R&S®EVS300-K9/-K10
GBAS and SCAT-I Analysis
User Manual

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Test & Measurement

User Manual

ROHDE&SCHWARZ

This manual applies to the following R&S®EVS300 models with firmware version 5.2 and higher:

- R&S®EVS300 (3544.4005.02)

(For exceptions see the data sheet.)
The following firmware options are described:

- R&S EVS300-K9 GBAS Analysis (5202.8154.02)
- R&S EVS300-K10 SCAT-I Analysis (5201.7783.00)

The firmware of the instrument makes use of several valuable open source software packages. For information, see the "Open Source Acknowledgement" on the user documentation CD-ROM (included in delivery).
Rohde & Schwarz would like to thank the open source community for their valuable contribution to embedded computing.

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The following abbreviations are used throughout this manual: R&S®EVS300 is abbreviated as R&S EVS300.

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1 Preface

1.1 About this Manual

This GBAS and SCAT-I Analysis User Manual provides all the information **specific to the application**. All general instrument functions and settings common to all applications are described in the main R&S EVS300 User Manual.

The main focus in this manual is on the analysis results and the tasks required to obtain them. The following topics are included:

- **Welcome to the GBAS and SCAT-I Analysis Application**
  Introduction to and getting familiar with the application
- **Result Displays**
  Details on result displays
- **GBAS and SCAT-I Analysis Basics**
  Background information on basic terms and principles in the context of the analysis
- **GBAS and SCAT-I Configuration + Analysis**
  A concise description of all functions and settings available to configure measurements and analyze results with their corresponding remote control command
- **Optimizing and Troubleshooting the Analysis**
  Hints and tips on how to handle errors and optimize the test setup
- **Remote Commands for GBAS and SCAT-I Analysis**
  Remote commands required to configure and perform GBAS and SCAT-I Analysis in a remote environment, sorted by tasks
  (Commands required to set up the environment or to perform common tasks on the instrument are provided in the main R&S EVS300 User Manual)
- **Annex**
  Reference material
- **List of remote commands**
  Alpahabetical list of all remote commands described in the manual
- **Index**

1.2 Typographical Conventions

The following text markers are used throughout this documentation:

Convention	Description
"Graphical user interface elements"	All names of graphical user interface elements on the screen, such as dialog boxes, menus, options, buttons, and softkeys are enclosed by quotation marks.
KEYS	Key names are written in capital letters.

Convention	Description
`File names, commands, program code`	File names, commands, coding samples and screen output are distinguished by their font.
Input	Input to be entered by the user is displayed in italics.
Links	Links that you can click are displayed in blue font.
"References"	References to other parts of the documentation are enclosed by quotation marks.

2 Welcome to the GBAS and SCAT-I Analysis Application

The R&S EVS300-K9/-K10 options are firmware applications that add functionality to perform GBAS and SCAT-I Analysis on the R&S EVS300.

The K9 option enables you to receive and analyze the very high frequency (VHF) Data Broadcast (VDB) Signal-in-Space transmitted from a Ground Based Augmentation System (GBAS) ground subsystem to the airborne subsystem. This implementation is in line with the specification RTCA DO-246D [1] (see chapter A.1, "References", on page 61).

Similarly, using option K10, data from special category I (SCAT-I) systems can be received and analyzed. The main difference is the content of the message data. This implementation is in line with the specification RTCA DO217 [2] (see chapter A.1, "References", on page 61).

The R&S EVS300-K9/-K10 applications feature:

- Receiving GBAS signal data from a GBAS ground station in a frequency range between 108.000 and 117.975 MHz with a channel spacing of 25 kHz
- Receiving SCAT-I signal data from a SCAT-I ground station in a frequency range between 108.025 and 117.95 MHz with a channel spacing of 25 kHz
- Analyzing the RF characteristics, signal strength and frequency accuracy of the GBAS/SCAT-I signal
- Demodulating, decoding and displaying GBAS/SCAT-I signal data
- Analyzing up to 8 time slots or individual time slot details in the GBAS/SCAT-I signal data
- Analyzing individual Final Approach Segment (FAS) data blocks
- Logging and storing up to 9999 lists of received GBAS/SCAT-I signal data

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

All functions not discussed in this manual are the same as in the base unit and are described in the R&S EVS300 User Manual. The latest version is available for download at the product homepage.

- Installing and Activating the GBAS and SCAT-I Analysis Applications 7
- Starting the GBAS and SCAT-I Analysis Application 9

2.1 Installing and Activating the GBAS and SCAT-I Analysis Applications

The GBAS and SCAT-I Analysis applications require an additional option:
R&S EVS300-K9 (GBAS) or R&S EVS300-K10 (SCAT-I). When you purchase these

options, Rohde & Schwarz provides the necessary license key. This key must be activated before the applications can be started.

In order to install the R&S EVS300-K9 or the R&S EVS300-K10 options, firmware version 5.1 or higher is required on the R&S EVS300.

Both the R&S EVS300-K9 and the R&S EVS300-K10 options add the common GBAS/SCAT-I mode to the R&S EVS300.

However, in order to see the detailed GBAS data ("MT1 View", "MT4 View", "MT1 Graph", see chapter 4, "Result Displays", on page 16), the option R&S EVS300-K9 is required.

In order to see the detailed SCAT-I data ("MT1 View", "MT4 View", "MT1 Graph", see chapter 4, "Result Displays", on page 16), the option R&S EVS300-K10 is required.

To activate the license key

1. Press the SETUP key.
2. Press the ^ key (below SK7) to switch to the "Setup - GeneralSettings" window (2/2).
3. Press the "Options" softkey to display an overview of all available R&S EVS300 options.
4. Press the ENTER button to open an input edit field for "KEY".
5. Enter the license key number as provided by Rohde & Schwarz.
   (Note: the license key consists of 18 numbers, separated by commas)
6. Press ENTER to confirm the entry.

   If the key is valid, the purchased options are enabled and identified as "available" in the overview.

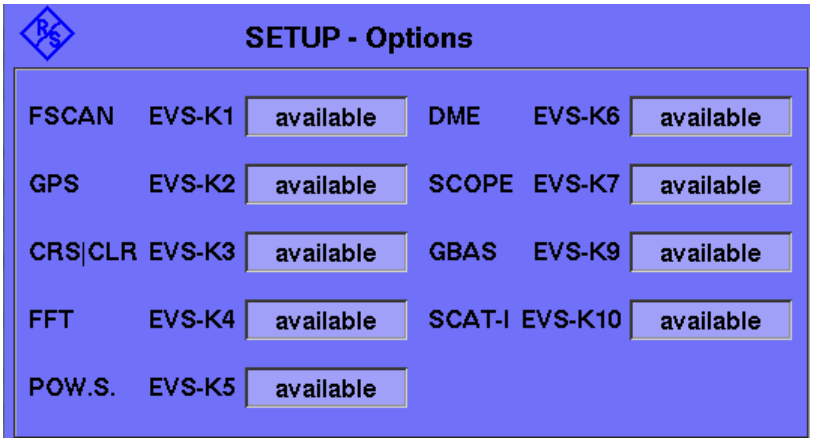

Fig. 2-1: Available R&S EVS300 options

If the key is not valid, the entered number is displayed in red.

Fig. 2-2: Invalid option key

Correct the number and try again.

2.2 Starting the GBAS and SCAT-I Analysis Application

The GBAS and SCAT-I Analysis application adds a new mode to the R&S EVS300.

► To activate the GBAS/SCAT-I mode, press the SPLIT button and select the "GBAS/SCAT-I" option.

The main GBAS/SCAT-I window is displayed.

Remote command:

`MODE_GBAS` on page 46

PPS input recommended

It is strongly recommended that you connect the PPS signal of the GPS receiver to the trigger input of the R&S EVS300. Although it is possible to operate the R&S EVS300 without the PPS signal connected, this may lead to an incorrect assignment of the data to the time slots.

For details see chapter 3.6, "Time Slot Synchronization via PPS", on page 15.

3 Basics on GBAS and SCAT-I Analysis

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

- GBAS Specifics 10
- Broadcast Timing Structure 12
- Final Approach Segment (FAS) Construction Data 12
- Data Acquisition with the Data Logger 13
- Data Streaming 14
- Time Slot Synchronization via PPS 15

3.1 GBAS Specifics

GBAS is a ground based augmentation system that can enhance satellite navigation. The GBAS is intended to improve aircraft safety and to enhance satellite navigation and the full range of precision approach and landing procedures, as well as the terminal area operations.

GBAS components

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

- the GNSS satellite subsystem
- the airborne subsystem
- the GBAS ground subsystem.

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

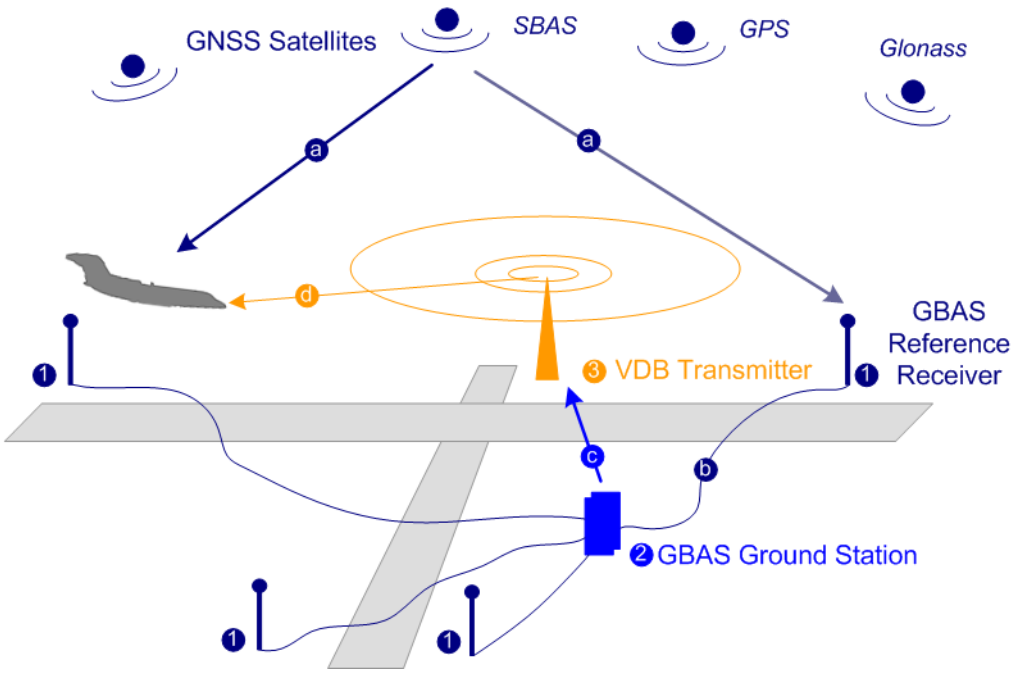

Fig. 3-1: GBAS components and signals (simplified representation)

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

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

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

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

Carrier frequencies and frequency channels

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

3.2 Broadcast Timing Structure

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

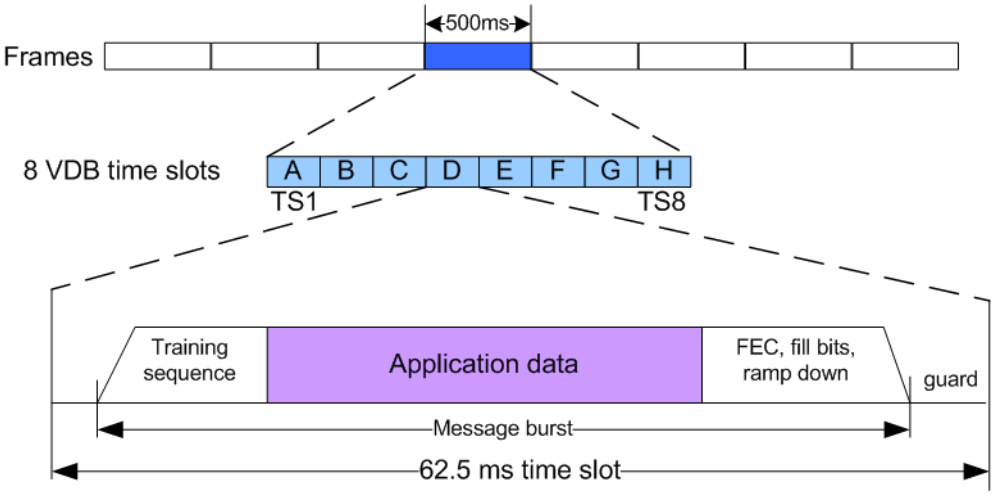

Fig. 3-2: TDMA timing structure (simplified representation)

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

The GBAS specification [1] defines the TDMA timing structure, including timing budget of the VDB bursts, burst data contents and message encoding in great details. The R&S EVS300 receives the required training sequence, decodes the message according to [1] and demodulates the D8PSK modulated data automatically.

3.3 Final Approach Segment (FAS) Construction Data

According to the standard [1], the message type 4 contains one or more data sets that contain approach data, associated vertical/lateral alert limits, and/or the Terminal Area Path (TAP).

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

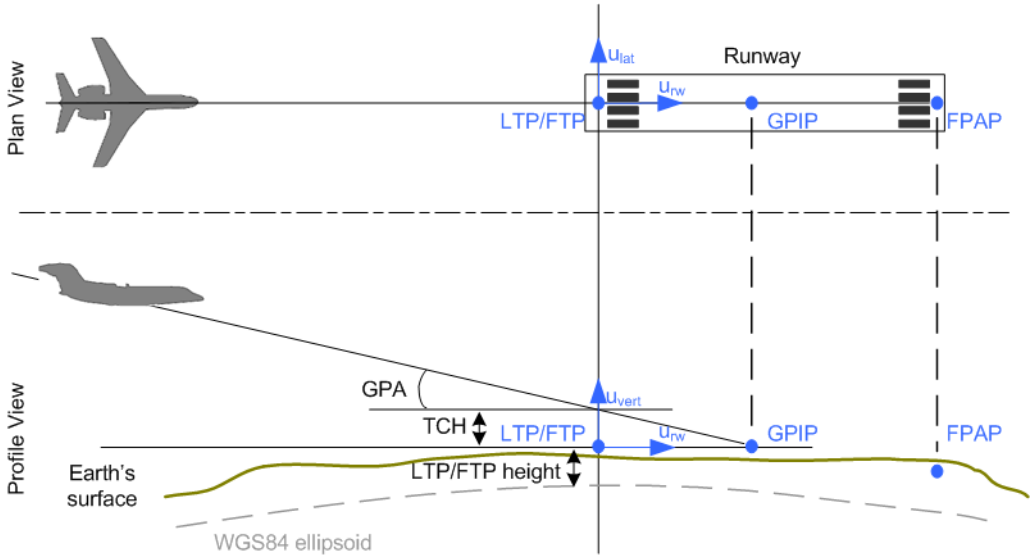

Fig. 3-3: Final Approach Segment (FAS) diagram, according to [1]

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

The coordinates of the LTP/FTP are defined in WGS84 coordinates. In this coordinate system, a location is identified by three coordinates, the altitude, the latitude and the longitude.

3.4 Data Acquisition with the Data Logger

The Data Logger records and manages the data captured during a single measurement or a series of measurements. You can define when and how long data is stored, and from which time slots. Up to 9999 lists with a maximum of 1 000 000 data lines each can be recorded in GBAS/SCAT-I mode. One line corresponds to the captured data at the receive frequency for the GBAS signal in one time slot. Within a list, each data entry is represented by a unique index. Different lists can be used to store multiple measurements at different times, for example. The data lists are stored on the internal compact flash card of the R&S EVS300.

The stored data can be output graphically on the screen or as a data stream in remote operation. You can select the relevant parameters for analysis individually. For further processing, the data can be exported to a USB storage device in CSV format.

Selecting parameters

For each list you can define which parameters are to be displayed and stored by the Data Logger, and in which order. Thus, you can save storage space if not all parameters are relevant for the current measurement scenario. If you add further parameters to the selection after logging, the columns and headers will be added to the list, however the contents of those columns will remain empty. Only in subsequent data logs the new parameters will be available. On the other hand, if you reduce the number of selected parameters, the display is restricted immediately. However, the logged parameter values remain available on the instrument.

When a list is stored to a file, a header line is automatically included that describes the provided parameters.

In **remote operation**, the individual parameter selection is not considered. Only a complete or a short list of parameters can be selected.

Selecting time slots

Furthermore, you can select from which time slots data is logged, which can also reduce the required storage space for the data list. Note, however, that if no time slots are selected, data logging can not be activated.

For a detailed description of the stored data see the chapter A.2, "Format Description of GBAS and SCAT-I Data", on page 61.

Time synchronization for longterm measurements

For longterm measurements, you can configure data logging to start a new list every hour of the day (see "Logging Mode" on page 34). This is useful to determine the used list at a specific time easily.

To determine when to start a new list, the Data Logger refers to the operating system clock of the R&S EVS300. In order to improve accuracy you can synchronize this clock to a GPS or NTP server (see chapter 5.3.2, "Synchronizing the R&S EVS300 Clock", on page 35). If the R&S EVS300 clock differs from the selected synchronization source time by more than 1000 ms, the R&S EVS300 clock is adjusted accordingly.

3.5 Data Streaming

In addition to the Data Logger, which can be operated both manually and remotely, a data *streaming* function is provided for remote operation. As opposed to the Data Logger, which stores the measurement results internally in lists, the data streaming function outputs the results directly to the connected remote control device, synchronously with the measurement. Thus, the results can be analyzed on the remote device during an on-going measurement. The internal storage with its lists is bypassed entirely; no results are stored on the R&S EVS300.

Using the R&S EVS300's remote commands for streaming you can specify which time slots and channels to output, and whether a full or only a short list of parameters is streamed. However, more detailed timing parameters as for the data logger are not

available for streaming. Functions other than starting and stopping the data stream must be controlled by the remote control device using other means.

3.6 Time Slot Synchronization via PPS

The data captured by the R&S EVS300 is assigned to the eight time slots and then decoded.

A PPS signal from a connected GPS receiver can help the R&S EVS300 detect the individual time slots accurately. In this case, the positive slope of the PPS signal indicates the time "0" for slot A. Data transmission may start from -1.5 ms before to +5 ms after the PPS.

Thus, it is strongly recommended that you connect the PPS signal of the GPS receiver to the trigger input of the R&S EVS300. Although it is possible to operate the R&S EVS300 without the PPS signal connected, this may lead to an incorrect assignment of the data to the time slots.

The status of the PPS signal is indicated in the main view of the GBAS/SCAT-I mode.

The PPS signal should be as short as possible, with a maximum duration of **1 ms**. Longer signals may cause errors at the AC-coupled trigger input of the R&S EVS300. Note that the default PPS duration on many GPS receivers is *100* ms!

Triggering on PPS

In order to ensure a common time reference between multiple measured data sets, data logging can be triggered such that the GPS time in the data sets is synchronized with the PPS signal of a connected GPS receiver (see "Logging Source" on page 33).

4 Result Displays

The data that was received by the R&S EVS300 can be evaluated in increasing detail.

- Overview of Captured Data (Main View)....16
- Time Slot Details - Received Messages (Time Slot View)....18
- Message Type 1 - Differential Corrections (MT1 View)....19
- Message Type 4 - Final Approach Segment Data (FAS DB View)....22
- GBAS / SCAT Data Logger List View....26
- Pseudorange Correction Data Graph (PRC Graph)....27
- GPS Information....29

4.1 Overview of Captured Data (Main View)

When you activate GBAS/SCAT-I mode, the main view displays an overview of the captured data in all eight slots. You can return to this view from most other views by selecting the "Main View" softkey.

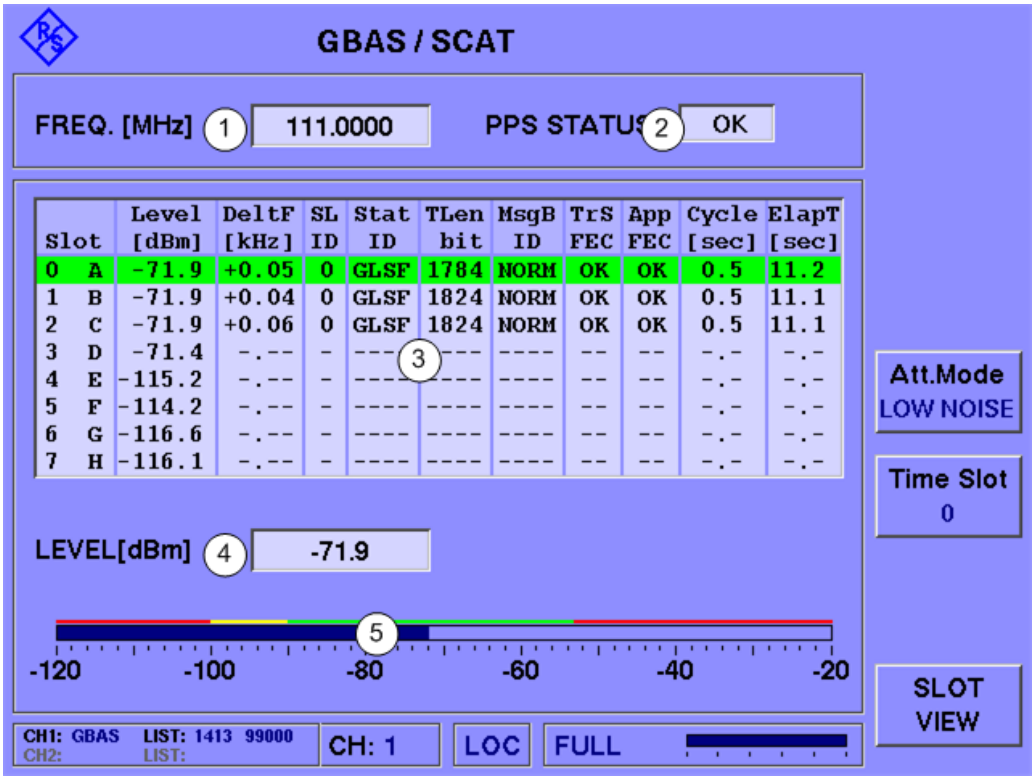

Fig. 4-1: Application-specific elements in the GBAS/SCAT-I main view

1 = Receive frequency in MHz
2 = Pulse per second (PPS) status from GPS
3 = Overview of captured data in all 8 slots
4 = Measured power level in the selected slot
5 = Color bar for power level

The following general information is displayed for a GBAS/SCAT-I measurement:

Table 4-1: Displayed general information for a GBAS/SCAT-I measurement

Label / Element	Description
FREQ. [MHz]	Receive frequency in MHz
PPS Status	Pulse per second (PPS) status from GPS; if error occurs, measurement results may be invalid; check GPS receiver connection

The overview of captured data displays the following data for each of the 8 time slots:

Table 4-2: Displayed information for each captured slot in main view

Column	Description
Slot	Slot 0 to 7 (A to H)
Level [dBm]	Measured power level
DeltF [kHz]	Delta between measured frequency and nominal receive frequency
SS ID	Received station slot identifier
Stat ID	Received station ID, equivalent to GBAS ID or SCAT ID
TLen [bit]	Transmission length in bits
MsgB ID	Message identifier to distinguish GBAS/SCAT-I messages
TrS FEC	FEC of the training sequence
App FEC	FEC of the data content
Cycle [sec]	Time difference between the last 2 incoming bursts
ElapT [sec]	Elapsed time since the last burst reception

Selected slot

One of the slots is always selected for display or further analysis, this slot is highlighted. To change the selected slot, select the "Time Slot" softkey and select a different slot number.

Time slot details in the "Time Slot" view are always displayed for the currently selected slot.

In addition to the information displayed in the overview, the following information is highlighted for the selected slot in the GBAS/SCAT-I main view:

Table 4-3: Highlighted information for the selected slot in the main view:

Label / Element	Description
LEVEL [dBm]	Measured power level in the selected slot
Color bar	Position of measured power level within range of valid values (according to data sheet); for valid measurements, ensure the power level is within the green area of the color bar (adjust attenuation)

Remote commands:

Querying results:

`GBAS:LEV?` on page 59

`GBAS:FMEAS?` on page 58

`GBAS:GETMDEF` on page 58

4.2 Time Slot Details - Received Messages (Time Slot View)

Detailed information for each of the time slots is available in the "Time Slot" view. To display this view, select the "Slot View" softkey in the main window or any other GBAS/ SCAT-I window.

Time slot details in the "Time Slot" view are always displayed for the slot currently selected in the main view. This slot is highlighted. To change the selected slot, select the "Time Slot" softkey and select a different slot number.

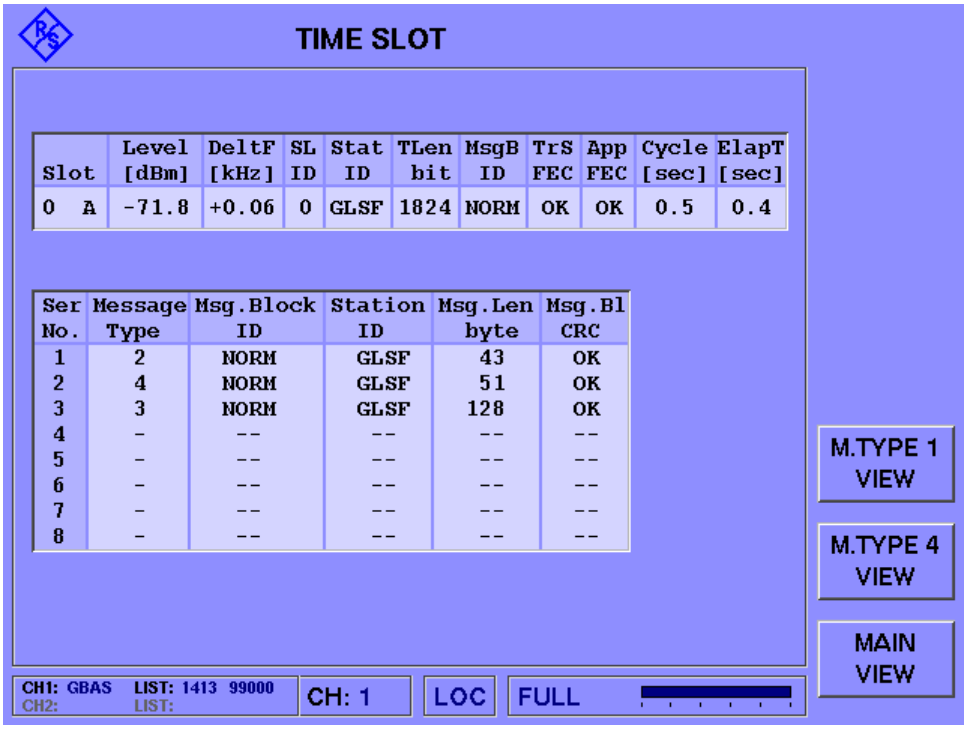

Fig. 4-2: Information on received messages for an individual time slot

At the top of the "Time Slot" view, the general information for the time slot from the main view is repeated for reference (for a description of the information see chapter 4.1, "Overview of Captured Data (Main View)", on page 16).

In addition, the following information on the received message blocks in the selected time slot is displayed:

Table 4-4: Displayed information for each message block in the slot in Time Slot view

Column	Description
Ser.Nr.	Serial number of message
Message Type	Message type (1,2,4,11)
Msg.Block ID	Message block ID: • 1001 1001: SCAT-I • 1010 1010: normal LAAS message (GBAS) • 1111 1111: test LAAS message (GBAS)
Station ID	Received station ID, equivalent to GBAS ID or SCAT ID
Msg. Len [byte]	Message length
Msg.Bl. CRC	Message block CRC

For message types 1 and 4 further details can be displayed.

4.3 Message Type 1 - Differential Corrections (MT1 View)

If the time slot contains a message of type 1, further details on the differential correction data contained in the message can be displayed in the "MT1" view (it is assumed that no more than one message of this type is available per slot). To display this view, select the "M.Type 1 View" softkey in the "Time Slot" view.

The displayed information differs for GBAS and SCAT-I signals.

In order to see the detailed GBAS data the option R&S EVS300-K9 is required (see chapter 2.1, "Installing and Activating the GBAS and SCAT-I Analysis Applications", on page 7).

In order to see the detailed SCAT-I data the option R&S EVS300-K10 is required (see chapter 2.1, "Installing and Activating the GBAS and SCAT-I Analysis Applications", on page 7).

4.3.1 GBAS Message Type 1 View

The message type 1 view displays further details on the differential correction data contained in the message.

In order to see the detailed GBAS data the option R&S EVS300-K9 is required (see chapter 2.1, "Installing and Activating the GBAS and SCAT-I Analysis Applications", on page 7).

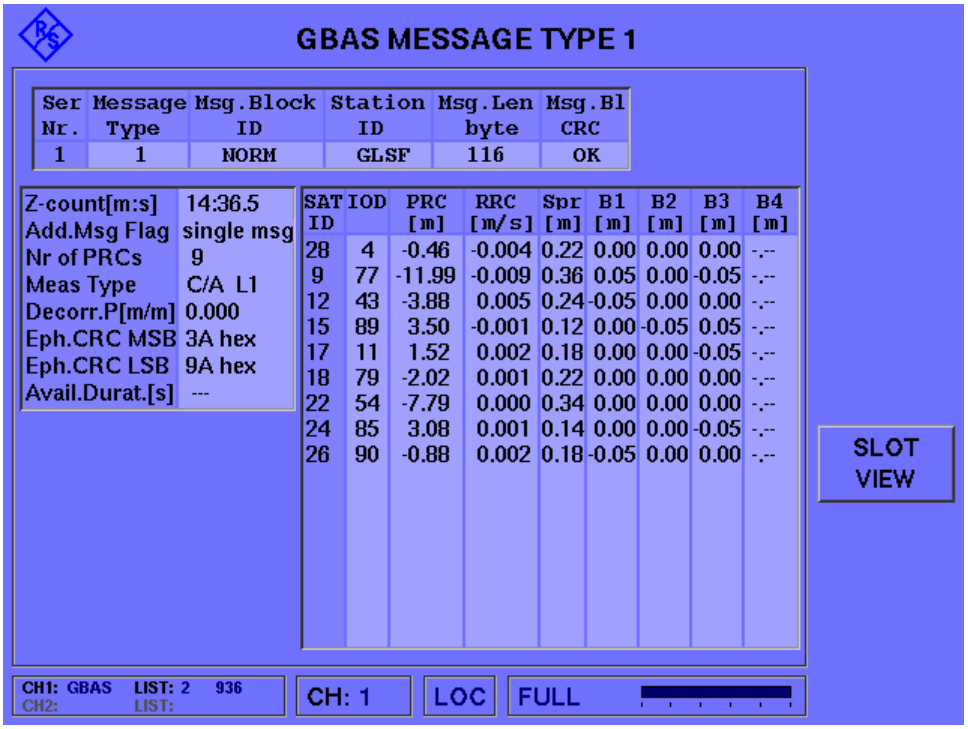

Fig. 4-3: GBAS Message Type 1 view

At the top of the window, the information for the selected message block from the Time Slot view is displayed (see table 4-4.

On the left-hand side of the window, the following satellite-independant information is displayed:

Table 4-5: Displayed satellite-independant information for each type 1 message in MT1 view

Z-count [m:s]
Add.Msg Flag
No. of PRCs
Meas Type
Decorr.P [m/m]
Eph.CRC MSB
Eph.CRC LSB
Avail.Durat.[s]

In addition, the following details for the differential correction data from up to 12 satellites are displayed in the MT1 view (in the order of reception):

Table 4-6: Displayed correction data for each satellite in MT1 view

SAT ID
IOD
PRC [m]

RRC [m/s]
Spr [m]
B1 [m]
B2 [m]
B3 [m]
B4 [m]

For details on the correction data parameters refer to the GBAS specification [1].

4.3.2 SCAT-I Message Type 1 View

The message type 1 view displays further details on the differential correction data contained in the message.

In order to see the detailed SCAT-I data the option R&S EVS300-K10 is required (see chapter 2.1, "Installing and Activating the GBAS and SCAT-I Analysis Applications", on page 7).

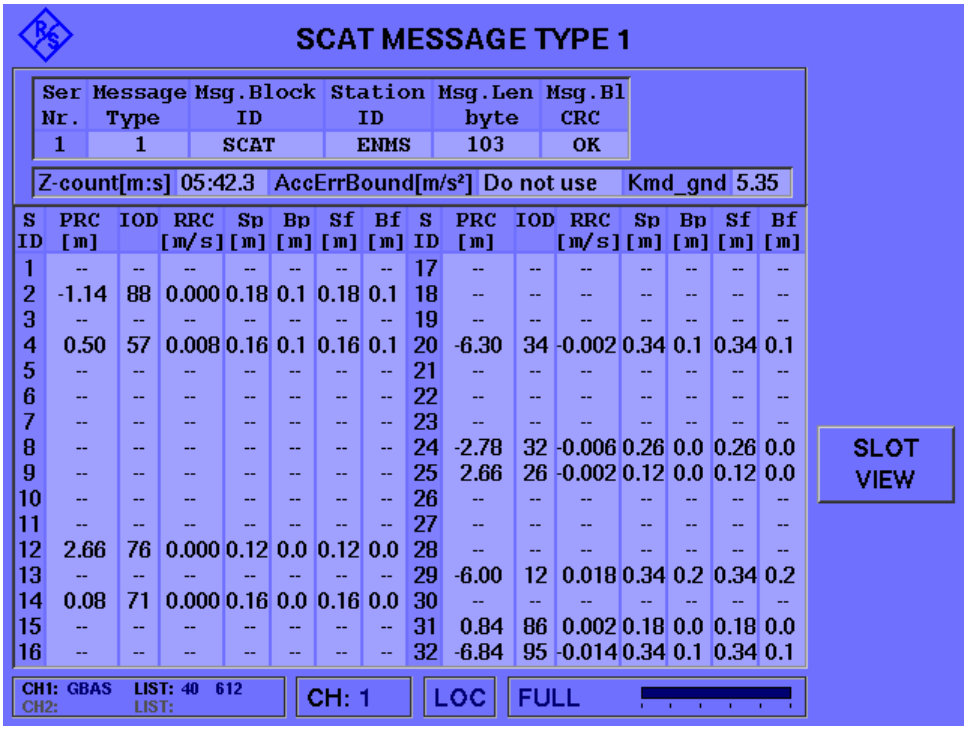

Fig. 4-4: SCAT-I Message Type 1 view

At the top of the window, the information for the selected message block from the Time Slot view is displayed (see table 4-4.

Beneath the message block information, the following satellite-independant information is displayed:

Table 4-7: Displayed satellite-independant information for each type 1 message in MT1 view

Z-count [m:s]
AccErrBound [m/s²]
Kmd_gnd

In addition, the following details for the differential correction data from up to 12 satellites are displayed in the MT1 view (in the order of reception):

Table 4-8: Displayed correction data for each satellite in MT1 view

SAT ID
PRC [m]
IOD
RRC [m/s]
Sp [m]
Sf [m]
Bf [m]

For details on the correction data parameters refer to the SCAT specification [2].

4.4 Message Type 4 - Final Approach Segment Data (FAS DB View)

If the time slot contains one or more messages of type 4, further constructional details on the final approach segment contained in the message can be displayed in the "MT4" view. A time slot may contain multiple messages of type 4, from different final approach segments. Each segment is uniquely identified by its "Reference Path ID". Thus, you can display the details for a particular reference path by selecting one of up to 46 "Reference Path Data Selector"s.

The displayed information differs for GBAS and SCAT-I signals.

In order to see the detailed GBAS data the option R&S EVS300-K9 is required (see chapter 2.1, "Installing and Activating the GBAS and SCAT-I Analysis Applications", on page 7).

In order to see the detailed SCAT-I data the option R&S EVS300-K10 is required (see chapter 2.1, "Installing and Activating the GBAS and SCAT-I Analysis Applications", on page 7).

4.4.1 GBAS Final Approach Segment Data (GBAS FAS DB View)

The details for a particular reference path are displayed in the "GBAS FAS DB" view. To display this view, select the "M.TYPE 4 VIEW" softkey in the "Time Slot" view.

To view the details for a different reference path, select "Sel.FASDB" and then select one of the available Reference Path Data Selectors (RPDS) from the list on the left-hand side.

In order to see the detailed GBAS data the option R&S EVS300-K9 is required (see chapter 2.1, "Installing and Activating the GBAS and SCAT-I Analysis Applications", on page 7).

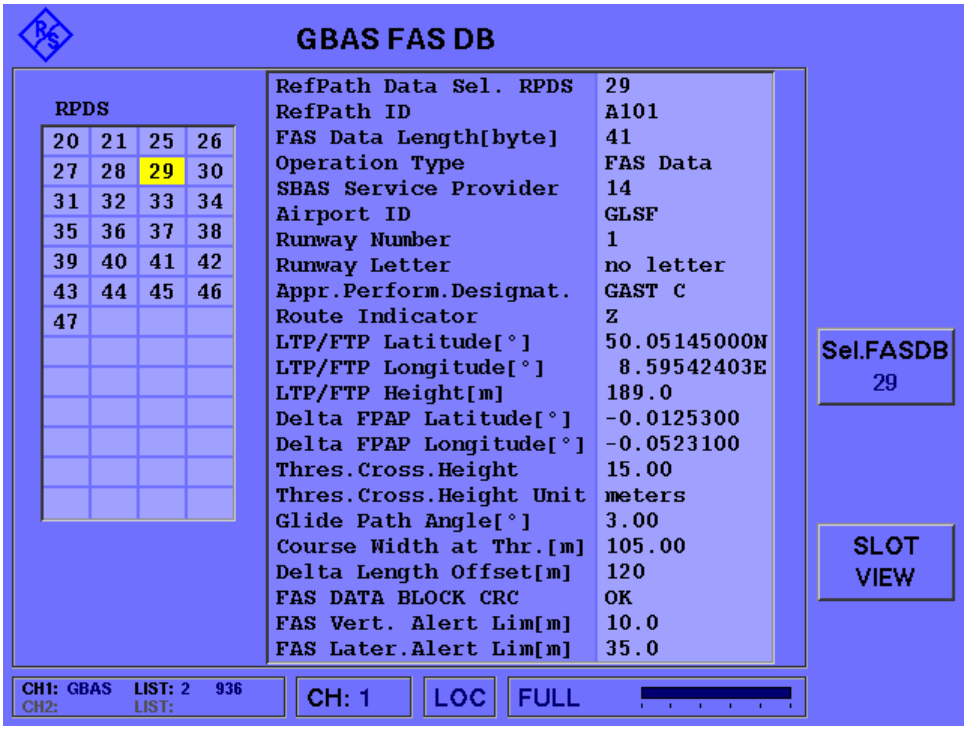

Fig. 4-5: GBAS Final Approach Segment Data (FAS DB) view

The following specific FAS DB data is displayed:

For a visualization of the most important GBAS FAS data parameters see figure 3-3.

Table 4-9: Displayed FAS DB for a single GBAS reference path in GBAS FAS DB view

Reference Path Data Selector
Reference Path ID
FAS Data Length [byte]
Operation Type

SBAS Service Provider
Airport ID
Runway Number
Runway Letter
Appr. Perform.Designator
Route Indicator
LTP/FTP Latitude [°]
LTP/FTP Longitude [°]
LTP/FTP Height [m]
Delta FPAP Latitude [°]
Delta FPAP Longitude [°]
Thres.Cross.Height
Thres.Cross.Height Unit
Glide Path Angle (GPA) [°]
Course Width at Threshold [m]
Delta Length Offset [m]
FAS DATA BLOCK CRC
FAS Vertical Alert Limit [m]
FAS Lateral Alert Limit [m]

4.4.2 SCAT-I Final Approach Segment Data (SCAT-I FAS DB View)

The details for a particular reference path are displayed in the "SCAT-I FAS DB" view. To display this view, select the "M.TYPE 4 VIEW" softkey in the "Time Slot" view.

To view the details for a different reference path, select "Sel.FASDB" and then select one of the available Reference Path Data Selectors (RPDS) from the list on the left-hand side.

In order to see the detailed SCAT-I data the option R&S EVS300-K10 is required (see chapter 2.1, "Installing and Activating the GBAS and SCAT-I Analysis Applications", on page 7).

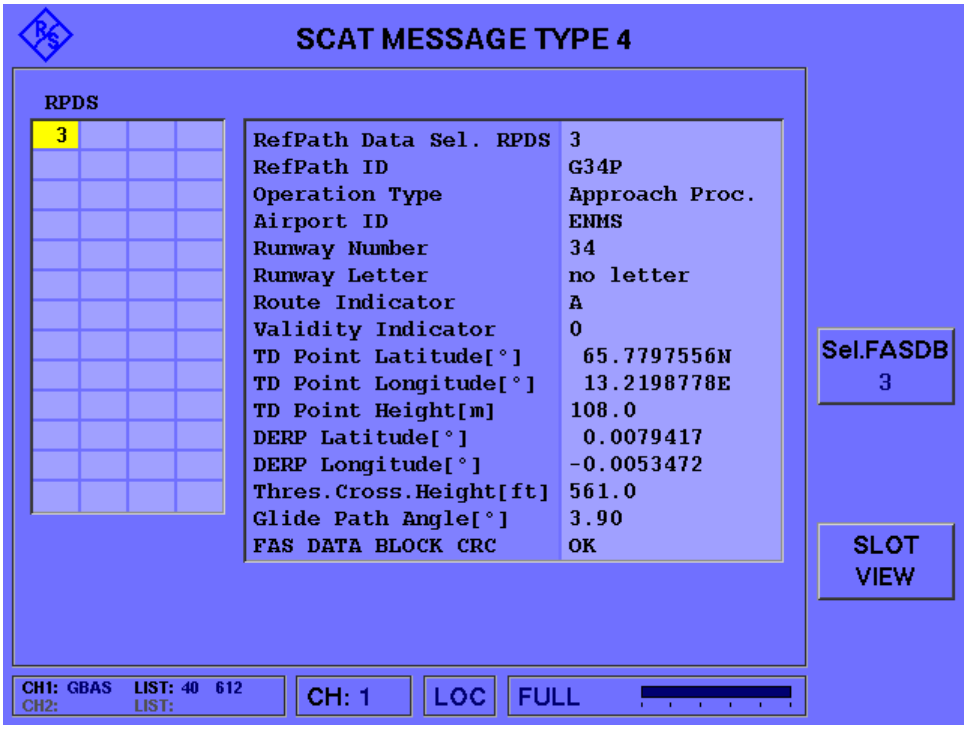

Fig. 4-6: SCAT-I Final Approach Segment Data (FAS DB) view

The following specific FAS DB data is displayed:

Table 4-10: Displayed FAS DB for a single SCAT-I reference path in SCAT-I FAS DB view

Reference Path Data Selector
Reference Path ID
Operation Type
Airport ID
Runway Number
Runway Letter
Route Indicator
Validity Indicator
TD Point Latitude [°]
TD Point Longitude [°]
TD Point Height [m]
DERP Latitude [°]
DERP Longitude [°]
Thres.Cross.Height

Glide Path Angle (GPA)
FAS DATA BLOCK CRC

4.5 GBAS / SCAT Data Logger List View

The "GBAS / SCAT-1" mode provides a data logger function. You can specify when and how long the data is logged.

In the list view, the logged data is provided as an overview.

To display this view, select the MEM key in "GBAS / SCAT-1" mode.

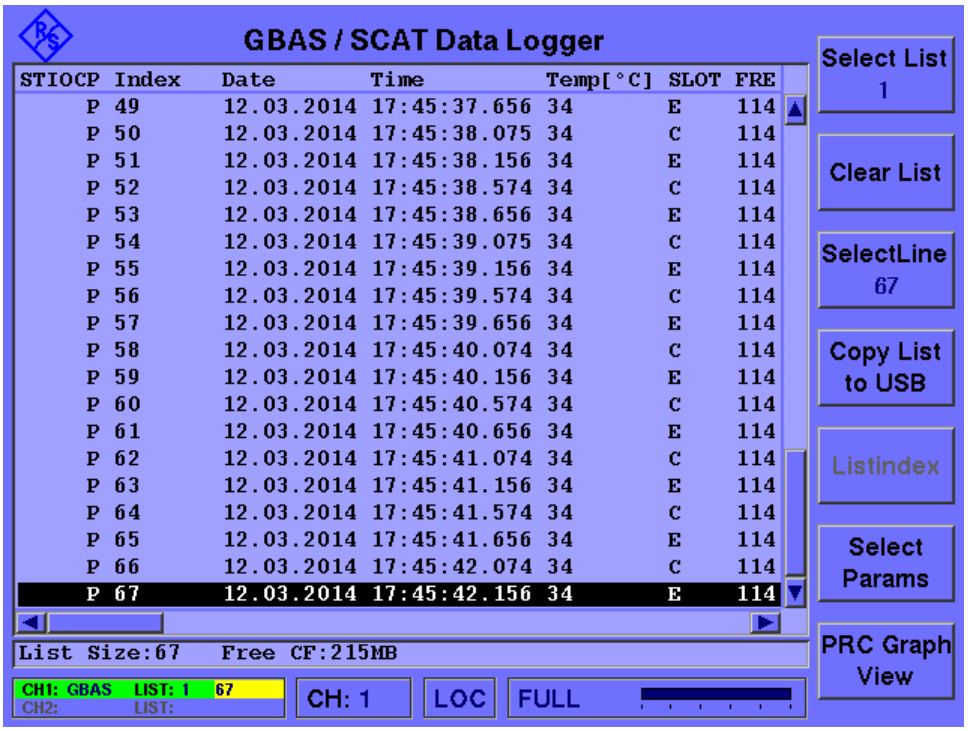

Fig. 4-7: GBAS / SCAT Data Logger List view

Each data entry is represented by a unique index, in the chronological order it was recorded. Furthermore, for each entry, the time it was logged is stored. Up to 30 parameters can be displayed for each data entry, if available. You can select the parameters and time slots whose information is to be displayed individually. For a description of the individual parameters see chapter A.2, "Format Description of GBAS and SCAT-I Data", on page 61.

Furthermore, the following general list information is provided beneath the list:

Label	Description
List Size	Number of data entries within the current list.
Free CF	Available memory on the internal compact flash card

To scroll through the parameters of an entry, use the rotary knob.

The information in the data log can also be displayed graphically, in the Pseudorange Correction Data Graph (PRC Graph).

For further functions available for data logs see chapter 5.3.4, "Analyzing the Data Logger Entries", on page 38.

4.6 Pseudorange Correction Data Graph (PRC Graph)

The PRC graph displays the data from the data logger graphically. It displays the pseudorange correction data contained in messages of type 1 in the stored data log.

To display this view, select the "PRC Graph" softkey from the "GBAS / SCAT Data Logger" list view.

In order to see the SCAT-I correction data graph the option R&S EVS300-K10 is required (see chapter 2.1, "Installing and Activating the GBAS and SCAT-I Analysis Applications", on page 7).

The graph displays three traces:

- **yellow:** the RF **level** in dBm measured in the time slot versus time
- **green:** distance in meters between the **GPS** reference point and the decoded GPS location (see also chapter 4.7, "GPS Information", on page 29)
- **white:** pseudorange correction (**PRC**) data in meters vs. time for the specified slot and satellite

For each trace, the start value, stop value and scaling per division is indicated in the table above the diagram. The scaling for each trace can be defined individually.

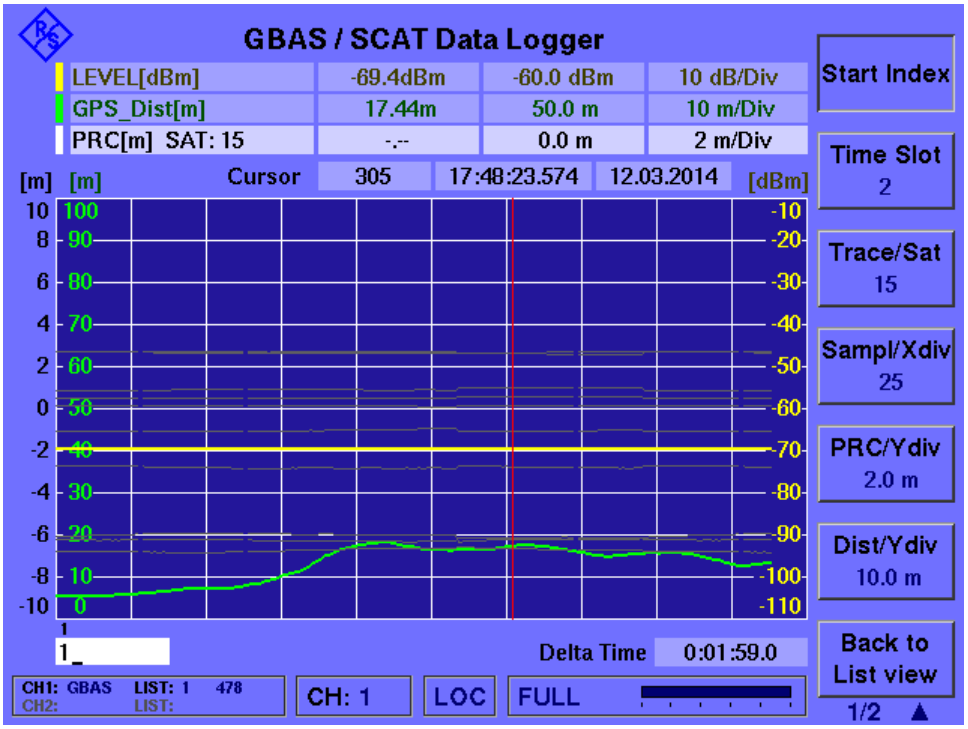

Fig. 4-8: Graphical display of pseudorange correction data contained in a message of type 1

Time axis

The x-axis indicates the time of the data log entry. However, the time axis need not be linear, and the duration in time between two samples need not be equal if the data was not logged continuously. Each data entry is represented by an index. The start index and the scaling of the x-axis are user-definable.

The actual time of an individual data entry is indicated when you position a *cursor* on a particular data entry, see below.

Cursor

A cursor is available to select an individual data log entry. The cursor is indicated as a vertical red line and can be positioned to any available list entry in the data log. The position of the cursor on the x-axis, as well as the time of the selected list entry, is indicated above the diagram.

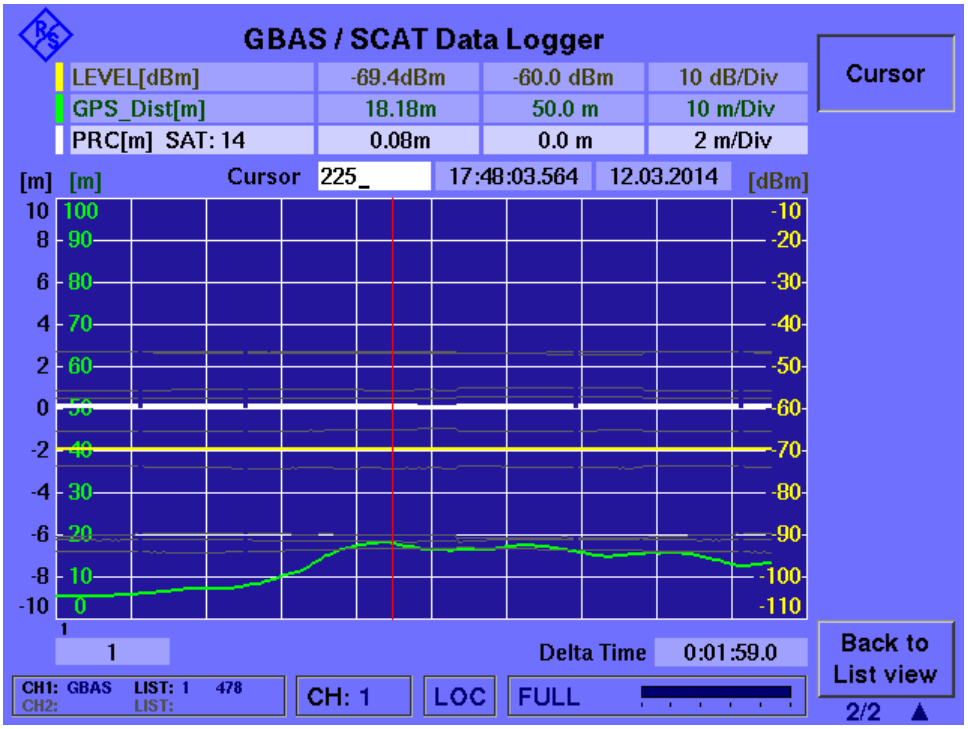

Fig. 4-9: Cursor in the Data Logger

4.7 GPS Information

In addition to the specific GBAS/SCAT-I data, the captured GPS data may be of interest. If option R&S EVS300-K2 is installed, the GPS mode is available. The GPS view now includes information on a specified reference point and the distance between the currently received GPS data and the specified reference point.

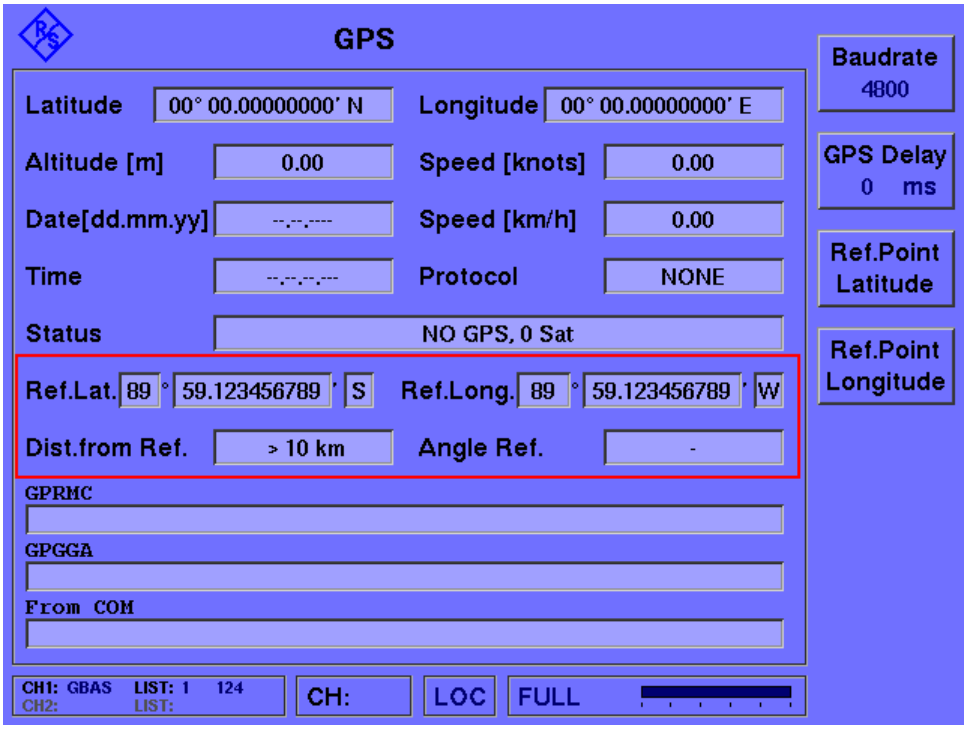

Fig. 4-10: GPS view with additional information on GPS reference point

The following information has been added:

- **Ref. Lat.:** Latitude of the reference point in degrees, minutes (decimal format) and direction
- **Ref. Long.:** Longitude of the reference point in degrees, minutes (decimal format) and direction
- **Dist. from Ref.:** Distance of the received GPS position from the indicated reference point
- **Angle Ref.:** Angle of the received GPS position from the indicated reference point

Reference point

The reference point is preset to a default position. However, it can be changed manually to any other position.

To change the position of the reference point, select the "Ref.Point Latitude" or "Ref.Point Longitude" softkey. Select the softkey again to toggle between the degree, minute, and direction information.

Remote command:

`SETUP:GPSREF` on page 48

For more information on the GPS mode see the main R&S EVS300 User Manual.

5 Configuration and Analysis

GBAS and SCAT-I Analysis require a special application on the R&S EVS300, which you activate using the SPLIT key on the front panel.

- Defining the Receive Frequency....31
- Setting the RF Input Attenuation....31
- Working with the Data Logger....32

5.1 Defining the Receive Frequency

The frequency at which data is received from the ground station is configured via the FREQ key. The currently recieved frequency is indicated in the GBAS/SCAT-I main window.

Remote command:

`RF` / `GBAS:FREQRF` on page 47

5.2 Setting the RF Input Attenuation

The input attentuation mode determines the sensitivity of the input channel. Depending on the level of the incoming signal, the input connector of the R&S EVS300 must be protected from overload, while avoiding signal distortion for weak signals. The attenuation mode changes the sensitivity of the input connector by selecting a different signal path for each mode. The valid input levels for each mode are indicated by a color bar in the GBAS/SCAT-I main view. The attenuation mode should be selected such that the input level always remains within the green area.

Att.Mode
The following attenuation modes are provided:

"Low Noise" For signal levels in the range of -90 dBm to -53 dBm
Provides a high sensitivity;
Suitable when scanning the area for distant signals, as the noise level is kept low and high-level signals are not to be expected.

"Normal" For signal levels in the range of -65 dBm to -23 dBm
Provides a normal sensitivity;
Suitable when a signal has been detected in the distance and only medium-level signals are expected.

"Low Distortion"
For signal levels in the range of -35 dBm to +13 dBm
Provides a low sensitivity and high protection;
Suitable when analyzing a nearby signal, to avoid overload due to high-level signals.

"LN+AGC" For signal levels in the range of -90 dBm to -20 dBm
The signal attenuation is selected automatically according to the signal strength in each slot.
Since the signal offers only a very short period of time for such AGC operations, this mode works best with clean signals. In difficult receiving conditions it may be more stable to use the "Low Noise", "Normal" or "Low Distortion" mode.
When monitoring signals with mostly constant signal levels, it is also recommended that you use the "Low Noise", "Normal" or "Low Distortion" mode.

Remote command:
`GBAS:ATTMODE` on page 47
`GBAS:LEV?` on page 59

5.3 Working with the Data Logger

The Data Logger records and manages the data captured during a single measurement or a series of measurements. Data Logger functions are available when you press the MEM key in GBAS/SCAT-I mode.

For details on the Data Logger see chapter 3.4, "Data Acquisition with the Data Logger", on page 13.

- Setting Up the Data Logger....32
- Synchronizing the R&S EVS300 Clock....35
- Starting and Stopping the Data Logger....37
- Analyzing the Data Logger Entries....38
- Managing Data Logger Lists....39
- Selecting Parameters in the Data Logger List....41
- Configuring the PRC Graph....43

5.3.1 Setting Up the Data Logger

You can define when and how often data is logged. These settings are available when you press the SETUP key and then select "Data Logger".

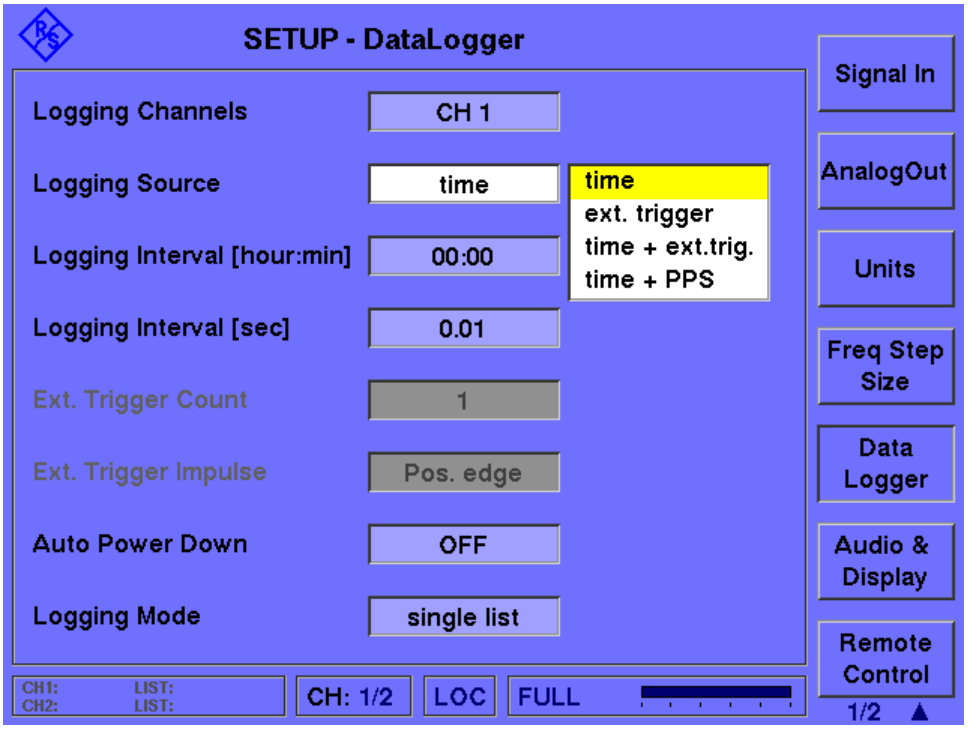

Fig. 5-1: Data Logger Setup dialog box

Logging Channels 33
Logging Source 33
Logging Interval 34
Ext. Trigger Count 34
Ext. Trigger Impulse 34
Auto Power Down 34
Logging Mode 34

Logging Channels
Selects the channel (RF board 1 or 2) to be logged.

Logging Source
Specifies the function that defines when and how often data is logged.

"time"	A time interval defines how often data is logged.
"ext. trigger"	When the specified number of pulses was received from an external trigger (Ext. Trigger Count), the R&S EVS300 logs a single data set.
"time + ext. trigger"	Data is logged in the specified time interval, and additionally when an external trigger is received. A data set that was logged due to a trigger is indicated by a status flag "T".
"time + PPS"	A time interval defines how often data is logged. The GPS time in the data sets is synchronized with the PPS signal of a connected GPS receiver to ensure a common time reference. This setting requires a GPS receiver with PPS to be connected to the R&S EVS300.

Logging Interval
Defines the interval of logging in hours and minutes, in seconds (decimal format), or both. Each time the interval is completed, a single data set is logged.

Ext. Trigger Count
If an external trigger is used as the Logging Source, this parameter specifies how many pulses the connected device must send before data logging is triggered.

Ext. Trigger Impulse
If an external trigger is used as the Logging Source, this parameter specifies whether rising (positive) or falling (negative) edges are counted on the signal from the trigger device.

Auto Power Down
If enabled, the R&S EVS300 automatically switches off after each measurement. Two minutes before the next measurement is due, the R&S EVS300 automatically boots again in order to be ready in time. Thus, this function is only useful for time intervals larger than five minutes in order to save battery power.

Logging Mode
Defines how often the active list which is used for logging is switched.

Note: If the list is full before the specified switching time, logging is stopped.

"single"	The same active list is used continuously. When the list is full, logging is stopped.
"week"	For each day of the week (starting Monday), a different list is activated. After one week, the first list is cleared and logging starts in this list again.
"month"	For each day of the month, a different list is activated. After one month, the first list is cleared and logging starts in this list again.
"24/7"	After each hour, a new list is activated. For each day of the week specific lists are used: Monday: lists 100 to 123 Tuesday: lists 200 to 223 Wednesday: lists 300 to 323 etc. After one week, the first list is cleared and logging starts in this list again. This is useful to determine the used list at a specific time easily. (See also chapter 5.3.2, "Synchronizing the R&S EVS300 Clock", on page 35).

"24/31" After each day of the month, after each hour, a new list is activated.
For each day of the month specific lists are used:
First day: lists 100 to 123
Second day: lists 200 to 223
etc.
31st day: lists 3100 to 3123
After one month, the first list is cleared and logging starts in this list again.
This is useful to determine the used list at a specific time easily.
(See also chapter 5.3.2, "Synchronizing the R&S EVS300 Clock", on page 35).

Remote command:
`LISTMODE` on page 51

5.3.2 Synchronizing the R&S EVS300 Clock

For longterm measurements, you can define data logging where a new list is started every hour of the day (see "Logging Mode" on page 34). To determine when to start a new list, the Data Logger refers to the operating system clock of the R&S EVS300. In order to improve accuracy you can synchronize this clock to a GPS or NTP server.

These settings are available when you press the SETUP key and then select "General Settings".

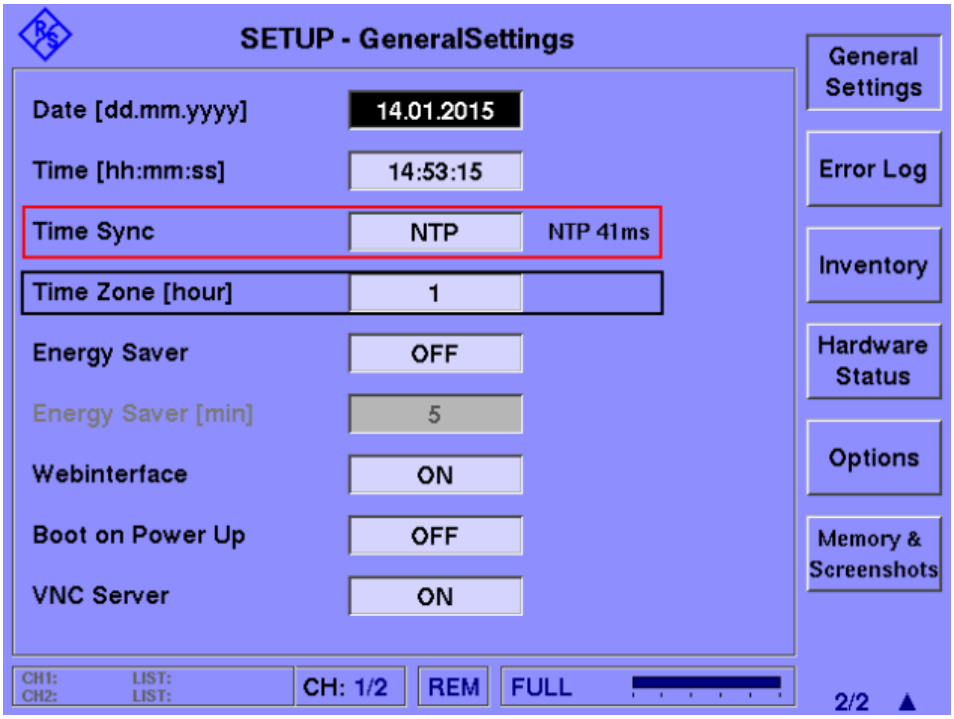

Fig. 5-2: Time Synchronization settings

Time Sync 36
Time zone 36
NTP Server 36

Time Sync
Defines the time source with which the R&S EVS300 clock is synchronized. The current offset from the source is indicated next to the input field (if synchronization is successful). If the R&S EVS300 clock differs from the selected synchronization source time by more than 1000 ms, the R&S EVS300 clock is adjusted accordingly.

Supported synchronization sources:

"Off"	No synchronization is performed for the internal R&S EVS300 clock.
"GPS"	Synchronization with a connected GPS (see the main R&S EVS300 User Manual)
"NTP"	Synchronization with a connected NTP server (see "NTP Server" on page 36)

Remote command:
`SETUP:TIMESYNC` on page 56
`SETUP:GETSYNCSTATUS?` on page 55

Time zone
GPS and NTP usually provide normal time (UTC). In order to take a time zone difference into account on the R&S EVS300, define an offset in hours.

Remote command:
`SETUP:TIMEZONE` on page 56

NTP Server
The NTP server for time synchronization is specified by its IP address under "Setup > Remote Control":

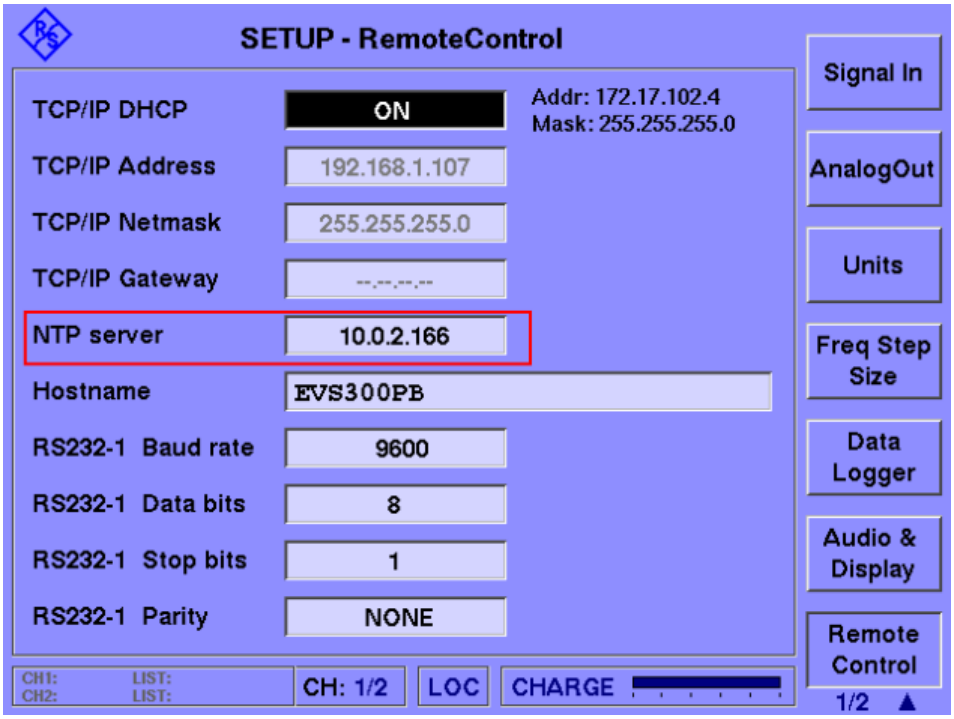

Fig. 5-3: NTP Server configuration

Remote command:
SETUP:NTPSERVER on page 55

5.3.3 Starting and Stopping the Data Logger

You can start and stop the Data Logger manually.

Starting the Data Logger 37
Stopping the Data Logger 38

Starting the Data Logger
Press the START key to start logging data for the selected time slots. The data received from the selected channel and the selected receive frequency is stored internally and can be streamed via remote control or displayed on the screen (see "PRC Graph View" on page 39).

Note: Be aware that if no time slots are selected for logging (see chapter 5.3.6, "Selecting Parameters in the Data Logger List", on page 41), logging cannot be activated.

You can select which parameters are displayed; see chapter 5.3.6, "Selecting Parameters in the Data Logger List", on page 41.

Remote command:
DL_START on page 49

Stopping the Data Logger
Press the STOP key to stop logging data.

Remote command:
DL_STOP on page 50

5.3.4 Analyzing the Data Logger Entries

The stored data can be output graphically on the screen or as a data stream in remote operation.

Press the MEM key to display the main Data Logger view.

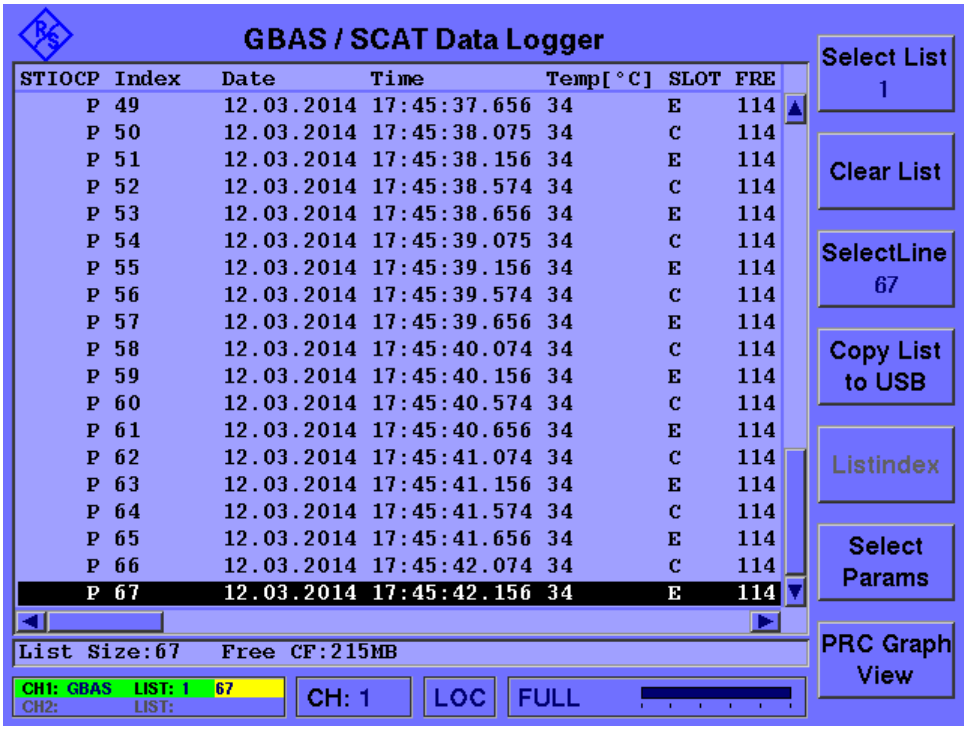

Fig. 5-4: Main Data Logger view

Select List....39
Clear List....39
Select Line....39
Copy List to USB....39
List Index....39
Select Params....39
PRC Graph View....39

Select List
Selects one of up to 9999 data set lists for analysis. The contents of the currently selected list are displayed in the overview. When the data logger is started, the data is appended to the currently selected list.

Remote command:
SETACTIVELIST on page 54

Clear List
Clears the currently selected list. All entries are deleted.

Remote command:
CLEARACTIVELIST on page 49

Select Line
Selects an individual data entry in the data log. Scroll through the entries in the list using the rotary knob or the "Up Arrow" and "Down Arrow" keys.

Note that a single list may contain up to 1 000 000 entries!

Copy List to USB
Copies the selected list to a connected USB storage device as a .CSV file. A default file name is proposed but can be edited.

Remote command:
SAVEACTIVELIST2USB on page 53

List Index
Displays an overview of all available Data Logger lists. For details see chapter 5.3.5, "Managing Data Logger Lists", on page 39.

Select Params
Selects the parameters and time slots for which data is displayed. For details see chapter 5.3.6, "Selecting Parameters in the Data Logger List", on page 41.

Remote command:
SELECTLISTPARAM on page 54

PRC Graph View
Displays the Pseudorange Correction Data Graph (PRC Graph) of the displayed data list. The diagram can be configured, see chapter 5.3.7, "Configuring the PRC Graph", on page 43 for details.

5.3.5 Managing Data Logger Lists

Up to 9999 lists with a maximum of 1 000 000 data lines each can be recorded in GBAS/SCAT-I mode. These lists can be managed in the Data Logger list index view.

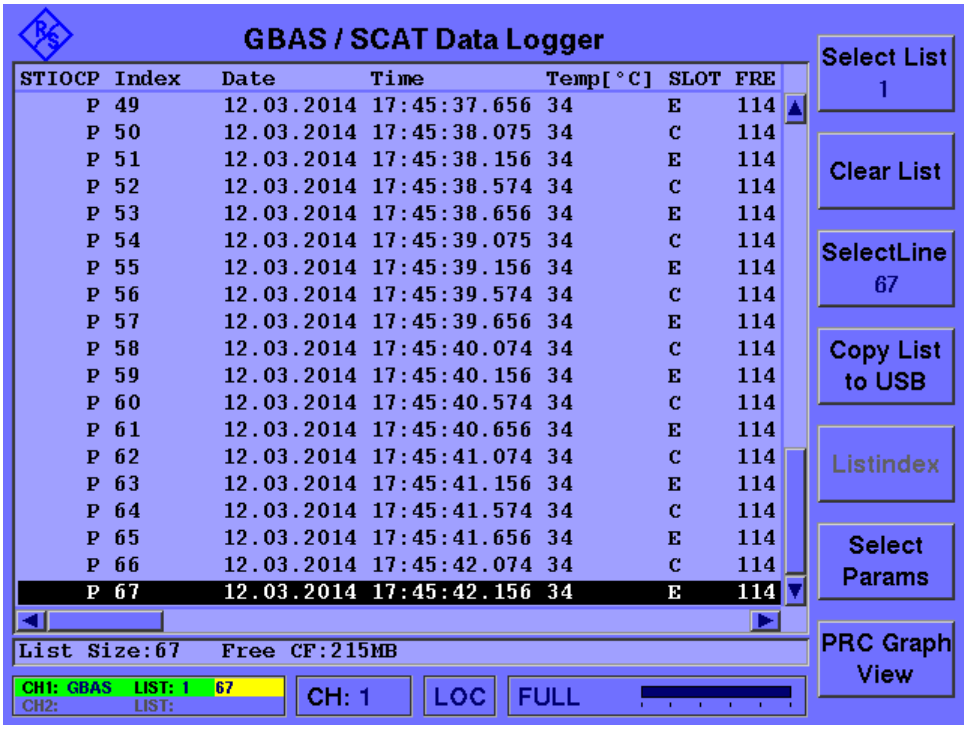

Fig. 5-5: Data Logger list index view

This view is displayed when you press the MEM key in GBAS/SCAT-I mode and then select "List Index".

Select List....40
Clear List....40
Rename....40
Copy List to USB....41
Next Empty List....41
Clear All Lists....41
Back to List View....41

Select List
Selects an individual list in the data log list index. Scroll through the entries in the index using the rotary knob or the "Up Arrow" and "Down Arrow" keys.

Note that the index may contain up to 9999 entries!

Remote command:
SETACTIVELIST on page 54

Clear List
Clears the currently selected list. All entries are deleted.

Remote command:
CLEARACTIVELIST on page 49

Rename
Renames the currently selected list to the user-defined name.

Copy List to USB
Copies the selected list to a connected USB storage device as a .CSV file. A default file name is proposed but can be edited.

Remote command:
SAVEACTIVELIST2USB on page 53

Next Empty List
Selects the next list in the index that does not yet contain data. This is useful to start a new list rather than appending data to an existing data list when the data logger is started.

Clear All Lists
Clears all lists in the index. All data in the lists is deleted.

Remote command:
CLEARALLLISTS on page 49

Back to List View
Returns to the Data Logger list view for the selected list.

5.3.6 Selecting Parameters in the Data Logger List

You can define which data is logged and displayed for the currently selected list.

This view is displayed when you press the MEM key in GBAS/SCAT-I mode and then select "Select Params".

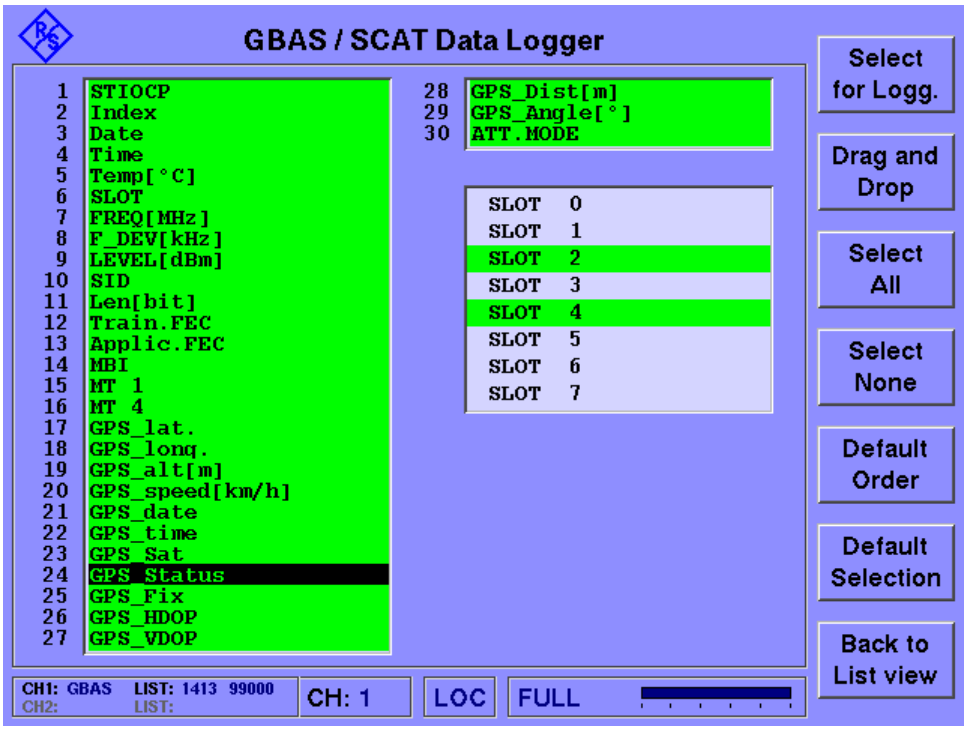

Fig. 5-6: GBAS / SCAT Data Logger parameter and time slot selection

For more information on selecting parameters for the Data Logger see "Selecting parameters" on page 14.

Select for Logg. 42
Drag and Drop (Changing the order of the parameters) 42
Select All 42
Select None 42
Default Order 42
Default Selection 42
Back to List View 42

Select for Logg.
Toggles the selection for the currently highlighted parameter or time slot for logging. If the parameter or time slot was previously already selected, it is deselected. All parameters and slots selected for logging are displayed with a green background.

To scroll through the list of available parameters and time slots use the rotary knob or the "Up Arrow" and "Down Arrow" keys.

Only the parameters selected for logging are displayed and stored in the data log. Note that if no time slots are selected, data logging can not be activated.

Drag and Drop (Changing the order of the parameters)
Marks the selected parameter (with a blue background) to move it to a different position in the list. Use the rotary knob to select the new position within the list. Select "Drag and Drop" again to insert the selected parameter at the new position.

Note that the data is stored in this order.

Select All
Selects all parameters and all time slots for logging.

Select None
Deselects all parameters and all time slots for logging.

Note: Be aware that if no time slots are selected for logging, logging cannot be activated.

Default Order
Restores the default order of the parameters according to the factory defaults (as described in chapter A.2, "Format Description of GBAS and SCAT-I Data", on page 61).

Default Selection
Restores the default selection of the parameters according to the factory defaults (as described in chapter A.2, "Format Description of GBAS and SCAT-I Data", on page 61).

Back to List View
Returns to the Data Logger list view for the selected list.

5.3.7 Configuring the PRC Graph

The information in the data log for a single slot and a single satellite can also be displayed graphically, in the Pseudorange Correction Data Graph (PRC Graph).

This view is displayed when you press the MEM key in GBAS/SCAT-I mode and then select "PRC Graph".

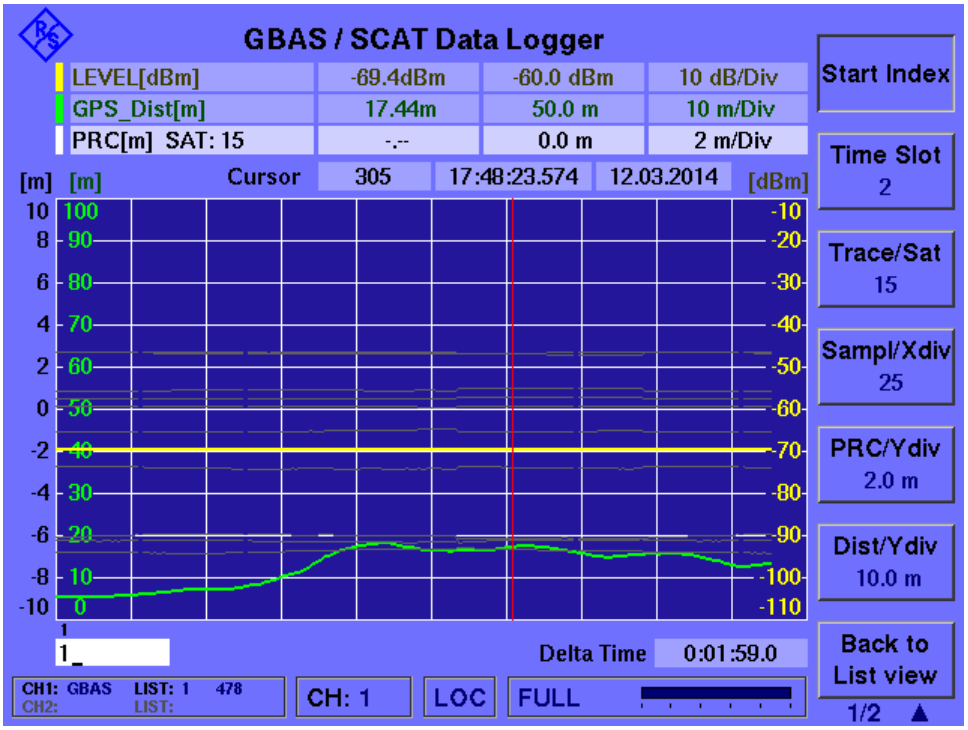

Fig. 5-7: GBAS/SCAT-I PRC graph

The diagram can be configured using the following functions:

Start Index....43
Time Slot....43
Trace/Sat....43
Sample/Xdiv....44
PRC/Ydiv....44
Dist/Ydiv....44
Cursor (2/2)....44
Back to List View....44

Start Index
Defines the starting point of the x-(time-)axis.

Time Slot
Selects the time slot (0 to 7) for which data is displayed in the graph.

Trace/Sat
Selects one trace, that is: one satellite (1 to 32), for which data is highlighted white in the graph. All other satellite traces are indicated by gray lines.

Sample/Xdiv
Defines the scaling of the x-(time-)axis as the number of samples displayed per division. Predefined values between 5 and 500 are available.

PRC/Ydiv
Defines the y-axis scaling for the PRC graph as the meters displayed per division. Predefined values between 0.2 m and 200.0 m are available.

Dist/Ydiv
Defines the y-axis scaling for the distance to reference point trace as the meters displayed per division. Predefined values between 0.1 m and 20.0 m are available.

Cursor (2/2)
Sets the cursor (vertical red line) to the data entry selected by its index in the Data Logger list.

The position of the cursor on the x-axis, as well as the time of the selected list entry, is indicated above the diagram.

(This softkey is available on the second softkey page for the PRC graph.)

Back to List View
Returns to the Data Logger list view for the selected list.

6 Optimizing and Troubleshooting Analysis

If the results do not meet your expectations, possibly the following information will help:

Error message: UNCAL 45
Unstable results display 45
Incorrect slot assignment 45
No values displayed 45

Error message: UNCAL
Error which might cause incorrect results.

Solution: Reboot the instrument.

If the error persists, a hardware error may be the cause. Contact your Rohde & Schwarz service representative.

Unstable results display
Possible solutions:

- Define a suitable *input attenuation* mode manually rather than using "LN+AGC" mode (see chapter 5.2, "Setting the RF Input Attenuation", on page 31)
- Check the status of the *PPS* signal in the main view. If the status is NOK, check the GPS receiver connection. (See also chapter 3.6, "Time Slot Synchronization via PPS", on page 15.)

Incorrect slot assignment
Possible solution:

Check the status of the *PPS* signal in the main view. If the status is NOK, check the GPS receiver connection.

Using an oscilloscope, check the PPS signal. Each pulse per second should have a maximum duration of 1 ms. (See also chapter 3.6, "Time Slot Synchronization via PPS", on page 15.)

No values displayed
Possible solution:

Restart the internal signal processing by pressing the checkmark key on the front panel of the R&S EVS300 (in the navigation area beneath the rotary knob).

7 Remote Commands to Perform GBAS and SCAT-I Analysis

The following commands are required to perform measurements in the GBAS and SCAT-I Analysis application in a remote environment. It is assumed that the R&S EVS300 has already been set up for remote operation in a network as described in the R&S EVS300 User Manual.

Note that basic tasks that are also performed in the base unit in the same way are not described here. For a description of such tasks, see the R&S EVS300 User Manual.

Conventions used in Remote Command Descriptions

Note the following conventions used in the remote command descriptions:

- **Command and parameter syntax**
  All commands and parameters described here are case-**insensitive**.
- **Default unit**
  This is the unit used for numeric values if no other unit is provided with the parameter.
- **Manual operation**
  If the result of a remote command can also be achieved in manual operation, a link to the description is inserted.

The following tasks specific to the GBAS and SCAT-I Analysis application are described here:

- Activating GBAS and SCAT-I Analysis 46
- Configuring GBAS and SCAT-I Analysis 47
- Configuring the GPS Reference Point 48
- Configuring the Data Logger 48
- Configuring Time Synchronization with the R&S EVS300 Clock 55
- Activating a Data Stream 57
- Retrieving Results 58

7.1 Activating GBAS and SCAT-I Analysis

GBAS and SCAT-I Analysis requires a special application on the R&S EVS300. A measurement is started immediately with the default settings.

MODE_GBAS 46

MODE_GBAS

Activates the GBAS/SCAT-I mode.

Usage: Setting only

7.2 Configuring GBAS and SCAT-I Analysis

The following commands are required to configure GBAS and SCAT-I analysis.

GBAS:FREQRF? 47
GBAS:FREQRF 47
GBAS:ATTMODE? 47
GBAS:ATTMODE 47

GBAS:FREQRF?
GBAS:FREQRF <Freq>

This command defines the receive frequency for the GBAS signal. The query returns the most recently measured frequency.

This command is identical to the general R&S EVS300 `RF` command.

Parameters:

<Freq>

Default value: 108 MHz

Range: 75 MHz to 350 MHz
Default unit: kHz

Return values:

<SettingResult>

READY
Setting was successfully applied.

ERROR
An error occurred; setting was not successful.

Example:

```
GBAS:FREQRF 117.975
```

GBAS:ATTMODE?
GBAS:ATTMODE <Mode>

This command defines the attenuation mode. The query returns the mode that was actually used for the current measurement.

Parameters:

<Mode>

LN
(Low Noise) Applies an attenuation of +10 dB.

NORM
(Normal) Applies no attenuation.

LD
(Low Distortion) Applies an attenuation of -25 dB.

LN+AGC
The attenuation mode is selected automatically, depending on the measured power level.

Default value: LN+AGC

Return values:

<SettingResult> **READY**
Setting was successfully applied.

ERROR
An error occurred; setting was not successful.

Example: `GBAS:ATTMODE LN`

Manual operation: See "Att.Mode" on page 31

7.3 Configuring the GPS Reference Point

In addition to the specific GBAS/SCAT-I data, the captured GPS data may be of interest. If option R&S EVS300-K2 is installed, the GPS mode is available. The GPS view now includes information on a detected or manually specified reference point and the distance between the currently received GPS data and the indicated reference point. The new command to define the reference point is described here. For all other GPS-related commands, see the main R&S EVS300 User Manual.

SETUP:GPSREF 48

SETUP:GPSREF <Latitude>,<Longitude>

By default, the reference point for GPS information is automatically taken from the position of the built-in GPS antenna of the R&S EVS300. However, it can be changed manually to any other position using this command.

Parameters:

<Latitude> <degrees><minutes><direction>
Latitude of the reference point in degrees, minutes (decimal format) and direction (S | N)

<Longitude> <degrees><minutes><direction>
Longitude of the reference point in degrees, minutes (decimal format) and direction (W | E)

Example: `SETUP:GPSREF 89°44.123456789S,23°55.123456789S`

7.4 Configuring the Data Logger

You can define which data is stored during the measurement.

For details on the Data Logger see chapter 3.4, "Data Acquisition with the Data Logger", on page 13.

Useful commands for the Data Logger described elsewhere:

- chapter 7.5, "Configuring Time Synchronization with the R&S EVS300 Clock", on page 55

Remote commands exclusive to configuring the Data Logger:

CLEARACTIVELIST 49
CLEARALLLISTS 49
DL_START 49
DL_STOP 50
GETACTIVELIST 50
GETFREEMEMORY 50
GETLISTDATA 51
GETLISTSIZE 51
LISTMODE 51
GBAS:LOGSLOTS 52
SAVEACTIVELIST2USB 53
SELECTLISTPARAM 54
SETACTIVELIST 54

CLEARACTIVELIST

This command clears the currently active list. All entries are deleted.

Return values:

<EventResult>

READY
Command was executed successfully

ERROR
An error occurred; command was not successful

Example:

`SETACTIVELIST 2`
Defines list 2 as the active list.
`CLEARACTIVELIST`
Clears list 2.

Manual operation: See "Clear List" on page 39

CLEARALLLISTS

This command clears all 999 list for the GBAS/SCAT-I mode. All entries are deleted in all lists.

Return values:

<EventResult>

READY
Command was executed successfully

ERROR
An error occurred; command was not successful

Manual operation: See "Clear All Lists" on page 41

DL_START

Starts logging data for the selected time slots and the currently selected parameters until the `DL_STOP` command is executed. The data received from the selected channel and the selected receive frequency is stored internally.

To reduce the amount of logged data, restrict it to specific time slots or parameters, or both. See SELECTLISTPARAM on page 54 and GBAS:LOGSLOTS on page 52.

In the default settings, the "short list" of parameters as specified in table 1-1 are selected.

Return values:

<EventResult> **READY**
Command was executed successfully

ERROR
An error occurred; command was not successful

Usage: Event

Manual operation: See "Starting the Data Logger" on page 37

DL_STOP

Stops logging data.

Return values:

<EventResult> **READY**
Command was executed successfully

ERROR
An error occurred; command was not successful

Usage: Event

Manual operation: See "Stopping the Data Logger" on page 38

GETACTIVELIST

This command retunrs the number of the currently active list for the Data Logger in the GBAS/SCAT-I mode.

Return values:

<ListNo> integer
list number
Range: 1 to 999

Example:
```
SETACTIVELIST 2
```
Defines list 2 as the active list.
```
GETACTIVELIST
```
Queries the number of the active list.
Result:
```
2
```

GETFREEMEMORY

This command queries the amount of free storage space on the internal flash memory.

Return values:
<FreeMemSize> Default unit: MByte

GETLISTDATA <ListNo>

This command queries the contents of the selected list.

Setting parameters:
<ListNo> integer
list number
Range: 1 to 999

Return values:
<ListData> Contents of the list as described in chapter A.2, "Format Description of GBAS and SCAT-I Data", on page 61.

<EventResult> **READY**
Command was executed successfully
ERROR
An error occurred; command was not successful

Example:

GETLISTSIZE

This command queries the size of the active list.

Return values:
<NoEntries> integer
Number of entries in the active list.
Range: 0 to 1 000 000

LISTMODE <Mode>

This command defines how often the active list which is used for logging is switched.

Parameters:

<Mode>

SINGLE
(**Default**:) The same active list is used continuously. When the list is full, logging is stopped.

WEEK
For each day of the week (starting Monday), a different list is activated. After one week, the first list is cleared and logging starts in this list again.

MONTH
For each day of the month, a different list is activated. After one month, the first list is cleared and logging starts in this list again.

24_7
After each hour, a new list is activated. For each day of the week specific lists are used:
Monday: lists 100 to 123
Tuesday: lists 200 to 223
Wednesday: lists 300 to 323
etc.
After one week, the first list is cleared and logging starts in this list again.

24_31
After each day of the month, after each hour, a new list is activated. For each day of the month specific lists are used:
First day: lists 100 to 123
Second day: lists 200 to 223
etc.
31st day: lists 3100 to 3123
After one month, the first list is cleared and logging starts in this list again.
This is useful to determine the used list at a specific time easily.

Return values:

<SettingResult>

READY
Setting was successfully applied.

ERROR
An error occurred; setting was not successful.

Example: `LISTMODE MONTH`

Manual operation: See "Logging Mode" on page 34

GBAS:LOGSLOTS <Channel>{<Channel},<TimeSlot>{<TimeSlot>}

This command defines the slots to be logged by the Data Logger.

Tip: to select the **parameters** to be included in data logging use the `SELECTLISTPARAM` command.

Setting parameters:

<Channel> 1 | 2

Channel assigned to the receiving antenna (RF board);

<TimeSlot> 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7

Numbers of the time slots for which the results are to be logged. By default, the results for all time slots are logged.

Return values:

<EventResult> **READY**
Command was executed successfully

ERROR
An error occurred; command was not successful

Usage: Setting only

SAVEACTIVELIST2USB <Filename>

This command copies the active list to a connected USB storage device as a .CSV file with the specified name.

Note that this command may be very time-consuming for long lists (max. 1 000 000 entires!).

To reduce the amount of logged data, restrict it to specific time slots or parameters, or both. See `SELECTLISTPARAM` on page 54 and `GBAS:LOGSLOTS` on page 52.

Parameters:

<Filename> string

Path, file name and extension of the file on the USB device to which the data will be stored: Note that a specified path must already exist on the USB device, otherwise an error occurs.

Return values:

<EventResult> **MOUNT**
Preparing access to USB device

COPY
Copying files to USB device

UNMOUNT
Exiting USB device

READY
Command was executed successfully

ERROR
An error occurred; command was not successful

Example:

```
SETACTIVELIST 2
//Defines list 2 as the active list.
SAVEACTIVELIST2USB DataLogs\Mar2014\DataLog1.csv
```

Manual operation: See "Copy List to USB" on page 39

SELECTLISTPARAM <Params>

This command selects the parameters to be logged. For details see chapter 5.3.6, "Selecting Parameters in the Data Logger List", on page 41.

In the default settings, the "short list" of parameters as specified in table 1-1 are selected.

Tip: to select the **time slots** to be included in data logging use the `GBAS:LOGSLOTS` command.

Parameters:

<Params> Parameters to be included in data log.

ALL
All parameters are selected for logging.
Repeat the command with specific parameter numbers to exclude individual parameters in a subsequent step.

NONE
All parameters are deselected.
Repeat the command with specific parameter numbers to include individual parameters in a subsequent step.

<integer>;{<integer>;}
The parameters with the specified numbers are selected for logging.

!<integer>;{!<integer>;}
The parameters with the specified numbers are deselected for logging.

Example:

```
//Deselect all parameters for logging
SELECTLISTPARAM NONE
//Select the first 5 parameters in the list for logging
SELECTLISTPARAM 1;2;3;4;5;
```

(See table 1-1) .

Example:

```
//Select all parameters for logging
SELECTLISTPARAM ALL
//Deselect the GPS parameters for logging.
SELECTLISTPARAM !19;!20;!21;!22;!23;!24;!25;!26;!27;
```

Manual operation: See "Select Params" on page 39

SETACTIVELIST <ListNo>

This command selects one of the 999 possible lists for subsequent Data Logger tasks in the GBAS/SCAT-I mode.

Setting parameters:

<ListNo> integer

list number

Range: 1 to 999

Return values:

<EventResult> **READY**
Command was executed successfully

ERROR
An error occurred; command was not successful

Example: `SETACTIVELIST 2`

Usage: Setting only

Manual operation: See "Select List" on page 39
See "Select List" on page 40

7.5 Configuring Time Synchronization with the R&S EVS300 Clock

In order to improve accuracy in longterm data logging you can synchronize the R&S EVS300 clock to a GPS or NTP server.

SETUP:GETSYNCSTATUS? 55
SETUP:NTPSERVER 55
SETUP:TIMESYNC? 56
SETUP:TIMESYNC 56
SETUP:TIMEZONE? 56
SETUP:TIMEZONE 56

SETUP:GETSYNCSTATUS?

Queries the current offset of the internal R&S EVS300 clock from the time synchronization source if synchronization is successful (see `SETUP:TIMESYNC` on page 56).

If the R&S EVS300 clock differs from the selected synchronization source time by more than 1000 ms, the R&S EVS300 clock is adjusted accordingly.

Return values:

<Offset> Deviation in ms

Example:

```
SETUP:TIMESYNC NTP
SETUP:NTPSERVER 10.0.2.166
SETUP:GETSYNCSTATUS?
0.001
```

Usage: Query only

Manual operation: See "Time Sync" on page 36

SETUP:NTPSERVER <IPAdress>

Defines the IP address of the NTP server used for time synchronization of the internal R&S EVS300 clock (see `SETUP:TIMESYNC` on page 56).

Parameters:

<IPAdress> TCP/IP address between 0.0.0.0 and 0.255.255.255

Example:
```
SETUP:TIMESYNC NTP
SETUP:NTPSERVER 10.0.2.166
```

Usage: Setting only

Manual operation: See "NTP Server" on page 36

SETUP:TIMESYNC?
SETUP:TIMESYNC <Source>

Defines or queries the time source with which the R&S EVS300 clock is synchronized. If the R&S EVS300 clock differs from the selected synchronization source time by more than 1000 ms, the R&S EVS300 clock is adjusted accordingly.

Parameters:

<Source>

OFF
No synchronization is performed for the internal R&S EVS300 clock.

GPS
Synchronization with a connected GPS (see the main R&S EVS300 User Manual)

NTP
Synchronization with a connected NTP server (see `SETUP:NTPSERVER` on page 55)

Example:
```
SETUP:TIMESYNC NTP
```

Manual operation: See "Time Sync" on page 36

SETUP:TIMEZONE?
SETUP:TIMEZONE <Offset>

Defines or queries an offset in hours to the normal time (UTC) provided by the GPS or NTP server. The offset is considered for time synchronization of the internal R&S EVS300 clock.

Parameters:

<Offset> numeric value

Range: -12 to +12
Default unit: h

Example:
```
SETUP:TIMEZONE -1
```

Manual operation: See "Time zone" on page 36

7.6 Activating a Data Stream

Data for a running measurement can be output to an external storage medium, independantly of the Data Logger.

For details on data streaming see chapter 3.5, "Data Streaming", on page 14.

GBAS:STREAM 57
GBAS:STOPSTREAM 57

GBAS:STREAM <ListType>,<Channel>{<Channel},<TimeSlot>{<TimeSlot>}

This command starts sending a data stream with the results of the specified channel and time slots to the remote control device. The data stream continues until the `GBAS:STOPSTREAM` command is executed.

Setting parameters:

<ListType> FULL | SHORT

FULL
Outputs the complete list of data, as described in chapter A.2, "Format Description of GBAS and SCAT-I Data", on page 61.

SHORT
Outputs an extract of the list of data, as described in chapter A.2, "Format Description of GBAS and SCAT-I Data", on page 61.

<Channel> 1 | 2

Channel assigned to the receiving antenna (RF board);

<TimeSlot> 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7

Numbers of the time slots for which the results are to be output.

Example: `GBAS:STREAM FULL,12,24`
Starts streaming the full list of results for channels 1 and 2 in time slots 2 and 4.

Usage: Setting only

GBAS:STOPSTREAM

This command stops the data stream.

Return values:

<EventResult> **READY**
Command was executed successfully

ERROR
An error occurred; command was not successful

Usage: Event

7.7 Retrieving Results

The following commands are required to retrieve the received data.

Useful commands for retrieving results described elsewhere:

- `GBAS:FREQRF?` on page 47
- `GBAS:ATTMODE?` on page 47

Remote commands exclusive to retrieving results:

GBAS:FMEAS? 58
GBAS:GETMDEF 58
GBAS:GETMEAS 59
GBAS:LEV? 59

GBAS:FMEAS? <TimeSlot>

This command queries the difference between the measured frequency and the nominal receive frequency for the GBAS signal in the specified time slot.

Query parameters:

<TimeSlot> 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7
Time slot

Return values:

<DeltaFreq> Default unit: kHz

Example: `GBAS:FMEAS? 2`
Queries the measured delta frequency for time slot 2.

Usage: Query only

GBAS:GETMDEF <ListType>,<Channel>{<Channel}

This command returns the description of the contents of one line in the logged data. The result can be used as a header row for a result table, for example.

One line corresponds to the captured data at the receive frequency for the GBAS signal in one time slot.

For details on the returned values see the chapter A.2, "Format Description of GBAS and SCAT-I Data", on page 61.

Setting parameters:

<ListType> FULL | SHORT

FULL
Returns headers for the complete list of logged data, as described in chapter A.2, "Format Description of GBAS and SCAT-I Data", on page 61.

SHORT
Returns headers for an extract of the list of logged data, as described in chapter A.2, "Format Description of GBAS and SCAT-I Data", on page 61.

<Channel> 1 | 2

Channel assigned to the receiving antenna (RF board); (currently irrelevant, but required)

Example: `GBAS:GETMDEF FULL`
Returns the header row for a complete table of logged data.

GBAS:GETMEAS <ListType>,<Channel>{<Channel},<TimeSlot>{<TimeSlot>}

This command returns the contents of one line in the logged data.

For details on the returned values see the chapter A.2, "Format Description of GBAS and SCAT-I Data", on page 61.

Setting parameters:

<ListType> FULL | SHORT

FULL
Returns the complete list of logged data, as described in chapter A.2, "Format Description of GBAS and SCAT-I Data", on page 61.

SHORT
Returns an extract of the list of logged data, as described in chapter A.2, "Format Description of GBAS and SCAT-I Data", on page 61.

<Channel> 1 | 2

Channel assigned to the receiving antenna (RF board);

<TimeSlot> 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7

Numbers of the time slots for which the results are to be returned. By default, the results for all time slots are returned.

Example: `GBAS:GETMEAS FULL,12,24`
Returns the full list of results for channels 1 and 2 in time slots 2 and 4.

GBAS:LEV? <TimeSlot>

This command queries the most recently measured power level at the receive frequency for the GBAS signal in the specified time slot.

This command is identical to the general R&S EVS300 `LA?` query.

Query parameters:

<TimeSlot> 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7
Time slot

Return values:

<Level> Default unit: dBm

Example: `GBAS:LEV? 2`
Queries the measured power level for time slot 2.

Usage: Query only

Manual operation: See "Att.Mode" on page 31

A Annex

A.1 References

- [1] RTCA DO-246D, "GNSS-Based Precision Approach Local Area Augmentation System (LAAS) Signal-in-Space Interface Control Document (ICD)"
- [2] RTCA DO217, Minimum aviation system performance standards DGNSS instrument approach system: Special Category I (SCAT-I) , DO-217, August 1993

A.2 Format Description of GBAS and SCAT-I Data

The Data Logger records and manages the data captured during one or a series of measurements. Up to 999 lists with a maximum of 1 000 000 data lines each can be recorded. One line corresponds to the captured data at the receive frequency for the GBAS signal in one time slot.

Similarly, a data stream consists of lines of measurement results, where one line corresponds to the captured data at the receive frequency for the GBAS signal in one time slot.

You can also query a single measurement result, which corresponds to one row in the Data Logger list.

In all three cases, the available parameters and their format are identical.

Which parameters are logged and in which order is user-definable and can be defined individually for each list. The following overview describes all available parameters (complete list) in their default order.

The format of the data for each slot is identical, regardless whether a parameter contains data or not. This allows you to create a table from the exported comma-separated list. If a slot is empty, only the general data is stored in the list entry; the message-specific parameters are cropped.

When a list is stored to a file, a header line is automatically included that describes the provided parameters.

General Information

The following general information is always included, regardless whether the slot contains data or not, and whether the signal is GBAS or SCAT type.

The number ("No.") in the following table is required to select the individual parameters to be logged in remote operation, see SELECTLISTPARAM on page 54.

The parameters in this table are included in the "short list" for remote operation.

Table 1-1: General information for the individual slot

No.	Column	Description
	Channel	RF board 1 or 2
1	STIOCP	Status Flags: • **S**: Start (started manually) • **T**: Triggered (externally) • **I**: Invalid (power level not permitted or too low) • **O**: Overload (RF input signal too high) • **C**: Corrected (includes RF input correction factor) • **P**: PPS-synced (triggered by external PPS)
2	Index	Counts each measurement
3	Date	Date of measurement
4	Time	Time of measurement
5	Temp[°C]	Temperature on R&S EVS300 mainboard
6	SLOT	Time slot (A | B | C | D | E | F | G | H)
7	FREQ[MHz]	Receiving frequency
8	F_DEV[kHz]	Frequency deviation
9	LEVEL[dBm]	Level measured over the "Synchronization and Ambiguity Resolution" period of the GBAS/SCAT signal
10	SSID	Received Station ID, equivalent to GBAS ID or SCAT ID
11	Len[bit]	Length of the entire message block
12	Train.FEC	FEC of the training sequence
13	Applic.FEC	FEC of the data content
14	MBI	Message block identifier
15	MT 1	Message type 1 available (YES | NO)
16	MT 4	Message type 4 available (YES | NO)
17	GPS_lat.	Received GPS data
18	GPS_long.	
19	GPS_alt[m]	
20	GPS_speed[km/h]	
21	GPS_date	
22	GPS_time	
23	GPS_Sat	
24	GPS_Status	
25	GPS_Fix	
26	GPS_HDOP	
27	GPS_VDOP	
28	GPS_Dist[m]	Distance between GPS reference point and current GPS position

No.	Column	Description
29	GPS_Angle[°]	Angle between GPS reference point and current GPS position
30	ATT.MODE	Attenuator mode during slot measurement (LN | NORM | LD) In AUTO mode: the used hardware setting

GBAS Signal - MT1

After the general information, if the slot contains a message type 1, the following burst data is provided for each of the up to 32 satellites (in "full" list only):

Table 1-2: Decoded message type 1 data for the individual slot and each satellite (GBAS)

Column	Description
MT1 GBAS	Section label (separator in list)
MB CRC	
MB ID	Message block ID: • `1010 1010`: normal LAAS message (GBAS) • `1111 1111`: test LAAS message (GBAS)
Stat ID	Received Station ID, equivalent to GBAS ID or SCAT ID
MsgLen[byte]	
Z-Cnt[m:s]	
Add.Msg.Flag	
NrOfMeasn	
MeasnType	
EphDecorPar[m/m]	
EphemCrcMSB	
EphemCrcLSB	
SrcAvailDur[sec]	
SatID	
IOD	
PRC[m]	
RRCor[m/s]	
S_pr_gnd[m]	
DiffnprcB1[m]	
DiffnprcB2[m]	
DiffnprcB3[m]	
DiffnprcB4[m]	

For details on the correction data parameters refer to the GBAS specification [1].

MT4

If the slot contains a message type 4, the following decoded message data is provided for each of the up to 15 FASDBs (in "full" list only):

Table 1-3: Decoded message type 4 data for the individual slot and each FASDB (GBAS)

Column	Description
MT4 GBAS	Section label (separator in list)
MB CRC	
MB ID	Message block ID: • `1010 1010`: normal LAAS message (GBAS) • `1111 1111`: test LAAS message (GBAS)
Stat ID	Received Station ID, equivalent to GBAS ID or SCAT ID
MsgLen[byte]	
DataSetLen	
OpType	
SbasServProv	
AirportID	
RunwayNo	
RunwayLtr	
ApproachPerfDesig	
RouteInd	
RPDS	
RefPathID	
LTP_FTP_Lat[°]	
LTP_FTP_Long[°]	
LTP_FTP_Height[m]	
DeltaFPAP_Lat[°]	
DeltaFPAP_Long[°]	
TCH	
UnitTCH	
GPA[°]	
CourseWidth[m]	
DeltaLenOffset[m]	
VertAlertLim[m]	
LatrAlertLim[m]	
FASCRC	

SCAT-I Signal - MT1

After the general information, if the slot contains a message type 1, the following burst data is provided for each of the up to 32 satellites (in "full" list only):

Table 1-4: Decoded message type 1 data for the individual slot and each satellite (SCAT-I)

Column	Description
MT1 SCAT	Section label (separator in list)
MB CRC	
MB ID	Message block ID: • `1001 1001`: SCAT-I
Stat ID	Received Station ID, equivalent to GBAS ID or SCAT ID
MsgLen[byte]	
Z-Cnt[m:s]	
Acc.Err.Bnd.[m/s*s]	
K_md_gnd	
SatID	
PRC[m]	
IOD	
RRCor[m/s]	
S_pr_gnd[m]	
B_pr_gnd[m]	
S_fail_gnd[m]	
B_fail_gnd[m]	
PRC[m]	

For details on the correction data parameters refer to the SCAT-I specification [2].

MT4

If the slot contains a message type 4, the following decoded message data is provided for each of the up to 15 FASDBs (in "full" list only):

Table 1-5: Decoded message type 4 data for the individual slot and each FASDB (SCAT-I)

Column	Description
MT4 DATA	Section label (separator in list)
MB CRC	
MB ID	Message block ID: • `1001 1001`: SCAT-I
Stat ID	Received Station ID, equivalent to GBAS ID or SCAT ID
MsgLen[byte]	

Column	Description
OpType	
AirportID	
RunwayNo	
RunwayLtr	
RouteInd	
ValInd	
RPDS	
RefPathID	
ThDP_Lat[°]	
ThDP_Long[°]	
ThDP_Height[m]	
DERP_LAT[°]	
DERP_Long[°]	
TCH[ft]	
GPA[°]	
FASCRC	

List of Commands

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CLEARALLLISTS 49
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GBAS:LOGSLOTS 52
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