (LRLM).
For the real navigation message, the Short/Long RLM Identifier, in the SAR data field is set accordingly (0 = Short RLM, 1 = Long RLM).

*RST: SPARe

Example: See Example "Configuring Galileo Search-and-Rescue (SAR) data" on page 102.

Manual operation: See "Galileo > Additional Data" on page 52

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:SAR:RLM<s2us> <SarRlmData>

Sets the 20-bit Search-and-Rescue Service (SAR) return link message (RLM) data for nominal mode operation.

For more information, refer to specification Galileo OS SIS ICD.

Suffix:
<s2us> 1 to 4/8
Selects the short/long RLM part.

Parameters:
<SarRlmData> integer
Range: 0 to 1048575
*RST: 0

Example: See Example "Configuring Galileo Search-and-Rescue (SAR) data" on page 102.

Manual operation: See "Galileo > Additional Data" on page 52

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:INAV:EPHemeris:SAR:SPARe <SpareData>

Sets the 21-bit Search-and-Rescue Service (SAR) spare data.

For more information, refer to specification Galileo OS SIS ICD.

Parameters:
<SpareData> integer
Range: 0 to 2097151
*RST: 0

Example: See Example "Configuring Galileo Search-and-Rescue (SAR) data" on page 102.

Manual operation: See "Galileo > Additional Data" on page 52

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:E5ADVS <DvsE5a>

Sets the data validity status - $E5a_{DVS}$.

Parameters:
<DvsE5a> integer
Range: -1 to 1
*RST: 0

Manual operation: See "Galileo > Additional Data" on page 52

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GALileo:NMESsage:FNAV:E5AHS <HsE5a>

Sets the signal health status - $E5a_{HS}$ parameter.

Parameters:

<HsE5a> integer

Range: -1 to 1
*RST: 0

Manual operation: See "Galileo > Additional Data" on page 52

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:SEType <SatType>

Sets the satellite ephemeris type - M parameter.

Parameters:

<SatType> GLO | GLOM

*RST: GLOM

Manual operation: See "GLONASS > Additional Data" on page 53

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:P <P>

Sets the satellite operation mode - P parameter.

Parameters:

<P> integer

Range: 0 to 3
*RST: 0

Manual operation: See "GLONASS > Additional Data" on page 53

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:AOEP <AgeOfEphemeris>

Sets the age of ephemeris page - P1 parameter.

Parameters:

<AgeOfEphemeris> A30M | A45M | A60M

*RST: A30M

Manual operation: See "GLONASS > Additional Data" on page 53

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:EPHemeris:TALignment <TbAlignment>

Sets the t_b alignment - P2.

Parameters:
<TbAlignment> EVEN | ODD
*RST: EVEN

Manual operation: See "GLONASS > Additional Data" on page 53

[:SOURce<hw>]:BB:GNSS:SVID<ch>:GLONass:NMESsage:NAV:CCORrection:EN <En>

Sets the E_n parameter.

Parameters:
<En> integer
Range: 0 to 31
*RST: 0

Manual operation: See "GLONASS > Additional Data" on page 53

[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:FNAV:TIME:CONVersion:UTC:WNOT <WNot>
[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:INAV:TIME:CONVersion:UTC:WNOT <WNot>
[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:UTC:WNOT <WNot>
[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:UTC:WNOT <WNot>
[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:LNAV:TIME:CONVersion:UTC:WNOT <WNot>

Sets the parameter W_{Not}.

Parameters:
<WNot> integer
Range: 0 to 529947
*RST: 0

Manual operation: See "GPS > Time Conversion" on page 47

[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:FNAV:TIME:CONVersion:UTC:TOT:UNSCaled <Tot>
[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:FNAV:TIME:CONVersion:UTC:TOT <Tot>
[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:INAV:TIME:CONVersion:UTC:TOT:UNSCaled <Tot>
[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:INAV:TIME:CONVersion:UTC:TOT <Tot>
[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:UTC:TOT:UNSCaled <Tot>
[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:UTC:TOT <Tot>

[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:UTC:TOT:UNSCaled <Tot>
[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:UTC:TOT <Tot>
[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:LNAV:TIME:CONVersion:UTC:TOT:UNSCaled <Tot>
[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:LNAV:TIME:CONVersion:UTC:TOT <Tot>

Sets the parameter T_{ot}.

Parameters:
<Tot> integer
Range: 0 to 65535

Manual operation: See "GPS > Time Conversion" on page 47

[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:UTC:ATWO:UNSCaled <A2>
[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:UTC:ATWO <A2>

Sets the A_2 parameter.

Parameters:
<A2> integer
Range: -64 to 63

Manual operation: See "GPS > Time Conversion" on page 47

[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:FNAV:TIME:CONVersion:UTC:AONE:UNSCaled <A1>
[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:FNAV:TIME:CONVersion:UTC:AONE <A1>
[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:INAV:TIME:CONVersion:UTC:AONE:UNSCaled <A1>
[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:INAV:TIME:CONVersion:UTC:AONE <A1>
[:SOURce<hw>]:BB:GNSS:SV:GLONass:NMESsage:NAV:TIME:CONVersion:UTC:AONE:UNSCaled <A1>
[:SOURce<hw>]:BB:GNSS:SV:GLONass:NMESsage:NAV:TIME:CONVersion:UTC:AONE <A1>
[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:UTC:AONE:UNSCaled <A1>
[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:UTC:AONE <A1>
[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:UTC:AONE:UNSCaled <A1>
[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:UTC:AONE <A1>

[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:LNAV:TIME:CONVersion:UTC:AONE:UNSCaled <A1>
[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:LNAV:TIME:CONVersion:UTC:AONE <A1>

Sets the parameter A_1.

Parameters:

<A1> integer
Range: -4096 to 4095

Manual operation: See "GPS > Time Conversion" on page 47

[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:FNAV:TIME:CONVersion:UTC:AZERo:UNSCaled <A0>
[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:FNAV:TIME:CONVersion:UTC:AZERo <A0>
[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:INAV:TIME:CONVersion:UTC:AZERo:UNSCaled <A0>
[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:INAV:TIME:CONVersion:UTC:AZERo <A0>
[:SOURce<hw>]:BB:GNSS:SV:GLONass:NMESsage:NAV:TIME:CONVersion:UTC:AZERo:UNSCaled <A0>
[:SOURce<hw>]:BB:GNSS:SV:GLONass:NMESsage:NAV:TIME:CONVersion:UTC:AZERo <A0>
[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:UTC:AZERo:UNSCaled <A0>
[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:UTC:AZERo <A0>
[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:UTC:AZERo:UNSCaled <A0>
[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:UTC:AZERo <A0>
[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:LNAV:TIME:CONVersion:UTC:AZERo:UNSCaled <A0>
[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:LNAV:TIME:CONVersion:UTC:AZERo <A0>

Sets the parameter A_0.

Parameters:

<A0> integer
Range: -32768 to 32767

Manual operation: See "GPS > Time Conversion" on page 47

[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:FNAV:TIME:CONVersion:GPS:WNOT <WNot>
[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:INAV:TIME:CONVersion:GPS:WNOT <WNot>

Sets the W_{Not} parameter.

Parameters:
<WNot> integer
Range: 0 to 529947
*RST: 0

Manual operation: See "Galileo > Time Conversion" on page 48

[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:GPS:TOT:UNSCaled <Tot>
[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:GPS:TOT <Tot>
[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:FNAV:TIME:CONVersion:GPS:TOT:UNSCaled <Tot>
[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:FNAV:TIME:CONVersion:GPS:TOT <Tot>
[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:INAV:TIME:CONVersion:GPS:TOT:UNSCaled <Tot>
[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:INAV:TIME:CONVersion:GPS:TOT <Tot>

Sets the T_{ot} parameter.

Parameters:
<Tot> integer
Range: 0 to 65535

Manual operation: See "Galileo > Time Conversion" on page 48

[:SOURce<hw>]:BB:GNSS:SV:GLONass:NMESsage:NAV:TIME:CONVersion:GPS:AZERo <A0>
[:SOURce<hw>]:BB:GNSS:SV:GLONass:NMESsage:NAV:TIME:CONVersion:GPS:AZERo:UNSCaled <A0>
[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:FNAV:TIME:CONVersion:GPS:AZERo:UNSCaled <A0>
[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:FNAV:TIME:CONVersion:GPS:AZERo <A0>
[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:INAV:TIME:CONVersion:GPS:AZERo:UNSCaled <A0>
[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:INAV:TIME:CONVersion:GPS:AZERo <A0>

[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:GPS:AZERo:UNSCaled <A0>
[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:GPS:AZERo <A0>

Sets the A_0 parameter.

Parameters:
<A0> integer
Range: -32768 to 32767

Manual operation: See "BeiDou > Time Conversion" on page 49

[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:FNAV:TIME:CONVersion:GPS:AONE:UNSCaled <A1>
[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:FNAV:TIME:CONVersion:GPS:AONE <A1>
[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:INAV:TIME:CONVersion:GPS:AONE:UNSCaled <A1>
[:SOURce<hw>]:BB:GNSS:SV:GALileo:NMESsage:INAV:TIME:CONVersion:GPS:AONE <A1>
[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:GPS:AONE:UNSCaled <A1>
[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:GPS:AONE <A1>

Sets the A_1 parameter.

Parameters:
<A1> integer
Range: -4096 to 4095

Manual operation: See "BeiDou > Time Conversion" on page 49

[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:GALileo:WNOT <WNot>

Sets the W_{not} parameter.

Parameters:
<WNot> integer
Range: 0 to 529947
*RST: 0

Manual operation: See "GPS > Time Conversion" on page 47

[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:GALileo:TOT:UNSCaled <Tot>
[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:GALileo:TOT <Tot>

[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:GALileo:TOT:UNSCaled <Tot>
[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:GALileo:TOT <Tot>

Sets the T_{ot} parameter.

Parameters:
<Tot> integer
Range: 0 to 65535

Manual operation: See "GPS > Time Conversion" on page 47

[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:GALileo:AZERo:UNSCaled <A0>
[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:GALileo:AZERo <A0>
[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:GALileo:AZERo:UNSCaled <A0>
[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:GALileo:AZERo <A0>

Sets the A_0 parameter.

Parameters:
<A0> integer
Range: -32768 to 32767

Manual operation: See "GPS > Time Conversion" on page 47

[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:GALileo:AONE:UNSCaled <A1>
[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:GALileo:AONE <A1>
[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:GALileo:AONE:UNSCaled <A1>
[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:GALileo:AONE <A1>

Sets the A_1 parameter.

Parameters:
<A1> integer
Range: -4096 to 4095

Manual operation: See "GPS > Time Conversion" on page 47

[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:GALileo:ATWO:UNSCaled <A2>
[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:GALileo:ATWO <A2>

Sets the A_2 parameter.

Parameters:
<A2> integer
Range: -64 to 63

Manual operation: See "GPS > Time Conversion" on page 47

[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:GLONass:WNOT <WNot>

Sets the W_{Not} parameter.

Parameters:
<WNot> integer
Range: 0 to 529947
*RST: 0

Manual operation: See "GPS > Time Conversion" on page 47

[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:GLONass:TOT:UNSCaled <Tot>
[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:GLONass:TOT <Tot>
[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:GLONass:TOT:UNSCaled <Tot>
[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:GLONass:TOT <Tot>

Sets the T_{ot} parameter.

Parameters:
<Tot> integer
Range: 0 to 65535

Manual operation: See "GPS > Time Conversion" on page 47

[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:GLONass:AZERo:UNSCaled <A0>
[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:GLONass:AZERo <A0>

[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:GLONass:AZERo:UNSCaled <A0>
[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:GLONass:AZERo <A0>

Parameters:

<A0> integer

Range: -32768 to 32767

Manual operation: See "GPS > Time Conversion" on page 47

[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:GLONass:AONE:UNSCaled <A1>
[:SOURce<hw>]:BB:GNSS:SV:BEIDou:NMESsage:DNAV:TIME:CONVersion:GLONass:AONE <A1>
[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:GLONass:AONE:UNSCaled <A1>
[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:GLONass:AONE <A1>

Sets the A_1 parameter.

Parameters:

<A1> integer

Range: -4096 to 4095

Manual operation: See "GPS > Time Conversion" on page 47

[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:GLONass:ATWO:UNSCaled <A2>
[:SOURce<hw>]:BB:GNSS:SV:GPS:NMESsage:CNAV:TIME:CONVersion:GLONass:ATWO <A2>

Sets the A_2 parameter.

Parameters:

<A2> integer

Range: -64 to 63

Manual operation: See "GPS > Time Conversion" on page 47

[:SOURce<hw>]:BB:GNSS:ATMospheric:BEIDou[:NMESsage:DNAV]:IONospheric:ALPHa<ch0>:UNSCaled <AlphaUnscaled>
[:SOURce<hw>]:BB:GNSS:ATMospheric:BEIDou[:NMESsage:DNAV]:IONospheric:ALPHa<ch0> <Alpha>
[:SOURce<hw>]:BB:GNSS:ATMospheric:GPS[:NMESsage:CNAV]:IONospheric:ALPHa<ch0>:UNSCaled <AlphaUnscaled>
[:SOURce<hw>]:BB:GNSS:ATMospheric:GPS[:NMESsage:CNAV]:IONospheric:ALPHa<ch0> <Alpha>

[:SOURce<hw>]:BB:GNSS:ATMospheric:GPS[:NMESsage:LNAV]:IONospheric:ALPHa<ch0>:UNSCaled <AlphaUnscaled>
[:SOURce<hw>]:BB:GNSS:ATMospheric:GPS[:NMESsage:LNAV]:IONospheric:ALPHa<ch0> <Alpha>

Sets the parameters alpha_0 to alpha_3 of the satellite's navigation message.

Suffix:
<ch0> 0 to 3

Parameters:
<Alpha> integer
Range: -128 to 127
*RST: 0

Manual operation: See "GPS > Ionosphere" on page 37

[:SOURce<hw>]:BB:GNSS:ATMospheric:GALileo[:NMESsage:FNAV]:IONospheric:AI<ch0>:UNSCaled <AiUnscaled>
[:SOURce<hw>]:BB:GNSS:ATMospheric:GALileo[:NMESsage:FNAV]:IONospheric:AI<ch0> <A_i>
[:SOURce<hw>]:BB:GNSS:ATMospheric:GALileo[:NMESsage:INAV]:IONospheric:AI<ch0>:UNSCaled <AiUnscaled>
[:SOURce<hw>]:BB:GNSS:ATMospheric:GALileo[:NMESsage:INAV]:IONospheric:AI<ch0> <A_i>

Sets the parameters effective ionization level 1st to 3rd order of the satellite's navigation message.

Parameters:
<A_i> integer
Range: a_i0 (0 to 2047), a_i1 (-1024 to 1023), a_i2 (-8192 to 8191)
*RST: 0

Manual operation: See "Galileo > Ionosphere" on page 38

[:SOURce<hw>]:BB:GNSS:ATMospheric:BEIDou[:NMESsage:DNAV]:IONospheric:BETA<ch0>:UNSCaled <BetaUnscaled>
[:SOURce<hw>]:BB:GNSS:ATMospheric:BEIDou[:NMESsage:DNAV]:IONospheric:BETA<ch0> <Beta>
[:SOURce<hw>]:BB:GNSS:ATMospheric:GPS[:NMESsage:CNAV]:IONospheric:BETA<ch0>:UNSCaled <BetaUnscaled>
[:SOURce<hw>]:BB:GNSS:ATMospheric:GPS[:NMESsage:CNAV]:IONospheric:BETA<ch0> <Beta>
[:SOURce<hw>]:BB:GNSS:ATMospheric:GPS[:NMESsage:LNAV]:IONospheric:BETA<ch0>:UNSCaled <BetaUnscaled>
[:SOURce<hw>]:BB:GNSS:ATMospheric:GPS[:NMESsage:LNAV]:IONospheric:BETA<ch0> <Beta>

Sets the parameters beta_0 to beta_3 of the satellite's navigation message.

Suffix:
<ch0> 0 to 3

Parameters:
<Beta> integer
Range: -128 to 127
*RST: 0

Manual operation: See "GPS > Ionosphere" on page 37

[:SOURce<hw>]:BB:GNSS:ATMospheric:GALileo[:NMESsage:FNAV]:IONospheric:SF<ch> <SF>
[:SOURce<hw>]:BB:GNSS:ATMospheric:GALileo[:NMESsage:INAV]:IONospheric:SF<ch> <SF>

Sets the parameters ionospheric disturbance flag for region 1 to 5 of the satellite's navigation message.

Suffix:
<ch> 1 to 5

Parameters:
<SF> integer
Range: 0 to 1
*RST: 0

Manual operation: See "Galileo > Ionosphere" on page 38

7.8 Marker Commands

Example: Configure and enable marker signals

```
SOURce1:BB:GNSS:TRIGger:OUTPut1:MODE REST
SOURce1:BB:GNSS:TRIGger:OUTPut1:MODE PPS
SOURce1:BB:GNSS:TRIGger:OUTPut1:PULSe:WIDTh 0.000002
SOURce1:BB:GNSS:TRIGger:OUTPut1:PULSe:WIDTh 0.000003
SOURce1:BB:GNSS:TRIGger:OUTPut1:PULSe:WIDTh 0.000004
SOURce1:BB:GNSS:TRIGger:OUTPut1:PULSe:WIDTh 0.000005
SOURce1:BB:GNSS:TRIGger:OUTPut1:MODE PATT
SOURce1:BB:GNSS:TRIGger:OUTPut1:MODE RAT
SOURce1:BB:GNSS:TRIGger:OUTPut1:MODE PULS
SOURce1:BB:GNSS:TRIGger:OUTPut1:MODE PP2S
SOURce1:BB:GNSS:TRIGger:OUTPut1:MODE REST
SOURce1:BB:DM:TRIGger:OUTPut1:MODE PULS
SOURce1:BB:DM:TRIGger:OUTPut1:MODE PATT
SOURce1:BB:DM:TRIGger:OUTPut1:MODE RAT
```

```
SOURce1:BB:GNSS:TRIGger:OUTPut2:MODE PATT
SOURce1:BB:GNSS:TRIGger:OUTPut2:MODE RAT
SOURce1:BB:GNSS:TRIGger:OUTPut2:ONTime 0.000001001
SOURce1:BB:GNSS:TRIGger:OUTPut2:ONTime 0.000001002
SOURce1:BB:GNSS:TRIGger:OUTPut2:ONTime 0.000001003
SOURce1:BB:GNSS:TRIGger:OUTPut2:ONTime 0.000001004
SOURce1:BB:GNSS:TRIGger:OUTPut2:ONTime 0.000001005
SOURce1:BB:GNSS:TRIGger:OUTPut2:ONTime 0.000001006
SOURce1:BB:GNSS:TRIGger:OUTPut2:OFFTime 0.000001001
SOURce1:BB:GNSS:TRIGger:OUTPut2:OFFTime 0.000001002
SOURce1:BB:GNSS:TRIGger:OUTPut2:OFFTime 0.000001003
SOURce1:BB:GNSS:TRIGger:OUTPut2:OFFTime 0.000001004
SOURce1:BB:GNSS:TRIGger:OUTPut2:OFFTime 0.000001005
SOURce1:BB:GNSS:TRIGger:OUTPut2:OFFTime 0.000001006

SOURce1:BB:GNSS:TRIGger:OUTPut3:MODE REST
SOURce1:BB:GNSS:TRIGger:OUTPut3:MODE PPS
SOURce1:BB:GNSS:TRIGger:OUTPut3:PULSe:WIDTh 0.000001004
SOURce1:BB:GNSS:TRIGger:OUTPut3:PULSe:WIDTh 0.000001005
SOURce1:BB:GNSS:TRIGger:OUTPut3:PULSe:WIDTh 0.000001006
SOURce1:BB:GNSS:TRIGger:OUTPut3:PULSe:WIDTh 0.000001007
SOURce1:BB:GNSS:TRIGger:OUTPut3:PULSe:WIDTh 0.000001008
SOURce1:BB:GNSS:TRIGger:OUTPut3:PULSe:WIDTh 0.000001009

SOURce1:BB:GNSS:TRIGger:OUTPut4:MODE PPS
SOURce1:BB:GNSS:TRIGger:OUTPut4:PULSe:WIDTh 0.000002
SOURce1:BB:GNSS:TRIGger:OUTPut4:PULSe:WIDTh 0.000003
SOURce1:BB:GNSS:TRIGger:OUTPut4:PULSe:WIDTh 0.000004
SOURce1:BB:GNSS:TRIGger:OUTPut4:MODE PATT
SOURce1:BB:GNSS:TRIGger:OUTPut4:MODE RAT
SOURce1:BB:GNSS:TRIGger:OUTPut4:MODE REST
```

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

Defines the signal for the selected marker output.

Parameters:

<Mode> PPS|PP2S|PULSe|PATTern|RATio|RESTart|PPS10

*RST: PPS

Example: See Example "Configure and enable marker signals" on page 149.

Manual operation: See "Marker x Mode" on page 55

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

Sets the number of chips during which the marker output is on or off.

Parameters:
<OffTime> float

Range: 0.000000011 to 0.1822215935
Increment: 1E-9
*RST: 1E-6

Example: See Example "Configure and enable marker signals" on page 149.

Manual operation: See "Marker x Mode" on page 55

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

Defines the bit pattern used to generate the marker signal.

Parameters:
<Pattern> 64 bits

Example: See Example "Configure and enable marker signals" on page 149.

Manual operation: See "Marker x Mode" on page 55

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

Sets the divider for pulse marker mode (`PULSe`).

Parameters:
<Divider> integer

Range: 2 to 1024
*RST: 2

Example: See Example "Configure and enable marker signals" on page 149.

Manual operation: See "Marker x Mode" on page 55

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

Queries the pulse frequency of the pulsed marker signal. The pulse frequency is derived by dividing the symbol rate by the divider.

Return values:
<Frequency> float

Example: See Example "Configure and enable marker signals" on page 149.

Usage: Query only

Manual operation: See "Marker x Mode" on page 55

[:SOURce<hw>]:BB:GNSS:TRIGger:OUTPut<ch>:PULSe:WIDTh <Width>

Sets the pulse width for 1PPS, 1PP2S and PPS10 marker mode.

Parameters:

<Width> float

Range: 1E-9 to 0.01
Increment: 1E-9
*RST: 1E-6

Example: See Example "Configure and enable marker signals" on page 149.

Manual operation: See "Marker x Mode" on page 55

Glossary: List of Publications with Further or Reference Information

Symbols

[1]: http://www.navipedia.net

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 pro_le in the ionosphere. Advances in Space Research

G

Galileo OS SIS ICD: European Commision: "European GNSS (Galileo) Open Service - Signal In Space Interface Control Document"
https://ec.europa.eu/docsroom/documents/11001/attachments/1/translations/en/renditions/native

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

T

TS 34.108: 3GPP TS 34.108 "Common test environments for User Equipment (UE); Conformance testing"

TS 34.171: 3GPP TS 34.171 "Terminal conformance specification; Assisted Global Positioning System (A-GPS); Frequency Division Duplex (FDD)"

TS 37.571-1: 3GPP TS 37.571-1 "User Equipment (UE) conformance specification for UE positioning; Part 1: Conformance test specification "

TS 37.571-2: 3GPP TS 37.571-2 "User Equipment (UE) conformance specification for UE positioning; Part 2: Protocol conformance"

TS 51.010-1: 3GPP TS 51.010-1 "Mobile Station (MS) conformance specification; Part 1: Conformance specification"

List of Commands

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