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A Vector Signal Generator for Production Applications

Recognition that the key requirements of test equipment used in an automated production environment are high throughput and reproducibility has led to the development of the R&S SMATE 200A vector signal generator. Designed as an optimum solution, this instrument features short setting times for frequency and level changes plus high signal quality.

As an automatic test equipment model, the instrument is based on the company's R&S SMU 200A vector signal generator and, like that model, can accommodate two independent signal generators in four height units. This means that it occupies only 50 percent of the rack space required by conventional instruments with similar functionality. This can be a major advantage in crowded production areas.

The RF range can include up to two paths. For this reason, the modules cover a frequency from either 100 kHz to 3 GHz or 100 kHz to 6 GHz for both paths. If the two-path option is implemented mixed installation is possible. Also, up to two internal baseband generators produce signals that can be digitally added together if required. As a result, the hardware components are optimally matched to one another and require no external cabling, allowing a level and a frequency offset to be applied.

Baseband generators with digital signal processing (DSP) and a coprocessor field-programmable gate array (FPGA) enable the calculation of complex signals in real time and signals for all common mobile radio standards are possible. A wide selection of modulation types are available — ASK, FSK, MSK, PSK (including 8 PSK EDGE) and QAM (up to 1024 QAM). The vector signal generator can also handle all common coding types and baseband filters. GSM/EDGE, 3GPP FDD including HSDPA, GPS, CDMA2000 and IEEE 802.11 a/b/g are supported.

Furthermore, the application of the company's WinIQSIM simulation software facilitates the generation of signals for additional standards (cdmaOne, 3GPP TDD or TD-SCDMA, for example). It is also possible to independently feed in external analog I/Q signals for both paths of the instrument.

Since the vector signal generator is modular in design, it can be used for numerous applications that previously required multiple signal generators. For example, when equipped with two baseband generators and one RF path, it can add together real time signals of various standards such as GSM/EDGE and 3GPP FDD, generate multicarrier signals with real time components or simulate antenna diversity. An R&S SMATE 200A equipped with one baseband path and two RF paths enables the generation of a modulated signal on one path and a continuous wave interference signal on the other.

HIGH THROUGHPUT

As was mentioned previously, production environments demand high throughput to keep costs down. This vector signal generator meets this need by providing short settling times of less than 2 ms for frequency and level. In List mode,

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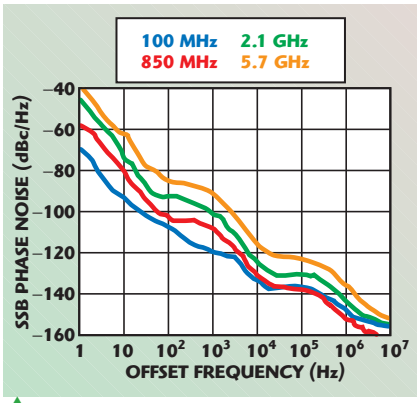

Fig. 1 The R&S SMATE 200A typical phase noise performance.

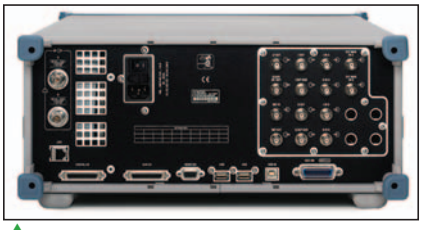

Fig. 2 The rear panel of the vector signal generator, showing all interfaces and connectors.

where frequency variations have previously been stored in a list, these times can typically fall to 400 µs. The flexibly addressable Fast Hop mode also operates at such short settling times. The baseband generators either provide complex signals in real time or output precalculated waveforms from the internal, 64 Msample arbitrary waveform generator, and the generated signals can be stored on the built-in, 20 Gbyte hard disk.

Claimed to be a unique function is the Multi Segment Waveform, which also enables high speed operation. In the baseband, this function makes it possible to rapidly switch between the various test signals in just a few microseconds. Rapid switching between the different waveforms becomes truly important in view of the increasingly numerous standards combined in mobile radio chips. For example, the single-chip solutions with GSM900, GSM1800 and GSM1900 technology will soon be supplemented with additional standards such as IEEE 802.11 a/b/g as well as EDGE or UMTS. Rapid switching cycles reduce dead time, thus contributing to high throughput.

SIGNAL QUALITY

Another significant feature of the instrument is its extremely low single sideband phase noise of typically –135 dBc (carrier offset 20 kHz, frequency 1 GHz, measurement bandwidth 1 Hz). ***Figure 1*** shows typical phase noise performance. A further improvement of 5 dB to a typical value of –140 dBc (under the same operating conditions) can be achieved by implementing the Low Phase Noise option.

Since multiple elements that cause attenuation are often located between the signal generator and the device under test, especially in production environments, a vector signal generator must have enough reserve power to compensate for the resulting loss. When equipped with the High Power Output option, the R&S SMATE 200A provides output levels of typically +26 dBm. The high power level makes external amplifiers unnecessary and the High Power Output option does not involve replacing the electronic attenuator.

In addition to speed, the reproducibility of measurements is crucial in production. A temperature-controlled RMS detector means high precision level setting independent of the signal characteristic. The output level typically varies no more than ±0.01 dB over a period of five days. The detector thus contributes to very high measurement repeatability and keeps test conditions constant over time.

Optimum values for phase noise, noise floor and the high linearity of the I/Q modulator leave sufficient leeway for adjacent channel leakage ratio measurements on base station amplifiers. In the case of a 3GPP single-carrier signal (3GPP test model 1, 64 DPCH), the vector signal generator typically reaches 70 dB in the adjacent channel and 74 dB in the alternate channel. This leaves enough room for more demanding future requirements. Notably, however, no compromises need to be made in error vector magnitude measurements. Consequently, this combination makes it possible to determine the two important parameters when testing power amplifiers without any changes to the instrument's set-up.

PRODUCTION-ORIENTED OPERATION

The external interfaces of the vector signal generator have been designed with production in mind. Owing to the instrument's reduced operating concept, the front panel provides just the elements needed — a power switch and four LEDs labeled Ready, Busy, Error and Remote that indicate the instrument's current status. All connectors are located at the rear of the instrument (see ***Figure 2***) and it is designed for remote control.

The generator therefore contains interfaces for GPIB (IEC 625/IEEE 488) and for Gigabit Ethernet. The latter is also ideal for handling the rapid measurement cycles common in production during remote control operation. The vector signal generator can be operated via a monitor and keyboard. The rear panel offers a VGA connection as well as USB interfaces for a mouse, keyboard or memory sticks, and remote operation via Remote Desktop is also possible. The trigger interfaces, which are combined on two standard SCSI connectors, also contribute to easy installation.

FUTURE-PROOFING

The R&S SMATE 200A's design and characteristics not only make it suitable for use in today's production lines, but also ready for tomorrow's requirements. While the internal baseband generator supports a bandwidth of 80 MHz, which is sufficient for all currently relevant standards, a modulation bandwidth of up to 200 MHz is available with externally supplied signals. Thus, the instrument is prepared to handle the next generation of broadband systems, too. Also, to ensure a long instrument lifespan when used in a rack, several fans cool the internal components and as a result, the vector signal generator's mean time between failures is high. Finally, another benefit is the instrument's three-year calibration cycle, which contributes to its low cost of ownership.

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