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FIG 1 The R&S®SMA100A high-end signal generator together with the new R&S®SMA-K25 firmware option provides precise signals for comprehensive air navigation receiver testing.

R&S®SMA100A Signal Generator

Precise signals for testing air navigation receivers

The new R&S®SMA-K25 firmware option makes the R&S®SMA100A signal generator (FIG 1) a precise signal source for testing air navigation receivers.

See page 70 for precautions on how to ensure that confidential R&S®SMA100A settings do not fall into the wrong hands.

Air navigation signals

VHF omnidirectional radio range (VOR) and instrument landing system (ILS) together with marker beacon (MKR BCN) continue to be used as analog navigation aids in international civil and military air traffic. VOR covers the frequency range from 108 MHz to 117.95 MHz and serves for automatic route navigation between the individual VOR beacons. ILS is used for runway approach and informs the pilot about any drift from the ideal course, thus allowing pure instrument landing if visibility is poor. An ILS localizer (LOC) informs the pilot about the aircraft's lateral position

with reference to the optimum approach line and uses the frequency range from 108.1 MHz to 111.95 MHz. ILS glideslope (GS), operating in the frequency range from 329 MHz to 335 MHz, is used to monitor the angle of approach during let down. The marker beacon includes three radio beacons, located at a distance of 7200 m, 1050 m, and 300 m in front of the runway, which emit signals between 74.6 MHz and 75.4 MHz. They help to ensure the correct altitude during approach.

Earlier automatic direction finder (ADF) systems are also sometimes still used in route navigation. They determine the

- ▶ direction by using non-directional beacons (NDB) in the frequency range from 190 kHz to 1.75 MHz.

Equipped with the R&S®SMA-K25 firmware option, the R&S®SMA 100A signal generator can now handle all above-mentioned modulation modes used in air navigation.

Digital signals of utmost quality

High precision of all set parameters is ensured by the purely digital generation of modulation signals. All important setting values for simulating real signals, e.g. the phase angle of modulation signals when applying VOR or the AM deviation difference (DDM) when applying ILS, can be set or varied as required.

The signal generator can also create specific pulsed modulation signals in accordance with the ICAO standard. To be able to distinguish between the three radio beacons during approach, the modulation signals are sent with different pulse-pause codings. Moreover, a VOR station or airport identifier (MUC for Munich, for example) can be added for all modulation modes via a COM/ID signal that is pulsed in accordance with the international Morse alphabet. You can activate the codings in the corresponding operating menu by pressing a button and modify the parameters.

The "ideal" modulation signal is directly provided at the LF generator output and can be fed into receiver modules.

Excellent RF performance

In addition to highly accurate modulation signal generation, the low frequency and phase response of the AM modulator are critical for the quality of the modulated RF signal (FIG 2). Level accuracy, stability, and linearity (FIG 3)

Most important settings of the R&S®SMA-K25 option

- ◆ Four different VOR test modes (Norm, Var, Subcarrier, Subcarrier + FM)
- ◆ Three different ILS test modes (Norm, 90 Hz, 150 Hz)
- ◆ Pulsed marker beacon in line with ICAO, Annex 10
- ◆ VOR bearing angle (REF to VAR) at a resolution of 0.01°
- ◆ ILS DDM resolution 10^{-4}
- ◆ AM deviation of all signals in 0.1 % steps
- ◆ Frequencies of all signals at a resolution of 0.1 Hz
- ◆ COM/ID signal pulsed in line with international Morse alphabet can be added
- ◆ External AM interfering signal can be added

are also essential parameters in receiver testing. Another extremely important factor in blocking and selectivity measurements on receivers is spectral purity (phase noise, broadband noise, and nonharmonics) of the signal generator. When performing these measurements, the response threshold of a receiver is tested which, at the same time, receives a jammer of far higher level in the adjacent channel. To avoid having the measurement result corrupted, the power sent from the jammer into the useful channel should be kept to a minimum. With regard to all these parameters, the R&S®SMA 100A offers excellent signal performance, thus minimizing the measurement uncertainty of a test setup and increasing the reproducibility of measurements.

Clear-cut, convenient, and user-friendly

Not only does the R&S®SMA 100A have excellent technical characteristics, its user-friendly operating concept and the clear-cut display of parameters on the built-in color monitor (FIG 4) make the signal generator an impressive tool. At a keystroke, you can use the appropriate standard mode as well as special modes to suppress specific signals in order to conveniently test the relevant alarm function of a receiver. If desired, you can also easily set all VOR/ILS/MKR BCN channels defined in the ICAO standard one after the other using the rotary knob.

All the parameters of the signal generator can of course be remote-controlled via IEC/IEEE bus or LAN, allowing you to perform automated test sequences in a very short time.

Owing to its compact design, the signal generator only requires two height units in a rack. Its light weight of less than 10 kg makes the instrument very easy to transport and thus suitable for a wide range of tasks. Equipped with the R&S®SMA-B46 option, it also meets the MIL-PRF-28800F requirements for an operating altitude up to 4600 m.

Summary

The R&S®SMA-K25 firmware option combines the special functions for generating air navigation signals with the versatile characteristics of an analog high-end signal generator [1, 2].

Jürgen Ostermeier

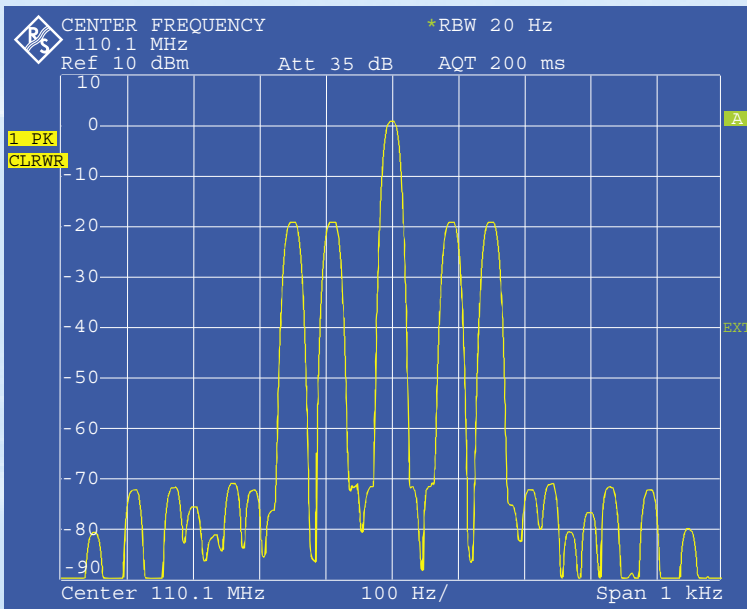


FIG 2 ILS/LOC spectrum with DDM = 0.

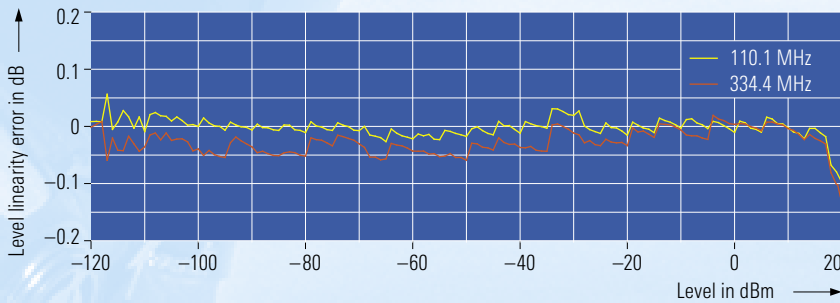


FIG 3 Level linearity error at 110.1 MHz and 334.4 MHz.

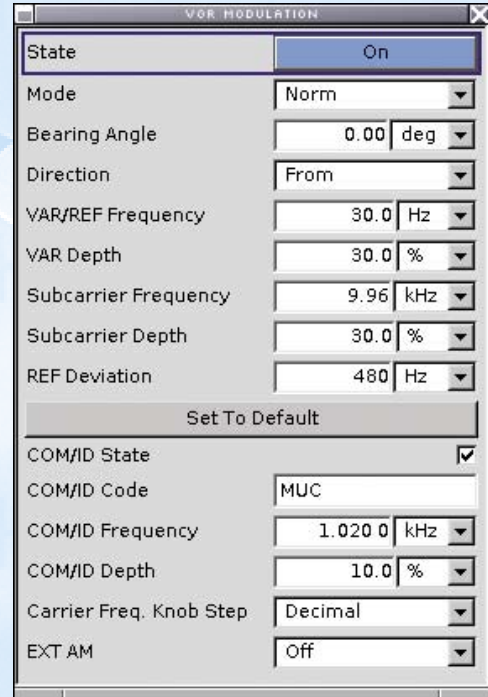


FIG 4 Clear-cut and user-friendly display: all parameters of the VOR menu.

Condensed data of the R&S®SMA100A

Frequency	
Frequency range	9 kHz to 3 GHz / 6 GHz
Level	
Level range	-145 dBm to +28 dBm
Level uncertainty (-120 dBm to +18 dBm)	<0.5 dB
Spectral purity	
Nonharmonics	
f < 1.5 GHz and offset > 10 kHz	<80 dBc
SSB phase noise	
f = 100 MHz and 20 kHz offset	typ. -151 dBc (1 Hz)
Wideband noise	
6.6 MHz < f < 750 MHz and 10 MHz offset	<-152 dBc (1 Hz)
Modulation modes	
AM / pulse modulation	standard
FM / φM	R&S®SMA-B20 option
VOR / ILS / MKR BCN / ADF	R&S®SMA-K25 option
Inaccuracy of VOR bearing angle	<0.05°
DDM inaccuracy	<0.0004 (at DDM = 0)
AM deviation error	<2% of set deviation
Frequency error of modulation signal	<0.02 Hz
Interfaces	IEC / IEEE bus, LAN, USB
Environmental conditions	
Operating temperature range	0 °C to 55 °C
Max. operating altitude	3000 m (standard) 4600 m (R&S®SMA-B46 option)

More information, brochure, and specifications at
www.rohde-schwarz.com
 (search term: SMA100)



REFERENCE

- [1] R&S®SMA100A Signal Generator – Analog signal generator that meets virtually every requirement. News from Rohde & Schwarz (2005) No. 189, pp 30–34
- [2] R&S®SMA100A Signal Generator – Frequency doubled: spectrally purest signals now up to 6 GHz. News from Rohde & Schwarz (2006) No. 191, pp 29–31

R&S®SMA100A Signal Generator

Caution: T&M equipment can also give away secrets

Measuring instruments used in security areas should not contain confidential instrument settings or useful data when taken outside these areas. The R&S®SMA100A signal generator from Rohde & Schwarz is extremely discreet in this respect: In addition to high performance, it features a number of important characteristics that make it safe to use in this environment.

Preventing access to confidential data

Some of the settings of electronic measuring instruments (e.g. frequency ranges, level ranges, or sweep ranges) as well as useful data are still stored internally even after the instrument is switched off. If these instruments are used in security-critical applications, it is important that third parties do not have access to these settings, since this information may provide clues about secret applications, for example. If such instruments are removed from the security area (e.g. when transported to another department or due to calibration or repair at an external service provider), precautions must be taken to ensure that this security-critical information does not fall into the wrong hands.

The R&S®SMA 100A signal generator from Rohde & Schwarz is exemplary here: As an analog high-end signal generator with excellent specifications, it is of course also used in security-critical applications, where it offers a number of special features.

Confidential data only on memory card

When the generator was designed, particular emphasis was placed on storing confidential data and settings in non-volatile form only on the generator's CompactFlash™ memory card. No security-relevant data is stored in the other storage locations in the instrument, or it is deleted when the generator is switched off.

If the generator is equipped with the R&S®SMA-B80 removable mass storage option, you can take out the CompactFlash™ memory card and safely remove the generator from the security area.

For operating the instrument outside the security area, an optional spare CompactFlash™ memory card (R&S®SMA-Z10) is available, which does not contain security-relevant data. You insert the spare card into the slot, switch on the signal generator, and then perform an internal instrument adjustment – the instrument is now ready for operation, calibration, or repair.

Deactivating interfaces by means of software

Instrument interfaces can also pose safety risks since they can be used to export confidential data, for example. In the case of the analog R&S®SMA 100A signal generator, USB and LAN interfaces can therefore be quickly and easily deactivated by means of software. A password is required in order to reactivate the interfaces.

Utmost safety – Linux operating system

Another safety advantage of the R&S®SMA 100A is its Linux operating system, which provides a high degree of safety against viruses, worms, and security gaps.

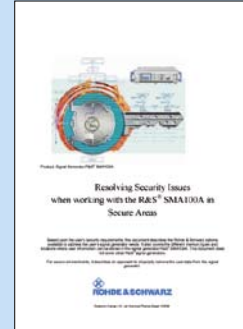
Document with technical details

On the Rohde & Schwarz website, you can find a Technical Information article about the R&S®SMA100A signal generator describing everything that has to do with its use in security areas (see box). The article also includes a detailed

description of the types of storage used in the signal generator and indicates where the data is stored. Moreover, the article provides details on how to use the CompactFlash™ memory card and how to deactivate/reactivate the instrument interfaces (USB/LAN).

Thomas Rieger

More information and
Technical Information at
www.rohde-schwarz.com
(search term: SMA100A)



Technical Information
“Resolving security issues
when working with the
R&S®SMA100A in secure
areas”.

When the R&S®SMA-B80 option is installed, internal instrument data and settings of the generator can be stored on a removable CompactFlash™ memory card.



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