FIG 1 The R&S®SMx signal generators (e.g. the R&S®SMU200A, bottom in figure) are the world's first generators to supply all signals for the TD-SCDMA mobile radio standard. Options for this standard are also available for the R&S®FSQ (top), R&S®FSU and R&S®FSP analyzers from Rohde&Schwarz.

Signal Generators R&S®SMx

The world's first integrated signal generator solution for TD-SCDMA

Unrivaled: The new TD-SCDMA and Enhanced TD-SCDMA options (R&S®SMx-K50 and R&S®SMx-K51) make the signal generators of the R&S®SMx family (FIG 1) the first generators worldwide to provide signals in compliance with the TD-SCDMA standard.

The third 3G standard

TD-SCDMA (time division synchronous code division multiple access) was proposed by the IMT 2000 (International Mobile Telecommunications at 2000 MHz) specification and approved by ITU as a standard for the third mobile radio generation in addition to 3GPP FDD and CDMA2000®. TD-SCDMA was initially developed by the Chinese Academy of Telecommunications Technology in cooperation with other partners in the industry. In the meantime, TD-SCDMA has been standardized as TDD low chip rate mode within the general framework of 3GPP. The Chinese Ministry of Information Industry (MII) is about to issue licenses for the various mobile radio standards. As the Chinese approach to 3G networks, TD-SCDMA will certainly be given special consideration.

The standard in detail

TD-SCDMA employs time division duplex (TDD), i.e. uplink and downlink traffic are transmitted on the same carrier frequency in time multiplex. A TD-SCDMA frame has a duration of 5 ms and contains seven timeslots for data transmission. Between these timeslots, three shorter timeslots are inserted for the transmission of pilot sequences for synchronization – downlink pilot timeslot (DwPTS) and uplink pilot timeslot (UpPTS) – and of a guard period (FIG 2). The assignment of the timeslots for uplink or downlink transmission is adjustable. The timeslots from slot 1 up to the switching point are dedicated to uplink traffic, slot 0 and the remaining timeslots to downlink traffic. The transmission capacity in the uplink and downlink can thus be adapted to the current data volume. For example, five timeslots can be allocated to the downlink to enable high-speed data transmission to a number of mobile units (for browsing on the Internet, downloading e-mails, etc), and two timeslots can be allocated to the uplink, e.g. for voice communications.

Within the timeslots, a CDMA method is used (chip rate 1.28 Mchip/s) that allows up to 16 code channels with spreading factors from 1 to 16 to be transmitted simultaneously in each timeslot. At the physical layer, a data channel (DPCH) consists of data fields and fields with control information (midamble, TPC, TFCI, sync shift) (FIG 3). The modulation modes used are QPSK or 8PSK and, for high-speed channels, also 16QAM.

Only signals of utmost quality comply with test specifications

For tests on TD-SCDMA components, mobile phones and base stations, signal generators have to meet complex and demanding requirements. Tests on multicarrier amplifiers, in particular, place exacting demands on test signals in terms of spectral purity and adjacent channel suppression.

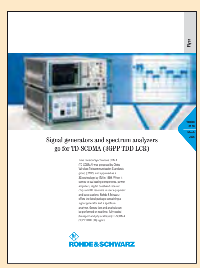
Especially at the beginning of a development and for testing components and amplifiers, test signals are required that optimally reflect the specific standard in terms of spectral and statistical characteristics (crest factor and CCDF). For this purpose, signals at the TD-SCDMA physical layer are used. Channel-coded data contents and the simulation of real propagation conditions are as a rule not required at this stage.

The next step usually involves testing the synchronization and demodulation of the transmitted signal in the receiver. Subsequently, channel decoding down to the transport layer is tested.

The Rohde & Schwarz analyzers also "speak" TD-SCDMA

Options for testing TD-SCDMA signals are also available for the Analyzers R&S®FSU, R&S®FSQ and R&S®FSP. The R&S®FS-K76 option is intended for base station tests; the R&S®FS-K77 option provides all measurements required for terminal equipment. All functions are available for manual as well as remote control.

Detailed information on the TD-SCDMA functionality of Rohde & Schwarz generators and analyzers is available in a flyer which can be downloaded from the Internet (search term: TD-SCDMA).



This step involves measuring the bit and block error ratios (BER and BLER), for which the signal generator must provide fully coded data and synchronization channels.

As a last step, conformance tests are performed. For these tests, receivers are subjected to blocking or interoperability measurements, for example, applying real propagation conditions (fading, AWGN) as well as interference signals (modulated or unmodulated).

R&S®SMx generator family: a solution that meets all requirements

The new TD-SCDMA and Enhanced TD-SCDMA options (R&S®SMx-K50 and R&S®SMx-K51) provide tailor-made solutions that fully meet the above requirements on TD-SCDMA signal generation and offer a wide scope of additional functions.

The **R&S®SMx-K50 option** generates standard-conforming TD-SCDMA signals for up to four uplink or downlink cells, where each cell can be configured separately. The switching point between the uplink and the downlink is variable; all timeslots can be user-configured within the limits of the standard. All specified channel types are available at the physical layer (FIG 4). Parameters such as the timeslot format, spreading factor, spreading code, power and user data can be set as required in a straightforward channel table. The R&S®SMx-K50 option also allows the easy generation of multicarrier TD-SCDMA signals [1] and is thus ideal for tests on multicarrier amplifiers.

FIG 2 Structure of a TD-SCDMA frame.

FIG 3 Typical configuration of a code channel, including data and control fields.

▶ The **R&S®SMx-K51 option** further expands test capabilities by adding measurement channels (reference measurement channels, 12.2 kbit/s to 2048 kbit/s) with full channel coding for the uplink and the downlink, as well as the broadcast channel (BCH) with channel coding and consecutive system frame numbers, plus all high-speed channels defined by the standard, including channel coding (H-RMC, 526 kbit/s and 730 kbit/s) (FIG 5). Bit and block errors can of course be simulated.

The flexible concept of the R&S®SMU generator family [2] allows complete tests of TD-SCDMA base stations and mobile radio units by means of a single signal generator – the tests including fading [3], the superposition of additive white noise and the simulation of a variety of interference scenarios (FIG 6).

Comprehensive graphical displays indicate the current settings and make the new options very easy to operate (frame configuration, code domain, configuration of timeslots, CCDF, FFT, etc).

Summary

The R&S®SMx-K50 and R&S®SMx-K51 options expand the range of applications of the R&S®SMU 200 A, SMATE 200 A and SMJ 100 A family of generators to cover all TD-SCDMA test specifications and provide tailor-made solutions for development, quality assurance and production.

Andreas Pauly

Measurements at a glance

Spectrum measurements	**R&S®SMU-K50**	**R&S®SMJ-K50**	**R&S®SMATE-K50**
Single carrier	✓	✓	✓
Multicarrier with baseband	✓	✓	✓
Multicarrier with second RF in one box	✓	–	✓

Receiver measurements*	**R&S®SMU-K50 and R&S®SMU-K51**	**R&S®SMJ-K50 and R&S®SMJ-K51**	**R&S®SMATE-K50 and R&S®SMATE-K51**
RMC with bit error / block error insertion	✓	✓	✓
RMC with extra fading option	✓	–	–
Reference sensitivity level	✓	–	✓
Dynamic range	✓	✓	✓
Adjacent channel selectivity (ACS)	✓	✓	✓
Blocking characteristics	✓	(✓)	✓
Intermodulation characteristics	✓	(✓)	✓

* The receiver measurements listed here are an excerpt from the 3GPP TS25.142 standard. The two-path concept implemented in the R&S®SMU / SMATE is very advantageous in most measurements because there are no problems with synchronization and no external cabling is required.

Performance measurements* (Fading measurements require an extra option)	**R&S®SMU-K50 and R&S®SMU-K51**	**R&S®SMJ-K50 and R&S®SMJ-K51**	**R&S®SMATE-K50 and R&S®SMATE-K51**
Demodulation under static propagation conditions	✓	(✓)	✓
Demodulation of DCH under multipath fading conditions	✓	–	–
Demodulation of DCH under moving propagation conditions	✓	–	–
Demodulation of DCH under birth / death propagation conditions	✓	–	–

* The performance measurements listed here are an excerpt from the standard. The R&S®SMU's two-path concept with internal fading is very advantageous as it allows all of these measurements to be performed with a single generator.

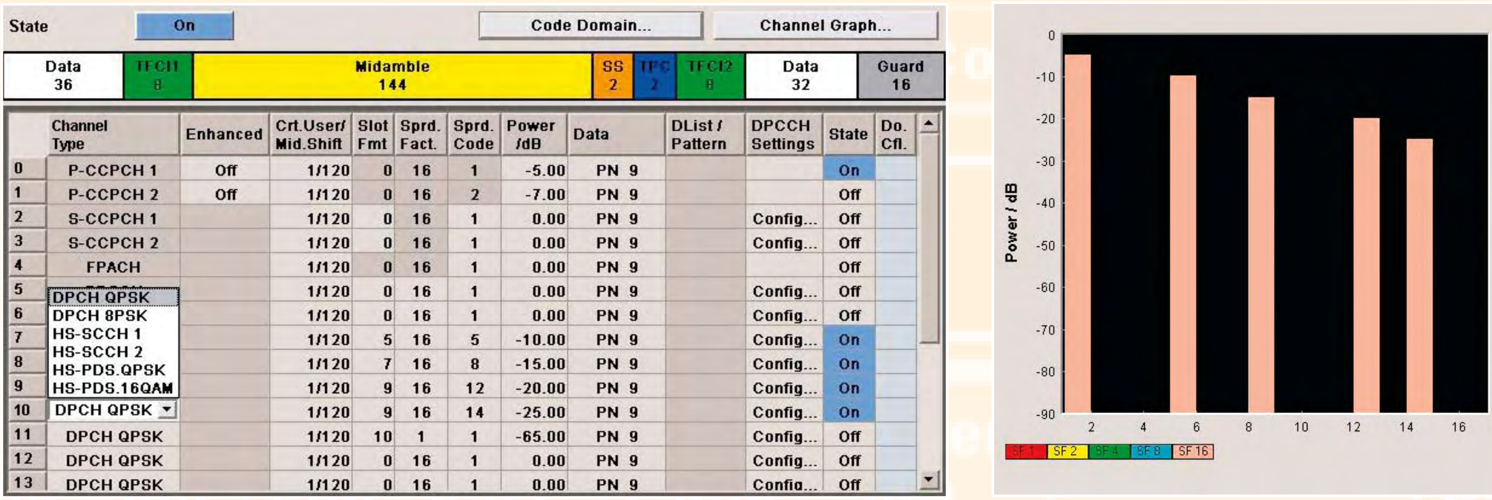


FIG 4 Channel table of a TD-SCDMA timeslot showing the configuration of the currently edited DPCH and the code domain power.

More information and data sheets at www.rohde-schwarz.com (search term: generator type designation)

REFERENCES

[1] Vector Signal Generator R&S®SMU200A: Signals for testing multicarrier power amplifiers. News from Rohde&Schwarz (2005) No. 188, pp 19–21

[2] Vector Signal Generator R&S®SMU200A: The art of signal generation. News from Rohde&Schwarz (2003) No. 180, pp 21–27

[3] Vector Signal Generator R&S®SMU200A: Digital fading simulator with unrivaled characteristics. News from Rohde&Schwarz (2004) No. 184, pp 16–18

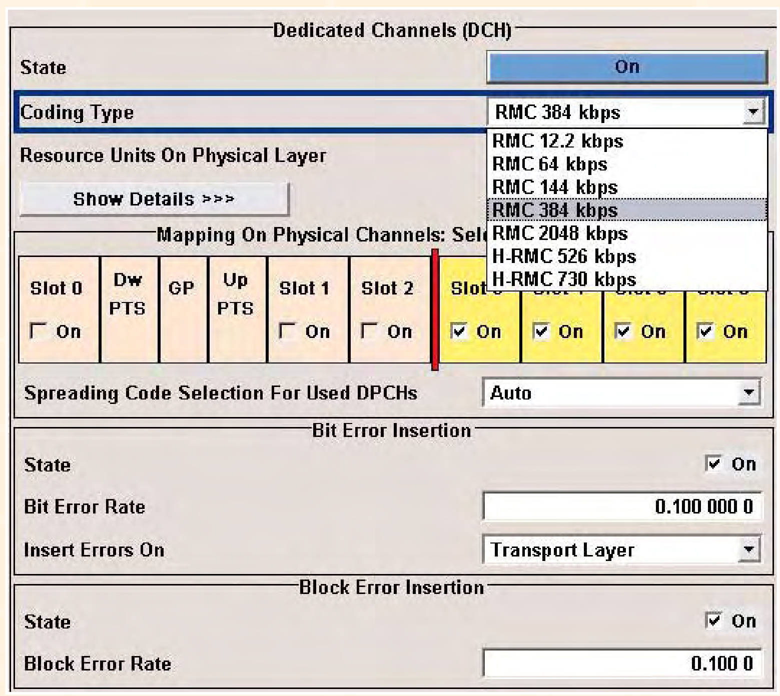


FIG 5 Configuration of measurement channels and channel coding.

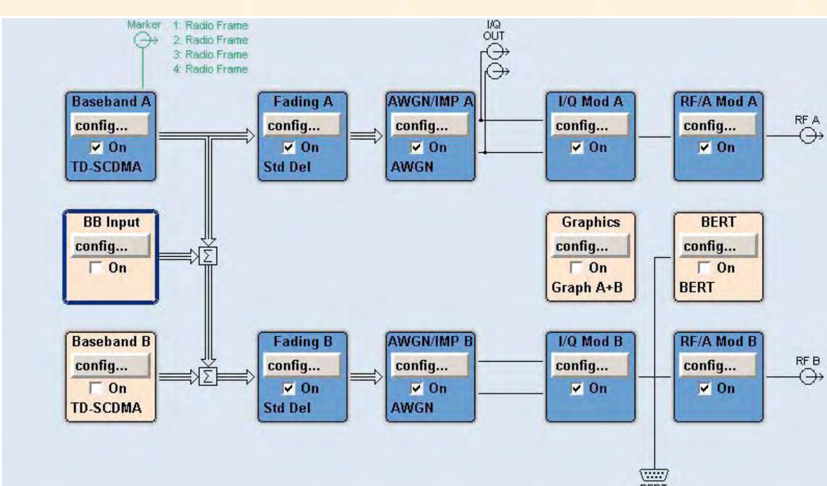


FIG 6 Typical settings on the R&S®SMU200A for a conformance test.