

Webinar

Ground- Flight- & Drone-Based Air-Nav Testing



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Test & Measurement

INTRODUCTION OF THE NEW R&S®EVSD1000 VHF/UHF NAV/DRONE ANALYZER

Extended ground inspection using drone technology for measurements of terrestrial navigation signals

Klaus Theißen - Software Economy Analyzer, Avionic Test

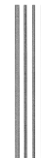
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TESTING WITH DRONES

ICAO DOC 8071 Volume I - Testing of Ground-based Radio Navigation Systems Fifth Edition, 2018 also mentions the use of RPAS or UAV's!!!



MANUAL
ON TESTING OF
RADIO NAVIGATION AIDS

1.18 USE OF REMOTELY PILOTED AIRCRAFT SYSTEMS

1.18.1 A basic principle of flight inspection to assess compliance with Annex 10 Standards is to use representative avionics at normal aircraft speeds. While flight inspection aircraft and their avionics are not representative of all aircraft and avionics, they nonetheless facilitate making judgements on the operational relevance of signal anomalies. This principle does not prevent the use of more advanced measurement capabilities both in ground and flight testing; however, it requires that good correlation (impact of filtering, etc.) needs to be established.

1.18.2 Remotely piloted aircraft systems (RPAS) or unmanned aerial vehicles (UAV) should be assessed to determine that they provide the payload capability, speed and range necessary to conduct a flight inspection for navigation aids as recommended herein in a cost-effective manner. RPAS can and have been used for special and advanced measurement applications which are difficult to achieve with traditional ground and flight measurement capabilities. Nothing in this manual is intended to prevent the development of such capabilities. Some States are studying how the use of RPAS can help in making more regular measurement checks with the aim to reduce the periodicity of a full flight inspection with a typical flight inspection aircraft. These studies should take into account the guidance in section 1.15.



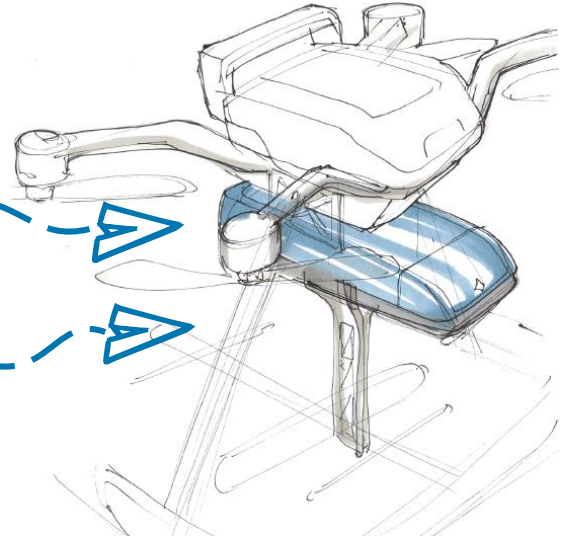
CUSTOMER SOLUTIONS

- ▶ The R&S® EVSF1000 is already in use with drones!



- ▶ Good measurement performance, but...
 - 3,7 kg weight requires a large drone (short flight time...)
 - No standard solution off the shelf (e.g. external battery required...)

THE IDEA



Mission:

- “Drone optimized receiver”
- Same or better performance as EVSG/EVSF
- Battery powered, modular, flexible
- Accessories needed (Antenna, data-link,...)

R&S® EVSD1000 VHF/UHF NAV/DRONE ANALYZER

- Signal level and modulation analyzer for medium-sized drones
- Mechanical and electrical design optimized for drone based measurements on terrestrial navigation systems
- Measurements on ILS, GBAS and VOR ground stations
- COM analysis



R&S® EVSD1000 VHF/UHF NAV/DRONE ANALYZER

- Compact and robust mechanical design
- Ideal instrument for use aboard measurement drones
- Allows usage of a medium-sized drone due to low weight (< 1.5 kg)

Example here with

- DJI M300 RTK drone and
- V/UHF antenna R&S® EVSD1-Z3
(can be mounted on top of the drone or below the receiver...)



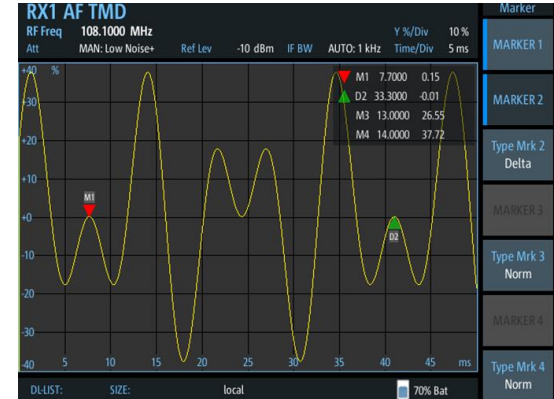
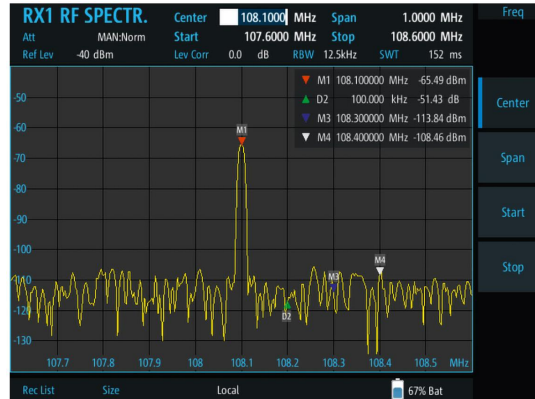
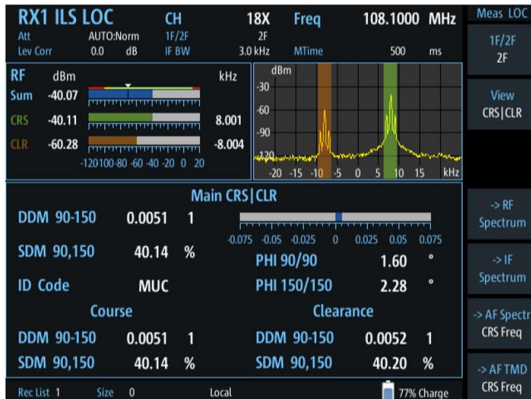
INHERITED FEATURES FROM R&S® EVSG1000

- ▶ Analysis of **ILS, GBAS, VOR, MB** and **ATC COM**
- ▶ Fully **ICAO compliant**
- ▶ **Same RF performance** as R&S®EVSG1000 and R&S®EVSF1000
- ▶ **High dynamic range**
- ▶ Up to **100 measurements per second**



INHERITED FEATURES FROM R&S® EVSG1000

- ▶ Gapless **recording** of measurement results, synced with GPS
- ▶ **I/Q data** recording and streaming
- ▶ **Remote Control** Interface identical to R&S®EVSG1000 and R&S®EVSF1000
- ▶ **Simultaneous** analysis of course and clearance signals in dual-frequency (2F) ILS systems
- ▶ **Frequency and time domain** analysis



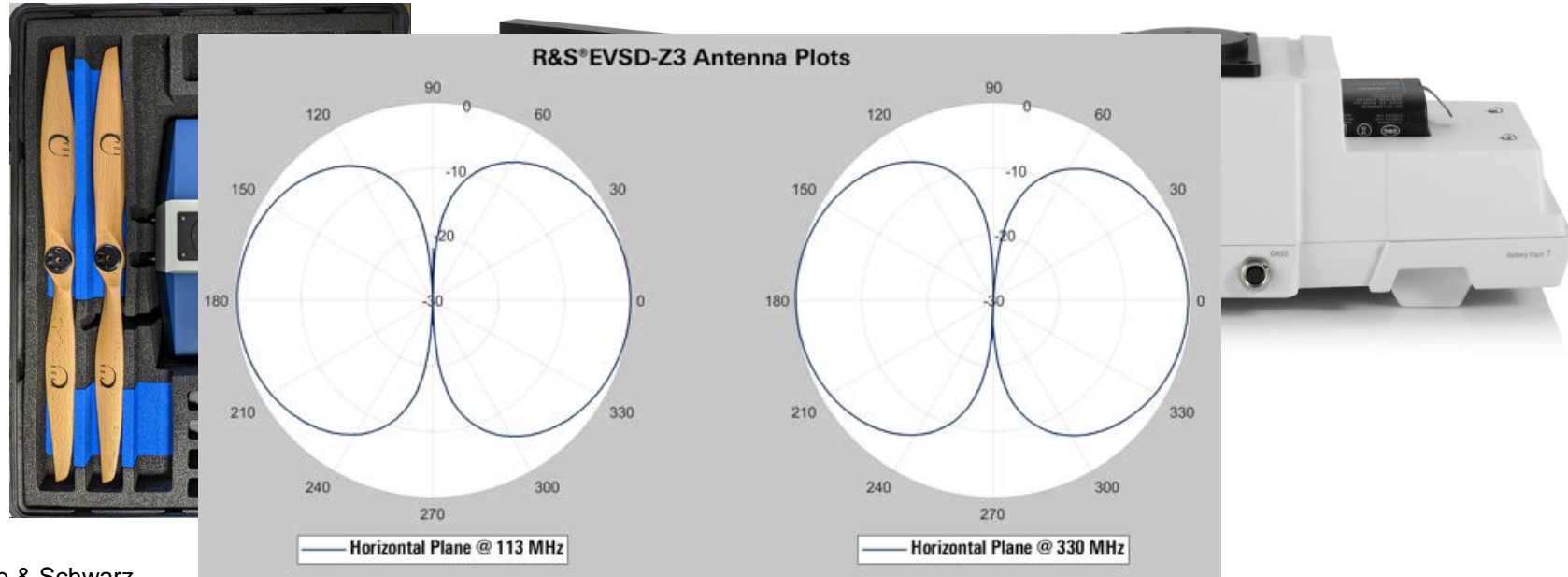
R&S® EVSD1000 NEW FEATURES

- ▶ **Aerodynamic** shape
- ▶ **Low weight** (< 1,5 kg)
- ▶ **Weatherproof housing (IP43)**
- ▶ **Modular** concept
- ▶ **Various interfaces** for easy integration



R&S®EVSD1000 NEW OPTIONS

- ▶ Small and lightweight **RX antenna**
- ▶ Transport case
- ▶ Internal **battery** (plus external charger)
- ▶ Internal **data-link-module** (Wi-Fi)
- ▶ Drone **adapter**



R&S®EVSD1000 – SW OPTIONS

R&S®EVSG-K1 – ILS CRS/CLR ANALYSIS

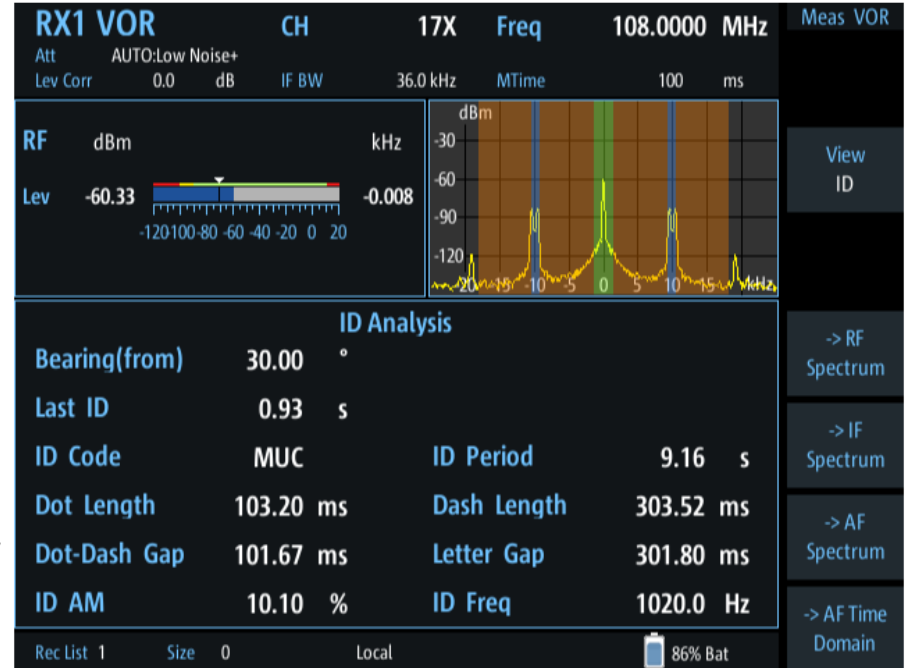
- The ILS analysis provides measurement information on both localizer and glideslope signals, including DDM, SDM, AM modulation and frequencies.
- The R&S®EVSG-K1 option adds simultaneous measurement of CRS and CLR with DDM's for each carrier.
- Views:
 - Modulation
 - CRS|CLR
 - Distortion (K2, K3, THD)
...plus residual FM distortion
 - Identification (Dash, Dot, Gap)
 - Data Recorder



R&S®EVSD1000 – SW OPTIONS

R&S®EVSG-K2 – VOR ANALYSIS

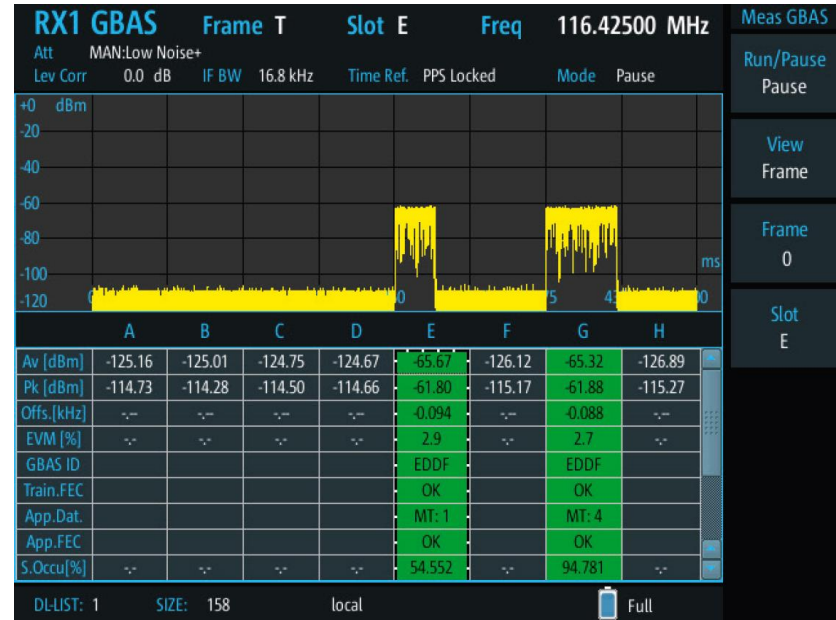
- The VOR analysis screen provides information on the levels and modulation parameters of conventional and Doppler VOR stations
- Measurement of VOR bearing, AM modulations depth's, FM parameters of the subcarrier and AF frequencies
- Views:
 - Modulation
 - Distortion (K2, K3, THD)
...plus AM distortion 60 Hz / 1440 Hz
 - Identification (Dash, Dot, Gap)
 - Data Recorder



R&S® EVSD1000 – SW OPTIONS

R&S® EVSG-K4 – GBAS ANALYSIS

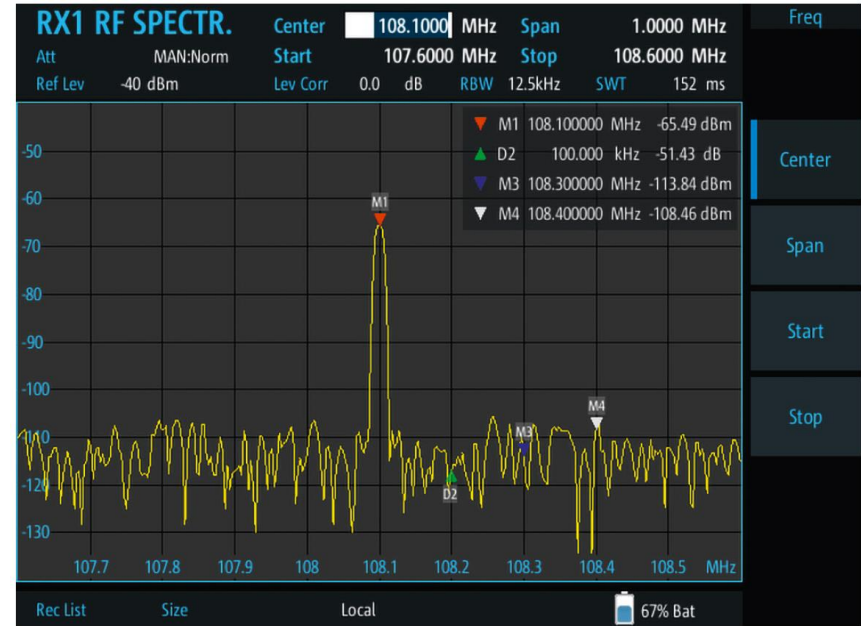
- Test of VHF data broadcast (VDB) of GBAS and SCAT ground-based satellite navigation systems
- Synchronization via external PPS signal
- Visualization of the sequence of GBAS/SCAT messages over time
- Analysis of a complete GBAS/SCAT frame
- Detailed time domain measurements on each GBAS/SCAT burst
- Analysis via constellation diagram
- Data content in message view



R&S®EVSD1000 – SW OPTIONS

R&S®EVSG-K10 – RF SPECTRUM ANALYSIS

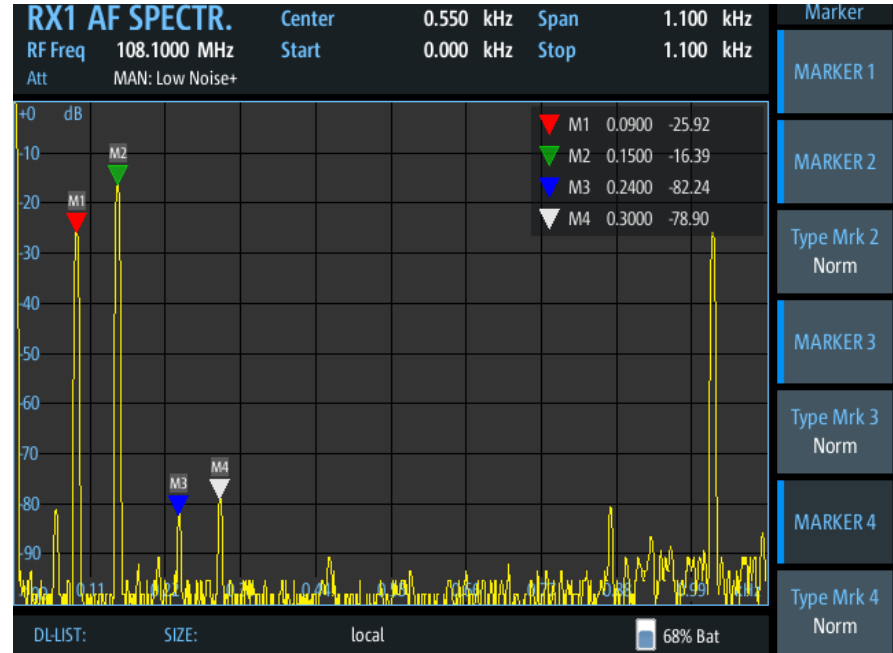
- Display the input signal's RF spectrum in the range from 70 MHz to 410 MHz.
- Clear/write, average and peak hold trace modes as well as markers and delta markers selectable.
- The instrument's wide dynamic range and low noise figure make it possible to analyze interference in ILS/VOR and COM bands.



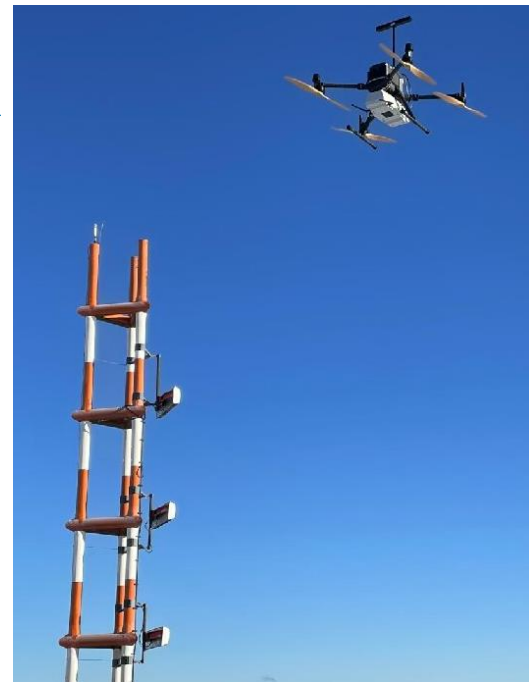
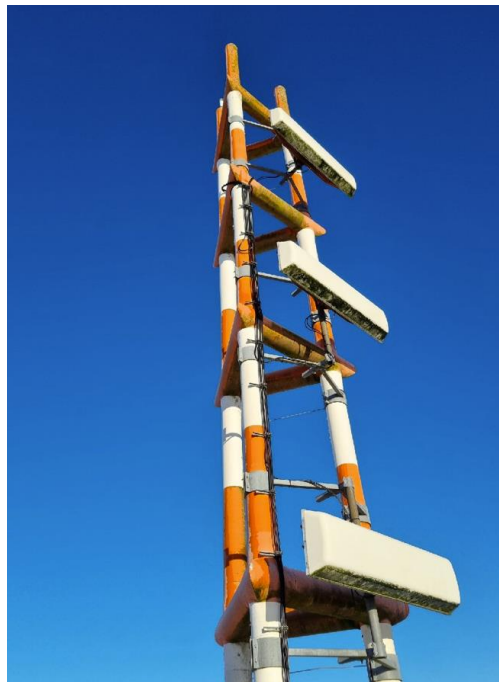
R&S®EVSD1000 – SW OPTIONS

R&S®EVSG-K11 – AF SPECTRUM ANALYSIS

- With the AF spectrum analysis option, the R&S®EVSG1000 performs a base band (AF) analysis. The source for this can be the demodulated RF signal or the signal on the base band input of the R&S®EVSG1000.
- This mode can be used to detect unwanted signal parts (harmonics....).
- Four markers (Norm, Delta) make it easy to recognize frequencies and levels.



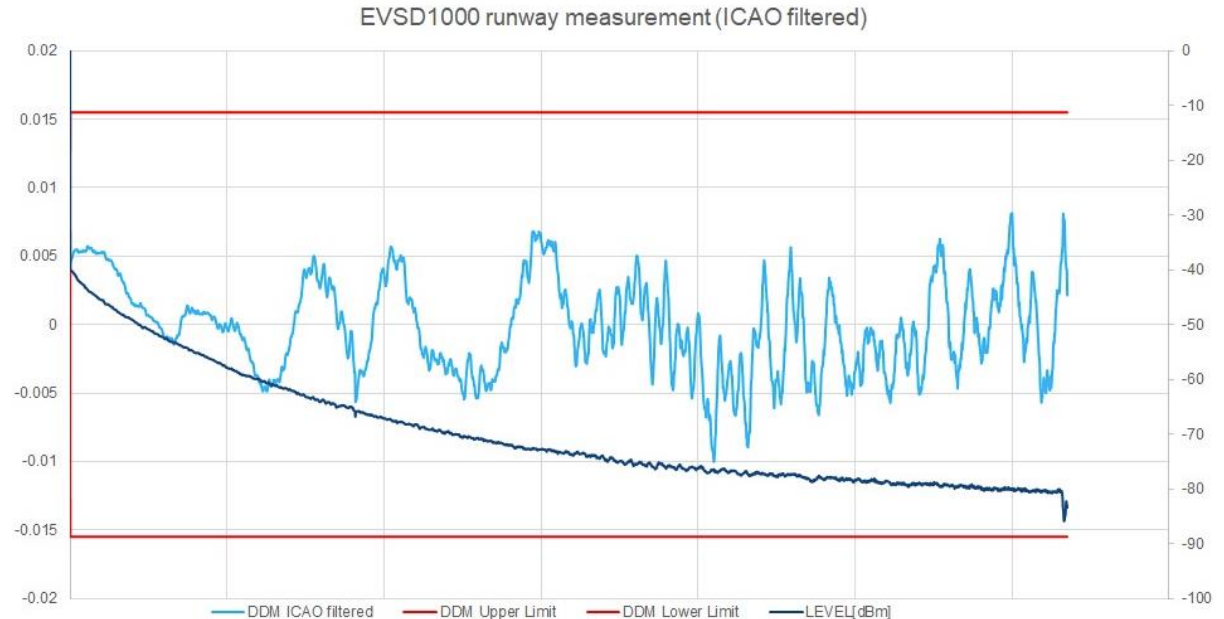
R&S® EVSD1000 FIELD TESTS



R&S®EVSD1000 FIELD TESTS

Automatic measurement (waypoints) with R&S®EVSD1000 plus R&S®EVSD1-Z3 on DJI-M300 RTK drone at a small airport:

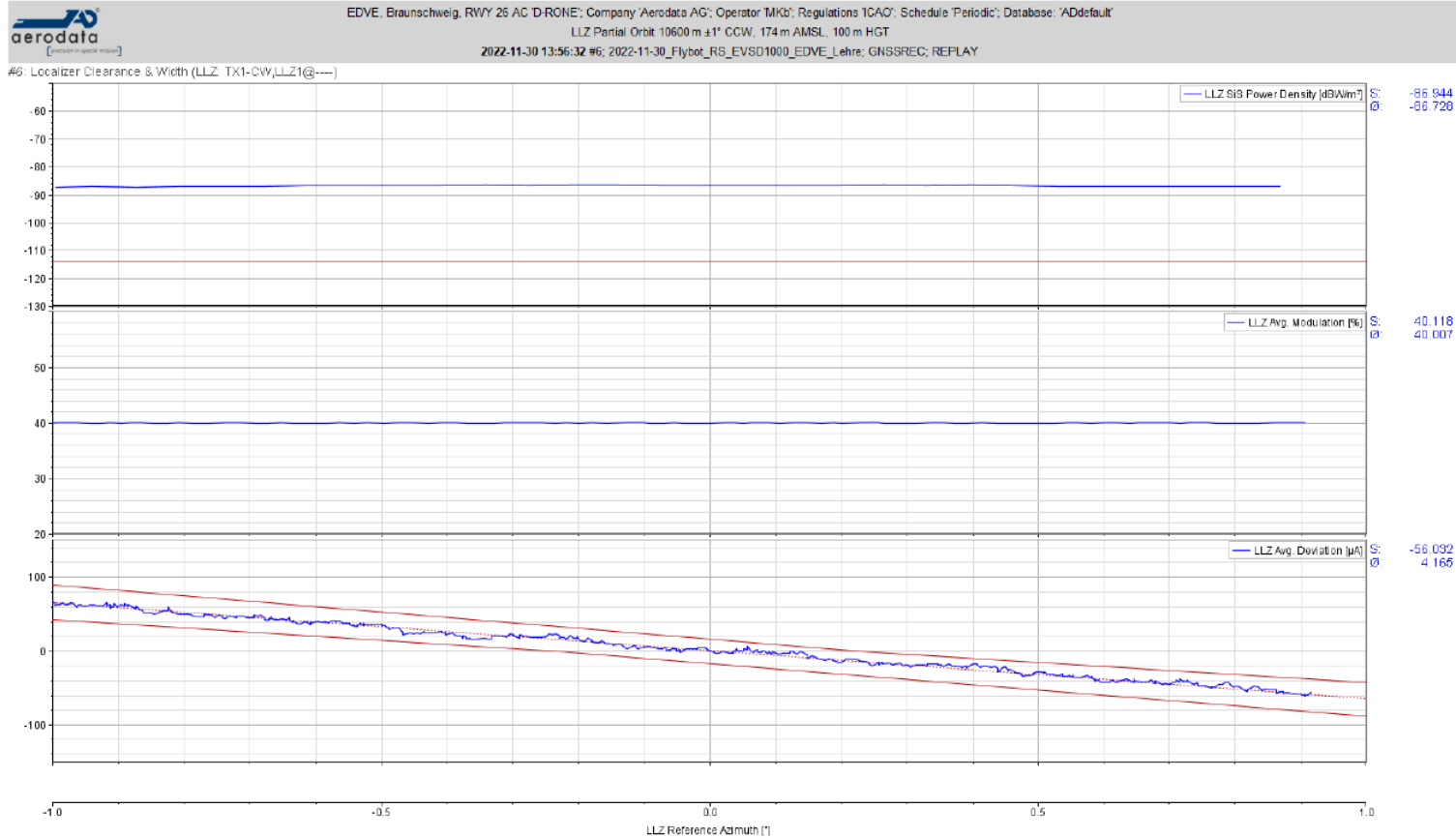
- ▶ Runway length: 1.5 km
- ▶ GPS: Reference station
- ▶ Speed: 36 km/h
- ▶ Antenna height: 4 m
- ▶ DDM: ICAO filtered (post-processing)



R&S®EVSD1000 FIELD TESTS



Measurement with R&S®EVSD1000 on DJI-M300 RTK drone together with AERODATA



Grounded in accuracy and speed



Key facts

- ▶ High-precision analysis of ILS, GBAS, VOR, NDB, MB and ATC COM ground systems
- ▶ In line with ICAO Doc. 8071 and ICAO Annex 10
- ▶ High dynamic range of > 130 dB, precise modulation depth measurements
- ▶ Extremely compact, with integrable battery
- ▶ Simultaneous analysis of CRS and CLR on dual-frequency (2F) ILS systems

Take flight with confidence



Key facts

- ▶ High-precision analysis of ILS, GBAS, VOR, NDB, MB and ATC COM ground systems
- ▶ In line with ICAO Doc. 8071 and ICAO Annex 10
- ▶ High dynamic range of > 130 dB, precise modulation depth measurements
- ▶ High sensitivity for coverage measurements
- ▶ 2 identical signal processing units for simultaneous LOC and GP measurement

Take flight with confidence

Rear panel view with ARINC connector



- ▶ Compact, robust design ARINC 404
- ▶ EVSF1000 is powered via the ARINC connector
- ▶ All signals (RF, GPS, DC-IN, LAN, USB, analog inputs and outputs and trigger/PPS) are available on the ARINC connector

R&S Certium Analysis Brochure on T&M Solutions for ATC

CERTIUM® ANALYSIS

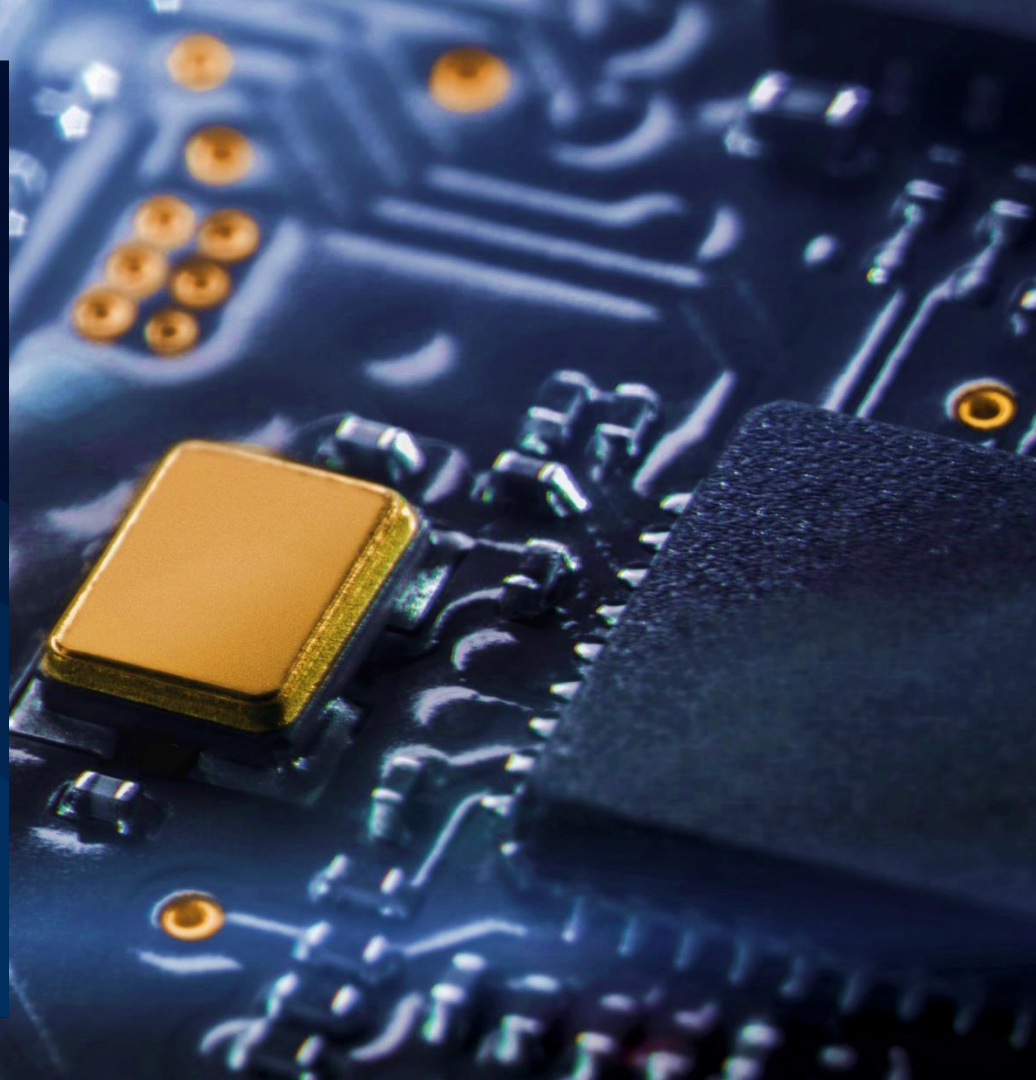
Air traffic control test and measurement solutions



- ▶ Radio testing and calibration with R&S®CMA180
- ▶ Cable/antenna testing using R&S®ZPH
- ▶ Interference hunting with R&S®PR200
- ▶ Advanced voice quality assurance with R&S®AVQA

TESTING YOUR AVIONIC DESIGNS

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Find out more

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