R&S®EVSF1000 VHF/UHF NAV/FLIGHT ANALYZER

3 year warranty

Efficient flight inspection of terrestrial navigation and communications systems



Product Brochure
Version 06.01

ROHDE&SCHWARZ
Make ideas real

AT A GLANCE

The R&S®EVSF1000 VHF/UHF nav/flight analyzer is a signal level and modulation analyzer for installation in flight inspection aircraft. It performs measurements on ILS, GBAS, VOR, NDB and marker beacon ground stations during startup, maintenance and servicing and analyzes air traffic control communications (ATC COM) signals. The instrument's mechanical and electrical design and high sensitivity make it ideal for state-of-the-art flight inspection. In addition, the R&S®EVSF1000 performs specialized, drone based measurements on terrestrial navigation systems.

As an integral component of an advanced flight inspection system (FIS) on board an aircraft, the R&S®EVSF1000 delivers precise, high-sensitivity analyses in the frequency range from 70 MHz to 410 MHz. It performs in-flight measurements on ILS, GBAS, VOR, NDB and marker beacon ground systems in line with ICAO standards and analyzes ATC COM signals.

The R&S®EVSF1000 hardware and software are largely identical to that of the R&S®EVSG1000 VHF/UHF airnav/com analyzer, which performs the same measurements from the ground. The identical performance of the two instruments ensures that results obtained in flight and from the ground are comparable, as stipulated by the ICAO standards.

The R&S®EVSF1000 base configuration includes all functions essential for flight inspection and can determine characteristic system parameters – such as modulation depth, DDM and SDM – with high precision at a rate of 100 data records per second. All data delivered by the R&S®EVSF1000 is acquired, visualized and stored by the flight inspection system software in a seamless data stream via a remote control connection (LAN).

The R&S®EVSF1000 features a highly compact, robust mechanical design and excellent sensitivity of the two signal processing units, making it an ideal instrument for use on board inspection aircraft. Spectrum and signal analysis options are available in addition.

At 3.7 kg, the instrument's weight is not an issue, so that the R&S®EVSF1000 can also be used together with modern drones and copters to perform measurements on ILS/VOR systems.



Front view of the R&S®EVSF1000 without the R&S®EVSF1-B4 option

Key facts

- Precise, reproducible analyses on ILS, GBAS, VOR, NDB and marker beacon ground systems (in line with ICAO Doc 8071 and ICAO Annex 10)
- High measurement rate, at 100 data records/s
- Analysis of ATC COM signals
- High sensitivity for coverage measurements
- Compact, robust design
- Two identical signal processing units for simultaneous localizer and glide path measurements

BENEFITS AND KEY FEATURES

Excellent performance for state-of-the-art flight inspection systems

- Level measurements with utmost accuracy
- Outstanding input sensitivity, efficient preselector
- Precision modulation analysis in real time
- Reliable measurement of identifier parameters
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Highly customizable for specific tasks

- 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)
- Testing of ground based augmentation systems (GBAS/SCAT-I) for satellite navigation (R&S®EVSG-K4, R&S®EVSG-K5)
- ATC COM signal analysis (R&S®EVSG-K6)
- LF analysis for nondirectional beacon and more (R&S®EVSG1-K7)
- Integrated data recording
- High measurement rate
- RF spectrum analysis (R&S®EVSG-K10)
- AF spectrum analysis (R&S®EVSG-K11)
- I/Q data streaming (R&S®EVSG1-K25)
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Tailored to flight inspection applications

- Integration into flight inspection aircraft (R&S®EVSF1-B4)
- Reliable bridging of short-term interruptions in the on-board power supply
- Compact, robust, lightweight
- Detailed analyses in line with ICAO requirements
- Simple remote control
- Maintenance, repair and service
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Rear view of the R&S®EVSF1000 without the R&S®EVSF1-B4 option



Rear view of the R&S®EVSF1000 with the R&S®EVSF1-B4 and R&S®EVSF1-Z1 options

EXCELLENT PERFORMANCE FOR STATE-OF-THE-ART FLIGHT INSPECTION SYSTEMS

Level measurements with utmost accuracy

The R&S®EVSF1000 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

Due to its high sensitivity, low noise figure and narrowband filters, the R&S®EVSF1000 is able to deliver highly precise results even at large distances from the transmit system with the resulting low levels.

The R&S®EVSF1000 also offers a wide input level range and steep-edged preselection filters that provide optimized interference rejection for ILS, GBAS, 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 FM transmitters.

Precision modulation analysis in real time

By using digital signal processing, the R&S®EVSF1000 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®EVSF1000 automatically measures and decodes the identifier of the station under test and returns the ID pulse repetition rate, the ID code and the dash, dot and gap lengths.

Flight inspection aircraft



Integrated flight inspection system



HIGHLY CUSTOMIZABLE FOR SPECIFIC TASKS

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

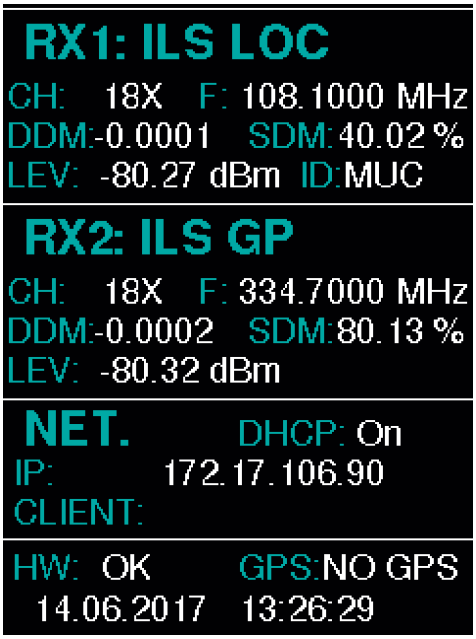
The R&S®EVSG-K1 option makes it possible to measure both carriers of a dual-frequency (2F) ILS system independently and simultaneously. The level and modulation values of each carrier (course and clearance) are measured and analyzed at the same time. This means that each carrier can be measured without 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.

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®EVSF1000 analyzes the characteristic parameters, such as bearing and modulation, of VOR systems. This allows orbital and radial inspection flights to be performed. In addition, the R&S®EVSF1000 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.

R&S®EVSF1000 status display



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

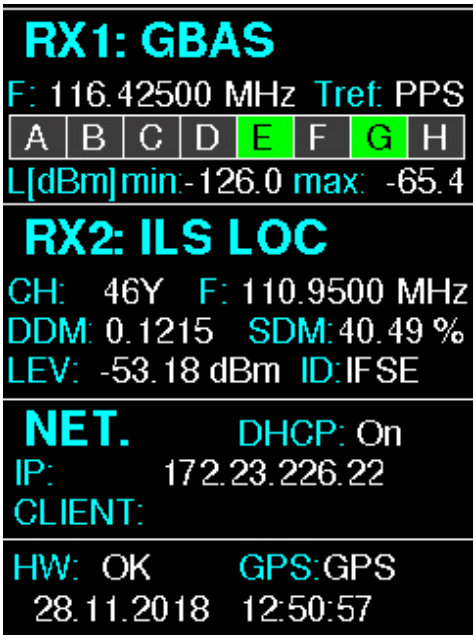
The R&S®EVSG-K4 and R&S®EVSG-K5 software options allow users to test the VHF data broadcast (VDB) of GBAS and SCAT-I ground based satellite navigation systems. The content of all GBAS/SCAT-I timeslots (A to H) is analyzed and synchronized using an external PPS signal.

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

To be prepared for eventual changes concerning message type (MT) 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.

Via VNC the R&S®EVSF1000 offers different views to allow deeper analysis of the sequence, frame, burst, constellation or the MT content. 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.



R&S®EVSF1000 status display – channel one in GBAS mode

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

ATC COM signal analysis (R&S®EVSG-K6)

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

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

Equipped with the R&S®EVSG1-K7 option, the R&S®EVSF1000 can do tests on various signals in the low IF and AF frequency range. The R&S®EVSG1-K7 option requires the R&S®EVSF1-B4 hardware option.
The R&S®EVSF1-B4 offers an "LF In" pin on the ARINC connector on the rear of the instrument. This is used to connect the antenna to the R&S®EVSF1000.

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, but for flight inspection systems and drone solutions the most important one is the analysis of nondirectional beacon (NDB) signals. The R&S®EVSF1000 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 graphical modes of the R&S®EVSF1000 (RF spectrum analysis and AF spectrum analysis available via VNC) 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 and/or R&S®EVSG-K11 option).

Integrated data recording

The R&S®EVSF1000 comes standard with a large internal memory that can store all data records, even if acquired at very high rates. This feature is especially useful if the instrument is to be evaluated before it is integrated into the R&S®EVSF1000 FIS software.

After flight inspection, recorded data can be transferred to a PC or laptop via a USB stick or LAN interface.

High measurement rate

The R&S®EVSF1000 can process up to 100 data records per second, making it possible to determine and analyze effects such as scallops and bends. Using an external GPS module, the instrument automatically links each data record to the correct GPS timestamp and location stamp.

RF spectrum analysis (R&S®EVSG-K10)

When equipped with the R&S®EVSG-K10 option, the R&S®EVSF1000 can display the RF spectrum of the input signal in the range from 70 MHz to 410 MHz on an external monitor. 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.

The R&S®EVSF1000 has an integrated VNC server that allows users to 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®EVSF1000.

AF spectrum analysis (R&S®EVSG-K11)

The R&S®EVSF1000 together with the R&S®EVSG-K11 option can be used for baseband analysis, which identifies harmonics and intermodulation products. The associated levels and frequencies can be conveniently read via remotely accessible markers and delta markers (LAN).

I/Q data streaming (R&S®EVSG1-K25)

The R&S®EVSF1000 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.

TAILORED TO FLIGHT INSPECTION APPLICATIONS

Integration into flight inspection aircraft (R&S®EVSF1-B4)

For easy integration into flight inspection systems (FIS), the R&S®EVSF1000 can be ordered with a modified rear panel (R&S®EVSF1-B4 option). The R&S®EVSF1-B4 is a factory fitted slide-in option that offers an ARINC connector instead of the normal interfaces. All signals (RF, GPS, DC-IN, LAN, USB, analog inputs and outputs and trigger/PPS) are available on the ARINC connector. The R&S®EVSF1-Z1 tray is specially designed for mechanical integration of the R&S®EVSF1000 plus R&S®EVSF1-B4 into FI systems. The status display on the front panel quickly provides information about the instrument status and the cabling to the RF antennas and the external (D)GPS receiver. A keyboard can be connected to the front panel USB port for configuring the instrument.

Reliable bridging of short-term interruptions in the on-board power supply

The R&S®EVSF1000 is directly connected to the system's on-board DC power supply (11 V to 32 V). The instrument comes with an integrated power supply that bridges short-term interruptions (RTCA DO-160G, section 16, category A, DC power interruptions up to 200 ms) and fluctuations in the on-board supply voltage so that they will not affect the mission or measurement accuracy.

Compact, robust, lightweight

Its compact size (95 mm × 177 mm × 360 mm) and low weight (3.7 kg) make the R&S®EVSF1000 ideal for integration into inspection aircraft or operation together with a test drone. The mechanical design of the R&S®EVSF1000 meets the requirements of RTCA DO-160G, section 7.0, with respect to shock and of RTCA DO-160G, section 8.5.2, with respect to random vibration.



Front view of the R&S®EVSF1000 with the R&S®EVSF1-B4 option

R&S®EVSF1-Z1 tray for mechanical integration of the R&S®EVSF1000 with the R&S®EVSF1-B4 option into a flight inspection rack



Detailed analyses in line with ICAO requirements

ICAO Doc 8071 and ICAO Annex 10 specify exactly how to service and maintain ILS, GBAS, VOR and marker beacon systems during flight inspection. Thanks to the high speed and flexibility of the R&S®EVSF1000, all necessary measurements can be performed with a high degree of accuracy and temporal resolution. Measurements include not only the standard modulation parameters but also distortion and residual modulation (residual FM, unwanted AM).

Simple remote control

The R&S®EVSF1000 is typically remotely controlled via LAN. This allows measurement data to be streamed to the FIS software for further processing.

Maintenance, repair and service

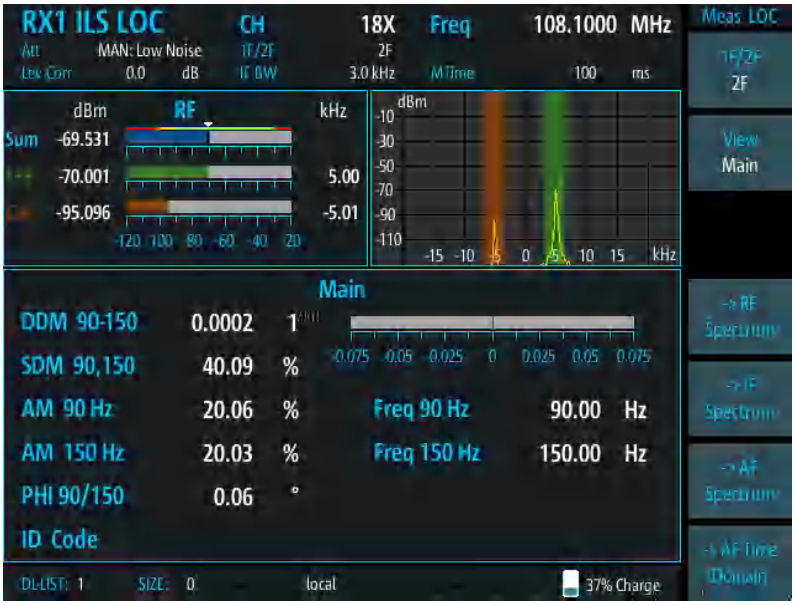
Its modular design and mechanical ruggedness make the R&S®EVSF1000 very serviceable. If faults occur or other service becomes necessary, the instrument is quickly returned to operation by replacing modules and carrying out calibration in line with the instructions given in the service manual.

For convenient operation of the R&S®EVSF1000 equipped with the R&S®EVSF1-B4 option in the lab, a service adapter (R&S®EVSF1-Z2) is available that converts the ARINC connector to standard connectors (RF connector, power supply, etc.). The R&S®EVSF1-Z2 makes it easy to operate the instrument without the need of an additional tray.

While the instrument is being serviced, measured values can be displayed via VNC on a PC (virtual screen).

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.

Virtual screen of the R&S®EVSF1000



R&S®EVSF1-Z2 service adapter for maintenance of the R&S®EVSF1000 equipped with the R&S®EVSF1-B4 option



ORDERING INFORMATION

Designation	Type	Order No.
Base unit		
VHF/UHF nav/flight analyzer	R&S®EVSF1000	1330.0008.02
Accessories supplied		
Getting started guide, English		
Hardware options		
Slide-in option, factory fitted (retrofit not possible)	R&S®EVSF1-B4	1330.1404.02
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
I/Q data streaming	R&S®EVSG1-K25	1329.9157.02
Recommended extras		
Documentation of calibration values	R&S®DCV-2	0240.2193.10
Tray, with mating connector (for R&S®EVSF1000 with R&S®EVSF1-B4 option)	R&S®EVSF1-Z1	1330.1410.02
Service adapter, with mating connector (for R&S®EVSF1000 with R&S®EVSF1-B4 option)	R&S®EVSF1-Z2	1330.1427.02
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

Warranty		
Base unit		3 years
All other items [1]		1 year
Options		
Extended warranty, one year	R&S®WE1	Please contact your local Rohde&Schwarz sales office.
Extended warranty, two years	R&S®WE2	
Extended warranty with calibration coverage, one year	R&S®CW1	
Extended warranty with calibration coverage, two years	R&S®CW2	
Extended warranty with accredited calibration coverage, one year	R&S®AW1	
Extended warranty with accredited calibration coverage, two years	R&S®AW2	

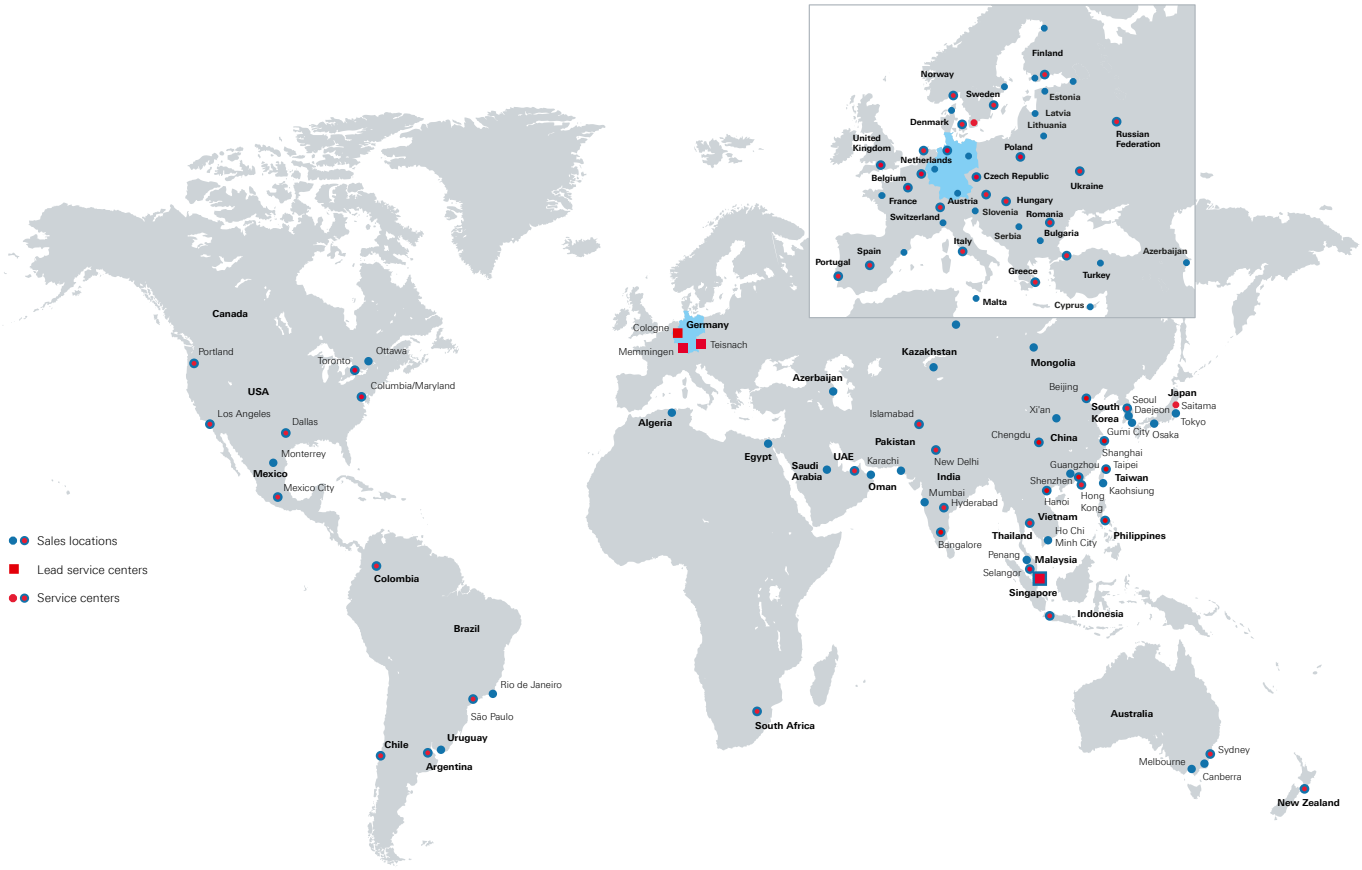
[1] For options that are installed, the remaining base unit warranty applies if longer than 1 year. Exception: all batteries have a 1-year warranty.

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