First WCDMA measurement functions

After providing support for the most important 2nd-generation mobile radio standards such as GSM, IS 136, AMPS and CDMA [1], [2], Rohde & Schwarz now presents the CMU 200 as a tester for mobile phones to the *WCDMA (3GPP/FDD)* standard*. The first functions described in this article carry out transmitter measurements on WCDMA uplink signals.

* Abbreviations in the text are explained in the box on page 15.

Main parameters of a WCDMA mobile phone

The most important parameter is the **transmit power** of the uplink signal:

- To ensure proper performance of the mobile phone, it is essential that the maximum transmit power (+33 dBm +1/–3 dB) is accurately met. If the transmit power is too high, too much current will be drained from the battery and other mobile phones in the network will be disturbed. If it is too low, the coverage range or the *QoS* is reduced.
- The mobile phone must be able to reduce its transmit power below a defined maximum level (<–50 dBm).
- When inactive, the mobile phone should not exceed a defined off power (–56 dBm).
- As with CDMA systems, accurate power ramping is also essential in *WCDMA* systems. With *WCDMA*, the mobile phone should send at a power level between +33 dBm and <–50 dBm which corresponds to a dynamic range of more than 83 dB. The individual power levels (1/2/3 dB) must be accurately met.

The CMU 200 measures this dynamic range with different measurement bandwidths for the maximum and the minimum/off power. The excellent level measurement accuracy and linearity of the CMU 200 are a great advantage in this case.

Another important parameter is the **modulation quality**. If the modulation quality is poor, bit errors and mutual interference of the code channels will occur. The error vector magnitude (*EVM*) and the frequency error are measured. I/Q errors, i.e. I/Q origin offset and I/Q imbalance, can be analyzed at the baseband level. They indicate a malfunction of the I/Q modulator. A typical parameter of *WCDMA* is the peak code domain error (*PCDE*). To measure this error, the total error vector is divided

FIG 1 Graphical display of modulation analysis

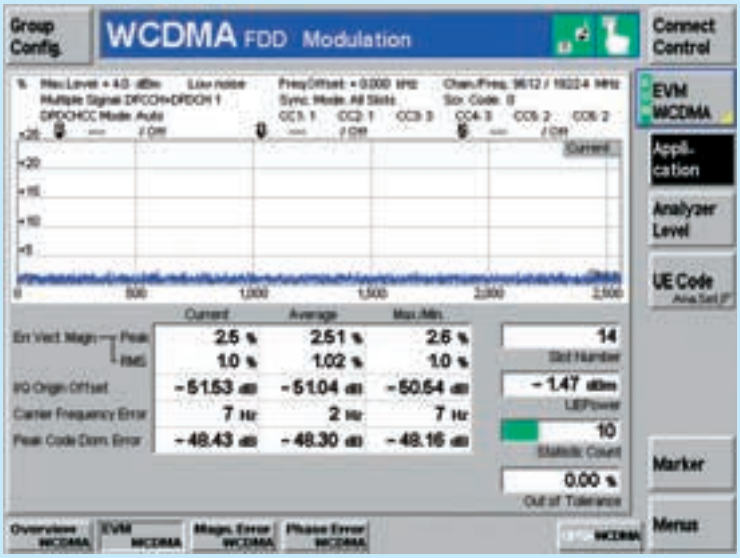
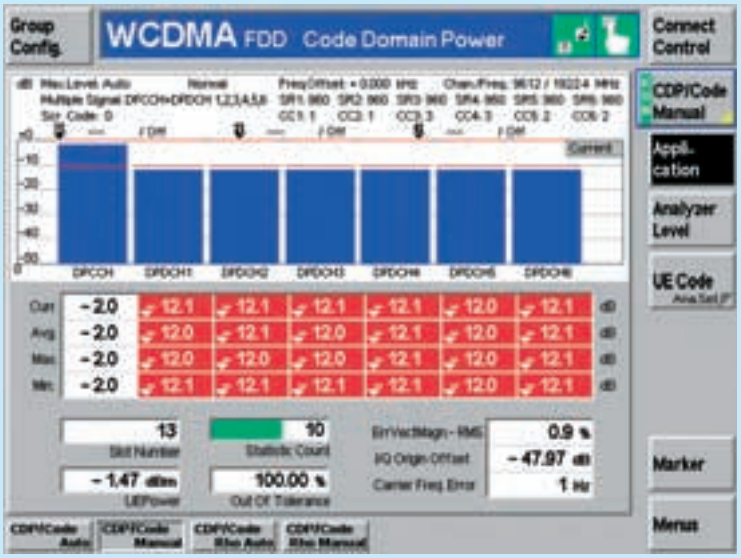


FIG 2 Code domain power



among the individual code channels. The code domain error is the ratio of the average code power to the average power of the reference signal. The *PCDE* is the maximum code domain error that occurs for all codes within a timeslot.

Results of modulation analysis are displayed on the CMU200 graphically versus time (FIG 1) or as numeric values in an overview menu.

Code domain power

Since data and control channels of *WCDMA/FDD* are separated by different codes that are mutually orthogonal, it is important for the analysis that the signal sent by the DUT can be split up again into the code channel components used. The power of one of these code channels is referred to as the code domain power (*CDP*) (see also [3] and [4]).

FIG 2 shows a *CDP* measurement with the CMU200. The *CDP* of the control channel (DPCCH) and of the six possible data channels (DPDCH) of a mobile phone is displayed. In the example, the *CDP* of the data channels is reduced by 10 dB with reference to the control channel.

Frequency spectrum

The frequency spectrum of the *WCDMA* signal generated by the transmitter limits the system performance. If a mobile phone exceeds the frequency range assigned to it, other subscribers or services will be disturbed. The *3GPP* standard defines an adjacent-channel leakage ratio (***ACLR***) **measurement** where the power of adjacent channels (±5 MHz offset from frequency used) and of alternate channels (±10 MHz) is measured. The CMU200 displays a continuous frequency spectrum with a span of 25 MHz (FIG 3) and the integrated power values of the four adjacent channels (FIG 4). The CMU200 naturally offers a sufficient dynamic range for the measurement (FIG 5).

Because of national requirements, additional spectrum characteristics are specified by the *3GPP* standard: the **spectrum emission mask** (continuous spectrum measured at 30 kHz and 1 MHz bandwidths, FIG 6) and the **occupied bandwidth** (bandwidth covering 99% of the total signal power). These measurements are an integral part of the *ACLR* analysis in the CMU200.

A test platform with proven characteristics

As defined by the standard, the CMU200 always considers a whole timeslot which is 666 µs long and contains 2560 chips. Free running and external triggering modes are provided so that continuous or one-shot measurements can be taken.

Statistical evaluation is possible by recording average, maximum and minimum values for a selectable number of timeslots.

Markers (absolute and relative) as well as auxiliary marker lines facilitate the reading of measured values in the dis-

FIG 3 ***ACLR*** **displayed as continuous frequency spectrum**

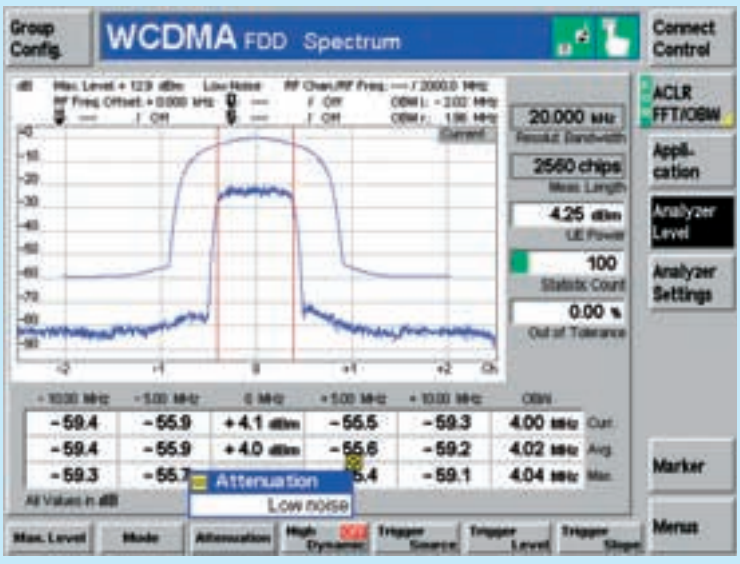
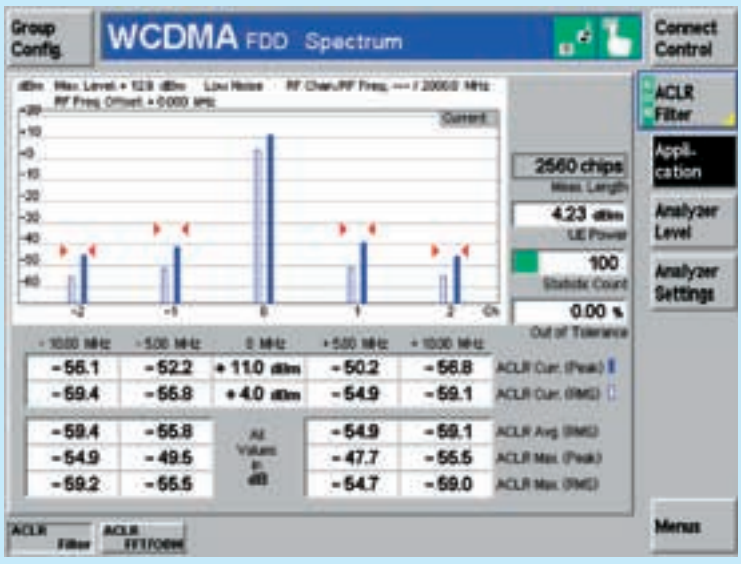


FIG 4 ***ACLR*** **in adjacent channels**



play menus. Tolerances can be set for go/nogo evaluation. Results violating a tolerance limit are displayed on a red background.

Using the CMU 200 platform for *WCDMA* has great advantages:

- The CMU 200 is a multistandard tester, i.e. measurement functions for all essential standards can be implemented. Switching from one standard to another takes only a few seconds.
- A flexible hardware and software update concept for the integration of additional *WCDMA* functionality levels or for the adaptation to changes in the *3GPP* standard.
- The CMU 200 has proven its great reliability, high measurement speed and accuracy as well as signal quality in many production lines.
- Low weight and compact design make it easy to handle.
- The well-known menu structure which provides easy operation of the CMU 200 is used for the *WCDMA* option. Users familiar with operating the CMU 200 in another network, e.g. GSM, will have no problems using *WCDMA*.
- Remote-control capabilities correspond to those of the CMU basic unit. Know-how acquired in the generation of remote-control programs for other function groups can therefore be directly utilized.

Functions planned for the future

The evolution of the CMU 200 advances at a great pace:

- Measurements of power ramping versus time (inner loop power)
- *WCDMA* generator for synchronizing mobile phones and for BER measurements
- Signalling for call setup and call clear-down as well as loop-back for BER measurements.

Gottfried Holzmann

REFERENCES

[1] CMU 200 – Adding CDMA now provides full 2G capability. News from Rohde & Schwarz (2001) No. 170, pp 7–11

[2] CMU 200 – Successful mobile-radio tester now with US TDMA and AMPS standards. News from Rohde & Schwarz (2000) No. 168, pp 10–15

[3] Signal Analyzer FSIQ – Ready for all measurements on 3GPP base station transmitters. News from Rohde & Schwarz (2001) No. 170, pp 15–17

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

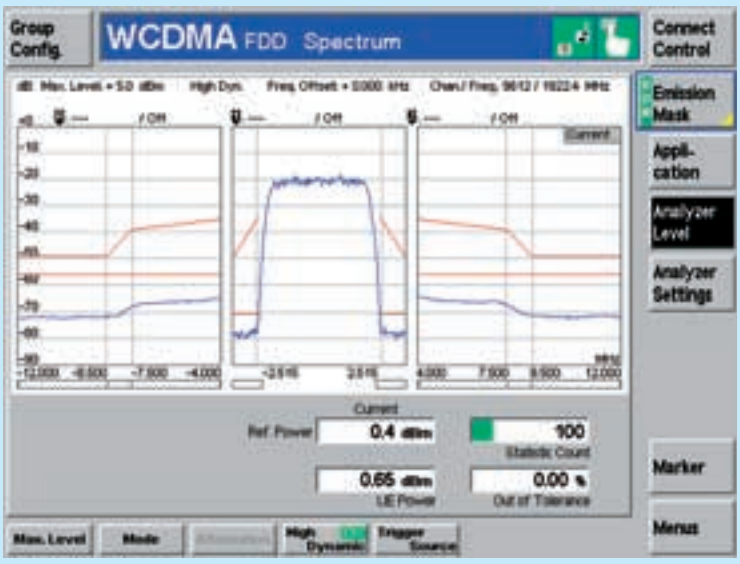
ADDITIONAL REFERENCES

– See box on page 12

Abbreviations used

ACLR	Adjacent channel leakage power ratio
CDP	Code domain power
EVM	Error vector magnitude
FDD	Frequency division duplex
ME	Magnitude error
OBW	Occupied bandwidth
PCDE	Peak code domain error
PE	Phase error
QoS	Quality of service
SEM	Spectrum emission mask
TDD	Time division duplex
WCDMA	Wideband code divison multiple access
3GPP	3rd generation partnership project

FIG 6 Spectrum emission mask



	Minimum requirements Mobile phone	Base station	Guaranteed dynamic range of CMU 200
Adjacent channel	33 dB	45 dB	54 dB
Alternate channel	43 dB	50 dB	62 dB

FIG 5 Dynamic range of CMU 200 with comfortable margin

Condensed data of WCDMA option for CMU 200

Standard	3GPP-FDD, testing mobile phones
Frequency range	specified: 1920 MHz to 1980 MHz unit functioning: 10 MHz to 2700 MHz
Measurement capabilities	
Power measurements	Max / Min / Off
Modulation analysis	EVM, ME, PE, freq error, I/Q offset, I/Q imbalance, rho, PCDE
Code domain power	CDP / rho value
Spectrum measurement	ACLR, OBW, SEM
Order designation	U65 / K65