Signal Generator SMIQ

Fit for 3G with new options

Last year the frequency range of Vector Signal Generator Family SMIQ (FIG 1) was extended to 6.4 GHz [*]. This year the emphasis is on upgrading SMIQ for third-generation mobile radio (3G). The versatility of the successful generators has been boosted by extra options and especially by a new version of the modulation coder.

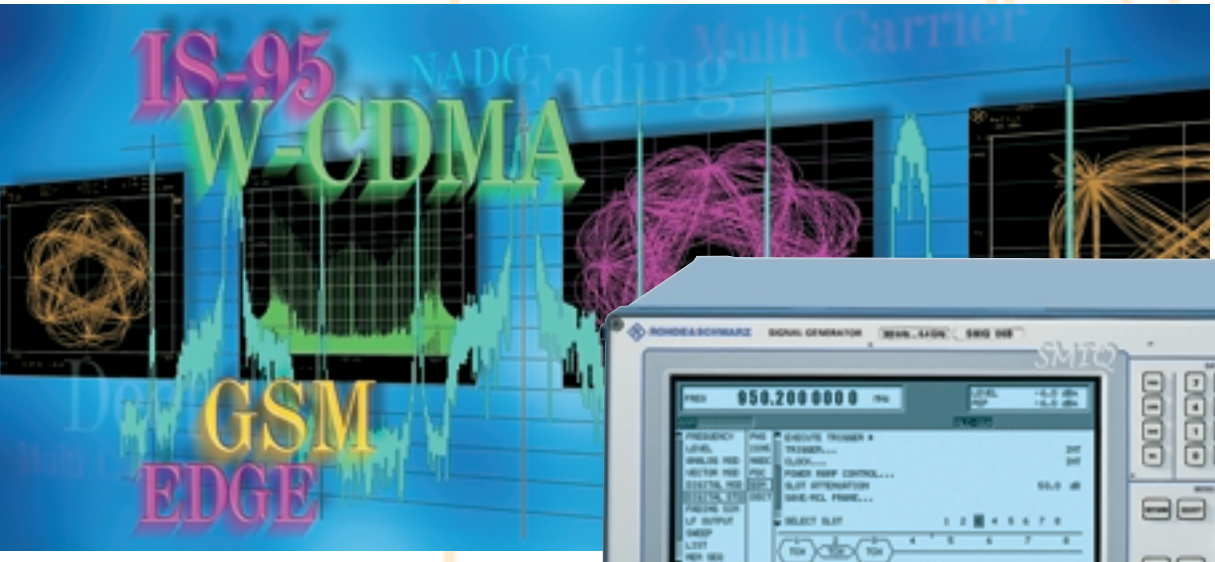


Photo 43 359/2

Photo 43 334

FIG 1
Signal Generator SMIQ is now ready to go for third-generation mobile radio

Modulation coder further improved

Like its predecessor, the new Modulation Coder SMIQ-B20 supports all relevant types of digital modulation from FSK to 256QAM and also all established mobile-radio standards. To meet future requirements, some of its specifications were improved and additional functions added (see box on right).

EDGE implemented

8PSK modulation as defined in the extension of GSM standard EDGE (enhanced data rate for GSM evolution) with $3\pi/8$ rotation and the associated linearized Gaussian filter are already implemented in the modulation coder. Especially worth noting is that SMIQ can process external data in real-time. Plus, SMIQ is the only unit on the market able to switch between GMSK and EDGE modulation from slot to slot, ie to simulate mixed GSM/EDGE signals like those to be processed by base stations if an old and a new mobile phone have to be operated at the same time (FIG 2). This unique feature saves a second signal source in such applications.

W-CDMA to 3GPP standard

Software option SMIQ-B45 supports generation of downlink and uplink signals to 3GPP standard (FDD mode)[1]. This means simulating the physical channels including their slot structure. The signals exactly conform to 3GPP standard in frame structure, spectral distribution and signal statistics, allowing correct testing of the particular components.

Versatile configuration

The current 3GPP standard is supported, stipulating a chip rate of 3.840 Mchip/s and 15 slots/frame as

1) Until the passing of the standard the functionality of the option will be adapted at regular intervals. Required software updates are free of charge. For users wanting to generate W-CDMA signals to NTTDoCoMo standard, option SMIQ-B43 can also be installed.

proposed by Operators Harmonization Group (OHG).

Up to four base stations or four mobile stations with separately selected scrambling code can be simulated. One BS may have up to 128 data channels in addition to special channels. An MS can be operated in the three modes PRACH only, PCPCH only and DPCCH + DPDCH (max. 6 DPDCHs).

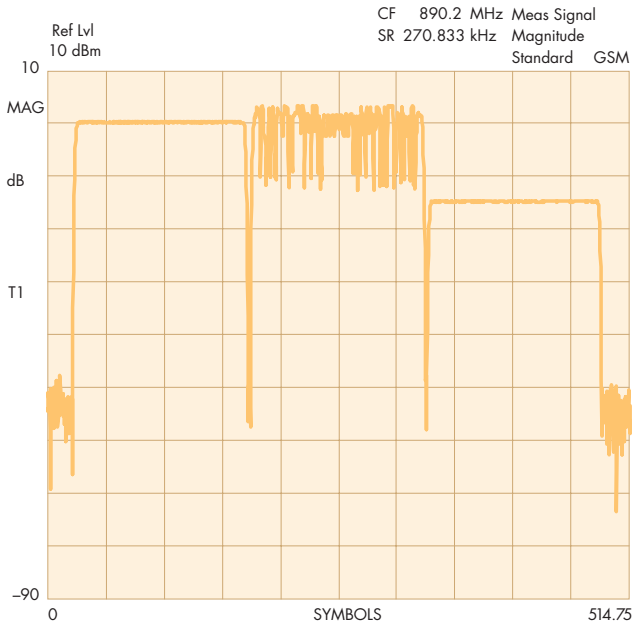
Symbol rate, channelization code, power (can even be varied in time) as well as data contents and timing offset can be selected for each code channel (timing offset can be used to influence signal statistics and thus crest factor).

P-/S-CPICH, P-/S-SCH, P-/S-CCPCH, AP-/CD-AICH, PDSCH, DL-DPCCH and DPCHs with their corresponding slot structure can be generated in the downlink. Transmit diversity is also already supported. The clipping function allows simple simulation of the clipping measures implemented in every base station.

Despite the large functionality of this option, W-CDMA signals can be generated fast by means of **assistant functions**. A W-CDMA signal is produced by a few keystrokes with the aid of predefined configurations, which may be varied through selection of the crest factor or the number of data channels. To avoid incorrect entries, overlapping of individual code channels (domain conflicts) can be displayed and even automatically resolved by a keystroke (FIG 3). The graphical display of constellation diagram, CCDF and occupied code domain serves to check generated signals for conformance. And this can be done far more easily than with an analyzer.

Oversampling is digital, so long signal lengths can be implemented (eg 13 frames with 3.84 Mchip/s), which allows much more realistic signals to be generated than by continuous repetition of the same frame.

FIG 2
Section of mixed GSM/EDGE signal generated with SMIQ (slots 1 and 3 contain GSM burst, slot 2 EDGE burst)



The new functions at a glance

- Generation of mixed GSM/EDGE signals
- Creation of multichannel, random configurable W-CDMA signals to 3GPP and power control of individual W-CDMA channels in realtime (with option B45/B48)
- Measurement of BER (with option B21)
- Optional two-channel arbitrary waveform generator

The new modulation coder enhances SMIQ by additional options and by various improvements:

- Maximum permissible symbol rate of 18 Msymbol/s, unrivalled and future-safe
- Amplitude shift keying (ASK) and split-phase filter are implemented. The special feature of this filter is that it generates Manchester-coded signals. These are signals where each symbol is represented by a signal change, ie the symbol adopts two states per symbol clock. Together with ASK modulation for example, this self-clocking code allows generation of signals for the Japanese ETC system (electronic toll collection) that is currently being developed
- Memory for storing user-specific modulation data per option can be extended up to max. 80 Mbits
- Improved resolution of digital filters. As a result, SMIQ can now achieve ACP values of –74 dB with TETRA standard
- The number of available filters was extended, the permissible range of their parameters widened and combination of filters with any modulation allowed. It is thus possible to simply simulate many applications outside the major standards

Second source for W-CDMA data

If SMIQ is equipped with Memory Extensions SMIQ-B11 and -B12, the modulation coder together with option B48 has a second means of generating W-CDMA data for up to four channels, called enhanced channels in SMIQ. These channels can be combined with the remaining channels and offer a variety of other applications:

- The maximum sequence length of enhanced channels is 200 frames. If only one channel is required, the maximum is even 800 frames. Very long signal sequences and endless PN sequences (eg PN9) like those often required for BER measurements can thus be implemented for the channel under test.
- The code power of enhanced channels can be varied **in real-time** by an external control signal. This enables testing the closed-loop power control function of a mobile station for example.
- To determine the performance of a W-CDMA receiver under real conditions, BER measurements have to be carried out in the presence of a large number of orthogonal adjacent channels. SMIQ can simulate this situation: the measurement channels are generated with the enhanced channels while up to 508 other channels simulate the OCNS (orthogonal channel noise simulation) signal. Due to the doubling of data sources in option B20, different periods can be selected for pseudo-random bit sequence (PRBS) and OCNS signals to avoid the same error occurring at the same point of the PRBS signal. This ensures measurements in realistic conditions.

Measurement of bit error rate

Option B21 enhances SMIQ for BER measurements at bit rates of up to 30 MHz. The DUT delivers the data to be tested and the related clock, while the BER tester compares them with the nominal data, calculates and displays the error rate. Selectable PRBS are used as nominal data. Status messages for missing clock and data or synchronization failure help in the event of problems. Signal sections of no interest can be blanked out by the Data Enable or Pattern Ignore function. Even non-continuous PRBS signals can be processed via a restart line (eg finite PRBS stored in an ARB).

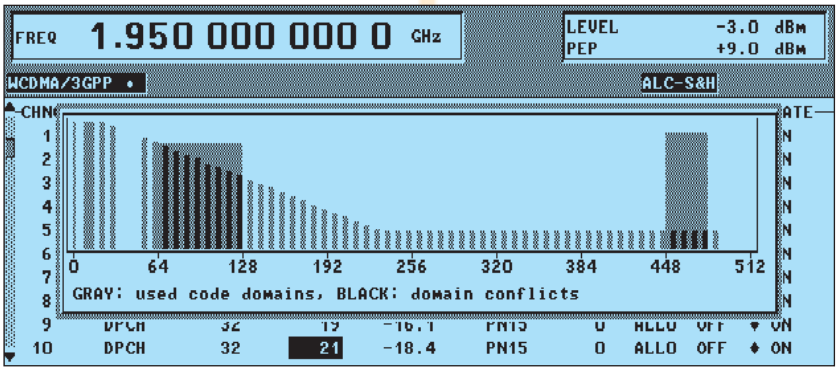
Two-channel arbitrary waveform generator

To further enhance the versatility of the modulation coder, a two-channel ARB generator with a maximum clock rate of 40 MHz is available (option SMIQ-B60). It can store up to 512 k externally computed I/Q values that are loaded into SMIQ. The supplied Windows Software WinIQSIM™ allows convenient calculation of I and Q baseband signals on a PC. Together with a convenient editor, the software can calculate any kind of TDMA frame configuration, simulate impairments by overlapping interference signals, generate multicarrier signals and much more. Ready computed data records can be saved in a nonvolatile memory four times the size of the output memory and need not be recomputed each time.

The two-channel ARB option (B60) and enhanced channels can easily be retrofitted by the user, as can the options BER measurement (B21) and W-CDMA (B45).

Wolfgang Kernchen

FIG 3
Display of occupied code domain of W-CDMA signal. Black areas indicate impermissible overlaps (domain conflicts)



REFERENCES

[*] Klier, Johann: Signal Generators SMIQ04B and SMIQ06B: I/Q modulation now up to 6.4 GHz. News from Rohde&Schwarz (1999) No. 163, pp 8–10

Reader service card 166/03