Анализатор коммуникационных каналов EVSG1000

AT A GLANCE

The R&S®EVSG1000 VHF/UHF airnav/com analyzer is a portable signal level and modulation analyzer specifically designed for commissioning and servicing ILS, GBAS, VOR, NDB and marker beacon ground stations and for analyzing air traffic control communications (ATC COM) signals. The instrument's high accuracy and measurement speed, robust mechanical design and integrated battery make it ideal for high-precision measurements in the field.

The R&S®EVSG1000 provides analysis of terrestrial navigation signals and ATC COM signals in a single instrument. It performs efficient analyses in the frequency range from 70 MHz to 410 MHz. These features enable the R&S®EVSG1000 to carry out fast, accurate, ICAO-compliant measurements on ILS, GBAS, VOR, NDB and marker beacon ground stations and to characterize ATC COM signals. System parameters such as modulation depth, DDM and SDM are determined with high precision.

The R&S®EVSG1000 has a modular design and comes with numerous options, allowing it to be tailored to the specific application. Options include, for example, software for analyzing ILS, GBAS, VOR, NDB, marker beacon and ATC COM systems, for carrying out detailed analyses in the frequency and time domain, and for data recording and high measurement rate.

An optional battery pack and intelligent battery management make it possible to perform measurements independent of the mains supply. A weatherproof bag, a dipole antenna, a rugged transport case and other accessories facilitate measurements in the field and protect the instrument during transport.

The R&S®EVSG1000 is easy to operate and provides full functionality even in harsh environments. Its 6.5" color display provides a clear overview of settings and results, which are easy to read even in direct sunlight. The spectrum preview function displays the signal's IF spectrum and the selected filter characteristic in a separate window. All data can be read by a control system via remote control (LAN) or stored to a USB stick.

Key facts

- High-precision analysis of ILS, GBAS, VOR, NDB and marker beacon ground systems (in line with ICAO Doc 8071 and ICAO Annex 10)
- Analysis of ATC COM signals
- High dynamic range of > 130 dB, precise level and modulation depth measurements
- Spectrum preview and detailed analysis options in the frequency and time domain
- Extremely compact, with integratable battery
- Dynamic measurements at up to 100 data records per second in high measurement rate mode
- Simultaneous analysis of course and clearance signals on dual-frequency (2F) ILS systems

Front view

BENEFITS AND KEY FEATURES

Unique measurement functions for high-precision, efficient ground inspection

- Level measurements with utmost accuracy
- Outstanding input sensitivity, efficient preselector
- Precision modulation analysis in real time
- Reliable measurement of identifier parameters
- AF signal analysis via the LF input
- page 4

User-friendly design and application-specific extras

- Intuitive operation via straightforward graphical user interface
- Detailed analyses in line with ICAO requirements
- Simple remote operation via standard interfaces
- Trigger and synchronization functions
- Easy maintenance, repair and service
- page 6

Software options for customized analysis

- Simultaneous analysis of course and clearance signals (R&S®EVSG-K1)
- Detailed analysis of VOR and marker beacon signals (R&S®EVSG-K2, R&S®EVSG-K3)
- ATC COM signal analysis (R&S®EVSG-K6)
- Testing of ground based augmentation systems (GBAS/SCAT) for satellite navigation (R&S®EVSG-K4, R&S®EVSG-K5)
- LF analysis for nondirectional beacon and more (R&S®EVSG1-K7)
- Integrated data recording (R&S®EVSG-K21)
- High measurement rate (R&S®EVSG-K22)
- I/Q data streaming (R&S®EVSG1-K25)
- RF spectrum analysis (R&S®EVSG-K10)
- AF spectrum analysis (R&S®EVSG-K11)
- AF time domain analysis (R&S®EVSG-K12)
- page 8

Hardware options and accessories

- Compact, robust, lightweight
- Battery-powered field measurements (R&S®EVSG-B3)
- Weather and transit protection for mobile use (R&S®EVSG-Z1)
- Safe transport in a hard-shell transport case (R&S®EVSG-Z2)
- ILS/VOR test antenna (R&S®EVS-Z3) with carrying bag
- page 13

Rear view

UNIQUE MEASUREMENT FUNCTIONS FOR HIGH-PRECISION, EFFICIENT GROUND INSPECTION

Level measurements with utmost accuracy

The R&S®EVSG1000 offers an extremely wide dynamic range that is achieved by means of switchable preamplifiers and selectable attenuators in combination with a high-level mixer. An integrated calibration generator with high long-term stability ensures accurate level measurements.

Outstanding input sensitivity, efficient preselector

The R&S®EVSG1000 offers outstanding input sensitivity due to its very low noise figure and narrowband filters. As a result, the instrument is able to perform highly precise signal analyses even for extremely low levels.

The R&S®EVSG1000 also offers a wide input level range and steep-edged preselection filters (R&S®EVSG-K23) that provide optimized interference rejection for ILS, VOR, marker beacon and COM measurements. As a result, the instrument features high intermodulation suppression and immunity to interference and can deliver reliable measurements even in the immediate vicinity of transmit antennas. This is especially beneficial in the presence of ATC COM signals.

Precision modulation analysis in real time

By using digital signal processing, the R&S®EVSG1000 offers outstanding accuracy during modulation analysis. The input signal is sampled at the IF using a high-precision analog-to-digital converter. FPGA technology is used to process results in real time with the highest degree of reproducibility.

Reliable measurement of identifier parameters

The R&S®EVSG1000 automatically measures and decodes the identifier of the station under test and displays the ID pulse repetition rate, the ID code and the dash, dot and gap lengths in a separate window.

AF signal analysis via the LF input

The R&S®EVSG1000 is equipped with an LF input, which is ideal for analyzing baseband signals from ILS/VOR stations. This makes it easy to identify system errors. All R&S®EVSG1000 analysis functions are also available for AF signals.

ILS measurements on ILS monitoring antenna

ILS test vehicle

USER-FRIENDLY DESIGN AND APPLICATION-SPECIFIC EXTRAS

Intuitive operation via straightforward graphical user interface

The R&S®EVSG1000 comes with a large display that provides users with all relevant information at a glance. Measured values and additional information are displayed for every measurement mode. Instrument settings such as channel, nominal frequency, bandwidth, measurement time and attenuator mode are also displayed for every mode at the top of the screen. The status bar at the bottom shows the remaining battery charge and the data recorder fill level.

Softkeys on the right edge of the screen allow users to select and modify all settings.

The spectrum preview function displays the measured signal and the configured filter characteristic.

Detailed analyses in line with ICAO requirements

ICAO Doc 8071 and ICAO Annex 10 specify exactly how to service and maintain ILS, VOR and marker beacon systems. The versatile functionality of the R&S®EVSG1000 makes it possible to perform all required measurements with a single instrument. Measurements include not only the standard modulation parameters but also distortion and residual modulation (residual FM, unwanted AM).

Simple remote operation via standard interfaces

The R&S®EVSG1000 can be operated via its front panel controls or via a remote connection. Users can integrate the R&S®EVSG1000 into existing systems via the instrument's TCP/IP Ethernet interface.

To simplify measurement tasks, the R&S®EVSG1000 can be remotely controlled using software installed on a PC or laptop. Remote control capability is an important prerequisite for using the R&S®EVSG1000 in runway test vehicles or for monitoring tasks.

The R&S®EVSG1000 has an integrated VNC server that allows users to remotely access measurement results and change settings without any special software. All that is needed is a PC or laptop with a standard VNC client and network access to the R&S®EVSG1000.

Trigger and synchronization functions

For installation in a test vehicle, the R&S®EVSG1000 is equipped with a trigger input for synchronization with the data delivered by the vehicle. The trigger characteristics can be defined in the instrument setup.

The optional GPS support (R&S®EVSG-K20) automatically links each data record with the vehicle's current position. The vehicle position data is delivered by an external (D)GPS receiver.

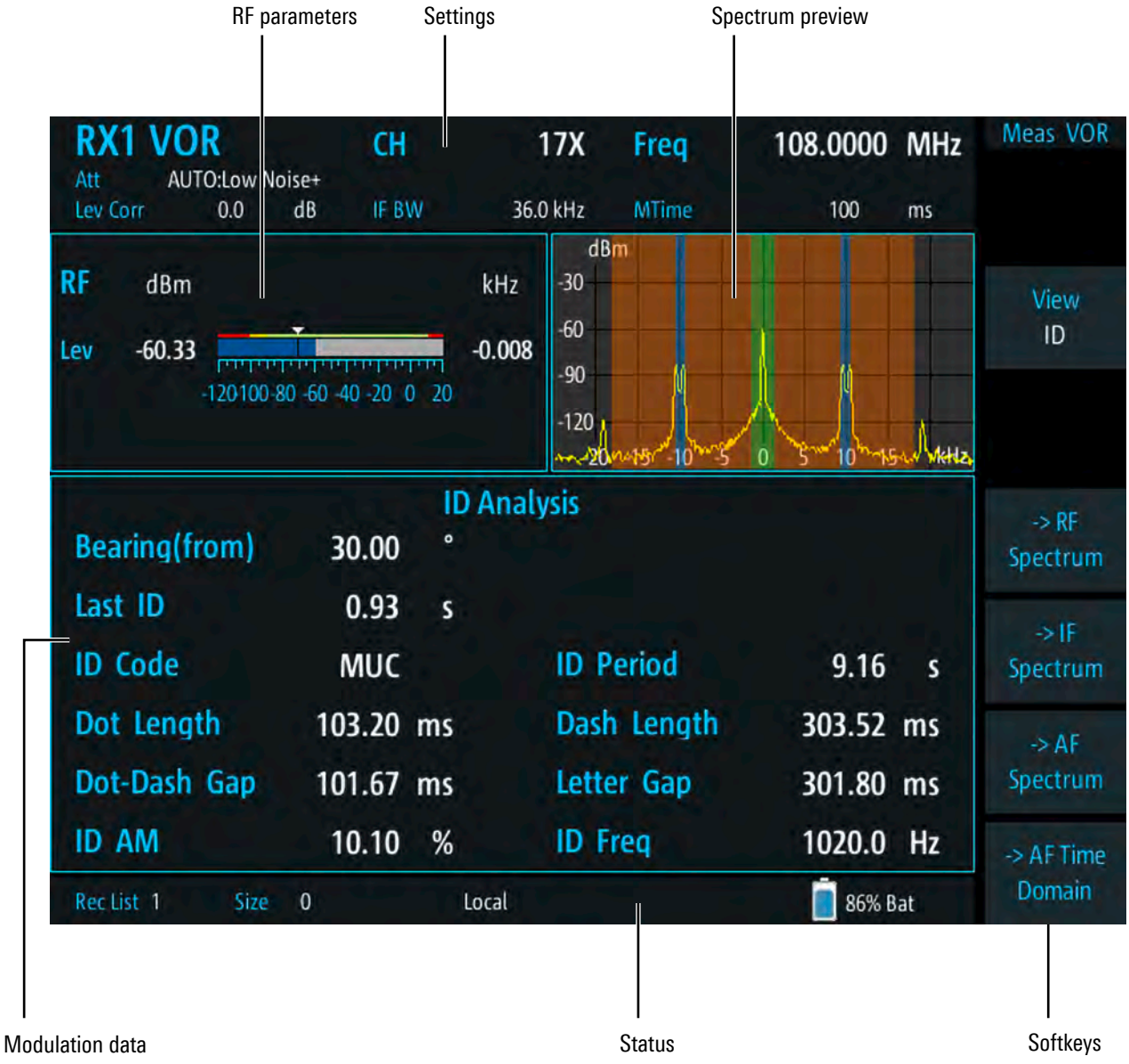
Easy maintenance, repair and service

Its modular design and mechanical ruggedness make the R&S®EVSG1000 very serviceable.

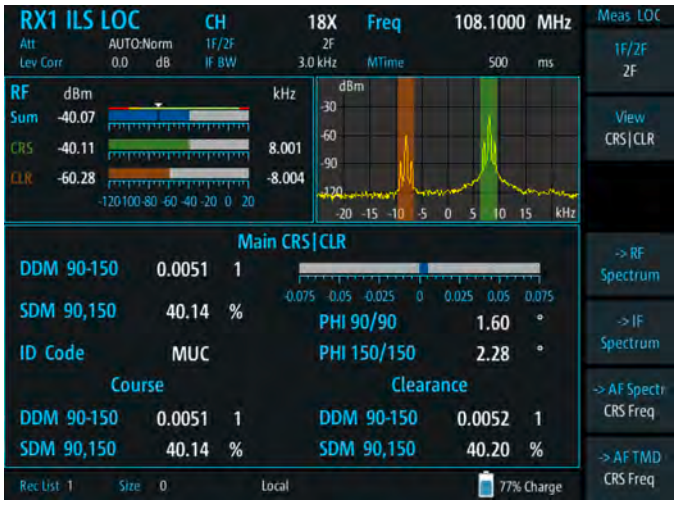
If faults occur or other service becomes necessary, the instrument is quickly returned to operation by replacing modules and carrying out calibration in line with the instructions given in the service manual.

The R&S®EVSG1-Z11 verification test software enables users to perform verifications themselves. The software runs on an external PC, performs all necessary and time-consuming measurements and automatically generates a test report.

Graphical user interface



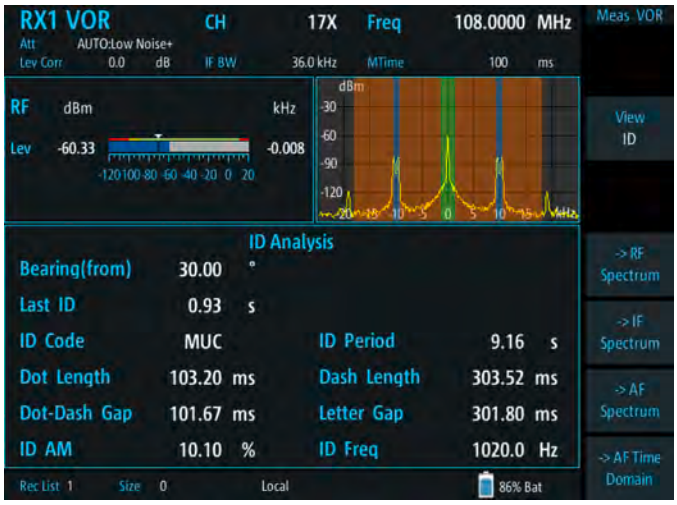
SOFTWARE OPTIONS FOR CUSTOMIZED ANALYSIS



Measurement of a 2F ILS installation

Simultaneous analysis of course and clearance signals (R&S®EVSG-K1)

The R&S®EVSG-K1 option makes it possible to measure both carriers of a dual-frequency (2F) ILS system independently and simultaneously. The level and modulation values of each carrier (course and clearance) are measured and analyzed at the same time. This means that each carrier can be measured without switching off the other carrier. This approach also allows users to determine the phase relationship between the 90 Hz and the 150 Hz AF tones of the single carriers.



VOR measurement

Detailed analysis of VOR and marker beacon signals (R&S®EVSG-K2, R&S®EVSG-K3)

In combination with the R&S®EVSG-K2 option, the R&S®EVSG1000 analyzes the characteristic parameters, such as bearing and modulation, of VOR systems. In addition, the R&S®EVSG1000 determines the AM distortion values, which are required in particular for Doppler VOR (DVOR) systems.

The R&S®EVSG-K3 option determines the modulation and frequency values of marker beacon systems. It also measures and displays the dash, dot and gap lengths of the marker beacon code.

Analysis of communications signals

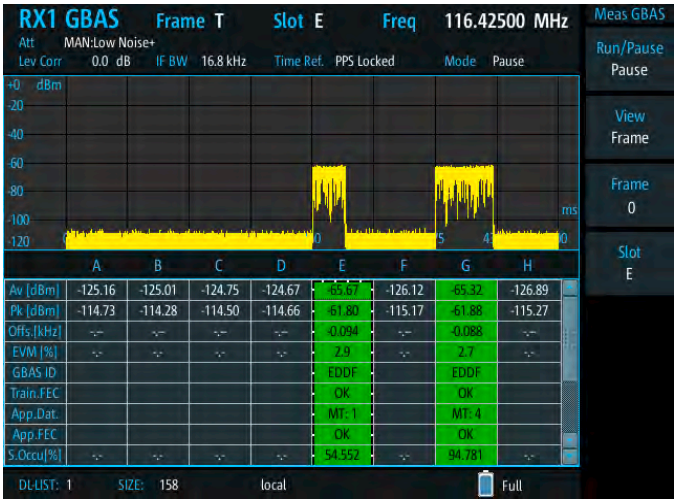
ATC COM signal analysis (R&S®EVSG-K6)

The R&S®EVSG-K6 analyzes the level, frequency and modulation (AM and FM) of ATC COM signals in the VHF and UHF bands.

Testing of ground based augmentation systems (GBAS/SCAT) for satellite navigation (R&S®EVSG-K4, R&S®EVSG-K5)

The R&S®EVSG-K4 and R&S®EVSG-K5 software options make it possible to test the VHF data broadcast (VDB) of GBAS and SCAT ground based satellite navigation systems. The content of all GBAS/SCAT timeslots (A to H) is analyzed and synchronized using an external PPS signal.

For each timeslot (A to H), the instrument analyzes all important GBAS/SCAT parameters (see table).



Time domain analysis of a GBAS frame

Different views allow users to:

- Visualize the sequence of GBAS/SCAT messages over time
- Analyze a complete GBAS/SCAT frame (time domain overview plus measurement results for each timeslot)
- Perform detailed time domain measurements on a single burst
- Analyze the signal via a constellation diagram
- Look at the data content in the message view

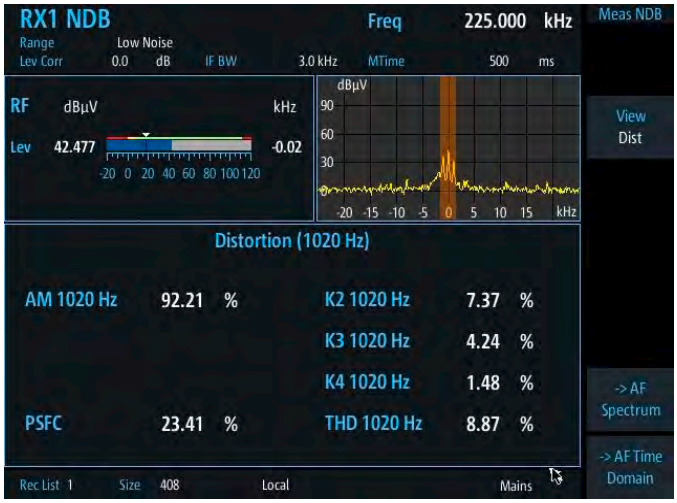
To ensure stable conditions for a further analysis, the sequence of messages can be paused and single frames or bursts can be selected. The analysis can then be done offline – without interrupting e.g. an ongoing data recording or streaming in the background.

To be prepared for eventual changes concerning message type specifications in the future, all MTs are defined by XML description files. Standard XML files for MT1 (contains GPS correction data – satellite information and pseudorange corrections), MT2, MT4 (contains the final approach segment data block – FASDB) and MT11 are part of the delivery. The files for the existing MTs can be modified or new MT description files can be created by the user if needed.

All measured values and data content can be streamed, recorded, saved and exported via USB stick using the instrument's data recorder.

GBAS measurements

Measurement value	Description
Burst level average in dBm	Arithmetic average measured over the period of the synchronization and ambiguity resolution field of the burst
Slot peak level in dBm	Highest measured power level in the slot
Carrier frequency offset in kHz	Offset of the measured carrier frequency from the tuned center frequency
Error vector magnitude (EVM) RMS in %	Indicates the quality of the transmitted symbols in relation to the ideal constellation point
GBAS identifier	Identification of the ground station broadcasting the message
Training sequence FEC	Training sequence status based on the FEC
Application data	Detected message types within a burst
Application FEC	Application data status based on the FEC
Slot occupancy in %	The percentage of all bits that are included in a single burst divided by the length of a single timeslot
Bit error rate (BER) before FEC	Bit error rate before FEC. The training sequence FEC and the application FEC are used to detect bit errors
Valid bursts count	Number of received bursts that pass the CRC
Failed bursts count	Number of received bursts that did not pass the CRC
Synchronization sequence start position in µs	Start position of the synchronization sequence within the burst
Overload	Indicates a power overload at any of the input connectors, which may account for inaccurate results



LF analysis

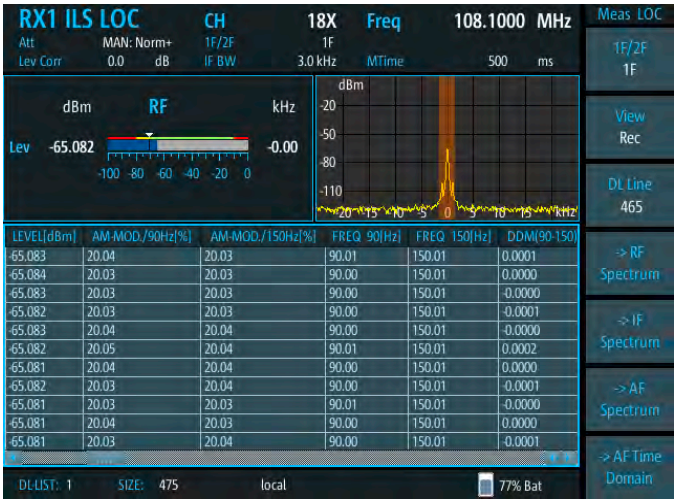
LF analysis for nondirectional beacon and more (R&S®EVSG1-K7)

Equipped with the R&S®EVSG1-K7 option, the R&S®EVSG1000 can do tests on various signals in the low IF and AF frequency range. The BNC connector "LF In" on the rear of the instrument is used to connect the signal source or antenna to the R&S®EVSG1000.

For input frequencies from 190 kHz to 1750 kHz, the LF input is configured as 50 Ω or 20 kΩ, AC coupled. For lower input frequencies (up to 50 kHz), the impedance of the LF input is switched to 20 kΩ, AC or DC coupled.

This offers various analysis possibilities. For nondirectional beacon (NDB) signals, the R&S®EVSG1000 analyzes all parameters of the NDB identifier including the ID code. The distortion view indicates not only the ID tone's AM modulation depth but also its K2, K3, K4 and THD values. The "Low IF" analysis feature allows users to do a full signal analysis on a carrier in the kilohertz frequency range (e.g. complete analysis on a 2F ILS signal on an 8 kHz carrier). Of course, R&S®EVSG1-K7 also allows users to perform a normal baseband signal analysis.

The graphical modes of the R&S®EVSG1000 (RF spectrum analysis, AF spectrum analysis and AF time domain analysis) can be used to carry out even more detailed signal analyses of the signal components, e.g. ILS/VOR AM modulation, demodulated VOR FM subcarrier, unwanted AM of the VOR FM subcarrier (requires R&S®EVSG-K10, R&S®EVSG-K11 and/or R&S®EVSG-K12 option).



Data recording

Integrated data recording (R&S®EVSG-K21)

The R&S®EVSG1000 is equipped with a large internal memory. With the R&S®EVSG-K21 option, the R&S®EVSG1000 can store all data records, even if acquired at very high rates. Measured values can be stored and displayed in lists according to user-specific criteria. Recorded data can be transferred to a PC or laptop via a USB stick or LAN interface.

High measurement rate (R&S®EVSG-K22)

The R&S®EVSG-K22 option enhances the R&S®EVSG1000 to include dynamic measurements in ILS test vehicles, making the instrument an ideal choice for performing runway measurements required by ICAO for CAT III systems. The R&S®EVSG1000 acquires ILS signals during test drives at a rate of up to 100 data records per second with high precision and temporal resolution, allowing effects such as scallops and bends to be determined and analyzed. The optional GPS support (R&S®EVSG-K20) in conjunction with an external GPS module automatically links the data records to the correct GPS time and position stamp.

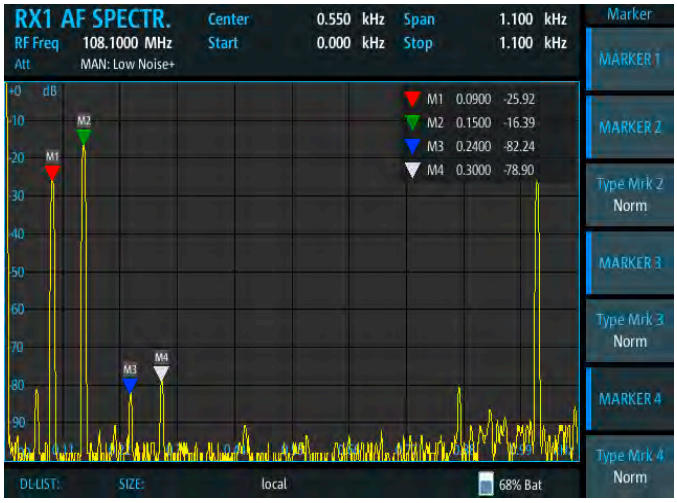
I/Q data streaming (R&S®EVSG1-K25)

The R&S®EVSG1000 can stream and internally store the I/Q data of the analyzed signal. This I/Q data can be used in an arbitrary waveform generator to replay the recorded signal, e.g. for comparison of various NavAid receivers.

RF spectrum analysis

RF spectrum analysis (R&S®EVSG-K10)

When equipped with the R&S®EVSG-K10 option, the R&S®EVSG1000 can display the RF spectrum of the input signal in the range from 70 MHz to 410 MHz. Clear/write, average and peak hold trace modes as well as markers and delta markers are selectable. The instrument's wide dynamic range and low noise figure make it possible to analyze interference in ILS/VOR and COM bands.



AF spectrum analysis

AF spectrum analysis (R&S®EVSG-K11)

The R&S®EVSG1000 together with the R&S®EVSG-K11 option can be used for baseband analysis. Either the demodulated RF signal or an AF signal applied to the instrument's LF input can be used as a source for AF spectrum analysis. With the R&S®EVSG-K11 option, harmonics and intermodulation products are identified and displayed by the R&S®EVSG1000 on a logarithmic or linear scale. The associated levels and frequencies can be conveniently read using marker and delta marker functions.

AF time domain analysis of an ILS signal

AF time domain analysis (R&S®EVSG-K12)

The R&S®EVSG-K12 option allows users to test CSB and SBO signals from ILS transmitters. Cursor functions facilitate the reliable detection of phase and level errors. Even small signal distortions are identified thanks to the instrument's fine graphical resolution and high vertical A/D converter resolution.

HARDWARE OPTIONS AND ACCESSORIES

Compact, robust, lightweight

Its compact size and low weight make the R&S®EVSG1000 ideal for measurements in the field. The mechanical design of the R&S®EVSG1000 meets the requirements of MIL-STD-810F with respect to shock. The R&S®EVS-Z6 protective hard cover is the ideal extra when the front panel needs to be protected.

Battery-powered field measurements (R&S®EVSG-B3)

An optional lithium-ion battery (R&S®EVSG-B3) is available for measurements in the field. The battery is inserted into a compartment on the instrument's rear and allows six to eight hours of operation. The battery is recharged via the external power supply or the instrument's DC input (10 V to 28 V DC).

R&S®EVS-Z6 protective hard cover for front panel

R&S®EVSG-Z1 water-resistant soft bag

Weather and transit protection for mobile use (R&S®EVSG-Z1)

The water-resistant R&S®EVSG-Z1 soft bag has a transparent cover that allows the R&S®EVSG1000 to be operated in the field even under adverse weather conditions. The front pocket can be used to transport accessories such as a spare battery.

The ergonomic carrying vest holster (R&S®FPL1-Z3) facilitates mobile measurements that take a long time, such as ILS off-course clearance measurements. The holster can be adjusted as required and is very comfortable to wear.

Safe transport in a hard-shell transport case (R&S®EVSG-Z2)

The R&S®EVSG-Z2 hard-shell transport case protects the R&S®EVSG1000 during transport or shipping. It offers space for a power supply, a spare battery and other accessories and has wheels for easy transport.

ILS/VOR test antenna (R&S®EVS-Z3) with carrying bag

The lightweight, compact R&S®EVS-Z3 ILS/VOR test antenna is ideal for mobile measurements. It comes with two sets of rods of different lengths to cover the ILS/VOR frequency ranges. The telescopic mast can be extended to 3.10 m.

The R&S®EVS-Z4 carrying bag can accommodate all test antenna components as well as other accessories.

R&S®EVSG-Z2 hard-shell transport case

R&S®EVS-Z3 ILS/VOR test antenna

R&S®EVS-Z4 carrying bag for test antenna

ORDERING INFORMATION

Designation	Type	Order No.
Base unit		
VHF/UHF airnav/com analyzer	R&S®EVSG1000	1329.8009.02
Accessories supplied		
External power supply, 100 V to 240 V; getting started guide, English		
Hardware options		
Second signal processing unit	R&S®EVSG-B1	1329.8809.02
Battery management	R&S®EVSG-B2	1329.8815.02
Battery pack	R&S®EVSG-B3	1329.8821.02
Software options		
ILS CRS/CLR analysis	R&S®EVSG-K1	1329.9005.02
VOR analysis	R&S®EVSG-K2	1329.9011.02
Marker beacon analysis	R&S®EVSG-K3	1329.9028.02
GBAS analysis	R&S®EVSG-K4	1329.9034.02
SCAT-I analysis	R&S®EVSG-K5	1329.9040.02
COM analysis	R&S®EVSG-K6	1329.9057.02
LF analysis	R&S®EVSG1-K7	1329.9163.02
RF spectrum analysis	R&S®EVSG-K10	1329.9063.02
AF spectrum analysis	R&S®EVSG-K11	1329.9070.02
AF time domain analysis	R&S®EVSG-K12	1329.9086.02
GPS support	R&S®EVSG-K20	1329.9092.02
Data recording	R&S®EVSG-K21	1329.9105.02
High measurement rate	R&S®EVSG-K22	1329.9111.02
Preselector	R&S®EVSG-K23	1329.9128.02
Power sensor support	R&S®EVSG-K24	1329.9134.02
I/Q data streaming	R&S®EVSG1-K25	1329.9157.02
Recommended extras		
Soft bag	R&S®EVSG-Z1	1329.8909.02
Carrying vest holster	R&S®FPL1-Z3	1323.1683.02
Transport case	R&S®EVSG-Z2	1329.8915.02
Test antenna	R&S®EVS-Z3	5200.6577.02
Carrying bag for test antenna	R&S®EVS-Z4	5200.9999.00
Protective hard cover	R&S®EVS-Z6	5201.7760.00
19" adapter	R&S®EVSG-Z7	1329.8967.02
Spare external power supply (100 V to 240 V)	R&S®EVSG1-Z8	1330.0289.02
Verification test software	R&S®EVSG1-Z11	1329.8921.02
Documentation of calibration values	R&S®DCV-2	0240.2193.24