I/Q Modulation Generator AMIQ/Signal Generator SMIQ

With WinIQSIM™ well equipped for 3G TDD standards

The successful team of AMIQ and SMIQ with I/Q Simulation Software WinIQSIM™ (FIG 1 and [1], [2], [3]) for generating test signals to digital standards has again been extended and become more versatile. The 3G standards TD-SCDMA and 3GPP-TDD are now implemented in WinIQSIM™, opening up a wide range of new test scenarios.

The challenge: third-generation mobile radio

The number of subscribers to second-generation mobile radio networks is constantly growing. Network capacity is almost exhausted – particularly in Japan – while the need for mobile data services using high data transmission rates is rapidly increasing. To promptly respond to market requirements, 2.5th-generation mobile radio systems (GPRS/EGPRS, HSCSD) are currently being set up as an interim solution. However, the high demands for new services can only be satisfied by third-generation (3G) mobile radio systems. The International Mobile Telecommunications-2000 (IMT-2000) has defined three different modes for the global 3G standard. The 3GPP-WCDMA-TDD (time division duplex) mode has been defined in addition to the multicarrier mode (cdma2000) [4] and the 3GPP-WCDMA-FDD mode (first mobile networks in Japan as of summer 2001), which can already be handled by WinIQSIM™. The new 3GPP-WCDMA-TDD mode is also intended for use in picocells and in-house networks.

TDD systems use the same frequency in both transmit directions. Uplink and downlink are separated by time multiplex, i.e. by assigning timeslots to a transmit direction.

In addition to the 3GPP-TDD mode using 3.84 Mchip/s, a low-chip-rate mode of 1.28 Mchip/s has been defined and is currently standardized in 3GPP under the name TD-SCDMA. For this mode, which is particularly favoured in China, the core of existing GSM systems can be used. Many major telephone and base station manufacturers will offer products for the FDD and the TDD mode of 3GPP, and by 2003 or 2004 the first mobile radio networks will be operating on a TDD basis. WinIQSIM™ is the first software on the market to simulate both TDD modes.

Common features of TD-SCDMA and 3GPP-TDD

TD-SCDMA and 3GPP-TDD are very similar. The special features of each standard are described in the boxes on the following pages. An outstanding characteristic of the 3GPP-TDD standard is that asymmetrical bandwidths can be assigned to the uplink and downlink. This means that large data quantities, e.g. data from the Internet, can be transmitted on the downlink while a lower

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FIG 1 The AMIQ (bottom) and the SMIQ are a good team, e.g. for simulating multicarrier applications such as GSM with TD-SCDMA if an RF test signal is required

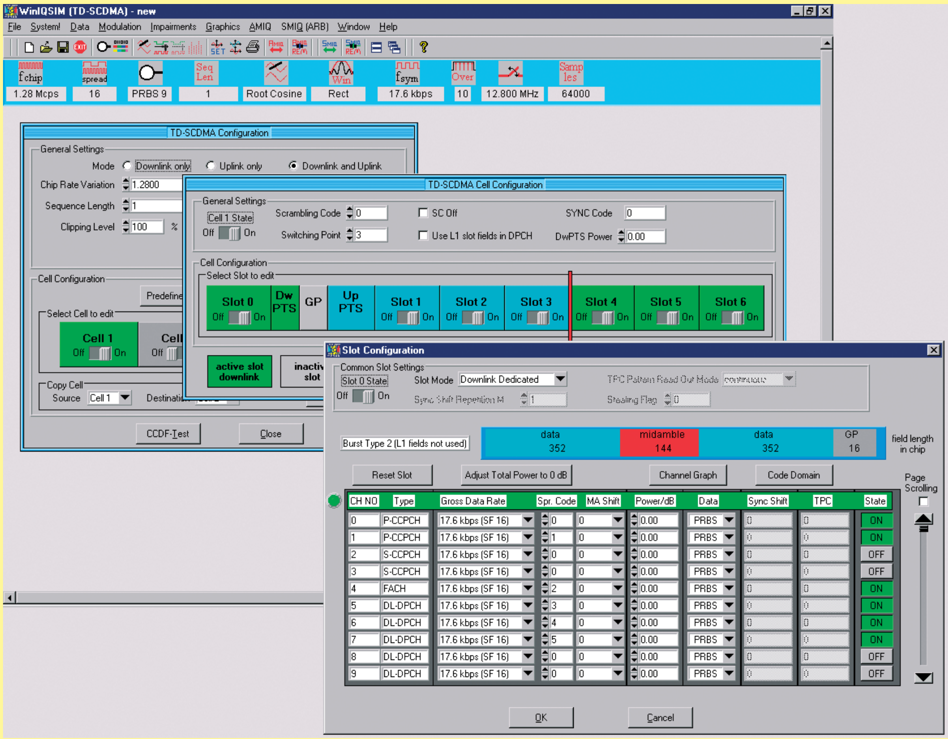

FIG 2 Configuration of a TD-SCDMA cell

Special features of TD-SCDMA

A TD-SCDMA frame consists of seven traffic timeslots for data transmission and two special slots for synchronization (DwPTS and UpPTS). Switchover between downlink slots and uplink slots is defined by a settable switching point. The first slot is always used for the downlink. It is followed by downlink and uplink pilot timeslots. The subsequent slots up to the switching point are used for the uplink, all others for the downlink. All the frame configurations defined by the standard are available (FIG 2). Burst types 1 and 2 of TD-SCDMA and all physical channel types can be set (P-CCPCH, S-CCPCH, FACH, DL-DPCH, UL-DPCH, PRACH).

A menu is available for convenient definition of standard test scenarios. In this menu the number of code channels and the height of the crest factor can be set.

data rate is available on the uplink, e.g. for transmitting the Internet address. The available bandwidth – a limited and expensive resource in mobile radio systems – can thus be tailored to requirements.

With WinIQSIM™, the uplink and the downlink can be simulated separately. To investigate the complete behaviour of a cell (base station with all connected mobiles), e.g. for interference measurements, the uplink and downlink can also be generated together. WinIQSIM™ simulates up to four of these cells (with settable scrambling code) simultaneously. Up to 16 code channels using different spreading codes may be active simultaneously in every timeslot of a frame. All the spreading factors defined by the standards can be set between 1 and 16. Frequency, scrambling code, timeslot and spreading code are therefore decisive parameters of a link in TD-SCDMA or 3GPP-TDD systems.

WinIQSIM™ supports the configuration of the new systems in many ways. The channel tables of the individual slots show domain conflicts (overlapping code channels in the code area) and eliminate them, if required. The whole code domain can be graphically displayed and the structure of an edited code channel consisting of data and control fields can also be shown.

Parameters such as power, data, spreading factor and spreading code can be set separately for each code channel. In addition to the standard signal representations in the time and frequency domain, WinIQSIM™ displays the complementary cumulative distribution function (CCDF) with the aid of which signal statistics and the probability of power peaks – e.g. when many channels are superimposed – can be observed. Methods for limiting the crest factors (clipping) are, of course, also available. The physical random access channel (PRACH) can be simulated in both standards and in TD-SCDMA it can be simulated together with the uplink pilot timeslot.

SMIQ or AMIQ?

The two new standards are offered – together with the I/Q Simulation Software WinIQSIM™ – for both the AMIQ and the option SMIQ-B60 (arbitrary waveform generator). The two platforms support the user in different ways.

Signal Generator SMIQ as stand-alone unit

The options SMIQ-B60 (arbitrary waveform generator), SMIQ-K13 (3GPP-TDD) and SMIQ-K14 (TD-SCDMA) enhance the SMIQ for comprehensive tests on amplifiers and components. All the effects of signal generation on signal spectrum and envelope can be simulated. Synchronization tests on mobiles can also be performed via the available signalling channels (P-CCPCH, P-/S-SCH or DwPTS).

I/Q Modulation Generator AMIQ

When equipped with the options AMIQ-K13 (3GPP-TDD) and AMIQ-K14 (TD-SCDMA), the AMIQ offers capabilities that are far beyond those of the SMIQ. The digital and differential outputs of the AMIQ allow accurate tests to be carried out directly in the baseband. With the AMIQ 04, long BER measurements can be performed at the physical level, where sequence lengths of more than 100 frames may occur with 3GPP-TDD and of more than 600 frames with TD-SCDMA. The AMIQ 04 is particularly suitable for simulating multicarrier applications such as GSM with TD-SCDMA or 3GPP-FDD with -TDD allowing the new systems to be tested under real operating conditions. If an RF test signal is required, an additional SMIQ is useful.

Special features of 3GPP-TDD

The 3GPP-TDD frame comprises 15 slots that can be assigned to the uplink or downlink as required. In contrast to TD-SCDMA, the transmit direction can be changed from slot to slot (FIG 3). Any of the three 3GPP burst types can be selected for each slot in addition to the transmit direction. All physical channel types are also available, and a combination of the TPC and TFCI fields can additionally be defined for each code channel.

The 3GPP-TDD standard sets very high demands on the ON/OFF ratio, i.e. the output power ratio between active and inactive slots. Because of the analog effects of signal generation (e.g. carrier leakage of I/Q modulator), it is not sufficient to generate baseband signals with a wide dynamic range. For inactive slots, the RF must also be switched off. WinIQSIM™ together with the AMIQ automatically supplies a data-active signal to a marker output. This signal with shiftable start and stop edges marks the area of an I/Q signal which contains active TDD system slots. The signal can be used to control the SMIQ pulse modulator and thus to switch off the RF signal in inactive slots. This considerably increases the ON/OFF ratio (FIG 4).

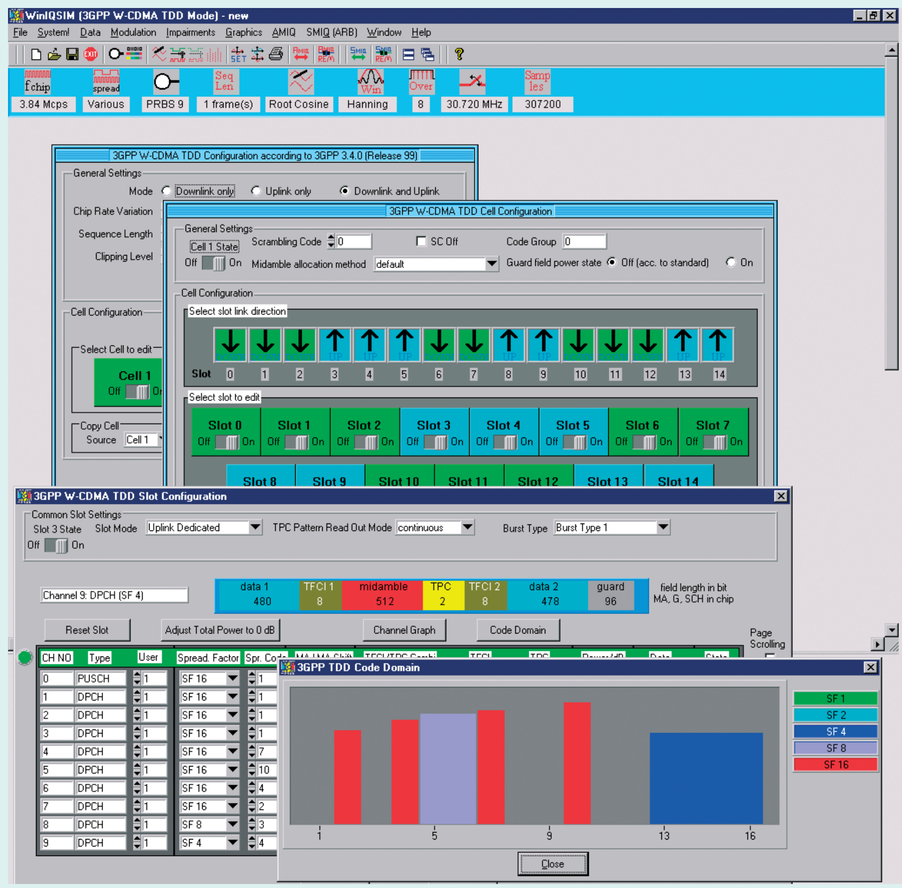

FIG 3
Configuration of a 3GPP-TDD cell

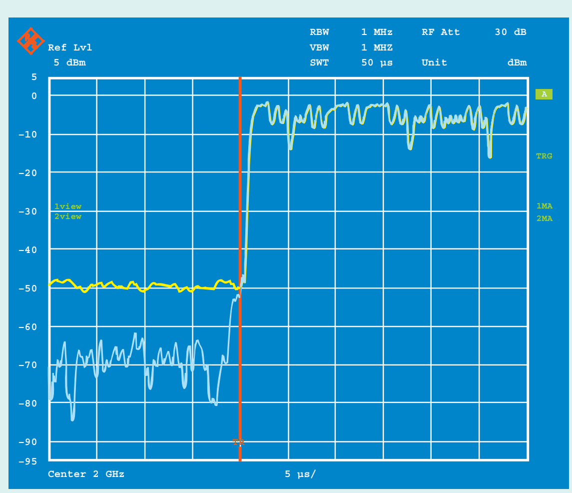

FIG 4
Increasing the ON/OFF ratio with data-active marker and pulse modulation (yellow: without, blue: with data-active marker)

Summary

Even in this early development phase, WinIQSIM™ – together with the AMIQ and SMIQ – supports the 3GPP-TDD and TD-SCDMA standards by offering comprehensive capabilities for signal generation. As with 3GPP-FDD, WinIQSIM™ system updates quickly adapt the software to new requirements as may be caused by modifications to the standard or by market developments.

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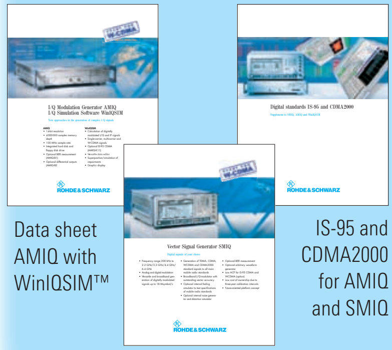
More information and data sheets at www.rohde-schwarz.com (search for AMIQ, SMIQ, WinIQSIM).



Data sheet AMIQ with WinIQSIM™

IS-95 and CDMA2000 for AMIQ and SMIQ

Data sheet SMIQ

REFERENCES

[1] I/Q Modulation Generator AMIQ – New models 03 and 04 as well as digital I/Q output option. News from Rohde & Schwarz (2000) No. 166, pp 22–23

[2] Signal Generator SMIQ – Fit for 3G with new options. News from Rohde & Schwarz (2000) No. 166, pp 10–12

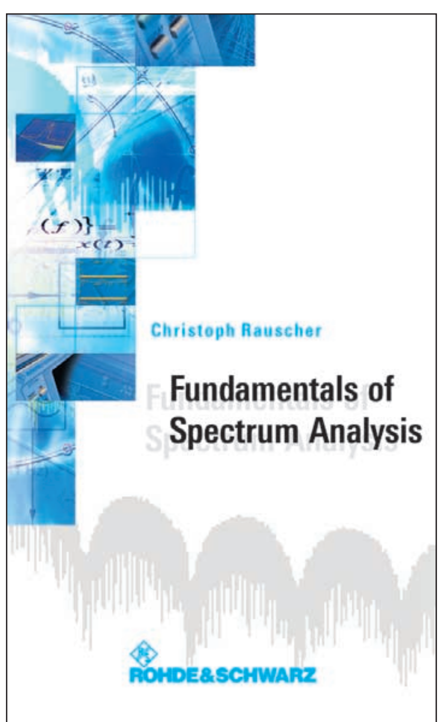
[3] I/Q Simulation Software WinIQSIM™ – New approaches in calculating complex I/Q signals. News from Rohde & Schwarz (1998) No. 159, pp 13–15

[4] I/Q Simulation Software WinIQSIM™ – CDMA2000 test signals in unrivalled variety. News from Rohde & Schwarz (2000) No. 168, pp 27–29

BOOK TIP | General purpose

Fundamentals of Spectrum Analysis

A comprehensive introductory guide to spectrum analysis, covering both theory and practice for carrying out typical measurement tasks, has now been published in-house by Rohde & Schwarz and can be obtained from our local representatives at a nominal charge of DM 10. The 220-page hardback book was written by Rohde & Schwarz experts, whose many years' experience in the development and practical application of spectrum analyzers enables them to convey in-depth insight into the subject. Extensively illustrated with full colour printing, the book makes a perfect reference source or textbook for scientists, technicians, or students involved in spectrum analysis.



The text first covers the physics of electrical signals in the time domain and the frequency domain, before explaining the basic measurements possible with a spectrum analyzer. The example of an analyzer operating on the heterodyne principle is used to illustrate the individual instrument modules, their characteristics and interdependencies; a fold-out block diagram makes for easy orientation. The middle chapters of the book deal with the performance characteristics of an analyzer, i.e. the characteristics that determine the quality of an instrument, such as spectral purity, dynamic range, measurement accuracy and measurement speed. The final third of the book describes day-to-day spectrum analysis measurement tasks, explains test setups and provides help for analyzing measurement results. A number of test tips spread across the book offer a practical guide for users, helping them avoid common errors, or providing simple solutions to standard measurement tasks.

In contrast to the few books available on the subject, all of which are rather outdated, Fundamentals of Spectrum Analysis is based on the latest technology and thus provides the reader with the know-how needed to carry out today's measurement tasks, such as those required in digital mobile radio. In addition, examples from a spectrum analyzer data sheet show the performance data that can realistically be expected from a state-of-the-art instrument.