

Microwave Signal Generators SMR

Microwave in handy size

Compact, lightweight and enormously powerful – that is probably the best characterization of the new SMR generator family. Rohde & Schwarz engineers succeeded in packing generators with excellent signal characteristics into 19-inch rackmounts that are only 88 mm high and 450 mm deep. Weighing less than 12 kg they are ideal for field applications. And what is more: all three SMR models can be upgraded from a pulse-modulated CW generator to an AM/FM signal generator or synthesized sweeper with analog frequency sweep. These features and the extremely attractive price make the generators highly appreciated signal sources in research, development and production as well as for EMC measurements.



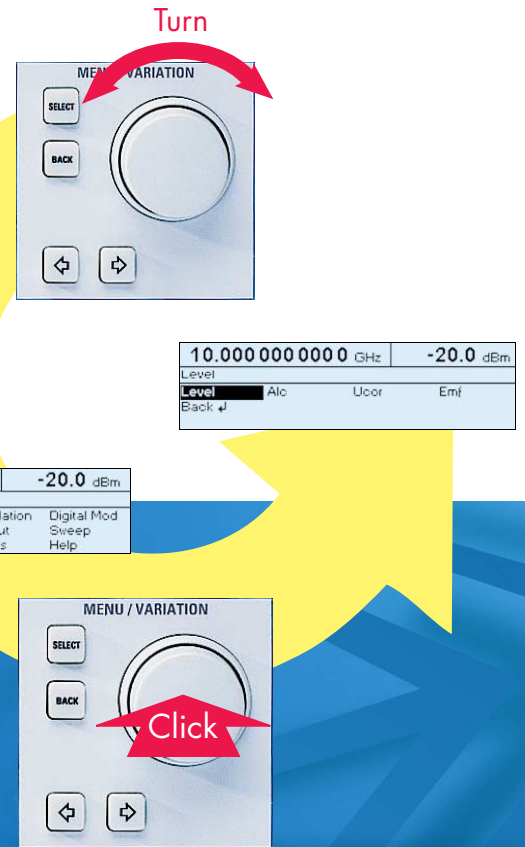
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FIG 1 Signal Generator SMR, the cost-effective, reliable microwave signal source versatile through options

The SMR family comprises three basic models designed as CW generators with pulse-modulation capability. All three have a lower frequency limit of 1 GHz and, depending on the model, provide coverage up to **20 GHz (SMR 20)**, **27 GHz (SMR 27)** or **40 GHz (SMR 40)**. The lower range limit can be extended down to 10 MHz by means of an option.

SMR as CW generator

SMR stands out for its **excellent spectral purity**. Advanced frequency synthesis with fractional-N divider makes for **low SSB phase noise** (FIG 2) and high spurious suppression, both essential for reliable receiver measurements. Modern microwave filters in the output path of the instrument ensure **excellent harmonics suppression**, necessary for precise results in scalar network analysis (see condensed data on page 6).



The sophisticated operating concept of SMR. For example just turn the wheel to select the desired menu item (here: Level). Push the wheel and you are in the submenu.

SMR has standard **frequency resolution of 1 kHz**, which offers a sufficient margin for most applications, eg frequency response measurements on filters and amplifiers. To satisfy more stringent requirements, eg radar cross-section measurements, frequency resolution can be improved to 0.1 Hz by means of an option.

All microwave test setups suffer from high losses. Expensive microwave amplifiers are usually the only remedy. This is not so with SMR: due to the **high output power of all SMR**

models these costly components are not needed (FIG 3).

Microwave signal generators are frequently used for level calibration of test receivers. This task calls for a highly accurate and stable output level that can be set with high resolution. In SMR this is ensured by a **highprecision, frequency-response-compensated level control** for levels above -20 dBm. The RF attenuator option extends the setting range to -130 dBm.

Pulse modulation is still the most important modulation mode for microwave applications. So each basic model is equipped with a **high-quality pulse modulator** with an on/off ratio better than 80 dB. The rise and fall times are shorter than 10 ns, pulse widths of less than 20 ns are possible. These guaranteed values make

SMR ideal for use in development, production and maintenance of radar equipment.

The **pulse generator option** is an ideal complement to the pulse modulator. It generates single and double pulses with pulse frequencies of up to 10 MHz. The pulse generator can be operated automatically, triggered externally or operated in the gate mode. A pulse width between 20 ns and 1 s and a delay between 40 ns and 1 s can be set.

Sweep functions are also provided in the SMR basic model: the digital frequency sweep with step times from 1 ms to 1 s permits convenient frequency response measurements on microwave circuits. The 20 dB level sweep allows amplifier or mixer compression to be determined for example.

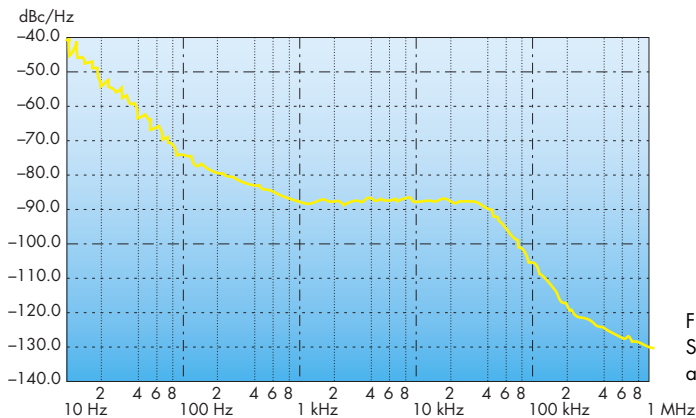


FIG 2
SSB phase noise
at 10 GHz

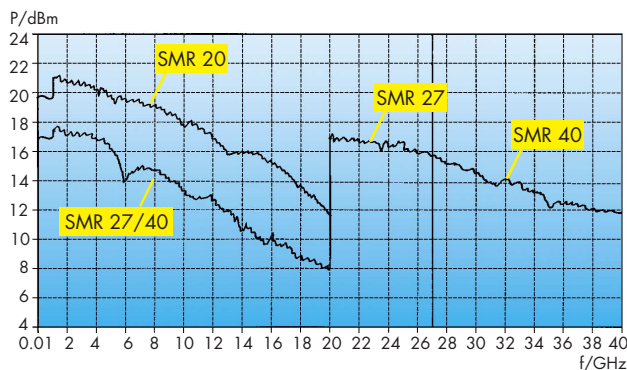


FIG 3
Typical maximum
output power (with-
out RF attenuator
option)

SMR as signal generator

With the **optional AM/FM/scan modulator** added, SMR becomes a signal generator with linear or logarithmic AM and FM capability (main application of log AM: simulation of radar antenna rotation). The bandwidth of the amplitude modulator ranges from DC to 100 kHz, the FM bandwidth from DC to 5 MHz with excellent carrier frequency stability.

The option also includes a **high-quality LF generator** based on direct digital synthesis that covers the range from 1 Hz to 10 MHz. All frequencies can be set with 0.1 Hz resolution, and sinewave as well as square-wave signals can be generated. With the aid of this option, the different SMR models provide coverage of the entire **frequency range from 1 Hz to 40 GHz**.

SMR as synthesized sweeper

After installation of the **analog ramp sweep option**, SMR offers a function that basically corresponds to the analog sweep of conventional sweep generators. There is only one essential difference: the frequency sweep is fully synchronized over the complete span. Thus the excellent frequency accuracy of digital step sweeps is almost achieved, and this with much higher **sweep speeds of up to 600 MHz/ms**. In conjunction with scalar network analyzers or suitable spectrum analyzers, realtime adjustment of microwave filters can be performed. As with the digital step sweep, the start and stop frequencies can be set as required in the whole RF range of SMR. The sweep time can be varied between 10 ms and 100 s.

To mark important frequency bands such as filter bandwidths or the position of attenuator poles, SMR has **ten user-selectable frequency markers** that can be output as pulse markers at the marker output (HCT/TTL level) or

modulated on the RF level in the form of level markers. SMR can thus simply be used in conjunction with many standard scalar network analyzers (FIG 4).

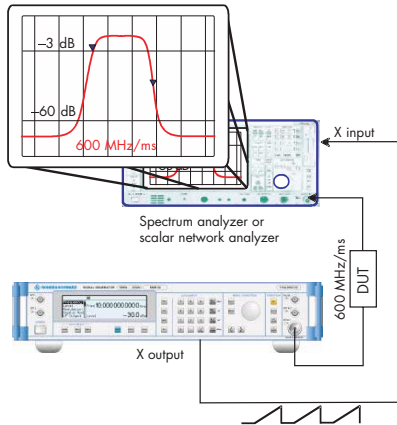


FIG 4 Network analysis with SMR as synthesized sweeper

SMR as upconverter

To generate digitally modulated signals up to 40 GHz, SMR offers **up-conversion capability by means of the IF input option**. A typical application is shown in FIG 5: vector signal generators such as SMIQ [1] from Rohde & Schwarz generate all kinds of digitally modulated signals up to RF frequencies of 3.3 GHz. I/Q Modulation Generator AMIQ [2] supplies the I and Q signals (1) for modulating SMIQ. The modulated RF signal of SMIQ (2) is directly applied to the IF input of SMR. The converted, digitally modulated signal of SMR is available at the RF output of SMR (3).

SMR – reliable and cost-effective

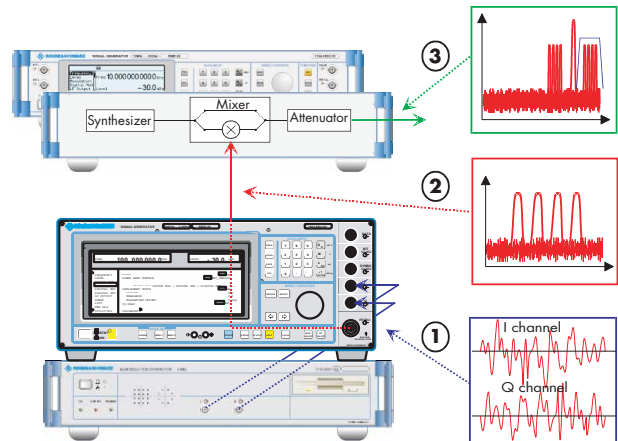
The reliability of microwave generators largely depends on the quality of the RF components. SMR does not make compromises on this point. All microwave stages are integrated in five modules, all designed in **aero-space-ried, patented thinfilm technology**. The stages are optimized for minimum power consumption, maximum reliability and long lifetime.

In the event of a fault, the **built-in diagnostics system** will simplify troubleshooting and shorten repair times. SMR excels not only through its extremely favourable price but also through low follow-up costs, particularly because it only needs **calibration every three years at the most**.
 Wilhelm Kraemer

REFERENCES

- [1] Klier, J.: Signal Generator SMIQ – High-quality digital modulation up to 3.3 GHz. News from Rohde & Schwarz (1997) No. 154, pp 4–6
- [2] Kernchen, W.; Tiepermann, K.-D.: I/Q Modulation Generator AMIQ – Convenient generation of complex I/Q signals. News from Rohde & Schwarz (1998) No. 159, pp 10–12

FIG 5 SMR as upconverter for digitally modulated signals



Condensed data of Microwave Signal Generators SMR

Frequency range SMR20/27/40	10 MHz to 20/27/40 GHz
Resolution	1 kHz (0.1 Hz with option SMR-B3)
Harmonics ≤20 GHz/>20 GHz	<-55 dBc/<-40 dBc
Subharmonics ≤20 GHz/>20 GHz	<-65 dBc/<-30 dBc
Spurious	
≤10 GHz/>10 to 20 GHz/>20 GHz	<-62 dBc/<-56 dBc/<-50 dBc
SSB phase noise	<-83 dBc (at 10 GHz, 10 kHz from carrier)
Level SMR 20 (at 20 GHz)	>+10 dBm
SMR 27 (at 27 GHz)	>+11 dBm
SMR 40 (at 40 GHz)	>+9 dBm
AM/FM (with option SMR-B5)	DC to 100 kHz/DC to 5 MHz
Pulse modulation on/off ratio	>80 dB
rise/fall time	<10 ns
LF generator (option)	
sinewave, squarewave	0.1 Hz to 10 MHz
Pulse generator (option) pulse period	100 ns to 85 s
IF input (option)	DC to 700 MHz
RF sweep	
Digital step sweep	1 ms/step to 1 s/step
Analog ramp sweep (option)	max. 600 MHz/ms

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