Contents

Digital Standard GPS

Introduction - Digital Standard GPS

The R&S Vector Signal Generator provides you with the ability to generate signals of up to four Global Positioning System (GPS) satellites.

The equipment layout for GPS signal generation includes the options Baseband Main Module (B13), Baseband Generator (B10/B11) and Digital Standard GPS (K44). B10 features a much larger ARB memory size than B11 (see data sheet). But apart from the memory size, both options have the same functionality and are installed alternatively.

The Global Positioning System consists of several satellites circling the earth in low orbits. The satellites permanently transmit information about their current position (ephimeris) and about the orbits of all satellites (almanac). An additionaly transmitted time information enables the GPS receiver to determine the runtimes of the transmitted signals. The position of a receiver on the earth can be determined by carrying out delay measurements of at least four signals emitted by different satellites.
Being transmitted on a single carrier frequency, the signals of the individual satellites can be distinguished by means of correlation (Gold) codes.With GPS, the code is known as C/A code (f_ca = 1.023 MHz) for civilian purposes. It is used as spreading code for the navigation data which is transmitted at a rate of 50 baud. The carrier L1 (f_L1= 1.57542 GHz) is modulated by C/A-code (BPSK).

***Note**: To avoid any damage to connected receivers, the user must ensure that the signal level used is not too high. A downstream attenuator pad must be connected to generate output levels below -145 dBm.*

A GPS signal which allows receiver function tests to be carried out, can be generated by the vector signal generator for up to four satellites.

Table 4-1 GPS system parameters

Carrier frequency	1.57542 GHz
Signal level, after antenna	Approx. –115 dBm, depending on receive conditions
Doppler shift	-100 kHz to +100 kHz selectable
Symbol rate (C/A code)	1.023 Mcps
C/A codes	1 to 37 selectable, 1023 chips per C/A code
Modulation	BPSK
Information data rate (navigation data)	50 Hz
Frame structure of navigation data	25 frames consisting of 5 subframes where 1 subframe consists of 10 words, 1 word consists of 30 data bits, 1 data bit consists of 20460 C/A code chips.

Use of navigation data
The C/A code used is fundamental to the simulation of GPS signals. The C/A code specifies the satellites to be simulated. Real navigation data (the almanac) contains the information about the currently valid ids. When using real navigation data, only valid ids can be selected in the operating menu. When using arbitrary data, the complete range of ids, 1 to 37, is available.

In addition to this, navigation data play an extremely important role, since they are essential for calculating the positions of the four satellites, which are the minimum prerequisite for localization purposes. However, even if only one satellite is available, real navigation data can be used to check the decoding of navigation information (such as GPS time, almanac and ephemeris) in addition to the recognition of the C/A code.

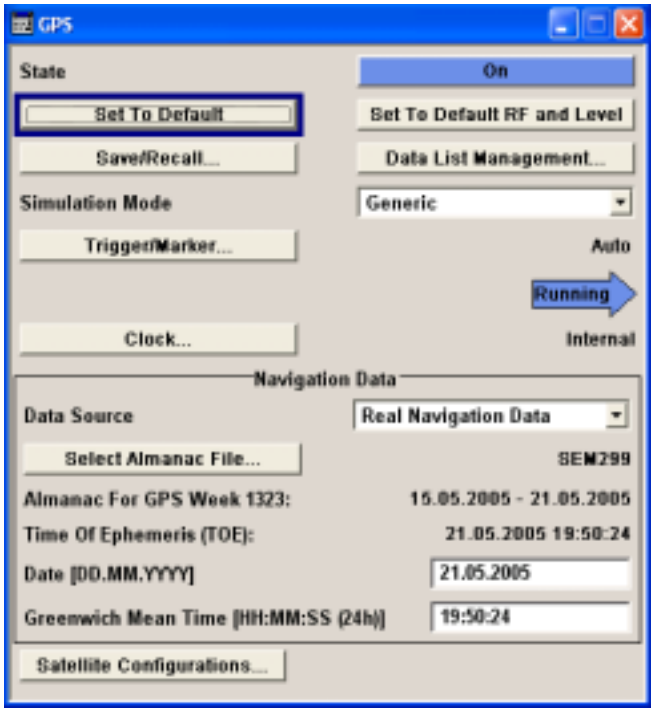
Current almanac data can be downloaded via the Internet and stored on the harddisk of the Vector Signal Generator. The almanac data is also used for extracting the satellite-specific navigation information (ephemeris).

For more detailed information on the content and frame structure of navigation data, as well as C/A code generation, refer to the specifications.

GPS Menu

The menu for setting the GPS digital standard is either called from the baseband block or from the menu tree under Baseband.

The menu is split into several sections for configuring the standard.



The upper section of the menu is where the GPS digital standard is enabled and the default settings are called.

Buttons lead to the submenus for loading and saving the GPS configuration and for configuring the trigger and clock parameters.

The **Navigation Data** menu section is where the data source for navigation information is selected and the data indicated (in case of real navigation data).

The button in the lower section leads to the submenu for configuring the satellite signals.

The upper section of the menu is where the GPS digital standard is enabled, the default settings are called. Buttons lead to the submenus for loading and saving the GPS configuration and for configuring the trigger and clock parameters.

State

Enables/disables the GPS signal simulation.
Enabling this standard disables all the other digital standards and digital modulation modes.
A continuous GPS signal is generated for up to four satellite in real time mode.

The associated signal level is set in the RF level menu.

Remote-control command:
`SOUR:BB:GPS:STAT ON`

Set to default

Calls the default settings. The following table gives an overview of the settings. The preset value for each parameter is specified in the description of the remote-control commands.

***Note**: RF and level are preset with button **Set to default RF and Level**.*

Remote-control command:
`SOUR:BB:GPS:PRES`

Parameter	**Value**
State	Not affected by Set to default
Simulation Mode	Generic
Navigation Data Source	Real navigation data
Almanac	SEM299
Date	Date of TOE
Time	Time of TOE
Satellite configuration	
State satellite 1	On
State satellite 2 ... 4	Off
Space Vehicle Id (satellite 1 ... 4)	1 / 2 / 3 / 4
Ranging Code	C/A
Time Shift / P-code-Chips	0
Doppler Shift	0 Hz

Set to default RF and Level

Calls the default RF and level settings for GPS signals.
The frequency is set to the GPS carrier frequency L1 of 1.57542 GHz and the output level LEVEL is set to –115.0 dBm.

***Note**: To avoid any damage to connected receivers, the user must ensure that the signal level used is not too high. A downstream attenuator pad must be connected to generate output levels below -145 dBm.*

Remote-control command:
`SOUR:BB:GPS:PRFL`

Save/Recall... Calls the **Save/Recall** menu.
From the **Save/Recall** menu the **File Select** windows for saving and recalling GPS configurations and the **File Manager** can be called.

GPS configurations are stored as files with the predefined file extension ***.gps.** The file name and the directory they are stored in are user-definable.
The complete settings in the **GPS** menu are saved and recalled.

Recall GPS setting Opens the **File Select** window for loading a saved GPS configuration.

The configuration of the selected (highlighted) file is loaded by pressing the **Select** button.

Remote-control command:
```
MMEM:CDIR 'F:\gen_lists\gps'

SOUR:BB:GPS:SETT:CAT?
                response:   'gps_1',gps_2'
SOUR:BB:GPS:SETT:LOAD "gps_1"
```

Save GPS setting Opens the **File Select** window for saving the current GPS signal configuration.

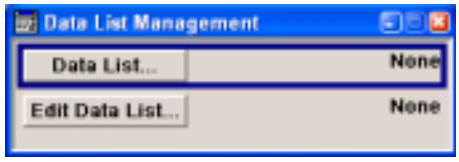
The name of the file is specified in the **File name** entry field, the directory selected in the **Save into** entry field. The file is saved by pressing the **Save** button.

Remote-control command:
```
MMEM:CDIR 'F:\gen_lists\gps'

SOUR:BB:GPS:SETT:STOR 'gps_3'
```

File Manager Calls the **File Manager**.
The **File Manager** is used to copy, delete and rename files and to create new directories.

Remote-control commands::
```
MMEM:CDIR 'F:\gen_lists\gps'

SOUR:BB:GPS:SETT:DEL 'gps_1'
```

Data List Management... Calls the **Data List Management** menu. This menu is used to create and edit a data list.



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

The data lists must be selected as a data source from the submenus under the individual function, e.g. in the channel table of the base stations.

Remote-control commands:

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

Creating and editing the data list:
```
SOUR:BB:DM:DLIS:SEL "3gpp"
SOUR:BB:DM:DLIS:DATA 1,1,0,1,0,1,0,1,1,1,1,0,0,0
SOUR:BB:DM:DLIS:DATA:APP 1,1,0,1,0,1,0,1,1,1,1,0,0
```

Selecting the data list:
```
SOUR:BB:GPS:DATA DLIS
SOUR:BB:GPS:DATA:DLISt "gps_data"
```

Simulation Mode Indicates the simulation mode.
The settings of the satellite signals are provided in the submenu **Satellite Configuration** (see following section).

Generic The satellite signals are configures by the user.

Remote-control command:
`SOUR:BB:GPS:SMOD GEN`

Localization Not yet available.
The satellite signals are configured corresponding to a 'real' location which can be selected by the user.

Trigger / Marker... Calls the menu for selecting the trigger source, for configuring the marker signals and for setting the time delay of an external trigger signal (see Section "*Trigger/Marker/Clock - GPS*").
The currently selected trigger source is displayed to the right of the button.
The marker signal is always related to the first active satellite.

Remote-control command: n.a.

Execute Trigger (only Trigger Source Internal)

Executes trigger manually.
A manual trigger can be executed only when an internal trigger source and a trigger mode other than **Auto** have been selected.

Remote-control commands:
```
SOUR:BB:GPS:TRIG:SOUR INT
SOUR:BB:GPS:SEQ RETR
SOUR:BB:GPS:TRIG:EXEC
```

Clock...

Calls the menu for selecting the clock source and for setting a delay (see Section "*Trigger/Marker/Clock - GPS*").

Remote-control command: n.a.

The **Navigation Data** menu section is where the data source for navigation information is selected and the data indicated (in case of real navigation data).

Data Source

Selects data source for the navigation information.
Navigation data play an extremely important role, since they are essential for calculating the positions of the four satellites, which are the minimum prerequisite for localization purposes. It also contains the information about the currently valid ids for the satellites.

Real Navigation Data

Real Navigation Data (almanacs) can be downloaded from the internet and stored on the harddisk of the generator.

Note: *Supported almanac files are SEM-files with data extension *.txt. YUMA almanac files are not supported.*

The almanac file to be used is selected in the file manager which is called with button **Select Almanac File...**. The time information of the file is indicated below the button. The simulated date and time can be set within the time interval determined by the loaded almanac (GPS week).
The satellite specific information (ephemeris) is also taken from the almanac. The time of ephemeris is indicated.

All indications and entries are made in Greenwich Mean Time.

Remote-control commands
```
SOUR:BB:GPS:NAV:DATA  RND
SOUR:BB:GPS:NAV:ALM "sem299"
```

PRBSxx Data List Pattern

Abitrary data can be used for basic tests on the GPS signals.
Data sources **PN9**, **PN15**, **PN16**, **PN20**, **PN21**, **PN23**, **ALL 0**, **ALL1**, and **Pattern** are all available.
If the **Pattern** data type is used, the bit pattern is defined in the **Pattern** input box. The length is limited to 64 bits.

Data lists are selected in the **File Select** window, which is called by means of the **Data List Management** button.
Signals generated in this way can be recognized by a GPS receiver. However, since there are no real navigation data on the C/A code, only the signal level of the simulated satellite(s) can be measured and displayed by the receiver.
A signal of this type is usually sufficient for performing simple function tests. It should be noted, however, that the receiver to be tested may have to be switched to a special test mode, since signals without correct navigation data are often not indicated (on a display, for example).

Remote-control commands
```
SOUR:BB:GPS:NAV:DATA    ZERO
SOUR:BB:GPS:NAV:DATA    PN9

SOUR:BB:GPS:NAV:DATA    PATT
SOUR:BB:GPS:NAV:DATA:PATT #H3F,8

SOUR:BB:GPS:NAV:DATA    DLIS
SOUR:BB:GPS:NAV:DATA:DSEL "gps_1"
```

Select Almanac File...

Opens the file manager for selecting the almanac file.
The button is only available if data soure **Real Navigation Data** is selected.
The downloaded files can be copied to the vector signal generator via USB interface or via a LAN network (see chapter 1). .
Current almanacs are currently available at the following internet sites:

U.S.Coast Guard Navigation Center GPS Homepage
(http://www.navcen.uscg.gov/ftp/GPS/almanacs/sem/)
The almanac file are named semxxxx.txt whereas xxxx denotes the GPS week.

http://www.celestrak.com/GPS/almanac/SEM/
The almanac file are named almanac.sem.weekXXXX.YYYYYY.txt whereas xxxx denotes the GPS week and yyyyyy the time of almanac (TOA).

Note: *Supported almanac files are SEM-files with data extension *.txt. YUMA almanac files are not supported.*

Remote-control commands:
```
SOUR:BB:GPS:NAV:DATA:SOUR RND
SOUR:BB:GPS:NAV:ALM "sem299"
```

Almanac for GPS week

Indicates the week in which the almanac was published. The simulation time (**Date**) can be set within this time interval.

The indication is only available if data source **Real Navigation Data** is selected.

Remote-control commands:

```
SOUR:BB:GPS:NAV:ALM:BEG:WNUM?
SOUR:BB:GPS:NAV:ALM:BEG:DAY?
SOUR:BB:GPS:NAV:ALM:BEG:MONT?
SOUR:BB:GPS:NAV:ALM:BEG:YEAR?
SOUR:BB:GPS:NAV:ALM:END:DAY?
SOUR:BB:GPS:NAV:ALM:END:MONT?
SOUR:BB:GPS:NAV:ALM:END:YEAR?
```

Time of Ephemeris (TOE)

Indicates the time of ephemeris, i.e the exact time up to the second to which the navigation data refers. As the ephemeris is extracted from the almanac, the TOE is identical to the TOA (time of almanac).
The indication is only available if data source **Real Navigation Data** is selected.

Remote-control commands:

```
SOUR:BB:GPS:NAV:ALM:TOEP?        Response:  "589824"
```

Date

Enters the date for the simulation. Only values within the almanac GPS week are valid.
The parameter is only available if data source **Real Navigation Data** is selected.

Remote-control commands:

```
SOUR:BB:GPS:NAV:SIM:BEG:DAY 12
SOUR:BB:GPS:NAV:SIM:BEG:MONT 7
SOUR:BB:GPS:NAV:SIM:BEG:YEAR 2005
```

Greenwich Mean Time

Enters the exact time for the simulation. The used time zone is Greenwich Mean Time.
The parameter is only available if data source **Real Navigation Data** is selected.

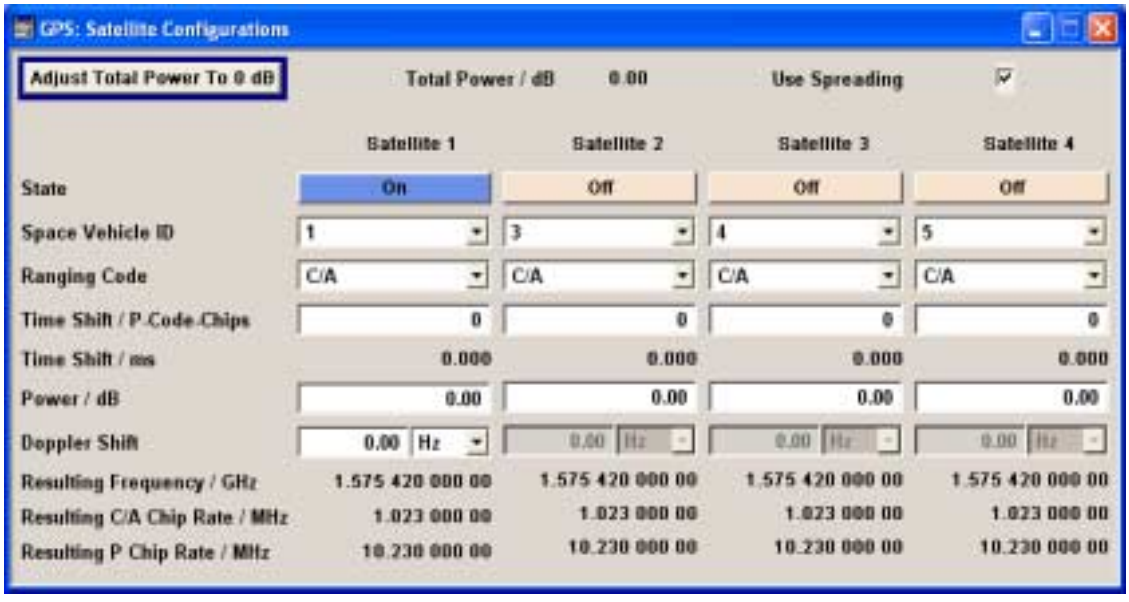
Remote-control commands:

```
SOUR:BB:GPS:NAV:SIM:BEG:SEC 14
SOUR:BB:GPS:NAV:SIM:BEG:MIN 24
SOUR:BB:GPS:NAV:SIM:BEG:HOUR 0
```

Satellite Configuration... Calls the menu for configuring the satellite data (see following section).

Remote-control command: n.a.

In the Satellite Configuration submenu the signal simulation of up to four satellites can be activated and configured.



Adjust Total Power to 0 dB Sets the power level of each satellite so that the sum of all levels results in 0 dB. This will not change the power ratio among the individual satellites.

Remote-control command:
`SOUR:BB:GPS:POW:ADJ`

Total Power / dB Displays the total power of all satellites.
The total power is calculated from the power ratio of the activated satellites.
After **Power Adjust**, this power corresponds to 0 dB.
If the value is not equal to 0 dB, the individual activated satellites (whilst still retaining the power ratios) are internally adapted so that the **Total Power** for achieving the set output level is 0 dB.

Remote-control command:
`SOUR:BB:GPS:POW?` `'Response: 0dB`

Use Spreading Activates/deactivates spreading. When spreading is deactivated the pure navigation data is modulated onto the RF carrier.

`Remote-control command:`
`SOUR:BB:GPS:SPR:STAT ON`

State

Activates/deactivates the generation of the satellite signal.

Remote-control command:
`SOUR:BB:GPS:SAT4:STAT ON`

Space Vehicle Id

Enters the id of the satellite to be simulated. This value is used to generate the corresponding C/A code.

37 ids are defined whereas 32 codes are used for identifying satellites.

If **Real Navigation Data** is used, only the valid ids which are listed in the almanac are selectable.

For arbitray data, all ids can be selected.

Remote-control command:
`SOUR:BB:GPS:SAT4:VID 24`

Ranging Code

Indicates the type of ranging code.
The C/A code (f_ca = 1.023 MHz) is provided for civilian purposes.
The P-code (f_p = 10.23 MHz) is provided for military purposes. They are used as spreading codes for the navigation data which is transmitted at a rate of 50 baud.

C/A Carrier L1 (f_L1= 1.57542 GHz) is modulated by C/A-code (BPSK).

Remote-control command:
`SOUR:BB:GPS:SAT4:RCOD?` Response: `CAC`

C/A + P Not available yet.
Carrier L1 (f_L1= 1.57542 GHz) is modulated by C/A code and P-code (QPSK).

P Not available yet.
Carrier L1 (f_L1= 1.57542 GHz) is modulated by P-code (BPSK).

Time Shift (P-Code Chips)

Sets a delay of the selected satellite relative to the other satellites.The time shift is set in multiples of the P-code chip length.

Note: *The P-code chip rate depends on the set doppler shift according to* $f_{P\text{-}resulting} = f_P \times \{1 + f_{Doppler} / f_{L1}\}$

Remote-control command:
`SOUR:BB:GPS:SAT4:TSPC 1233`

Time Shift (ms)

Indicates the time shift of the code sequence in milli seconds.

Remote-control command:
`SOUR:BB:GPS:SAT4:TSS?`

Power/dB

Sets the power offset of the satellite in dB. The offset determines the power ratio of the activated satellites.

Remote-control command:
`SOUR:BB:GPS:SAT4:POW -5`

Doppler Shift

Enters the doppler shift of the simulated signal of all satellites.
The simulation of Doppler-shifted GPS signals can be used to check the receiver characteristics under more realistic conditions than with zero Doppler. In contrast to the real system, however, the set Doppler frequency is fixed.

The relevant change to the chip rate of the C/A code is carried out automatically. The currently valid values for Doppler-shifted carrier frequency and chip rate are displayed under **Resulting Frequency, Resulting C/A chip rate,** and **Resulting P chip rate**.

Remote-control command:
`SOUR:BB:GPS:SAT:DSH 10.34kHz`

Resulting Frequency

Indicates the currently valid values for Doppler-shifted carrier frequency.

The resulting frequency is calculated according to the following:

$f_{L1resulting} = f_{L1} + f_{Doppler}$

Remote-control command:
`SOUR:BB:GPS:SAT4:FREQ?`

Resulting C/A Chip Rate

Indicates the currently valid values for the chip rate of the C/A code. The relevant change to the chip rate of the C/A code is carried out automatically if the doppler shift is changed.
The resulting C/A chip rate is calculated according to the following:

$f_{C/Aresulting} = f_{C/A} \times \{1 + f_{Doppler} / f_{L1}\}$

$f_{C/A}$ is fixed to 1.023 MHz.

Remote-control command:
`SOUR:BB:GPS:SAT4:CACR?`

Resulting P Chip Rate

Indicates the currently valid values for the chip rate of the P-code. The relevant change to the chip rate of the P-code is carried out automatically if the doppler shift is changed.
The resulting P-chip rate is calculated according to the following:

$f_{P\text{-}resulting} = f_P \times \{1 + f_{Doppler} / f_{L1}\}$

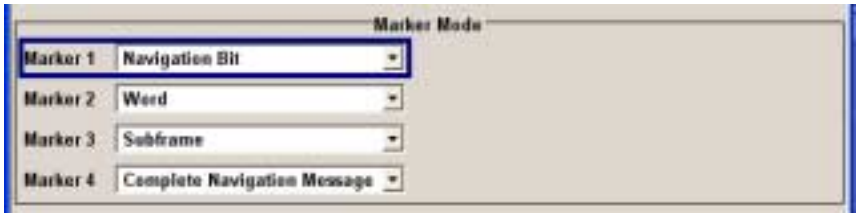
f_P is fixed to 10.230 MHz.

Remote-control command:
`SOUR:BB:GPS:SAT4:PCR?`

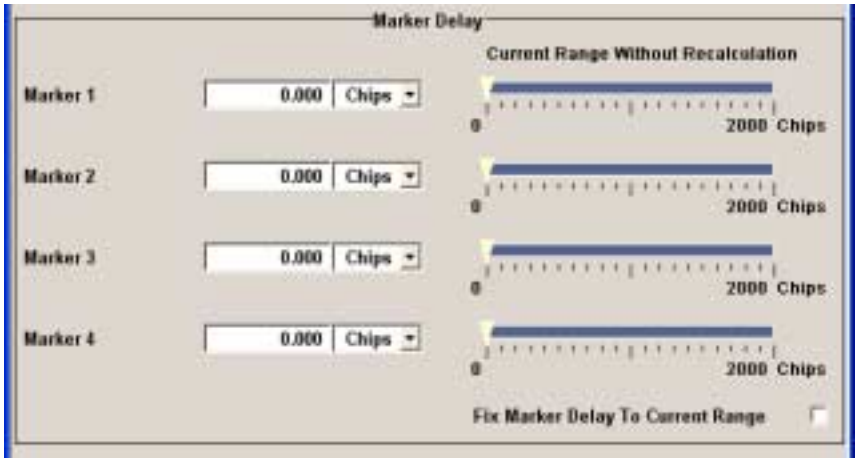
Trigger/Marker/Clock - GPS

The **Trigger/Marker/Clock** menu can be reached via the GPS main menu.

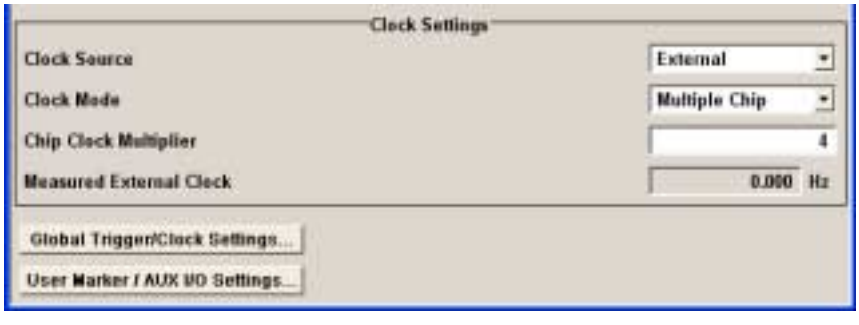
The **Trigger In** section is where the trigger for the GPS signal is set. Various parameters will be provided for the settings, depending on which trigger source - internal or external - is selected. The current status of signal generation (**Running** or **Stopped**) is indicated for all trigger modes.



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



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



The **Clock Settings** section is where the clock source is selected and - in the case of an external source - the clock type.
The **Global Trigger/Clock Settings** button leads to a submenu for general trigger and clock settings.
The **User marker / AUX I/O Settings** button leads to a submenu for mapping the AUX I/O connector on the rear of the instrument

The **Trigger In** section is where the trigger for the GPS signal is set. The current status of the signal generation is displayed for all trigger modes.

Trigger Mode

Selects trigger mode. The trigger mode determines the effect of a trigger on the signal generation.

Auto

The GPS signal is generated continuously..

Remote-control command::
`SOUR:BB:GPS:SEQ AUTO`

Retrigger

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

Remote-control command:
`SOUR:BB:GPS:SEQ RETR`

Armed_Auto

The GPS-Signal signal is generated only when a trigger event occurs. Then the signal is generated continuously.

Button **Arm** stops signal generation. A subsequent trigger event (internal with **Execute Trigger** or external) causes a restart.

Remote-control command:
`SOUR:BB:GPS:SEQ AAUT`

Armed_Retrig

The GPS-Signal signal is generated only when a trigger event occurs. Then the signal is generated continuously. Every subsequent trigger event causes a restart.

Button **Arm** stops signal generation. A subsequent trigger event (internal with **Execute Trigger** or external) causes a restart.

Remote-control command:
`SOUR:BB:GPS:SEQ ARET`

Single

The GPS signal is generated only when a trigger event occurs. Then the signal is generated once to the length specified at **Signal Duration**. Every subsequent trigger event (internal with **Execute Trigger** or external) causes a restart.

Remote-control command:
`SOUR:BB:GPS:SEQ SING`

Signal Duration Unit

Defines the unit for the entry of the length of the signal sequence to be output in the **Single** trigger mode. Available units are **Subframe**, **Chip**, **Navigation Bit** or **Complete Navigation Message**.

Remote-control commands: `SOUR:BB:GPS:TRIG:SLUN SYMB`

Signal Duration

Defines the length of the signal sequence to be output in the **Single** trigger mode. The input is to be expressed in chips. It is then possible to output deliberately just part of the signal, an exact sequence of the signal, or a defined number of repetitions of the signal.

Remote-control commands: `SOUR:BB:GPS:TRIG:SLEN 2000`

Running / Stopped

Displays the status of signal generation for all trigger modes. This display appears only when GPS is enabled (**State On**).

Remote-control command:
`SOUR:BB:GPS:TRIG:RMOD?`
Response: RUN or STOP

Running The GPS modulation signal is generated; a trigger was (internally or externally) initiated in triggered mode.

If Armed_Auto and Armed_Retrigger have been selected, generation of signals can be stopped with the Arm button. A new trigger (internally with Execute Trigger or externally) causes a restart.

Stopped The signal is not generated, and the instrument waits for a trigger event (internal or external).

Arm

Stops signal generation. This button appears only with **Running** signal generation in the **Armed_Auto** and **Armed_Retrigger** trigger modes.

Signal generation can be restarted by a new trigger (internally with **Execute Trigger** or externally).

Remote-control command:
`SOUR:BB:GPS:TRIG:ARM:EXEC`

Execute Trigger (Trigger Source Internal only)

Executes trigger manually. A manual trigger can be executed only when an internal trigger source and a trigger mode other than Auto have been selected.

Remote-control commands:
`SOUR:BB:GPS:TRIG:SOUR INT`
`SOUR:BB:GPS:SEQ RETR`
`SOUR:BB:GPS:TRIG:EXEC`

Trigger Source

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

Internal The trigger event is executed by **Execute Trigger**.

Remote-control command::
`SOUR:BB:W3GP:TRIG:SOUR INT`

External (TRIGGER 1 / 2) The trigger event is executed with the aid of the active edge of an external trigger signal. The trigger signal is supplied via the TRIGGER 1 or TRIGGER 2 connector.

The polarity, the trigger threshold and the input impedance of the TRIGGER input can be set in the **Global Trigger/Clock Settings** menu.

Remote-control command:
`SOUR:BB:W3GP:TRIG:SOUR EXT | BEXT`

External Delay (only Trigger Source External)

Sets trigger signal delay in chips on external triggering. This enables the R&S Vector Signal Generator to be synchronized with the device under test or other external devices.

Remote-control command::
`SOUR:BB:GPS:TRIG:EXT:DEL 3`

External Inhibit (only Trigger Source External)

Sets the duration for inhibiting a new trigger event subsequent to triggering. The input is to be expressed in chips.
In the **Retrigger** mode every trigger signal causes signal generation to restart. This restart is inhibited for the specified number of chips.
This parameter is only available on external triggering.

Remote-control command:
`SOUR:BB:GPS:TRIG:EXT:INH 1000`

The marker output signal for synchronizing external instruments is configured in the **Marker Settings** section **Marker Mode**.

Marker x Mode -

Selects a marker signal for the associated MARKER output. The marker signal is always related to the first active satellite.

Navigation Bit

A marker signal is generated for every navigation data bit (20460 C/A chips)

Remote-control command:
`SOUR:BB:GPS:TRIG:OUTP1:MODE NBIT`

Word

A marker signal is generated for every navigation data word (30 navigation bits).

Remote-control command:
`SOUR:BB:GPS:TRIG:OUTP1:MODE WORD`

Subframe

A marker signal is generated for every navigation subframe (corresponds to 10 words).

Remote-control command:
`SOUR:BB:GPS:TRIG:OUTP1:MODE SFR`

Page

A marker signal is generated for every navigation page (corresponds to 5 subframes).

Remote-control command:
`SOUR:BB:GPS:TRIG:OUTP1:MODE PAGE`

Message

A marker signal is generated for every complete navigation message (corresponds to 25 pages).

Remote-control command:
`SOUR:BB:GPS:TRIG:OUTP1:MODE MESS`

Pulse

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

Remote-control commands:
```
SOUR:BB:GPS:TRIG:OUTP1:MODE PULS
SOUR:BB:GPS:TRIG:OUTP1:PULS:DIV 4
SOUR:BB:GPS:TRIG:OUTP1:PULS:FREQ?
```

Pattern

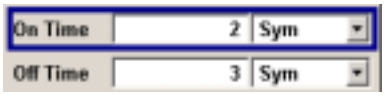
A marker signal that is defined by a bit pattern is generated. The pattern has a maximum length of 32 bits and is defined in an input field which opens when **pattern** is selected.

Remote-control commands:
```
SOUR:BB:GPS:TRIG:OUTP1:MODE PATT
SOUR:BB:GPS:TRIG:OUTP1:PATT #B1111,4
```

ON/OFF ratio

A regular marker signal that is defined by an ON/OFF ratio is generated. A period lasts one ON and OFF cycle.

The ON time and OFF time are each expressed as a number of symbols and are set in an input field which opens when **ON/OFF ratio** is selected.



Remote-control commands:
```
SOUR:BB:GPS:TRIG:OUTP1:MODE RAT
SOUR:BB:GPS:TRIG:OUTP1:OFFT 20
SOUR:BB:GPS:TRIG:OUTP1:ONT  20
```

The **Marker Delay** section can be used to set a delay for the markers.

Marker x

Enters the delay between the marker signal at the marker outputs and the start of the signal.
The input is expressed as a number of samples.
If the setting "**Fix marker delay to dynamic range**" is enabled, the setting range is restricted to the dynamic range. In this range the delay of the marker signals can be set without restarting the marker and signal.
The allocation of marker signals to the outputs is described in the section ""*Marker Output Signals*".

Remote-control command:
```
SOUR:BB:GPS:TRIG:OUTP2:DEL 20
```

Current Range without Calculation

Displays the dynamic range within which the delay of the marker signals can be set without restarting the marker and signal.
The delay can be defined by moving the setting mark.

Remote-control command:
```
SOUR:BB:GPS:TRIG:OUTP2:DEL:MAX?
SOUR:BB:GPS:TRIG:OUTP2:DEL:MIN?
```

Fix marker delay to current range

Restricts the marker delay setting range to the dynamic range. In this range the delay can be set without restarting the marker and signal.

Remote-control command:
`SOUR:BB:GPS:TRIG:OUTP:DEL:FIX ON`

The clock source is selected in the **Clock Settings** section.

Clock Source

Selects the clock source (also see section "*Clock Signals*").

Intern

The internal clock reference is used to generate the chip clock.

Remote-control command:
`SOUR:BB:GPS:CLOC:SOUR INT`

Extern

The external clock reference is fed in as the chip clock or multiple thereof via the CLOCK connector.

The chip rate must be correctly set to an accuracy of ± 2 % (see data sheet).

The polarity of the clock input can be changed with the aid of **Global Trigger/Clock Settings**.

Remote-control command:
`SOUR:BB:GPS:CLOC:SOUR EXT`

Clock Mode (for external clock source only)

Enters the type of externally supplied clock.

Chip

A chip clock is supplied via the CLOCK connector.

Remote-control command:
`SOUR:BB:GPS:CLOC:MODE CHIP`

Multiple

A multiple of the chip clock is supplied via the CLOCK connector; the chip clock is derived internally from this.

The **Multiplier** window provided allows the multiplication factor to be entered.

Remote-control command:
`SOUR:WIM:CLOC:MODE MCH`

Chip Clock Multiplier

Enters the multiplication factor for clock type **Multiple**.

Remote-control command:
`SOUR:BB:GPS:CLOC:MULT 4`

Measured External Clock (Clock Source External only)

Displays the measured frequency of the external clock signal. This enables the user to permanently monitor the frequency of the externally introduced clock.

This information is displayed only if the external clock source has been selected.

Remote-control command:
`:CLOC:INP:FREQ?`

Global Trigger/Clock Settings

Calls the **Global Trigger/Clock/Input Settings** menu. This menu is used among other things for setting the trigger threshold, the input impedance and the polarity of the clock and trigger inputs

The parameters in this menu affect all digital modulations and standards, and are described in the section "*Global Trigger/Clock/Input Settings – Setup -Environment* ".

User Marker AUX I/O Settings

Calls the **User Marker AUX I/O Settings** menu. This menu is used to map the connector on the rear of the instruments ee section "*User Marker - AUX IO - Setup-Environment-Global...Settings* ".

SOURce:BB:GPS Subsystem Remote-Control Commands

GPS - General Remote-Control Commands

This subsystem contains commands for the primary and general settings of the GPS standard. These settings concern activation and deactivation of the standard, setting the filter, clock, trigger and clipping settings, defining the frame duration and the sequence length, as well as the preset setting.
The commands for defining the satellite signal are described in the next section.

Command	Parameters	Default unit	Comments
[SOURce:]BB:GPS:CLOCk:MODE	CHIP | MCHip		
[SOURce:]BB:GPS:CLOCk:MULTiplier	1... 64		
[SOURce:]BB:GPS:CLOCk:SOURce	EXTernal | INTernal		
[SOURce:]BB:GPS:POWer:ADJust			No query
[SOURce:]BB:GPS:POWer[TOTal]			No query
[SOURce:]BB:GPS:PRESet			No query
[SOURce:]BB:GPS:PRFLevel			No query
[SOURce:]BB:GPS:SEQuence	AUTO | RETRigger | AAUTo | ARETrigger | SINGle		
[SOURce:]BB:GPS:SETTing:CATalog?			Query only
[SOURce:]BB:GPS:SETTing:DELete	<file_name>		
[SOURce:]BB:GPS:SETTing:LOAD	<file_name>		
[SOURce:]BB:GPS:SETTing:STORe	<file_name>		
[SOURce:]BB:GPS:SMODe	GENeric		
[SOURce:]BB:GPS:SPReading[:STATe]	ON | OFF		
[SOURce:]BB:GPS:STATe	ON | OFF		
[SOURce:]BB:GPS:TRIGger:ARM:EXECute			No query
[SOURce:]BB:GPS:TRIGger:EXECute			No query
[SOURce:]BB:GPS:TRIGger[:EXTernal<[1]|2>]:DELay	0 ...(2^32 - 1) chips		
[SOURce:]BB:GPS:TRIGger[:EXTernal<[1]|2>]:INHibit	0 ...(2^32 - 1) chips		
[SOURce:]BB:GPS:TRIGger:OUTPut<[1]...4>:DELay	0 ...(2^32 - 1) chips		
[SOURce:]BB:GPS:TRIGger:OUTPut:DELay:FIXed	ON | OFF	Hz	
[SOURce:]BB:GPS:TRIGger:OUTPut<[1]...4>:DELay:MAXimum			Query only
[SOURce:]BB:GPS:TRIGger:OUTPut<[1]...4>:DELay:MINimum			Query only
[SOURce:]BB:GPS:TRIGger:OUTPut<[1]...4>:MODE	NBIT | WORD | SFRame | PAGE | MESSage | PULSe | PATTern | RATio		
[SOURce:]BB:GPS:TRIGger:OUTPut<[1]...4>:OFFTime	2 ... (2^24 - 1) chips		
[SOURce:]BB:GPS:TRIGger:OUTPut<[1]...4>:ONTime	2 ... (2^24 - 1) chips		
[SOURce:]BB:GPS:TRIGger:OUTPut<[1]...4>:PATTern	#B0,1...#B111..1,32		
[SOURce:]BB:GPS:TRIGger:OUTPut<[1]...4>:PULSe:DIVider	2 ... 1024		
[SOURce:]BB:GPS:TRIGger:OUTPut<[1]...4>:PULSe:FREQuency			Query only
[SOURce:]BB:GPS:TRIGger:RMODe			Query only
[SOURce:]BB:GPS:TRIGger:SLENgth	0 ...(2^32 - 1) chips		
[SOURce:]BB:GPS:TRIGger:SLENgth:UNIT	SFRame | CHIP | NBIT | CNMessage		
[SOURce:]BB:GPS:TRIGger:SOURce	EXTernal | INTernal | BEXTernal		

[SOURce:]BB:GPS:CLOCk:MODE CHIP | MCHip

The command enters the type of externally supplied clock (`:BB:GPS:CLOCk:SOURce EXTernal`).

When `MCHip` is used, a multiple of the chip clock is supplied via the CLOCK connector and the chip clock is derived internally from this. The multiplier is entered with the command `:BB:GPS:CLOCk:MULTiplier`.

Example: `"BB:GPS:CLOC:MODE CHIP"` 'selects clock type **Chip**, i.e. the supplied clock is a chip clock.

*RST value	Resolution	Options	SCPI
CHIP	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:CLOCk:MULTiplier 1 ... 64

The command specifies the multiplier for clock type **Multiplied** (`:BB:GPS:CLOCk:MODE MCHip`) in the case of an external clock source.

Example: `"BB:GPS:CLOC:SOUR EXT"` 'selects the external clock source. The clock is supplied via the CLOCK connector.

`"BB:GPS:CLOC:MODE MCH"` 'selects clock type **Multiplied**, i.e. the supplied clock has a rate which is a multiple of the chip rate.

`"BB:GPS:CLOC:MULT 12"` 'the multiplier for the external clock rate is 12.

*RST value	Resolution	Options	SCPI
4	1	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:CLOCk:SOURce INTernal | EXTernal

The command selects the clock source.

Parameter:

INTernal The internal clock reference is used.

EXTernal The external clock reference is supplied to the CLOCK connector.

Example: `"BB:GPS:CLOC:SOUR EXT"` 'selects an external clock reference. The clock is supplied via the CLOCK connector.

`"BB:GPS:CLOC:MODE CHIP"` 'specifies that a chip clock is supplied via the CLOCK connector.

*RST value	Resolution	Options	SCPI
INTernal	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:POWer[:TOTal]?

The command queries the total power of all satellites. After **Power Adjust**, this power corresponds to 0 dB.

The command is a query command and therefore does not have an *RST value.

Example: "BB:GPS:POW?" 'queries the total power of all satellites.

Response: "-22.5" 'the total power is -25 dB.

*RST value	Resolution	Options	SCPI
-	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:POWer:ADJust

The command calculates the power level of each satellite so that the sum of all levels results in 0 dB.

The command triggers an action and therefore has no *RST value and no query form.

Example: "BB:GPS:POW:ADJ" 'the total power of all satellites is set to 0 dB.

*RST value	Resolution	Options	SCPI
-	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:PRESet

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

This command triggers an action and therefore has no *RST value and no query form.

Example: "BB:GPS:PRES" 'resets all the GPS settings to default values.

*RST value	Resolution	Options	Dependencies	SCPI
-	-	B10/B11 and B13 K44	All GPS settings are preset. .	Device-specific

[SOURce:]BB:GPS:PRFLevel

The command sets the RF to GPS standard L1 (1.575420 GHz) and the power level to -115.0 dBm. .

This command triggers an action and therefore has no *RST value and no query form.

Example: "BB:GPS:PRFL" 'sets the RF level to 1.575420 GHz and the level to -115.0 dBm.

*RST value	Resolution	Options	Dependencies	SCPI
-	-	B10/B11 and B13 K44	Sets commands SOUR:FREQ and SOUR:POW	Device-specific

[SOURce:]BB:GPS:SEQuence AUTO | RETRigger | AAUTo | ARETrigger | SINGle

The command selects the trigger mode.

Parameter:

AUTO The modulation signal is generated continuously.

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

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

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

SINGle
The modulation signal is generated only when a trigger event occurs. Then the signal is generated once to the length specified with command `SOUR:BB:GPS:TRIG:SLEN`. Every subsequent trigger event causes a restart.

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

*RST value	Resolution	Options	SCPI
AUTO	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:SETTing:CATalog?

This command reads out the files with IEEE 802.16 settings in the default directory. The default directory is set using command `MMEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. Only files with the file extension ***.gps** will be listed.

The command is a query command and therefore has no *RST value.

Example: `"MMEM:CDIR 'D:\user\gps"` 'sets the default directory to D:\user\gps.

`"BB:GPS:SETT:CAT?"` 'reads out all the files with GPS settings in the default directory.

Response: `"'gps_generic','gps_gen2'"` 'the files `''gps_generic'` and `'gps_gen2''` are available.

*RST value	Resolution	Options	SCPI
	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:SETTing:DELete <file_name>

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

This command triggers an event and therefore has no *RST value and no query form.

Example: `"BB:GPS:SETT:DEL 'gps'"` 'deletes file '`gps`'.

*RST value	Resolution	Options	SCPI
	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:SETTing:LOAD <file_name>

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

This command triggers an event and therefore has no *RST value and no query form.

Example: `"BB:GPS:SETT:LOAD 'gps'"` 'loads file '`gps`'.

*RST value	Resolution	Options	SCPI
	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:SETTing:STORe <file_name>

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

This command triggers an event and therefore has no *RST value and no query form.

Example: `"BB:GPS:SETT:STOR 'gps_sem299'"`
'stores the current settings into file '`gps_sem299`'.

*RST value	Resolution	Options	SCPI
	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:SMODe?

The command queries the simulation mode.

The command is a query only and therefore has no *RST value.

Example: "BB:GPS:SMOD?" 'queries the simulation mode.

Response: "GEN" 'generic satellite signals are generated.

*RST value	Resolution	Options	Dependencies	SCPI
	-	B10/B11 and B13 K44	BB:GPS:STAT ON deactivates the other standards and digital modulation.	Device-specific

[SOURce:]BB:GPS:SPReading[:STATe] ON | OFF

The command activates/deactivates spreading. When spreading is deactivated the pure navigation data is modulated onto the RF carrier.

Example: "BB:GPS:SPR ON" 'activates spreading of simulated GPS satellite signals.

*RST value	Resolution	Options	SCPI
ON	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:STATe ON | OFF

The command activates the signal generation of a simulated GPS satellite. Activating this standard deactivates all the other digital standards and digital modulation modes. .

Example: "BB:GPS:STAT ON" 'activates signal generation of a simulated GPS satellite.

*RST value	Resolution	Options	Dependencies	SCPI
OFF	-	B10/B11 and B13 K44	BB:GPS:STAT ON deactivates the other standards and digital modulation.	Device-specific

[SOURce:]BB:GPS:TRIGger:ARM:EXECute

The command stops signal generation for trigger modes Armed_Auto and Armed_Retrigger. A subsequent internal or external trigger event restart signal generation.

This command triggers an event and therefore has no *RST value and no query form.

Example:

```
"BB:GPS:TRIG:SOUR INT"        'sets internal triggering.
"BB:GPS:TRIG:SEQ ARET"        'sets Armed_Retrigger mode, i.e. every trigger event causes signal generation to restart.
"BB:GPS:TRIG:EXEC"            'executes a trigger, signal generation is started.
"BB:GPS:TRIG:ARM:EXEC"        'signal generation is stopped.
"BB:GPS:TRIG:EXEC"            'executes a trigger, signal generation is started again.
```

*RST value	Resolution	Options	SCPI
		B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:TRIGger:EXECute

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

This command triggers an event and therefore has no *RST value and no query form.

Example:

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

*RST value	Resolution	Options	SCPI
		B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:TRIGger[:EXTernal<[1]|2>]:DELay 0 ... 2^32-1

The command specifies the trigger delay (expressed as a number of chips) for external triggering. The numeric suffix to EXTernal distinguishes between the external trigger via the TRIGGER 1 (suffix 1) and TRIGGER 2 (suffix 2) connector.

Example: `"BB:GPS:TRIG:SOUR EXT"` 'sets an external trigger via the TRIGGER 1 connector.

`"BB:GPS:TRIG:DEL 50"` 'sets a delay of 50 chips for the trigger.

*RST value	Resolution	Options	SCPI
0 chips	1 chip	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:TRIGger[:EXTernal<[1]|2>]:INHibit 0 ... 2^32-1

The command specifies the number of chips by which a restart is to be inhibited following a trigger event. This command applies only in the case of external triggering. The numeric suffix to EXTernal distinguishes between the external trigger via the TRIGGER 1 (suffix 1) and TRIGGER 2 (suffix 2) connector.

Example: `"BB:GPS:TRIG:SOUR EXT"` 'selects an external trigger via the TRIGGER 1 connector

`"BB:GPS:TRIG:INH 200"` 'sets a restart inhibit for 200 chips following a trigger event.

*RST value	Resolution	Options	SCPI
0 chips	1 chip	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:TRIGger:OUTPut<[1]...4>:DELay 0 ... 2^32 - 1 Chips

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

Example: `"BB:GPS:TRIG:OUTP2:DEL 1600"`

'sets a delay of 1600 chips for the signal on connector MARKER 2.

*RST value	Resolution	Options	SCPI
0	1 chip	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:TRIGger:OUTPut:DELay:FIXed ON | OFF

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

Example: `"BB:GPS:TRIG:OUTP:DEL:FIX ON"`
'restricts the marker signal delay setting range to the dynamic range.

*RST value	Resolution	Options	SCPI
OFF	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:TRIGger:OUTPut<[1]...4>:DELay:MAXimum

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

The command is a query only and therefore has no *RST value.

Example: `"BB:GPS:TRIG:OUTP:DEL:FIX ON"`
'restricts the marker signal delay setting range to the dynamic range.

`"BB:GPS:TRIG:OUTP:DEL:MAX?"`
'queries the maximum of the dynamic range.

Response: `"2000"` 'the maximum for the marker delay setting is 2000 chips.

*RST value	Resolution	Options	SCPI
-	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:TRIGger:OUTPut<[1]...4>:DELay:MINimum

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

The command is a query only and therefore has no *RST value.

Example: `"BB:GPS:TRIG:OUTP:DEL:FIX ON"`
'restricts the marker signal delay setting range to the dynamic range.

`"BB:GPS:TRIG:OUTP:DEL:MIN?"`
'queries the minimum of the dynamic range.

Response: `"0"` 'the minimum for the marker delay setting is 0 chips.

*RST value	Resolution	Options	SCPI
-	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:TRIGger:OUTPut<[1]...4>:MODE
NBIT | WORD | SFRame | PAGE | MESSage | PULSe | PATTern | RATio

The command defines the signal for the selected marker output.

Parameter:

NBIT A marker signal is generated for every navigation data bit (20460 C/A chips).

WORD A marker signal is generated for every navigation data word (30 navigation bits).

SFRame A marker signal is generated for every navigation subframe (corresponds to 10 words).

PAGE A marker signal is generated for every navigation page (corresponds to 5 subframes).

MESSage A marker signal is generated for every complete navigation message (corresponds to 25 pages).

PULSe A pulsed marker signal is generated. The pulse frequency (= symbol rate/divider) is defined with the `SOUR:BB:GPS:TRIG:OUTP:PULSe:DIVider` command and can be queried with the `SOUR:BB:GPS:TRIG:OUTP:PULSe:FREQuency?` command.

PATTern A marker signal is generated according to the user defined pattern (command `SOURce:BB:GPS:TRIGger:OUTPut:PATTern`).

RATio A marker signal corresponding to the Time Off / Time On specifications in the commands `SOURce:BB:GPS:TRIGger:OUTPut:OFFT` and `SOURce:BB:GPS:TRIGger:OUTPut:ONT` is generated.

Example:
```
"BB:GPS:TRIG:OUTP2:MODE WORD"
```
'selects the word marker signal on output MARKER 2. A marker signal is generated for every navigation data word (30 navigation bits, 20460 C/A chips each)

*RST value	Resolution	Options	SCPI
NBIT	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:TRIGger:OUTPut<[1]...4>:OFFTime 1.. 2^24 - 1 (1..16 777 215) chips

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

Example:
```
"BB:GPS:TRIG:OUTP2:OFFT 200"
```
'sets an OFF time of 200 chips for marker signal 2.

*RST value	Resolution	Options	SCPI
1	1	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:TRIGger:OUTPut<[1]...4>:ONTime 1.. 2^24 - 1 (1..16 777 215) chips

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

Example: `"BB:GPS:TRIG:OUTP2:ONT 200"` 'sets an ON time of 200 chips for marker 2.

*RST value	Resolution	Options	SCPI
1	1	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:TRIGger:OUTPut<[1]...4>:PATTern #B0,1 ... #B111...1, 2

The command defines the bit pattern used to generate the marker signal in the setting `SOURce:BB:GPS:TRIGger:OUTPut:MODE PATTern`. 0 is marker off, 1 is marker on

Example: `"BB:GPS:TRIG:OUTP2:PATT #B000000011111111,15"`
'sets a bit pattern.

`"BB:GPS:TRIG:OUTP2:MODE PATT"` 'activates the marker signal according to a bit pattern on output MARKER 2.

*RST value	Resolution	Options	SCPI
#B,1	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:TRIGger:OUTPut<[1]...4>:PULSe:DIVider 2 ... 2^10

The command sets the divider for Pulse marker mode (`SOUR:BB:GPS:TRIG:OUTP:MODE PULSe`.). The resulting pulse frequency is derived by dividing the symbol rate by the divider.

Example: `"BB:GPS:TRIG:OUTP2:PULS:DIV 2"` 'sets the divider to 2 for the marker signal on output MARKER 2.

`"BB:GPS:TRIG:OUTP2:FREQ?"` 'queries the resulting pulse frequency of the marker signal.

Response: `"511511.038"` 'the resulting pulse frequency is 511.511 kHz.

*RST value	Resolution	Options	SCPI
2	1	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:TRIGger:OUTPut<[1]...4>:PULSe:FREQuency?

The command queries the pulse frequency of the pulsed marker signal in the setting `SOURce:BB:GPS:TRIGger:OUTPut:MODE PULSe`. The pulse frequency is derived by dividing the symbol rate by the divider.

The command is a query command and therefore has no *RST value.

Example:

`"BB:GPS:TRIG:OUTP2:PULS:DIV 2"`	'sets the divider marker signal on output MARKER 2 to the value 2.
`"BB:GPS:TRIG:OUTP2:MODE PULS"`	'enables the pulsed marker signal.
`"BB:GPS:TRIG:OUTP2:PULS:FREQ?"`	'queries the pulse frequency of the marker signal.
Response: `"511511.038"`	'the resulting pulse frequency is 511.511 kHz.

*RST value	Resolution	Options	SCPI
-	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:TRIGger:RMODe

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

The command is a query command and therefore has no *RST value.

Parameter:

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

Example:

`"BB:GPS:TRIG:MODE ARET"`	'selects the Armed_Retrigger mode
`"BB:GPS:TRIG:SOUR EXT"`	'sets external triggering via the TRIGGER 1 connector.
`"BB:GPS:TRIG:RMOD?"`	'queries the current status of signal generation.
Response: `"RUN"`	'the signal is generated, an external trigger was executed.

*RST value	Resolution	Options	SCPI
-	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:TRIGger:SLENgth 1 … (2^32-1) chips

The command defines the length of the signal sequence to be output in the **Single** trigger mode (`SOUR:BB:GPS:SEQ SING`). The input is made in terms of chips.

It is possible to output deliberately just part of the frame, an exact sequence of the frame, or a defined number of repetitions of the frame.

Example:

```
"BB:GPS:SEQ SING"
```
'sets trigger mode Single .

```
"BB:GPS:TRIG:SLEN 200"
```
'sets a sequence length of 200 chips. The first 200 chips of the current frame will be output after the next trigger event.

*RST value	Resolution	Options	SCPI
32 768 chips	1 chip	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:TRIGger:SLUNit SFRame | CHIP | NBIT | CNMessage

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

Parameter:

SFRame Unit subframe. A single subframe is generated after a trigger event.

CHIP Unit Chip. A single chip is generated after a trigger event.

NBIT Unit Navigation Bit. A single Navigation Bit is generated after a trigger event.

CNMessage Unit Complete Navigation Message. A single Complete Navigation Message is generated after a trigger event.

Example:

```
"BB:GPS:SEQ SING"
```
'sets trigger mode Single.

```
"BB:GPS:TRIG:SLUN SFR"
```
'sets unit Subframe for the entry of signal duration.

```
"BB:GPS:TRIG:SLEN 2"
```
'sets a signal duration of 2 subframes. The current subframe will be output twice after the next trigger event.

*RST value	Resolution	Options	SCPI
CHIP	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:TRIGger:SOURce INTernal | EXTernal | BEXTernal

The command selects the trigger source.

Parameter:

INTernal Triggering is executed by means of the Trigger command `SOURce:BB:GPS:TRIGger:EXECute` or `*TRG` in the case of remote control and by means of **Execute Trigger** in the case of manual operation.

EXTernal Triggering is executed by means of the signal on the TRIGGER 1 connector.

BEXTernal Triggering is executed by means of the signal on the TRIGGER 2 connector.

Example:

```
"BB:GPS:TRIG:SING"
```
'selects a trigger mode that requires a trigger.

```
"BB:GPS:TRIG:SOUR EXT"
```
'sets external triggering via the TRIGGER 1 connector .

*RST value	Resolution	Options	SCPI
INTernal	-	B10/B11 and B13 K44	Device-specific

SOURce-GPS - Satellite Signal Settings

The SOURce:BB:GPS:SATellite and SOURce:BB:GPS:NAVigation systems contain commands for setting the characteristics of the satellite signals.

Command	Parameters	Default unit	Comments
[SOURce:]BB:GPS:NAVigation:ALManac	<file name>		
[SOURce:]BB:GPS:NAVigation:ALManac:BEGin:DAY	1 ... 31		
[SOURce:]BB:GPS:NAVigation:ALManac:BEGin:MONTh	1 ... 12		
[SOURce:]BB:GPS:NAVigation:ALManac:BEGin:WNUMber	1 ... 5		
[SOURce:]BB:GPS:NAVigation:ALManac:BEGin:YEAR	-9999 ... 9999		
[SOURce:]BB:GPS:NAVigation:ALManac:END:DAY	1 ... 31		
[SOURce:]BB:GPS:NAVigation:ALManac:END:MONTh	1 ... 12		
[SOURce:]BB:GPS:NAVigation:ALManac:END:YEAR	-9999 ... 9999		
[SOURce:]BB:GPS:NAVigation:ALManac:TOEPhemeris			Query only
[SOURce:]BB:GPS:NAVigation:DATA	ZERO | ONE | PATTern | PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | RNData		
[SOURce:]BB:GPS:NAVigation:DATA:DSELect	<dlist_name>		
[SOURce:]BB:GPS:NAVigation::DATA:PATTern	#B0,1...B11..1,64		
[SOURce:]BB:GPS:SATellite<1|2|3|4>:CACRate			Query only
[SOURce:]BB:GPS:SATellite<1|2|3|4>:DSHift	-100.0 kHz ... 100.0 kHz	Hz	
[SOURce:]BB:GPS:SATellite<1|2|3|4>:FREQency			Query only
[SOURce:]BB:GPS:SATellite<1|2|3|4>:PCRate			Query only
[SOURce:]BB:GPS:SATellite<1|2|3|4>:POWer	-10.0 dB ... 10.0 dB	dB	
[SOURce:]BB:GPS:SATellite<1|2|3|4>:RCODe	CACode		
[SOURce:]BB:GPS:SATellite<1|2|3|4>:STATe	ON | OFF		
[SOURce:]BB:GPS:SATellite<1|2|3|4>:TSPChips	0 ... 1023000		
[SOURce:]BB:GPS:SATellite<1|2|3|4>:TSSeconds	0 ... 1023000.0/(10.0 *f_L1-100.0e3)	s	
[SOURce:]BB:GPS:SATellite<1|2|3|4>:VID	0 ... 37		

[SOURce:]BB:GPS:NAVigation:ALManac <text file name>

The command selects the almanac providing the navigation information). Current almanac data can be downloaded via the Internet. The files are provided as text files (*.txt).

The directory applicable to the following command is defined with the command `MMEMory:CDIR`. To access the files in this directory, onlythe file name is required, without the path and the file extension.

Example: `"MMEM:CDIR 'D:\Lists\gps'"`
'selects the directory for the almanac files.

`"BB:GPS:NAV:ALM 'SEM269'"`
'the file 'SEM269' is used for retrieving navigation information.

*RST value	Resolution	Options	SCPI
-	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:NAVigation:ALManac:BEGin:DAY?

The command queries the start day of the week in which the almanac was published.. The command is only available if data source Real Navigation Data is selected (`SOURce:BB:GPS:NAVigation:DATA RND`). The almanac is loaded with command `SOURce:BB:GPS:NAVigation:ALMananc`.

The command is a query command and therefore has no *RST value.

Example: `"BB:GPS:NAV:ALM:BEG:DAY?"`
'queries the start day of the GPS week.

Response: "12"
'the GPS week starts on the 12th of the month.

*RST value	Resolution	Options	SCPI
-	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:NAVigation:ALManac:BEGin:MONTh?

The command queries the start month of the week in which the almanac was published.. The command is only available if data source Real Navigation Data is selected (SOURce:BB:GPS:NAVigation:DATA RND). The almanac is loaded with command SOURce:BB:GPS:NAVigation:ALMananc.

The command is a query command and therefore has no *RST value.

Example: "BB:GPS:NAV:ALM:BEG:MONT?" 'queries the start month of the GPS week.

Response: "4" 'the week starts in April.

*RST value	Resolution	Options	SCPI
-	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:NAVigation:ALManac:BEGin:WNUMber?

The command queries the GPS week number of the almanac.. The command is only available if data source Real Navigation Data is selected (SOURce:BB:GPS:NAVigation:DATA RND). The almanac is loaded with command SOURce:BB:GPS:NAVigation:ALMananc.

The command is a query command and therefore has no *RST value.

Example: "BB:GPS:NAV:ALM:BEG:WNUM?" 'queries the GPS week number of almanac.

Response: "1233" 'the week number is 1233.

*RST value	Resolution	Options	SCPI
-	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:NAVigation:ALManac:BEGin:YEAR?

The command queries the year of the week in which the almanac was published.. The command is only available if data source Real Navigation Data is selected (SOURce:BB:GPS:NAVigation:DATA RND). The almanac is loaded with command SOURce:BB:GPS:NAVigation:ALMananc.

The command is a query command and therefore has no *RST value.

Example: "BB:GPS:NAV:ALM:BEG:YEAR?" 'queries the year of the GPS week.

Response: "2005" 'the year is 2005.

*RST value	Resolution	Options	SCPI
-	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:NAVigation:ALManac:END:DAY?

The command queries the final day of the week in which the almanac was published.. The command is only available if data source Real Navigation Data is selected (SOURce:BB:GPS:NAVigation:DATA RND). The almanac is loaded with command SOURce:BB:GPS:NAVigation:ALMananc.

The command is a query command and therefore has no *RST value.

Example: "BB:GPS:NAV:ALM:END:DAY?" 'queries the final day of the GPS week.

Response: "19" 'the GPS week ends on the 19th of the month.

*RST value	Resolution	Options	SCPI
-	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:NAVigation:ALManac:END:MONTh?

The command queries the final month of the week in which the almanac was published.. The command is only available if data source Real Navigation Data is selected (SOURce:BB:GPS:NAVigation:DATA RND). The almanac is loaded with command SOURce:BB:GPS:NAVigation:ALMananc.

The command is a query command and therefore has no *RST value.

Example: "BB:GPS:NAV:ALM:END:MONT?" 'queries the final month of the GPS week.

Response: "4" 'the GPS week ends in April.

*RST value	Resolution	Options	SCPI
-	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:NAVigation:ALManac:END:YEAR?

The command queries the year of the week in which the almanac was published.. The command is only available if data source Real Navigation Data is selected (SOURce:BB:GPS:NAVigation:DATA RND). The almanac is loaded with command SOURce:BB:GPS:NAVigation:ALMananc.

The command is a query command and therefore has no *RST value.

Example: "BB:GPS:NAV:ALM:END:YEAR?" 'queries the year of the GPS week.

Response: "2005" 'the year is 2005.

*RST value	Resolution	Options	SCPI
-	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:NAVigation:ALManac:TOEPhemeris?

The command queries the time of ephemeris, i.e the exact time in seconds to which the navigation data refers.. The command is only available if data source Real Navigation Data is selected (`SOURce:BB:GPS:NAVigation:DATA RND`). The almanac is loaded with command `SOURce:BB:GPS:NAVigation:ALMananc`.

The command is a query command and therefore has no *RST value.

Example: `"BB:GPS:NAV:ALM:TOEP?"` 'queries the time of ephemeris.

Response: `"589824"` 'the value is returned in seconds. Counting starts at 0.00 a.m. on sunday of the GPS week.

*RST value	Resolution	Options	SCPI
-	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:NAVigation:DATA
RNData **|** PN9 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | ZERO | ONE | PATTern

The command determines the data source for the navigation information.

Parameters:

RNData Real navigation data provided by an almanac file is used. The file is loaded with command `SOURce:BB:GPS:NAVigation:ALMananc`.

DLISt A data list is used. The data list is selected with the command `:BB:GPS:NAVigation:DATA:DSELect`.

PNxx The pseudo-random sequence generator is used as the data source. Different random sequence lengths can be selected.

ZERO | ONE Internal 0 and 1 data is used

PATTern Internal data is used The bit pattern for the data is defined by the command `:BB:GPS:NAVigation:DATA:PATTern`.

Example: `"BB:GPS:NAV:DATA PATT"` 'selects as the data source for the data fields of burst 0, the bit pattern defined with the following command.

`"BB:GPS:NAV:DATA:PATT #H3F,8"` 'defines the bit pattern.

*RST value	Resolution	Options	SCPI
RNData	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:NAVigation:DATA:DSELect <data list name>

The command selects the data list for the DLISt data source selection.

The lists are stored as files with the fixed file extensions ***.dm_iqd** in a directory of the user's choice. The directory applicable to the following commands is defined with the command `MMEMory:CDIR`. To access the files in this directory, you only have to give the file name, without the path and the file extension.

Example: `"BB:GPS:NAV:DATA DLIS"` 'selects the Data Lists data source.

`"MMEM:CDIR 'D:\Lists\DM\IqData'"`
'selects the directory for the data lists.

`"BB:GPS:NAV:DATA:DLIS 'GPS_list1'"`
'selects file '`GPS_list1`' as the data source. This file must be in the directory `D:\Lists\DM\IqData` and have the file extension *.dm_iqd.

*RST value	Resolution	Options	SCPI
-	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:NAVigation:DATA:PATTern
#B0,1... #B111..1,64

The command determines the bit pattern for the PATTern selection. The maximum length is 64 bits.

Example: `"BB:GPS:NAV:DATA:PATT #H3F,8"` 'defines the bit pattern.

*RST value	Resolution	Options	SCPI
0	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:NAVigation:SIMulation[:BEGin]:DAY 1... 31

The command sets the day for the simulation in Greenwich Mean Time.. The command is only available if data source Real Navigation Data is selected (`SOURce:BB:GPS:NAV:DATA RND`).

Example: `"BB:GPS:NAV:SIM:DAY 12"` 'sets day 12 for the exact time of the simulation

*RST value	Resolution	Options	SCPI
10	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:NAVigation:SIMulation[:BEGin]:HOUR 0 ... 11

The command sets the hour for the simulation in Greenwich Mean Time.. The command is only available if data source Real Navigation Data is selected (`SOURce:BB:GPS:NAV:DATA RND`).

Example: `"BB:GPS:NAV:SIM:HOUR 4"` 'sets hour 4 for the exact time of the simulation

*RST value	Resolution	Options	SCPI
0	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:NAVigation:SIMulation[:BEGin]:MINute 0 ... 59

The command sets the minute for the simulation in Greenwich Mean Time.. The command is only available if data source Real Navigation Data is selected (`SOURce:BB:GPS:NAV:DATA RND`).

Example: `"BB:GPS:NAV:SIM:MIN 4"` 'sets minute 4 for the exact time of the simulation

*RST value	Resolution	Options	SCPI
0	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:NAVigation:SIMulation[:BEGin]:MONTh 1 ... 12

The command sets the month for the simulation in Greenwich Mean Time.. The command is only available if data source Real Navigation Data is selected (`SOURce:BB:GPS:NAV:DATA RND`).

Example: `"BB:GPS:NAV:SIM:MONT 4"`
'sets April for the exact time of the simulation

*RST value	Resolution	Options	SCPI
10	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:NAVigation:SIMulation[:BEGin]:SECond 0 ... 59

The command sets the second for the simulation in Greenwich Mean Time.. The command is only available if data source Real Navigation Data is selected (`SOURce:BB:GPS:NAV:DATA RND`).

Example: `"BB:GPS:NAV:SIM:SEC 23"` 'sets the second 23 for the exact time of the simulation.

*RST value	Resolution	Options	SCPI
0	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:NAVigation:SIMulation[:BEGin]:YEAR -9999 ... 9999

The command sets the year for the simulation.. The command is only available if data source Real Navigation Data is selected (`SOURce:BB:GPS:NAV:DATA RND`).

Example: `"BB:GPS:NAV:SIM:YEAR 2005"` 'sets the year 2005 for the exact time of the simulation.

*RST value	Resolution	Options	SCPI
2004	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:SATellite<1|2|3|4>CACRate?

The command queries the currently valid values for the chip rate of the C/A code.The chip rate depends on the set doppler shift.

The command is a query command and therefore has no *RST value.

Example: `"BB:GPS:SAT4:CACR?"` 'queries the chip rate of the C/A code of satellite 4.

Response: `"1023022.077"` The chip rate is 1. 023022 08 MHz

*RST value	Resolution	Options	SCPI
-		B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:SATellite<1|2|3|4>:DSHift -100 kHz ... 100 kHz

The command sets the doppler shift of the simulated signal of all satellites. Therefore, the numeric suffix is without effect in this command. The relevant change to the chip rate of the C/A code is carried out automatically. The currently valid values for Doppler-shifted carrier frequency and chip rates are queried with commands `SOURce:BB:GPS:SATellite:CACRate`, `SOURce:BB:GPS:SATellite:PCRate` and `SOURce:BB:GPS:SATellite:FREQuency`

Example: `"BB:GPS:SAT:DSH 5 kHz"` 'sets a doppler shift of 5 kHz for the four satellites.

*RST value	Resolution	Options	SCPI
0	0.01 Hz	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:SATellite<1|2|3|4>CACRate?

The command queries the resulting C/A chip rate.

The command is a query command and therefore has no *RST value.

Example: "BB:GPS:SAT4:CACR?" 'queries the resulting C/A chip rate of satellite 4.

Response: "1023000.0067142857"
The resulting C/A chip rate is 11.023 MHz

*RST value	Resolution	Options	SCPI
-		B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:SATellite<1|2|3|4>:FREQuency?

The command queries the currently valid value for the doppler-shifted carrier frequency.

The command is a query command and therefore has no *RST value.

Example: "BB:GPS:SAT4:FREQ?" 'queries the resulting carrier frequency of satellite 4.

Response: "1575421111" The resulting carrier frequency is 1.57542 GHz

*RST value	Resolution	Options	SCPI
-		B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:SATellite<1|2|3|4>PCRate?

The command queries the currently valid value for the resulting P-chip rate.

The command is a query command and therefore has no *RST value.

Example: "BB:GPS:SAT4:PCR?" 'queries the resulting P-chip rate of satellite 4.

Response: "10230007.214285715"
The resulting P-chip rate is 10.230007 MHz.

*RST value	Resolution	Options	SCPI
-		B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:SATellite<1|2|3|4>:POWer -10 dB ... +10 dB

The command sets the power offset of the satellite.

Example: `"BB:GPS:SAT4:POW -2 dB"` 'sets a power offset of 2 dB.

*RST value	Resolution	Options	SCPI
0 dB	0.1 dB	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:SATellite<1|2|3|4>:RCODe?

The command queries the ranging code. The command is a query command and therefore has no *RST value.

Example: `"BB:GPS:SAT:RCOD?"` 'queries the ranging code.

Response: "CAC" The C/A code (f_ca = 1.023 MHz) is used. It is provided for civilian purposes.

*RST value	Resolution	Options	SCPI
0	-	B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:SATellite<1|2|3|4>:STATe ON | OFF

The command enables/disables generation of the signal of the selected satellite.

Example: `"BB:GPS:SAT4:STAT ON"` 'enables generation of the signal of satellite 4

*RST value	Resolution	Options	SCPI
SAT1: ON SAT<2|3|4>: OFF		B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:SATellite<1|2|3|4>:TSPChips 0 ...1023000

The command sets a delay of the selected satellite relative to the other satellites. The time shift is set in multiples of the P-code chip length.

Example: `"BB:GPS:SAT4:TSPC 100232"` 'sets a time shift of 100232 times the p-code chip length.

*RST value	Resolution	Options	SCPI
0		B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:SATellite<1|2|3|4>:TSSeconds?

The command queries the time shift of the code sequence in seconds.

The command is a query command and therefore has no *RST value.

Example: "BB:GPS:SAT4:TSS?" 'queries the time shift in seconds.

Response: "0.00979" 'the time shift is 9.799 ms.

*RST value	Resolution	Options	SCPI
		B10/B11 and B13 K44	Device-specific

[SOURce:]BB:GPS:SATellite<1|2|3|4>:VID 1 ... 37

The command sets the id of the satellite to be simulated. This value is used to generate the corresponding C/A code. If **Real Navigation Data** is used, only the valid Ids which are listed in the almanac are setable. For arbitray data, all Ids can be selected.

Example: "BB:GPS:SAT2:VID 4" 'sets id 4 for the second satellite.

*RST value	Resolution	Options	SCPI
SAT1: 1 SAT2: 2 SAT3: 3 SAT4: 4	-	B10/B11 and B13 K44	Device-specific

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