Product Brochure

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Universal Radio Communication Tester R&S®CMU 200V10

The multiprotocol tester for fast and conclusive measurements in the high end service of mobile phones

- Highly accurate measurements
- Modular future-proof design
- Comprehensive spectrum analyzer and signal generator

ROHDE&SCHWARZ

The R&S®CMU 200V10 – a new generation in the high end repair of mobile phones

For more than 70 years, Rohde & Schwarz has always been at the forefront of mobile radio technology. We continue this tradition of RF test and measurement with the Universal Radio Communication Tester R&S®CMU 200V10. The R&S®CMU 200V10 is a third-generation-platform design that offers true scalable multimode functionality.

The R&S®CMU 200V10 reflects the many years of expertise Rohde & Schwarz has gained in the world of mobile radio. In recent years, the company has helped to launch overwhelmingly successful mobile radio systems.

Rohde & Schwarz is a preferred supplier to many of the leading mobile equipment manufacturers and is the market leader for mobile radio test sets.

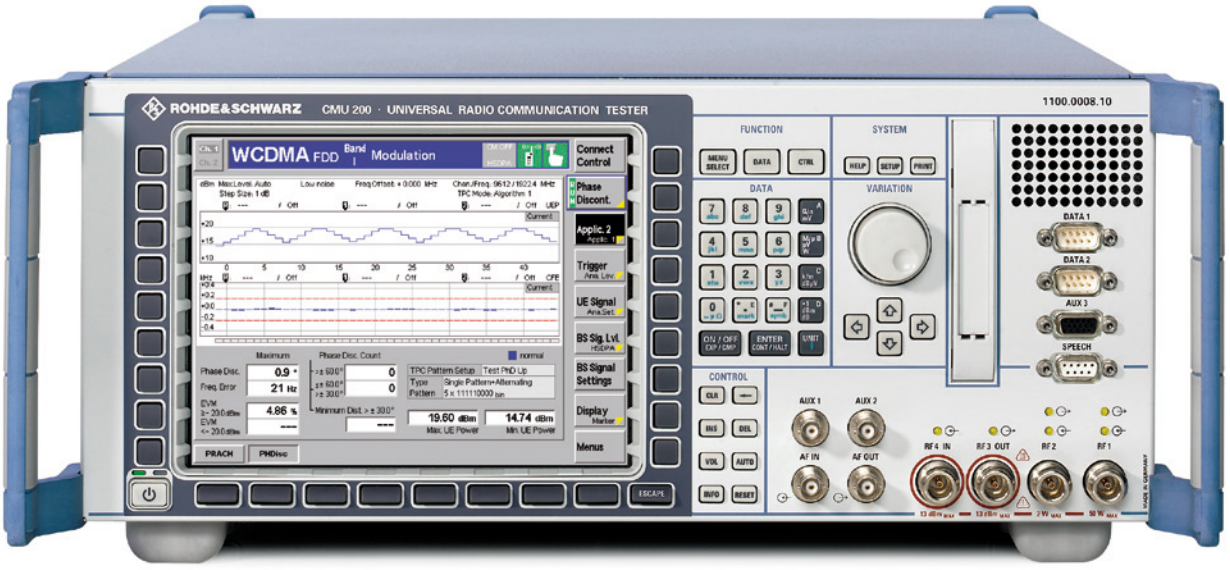
The R&S®CMU 200V10 is part of a complete range of mobile radio test equipment, encompassing everything from conformance test systems to system simulators, turnkey functional board test/final test systems and simple sales-counter Go/NoGo testers.

The base unit with its standard-independent module test provides many general purpose measurement facilities for the repair of all kinds of standards within its wide and continuous frequency range. If extended by the appropriate options, the R&S®CMU 200V10 offers the hardware and software necessary to handle your 3G, 2.5G and previous-generation testing applications.

Low cost of ownership

Selecting the R&S®CMU 200V10 is a decision for the future and results in a total cost of ownership that is sure to be among the lowest due to the following factors:

- The completely modular design of hardware components eliminates unnecessary investments right from the start merely because a feature might be needed at some point in the future. You only pay for what you need
- If an expansion becomes necessary because your needs grow, the modularity of the R&S®CMU 200V10 concept will make this easy. Many expansions to the tester may be installed on site. You pay for them only when you need them
- Maximum repair throughput in a compact 4-rack-unit-high package with minimum power dissipation allows compact space layout in the repair facilities
- With the intuitive R&S®CMU 200V10 user interface, even less experienced users do not require extensive training
- A new remote interface syntax reflects the inherent modularity of this real multimode tester



The R&S®CMU 200V10 brings all the well known and appreciated qualities of its big brother but is primary optimized and cost oriented for the high end service of mobile phones. The picture shows the front panel for desktop use.

Key strengths

The Radio Communication Tester R&S®CMU 200V10 ensures premium cost effectiveness through a variety of features, with extremely fast measurement speed and very high accuracy being the two most important ones. In addition, the secondary remote addressing of the tester's modular architecture makes for intelligent and autonomous processing of complete measurement tasks and fast control program design.

Maximum accuracy

In a service environment, or diagnostic place in production lines the tester's high accuracy allows devices under test to be tested for optimal mobile network performance. High-precision measurement correction over the entire frequency and dynamic range as well as compensation for temperature effects in realtime are critical factors for achieving the R&S®CMU 200V10's excellent accuracy. The new, globally standardized, Rohde&Schwarz calibration system can check the R&S®CMU 200V10's accuracy at a service center close to you or, in some cases, on your premises. A worldwide network of these standardized automatic calibration systems has been implemented in our service centers. Highly accurate and repeatable calibration can be performed wherever you are. Your local Rohde&Schwarz representative offers customized service contracts.

Top speed

The high processing speed is due to extensive use of ProbeDSP™ technology, parallel measurements and innovative remote command processing. These three aspects of the performance of the R&S®CMU 200V10 are explained in more detail below.

ProbeDSP™ technology
The modular architecture relies on decentralized ProbeDSP™ processing coordinated by a powerful central processor. Like an oscilloscope probe, DSPs dedicated to a specific local data acquisition and evaluation workload help to keep subsystem performance at a maximum even if additional modules are fitted to the R&S®CMU 200V10 mainframe.

Innovative remote processing
The novel secondary addressing mode can address similar functions of each of the R&S®CMU 200V10's subsystems (different mobile radio standards) in an almost identical way. Using this type of addressing, new remote test sequences can be programmed by a simple cut-and-paste operation followed by the editing of specific commands to adapt the control program to the new application. Secondary addressing is fully SCPI-compliant, which means that a subsystem address, for example GSM 1800, can be replaced by a string denoting a different subsystem (another mobile radio standard).

Exceptional reliability

The keys to the high reliability of the R&S®CMU 200V10 are the low power intake and the innovative cooling concept. Less power means less heat. Power consumption is way below 250 W due to specially selected low-power components, the minimum component count concept, plus low voltage design wherever possible.

Key advantages of the R&S®CMU 200V10

Speed
- Single measurement up to 10 times faster than with the previous generation of instruments

Accuracy
- Three times more accurate than the previous generation of instruments with excellent repeatability

Modularity
- Modular hardware and software concept providing easy expansion to enhanced functionality

Bullet-proof
- Low component count, low power consumption, and effective heat conduction for unparalleled reliability

Future-proof
- Easy migration to future standards

Remote control
- The user friendly remote control tool R&S®CMUgo is available for download free of charge

High-quality acoustic measurements
- The R&S®CMU 200V10 is the only radio communications tester for servicing that provides speech codecs for CDMA2000®, GSM and WCDMA

Strong service support
- The strong Rohde&Schwarz service network provides support in a very short time. The globally standardized, Rohde&Schwarz calibration system can check the R&S®CMU 200V10's accuracy at a service center close to you

The R&S®CMU 200V10 employs ultra-effective heat management between housing and individual components as well as between heat sinks and air flow. Independent cooling cycles for the front module controller, the power supply unit and the RF frontend add up to an optimized cooling system.

Base unit

Base unit

As the R&S®CMU 200V10 has a modular architecture, the base unit comes without any network or standard-specific hardware. Although the software for all supported networks is already included in the base unit, but the individual parts of software for each network is only activated by adding the corresponding standard-specific hardware. In this way there is only necessary to add the standard-specific hardware into the base unit in order to have the required network functionality – no software options need to be acquired.

The base unit can be used for testing the general parameters of RF or fault finding in the repair of the mobile phones. Integral parts of the R&S®CMU200V10 base unit are the RF generator and RF analyzer, which are complemented by a versatile, network independent time domain menu and a comprehensive spectrum analyzer.

Besides featuring a convenient operational concept, the spectrum analyzer stands out for a continuous frequency range (10 MHz to 2.7 GHz) and several selectable resolution bandwidths. The zero span mode represents a separate operation group with sophisticated trigger and timing functions (pre-trigger, delay, time-base, slope).

The RF switching matrix is one of the R&S®CMU 200V10's highlights. It is located directly behind the connectors and yields a superior VSWR of better than 1:1.2.

The instrument can be easily adjusted to the DUT by means of four flexible N connectors. Two connectors (RF1, RF2) are configurable as duplex RF interfaces.

The rear-panel reference input and output is the prerequisite for minimizing systematic frequency errors during measurement. It is fitted as standard. Besides the IEEE and RS-232-C interface, the base unit has two PCMCIA slots.

Operation

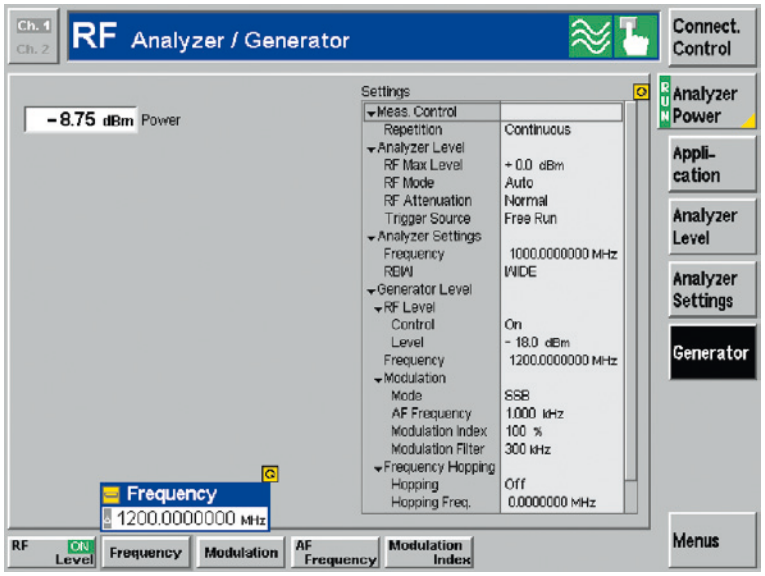
The instrument can be operated either manually or via the IEC/IEEE bus. The hierarchical menu structures in conventional communication testers have been replaced by context-sensitive selection, entry and configuration pop-up menus, which results in a uniquely flat menu structure.

Owing to the high resolution of the extremely bright high-contrast TFT display even the finest details can be displayed.

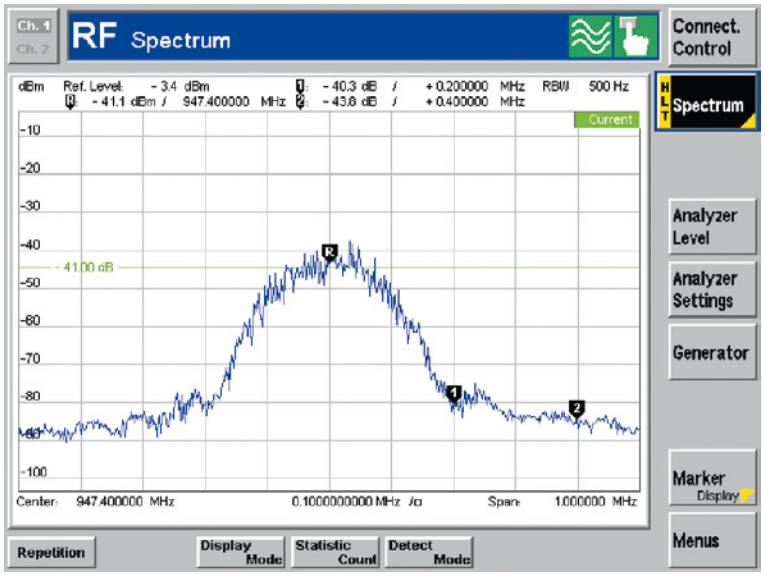
To increase speed, measurements that are not required can be switched off, which frees resources for the measurement you want to focus on.

Advanced operational ergonomics have been incorporated into an extremely compact package. In this way the R&S®CMU 200V10 can be easily integrated in the repair places of the service environment or diagnostic places in production lines.

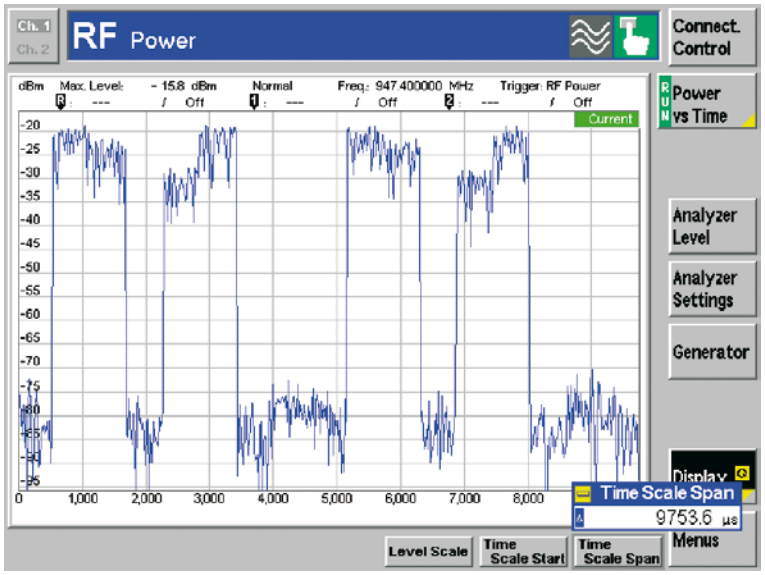
The base unit incorporates generic RF analyzer/ generator functions.



The spectrum analyzer provides several marker functions for a comprehensive investigation of the signal applied.



The zero span mode of the spectrum analyzer is optimized for all kinds of RF signals.



Optimized solutions for the high end repair of mobile phones

R&S®CMU 200V10 high-end service tester

The keys to success in the service market are efficiency and quality, plus fast repair and calibration. These aspects are indispensable to customer satisfaction. Changes in this market segment are shifting operations away from small service shops and toward regional service centers or "service factories". These service factories make it possible to provide high-end service and to streamline the mobile phone repair process.

Rohde&Schwarz is contributing to this trend by introducing a new version of the R&S®CMU 200 for high-end mobile phone service. The new R&S®CMU 200V10 (R&S®CMU 200 version 10) features all the familiar and valued qualities of the R&S®CMU 200 and optimizes them for the high-end servicing of mobile phones for the following cellular network standards:

- GSM/HSCSD/GPRS/EGPRS
- WCDMA (3GPP-FDD)
- CDMA2000®/AMPS

All service-relevant features and options are supported by the R&S®CMU 200V10 (For detailed information on the various measurements functions, refer to the section of the standard in this brochure). Furthermore, development- and production-related functions are available in the full-feature version of the R&S®CMU 200.

Repair concept

High-level repair focuses on the calibration of mobile phones. In principle, the repair of a mobile phone at the high service level can be divided into two parts:

- Adjustment
- Functional testing

Calibration of mobile phones

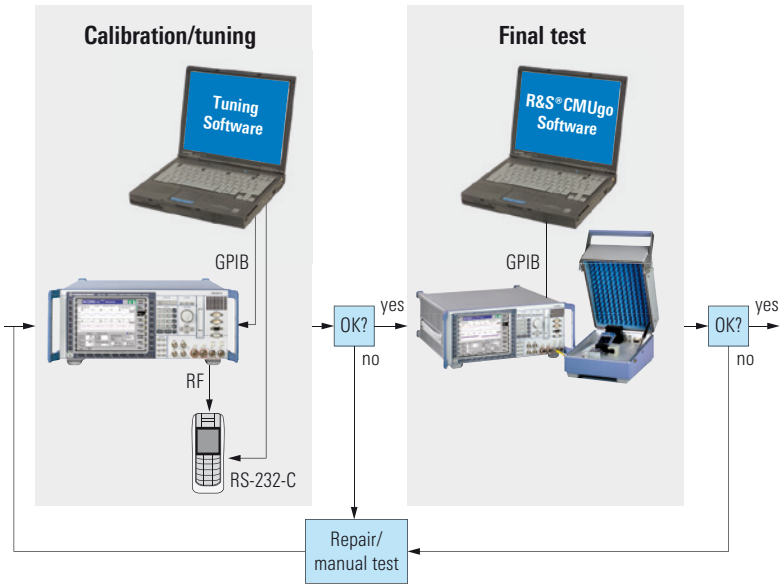
Calibration is performed in the non-signaling mode. The mobile phone is controlled via a service interface by means of a service tool provided by the mobile phone manufacturer. The same tool usually controls the tester via the GPIB interface. This is where the R&S®CMU 200V10 benefits from its big brother, the R&S®CMU 200, which is the reference standard on production lines. Most service tools are simplified versions of the production tools for mobile phones. By using a single-box solution like the R&S®CMU 200V10 rather than a generator and a spectrum analyzer, you can accelerate the calibration process. This is due to the interaction between the uplink and downlink signal, e.g. when performing receiver quality measurements. Furthermore, the tester needs to be supported by the tuning tools from all mobile phone manufacturers. Being able to repair any type of mobile phone from any number of manufacturers is one of the keys to success in this market. Since Rohde&Schwarz works hand-in-hand with the mobile phone manufacturers, the R&S®CMU 200V10 supports nearly all service tools.

Functional testing

The purpose of functional testing is to simulate the conditions of mobile phone use as realistically as possible, including in the testing of the antenna.
The Antenna Coupler R&S®CMU-Z10/-Z11 provides the necessary conditions. The tester controls the mobile phone via its signaling information. The R&S®CMUgo remote control software tool enables you to configure and perform test sequences in a very user-friendly manner, summarizing all important results in a test report at the end of the test.

Complete solution from one supplier

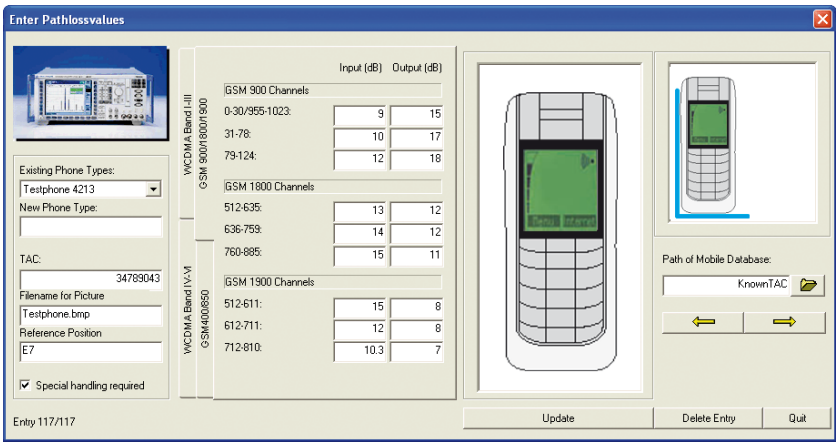
Rohde&Schwarz offers a complete solution for mobile phone functional tests. Combining the R&S®CMU 200V10, the Antenna Coupler R&S®CMU-Z10/-Z11 and the R&S®CMUgo remote control software tool to create a complete test solution provides you with a variety of of functionalities.



This figure shows the main concept for the high-end servicing of mobile phones. The R&S®CMU 200V10 is combined with the Antenna Coupler R&S®CMU-Z10/-Z11 and the R&S®CMUgo remote control software to perform both calibration and functional testing.

Key features at a glance

- User-friendly R&S®CMUgo remote control software
- Automatic setting of attenuation values
- Automatic start of test sequences matched to the DUT



The R&S®CMUgo path loss value table allows you to edit and visualize all attenuation values for different frequency bands and networks. All listed coupling factors are based on the best position of the mobile phone on the coupler. A reference point for the position with the smallest coupling factors is usually indicated. Furthermore, you can enter a picture of the mobile phone model for easier identification.

Remote control software R&S®CMUgo

The R&S®CMUgo remote control software offers comprehensive remote control programming capabilities for the R&S®CMU 200V10. R&S®CMUgo allows versatile automatic test configurations for various wireless networks supported by the R&S®CMU 200V10. Automatic test results are documented in an informative report which can be printed or stored for further analysis.

Automatic settings of attenuation values

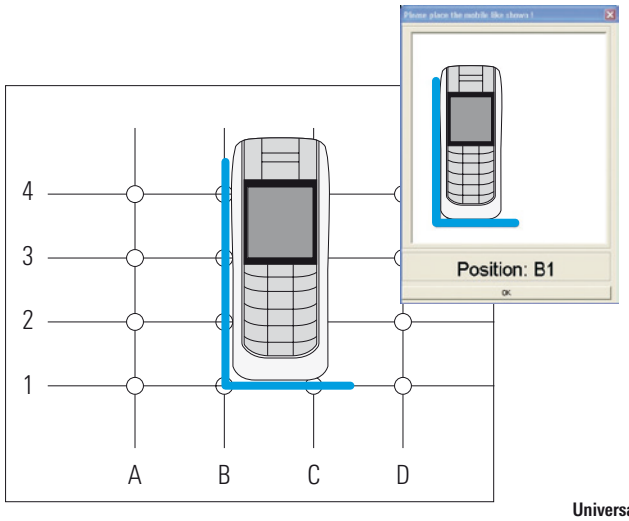
When connecting a mobile phone via an antenna coupler, it is necessary to compensate the path loss due to the connection over the air between the tester and the mobile phone. To provide minimum and reproducible attenuation values and to facilitate the handling of DUTs, the Antenna Coupler R&S®CMU-Z10/-Z11 is equipped with a numbered grid (1 to 26) and alphabetic characters (A to R).

The grid contains holes at all intersection points to make it easy to attach an L-shaped bracket. The ideal position of the bracket is usually the position with the smallest coupling factors.

The coupling factors corresponding to the best position on the Antenna Coupler R&S®CMU-Z10/-Z11 are stored in a database, which Rohde&Schwarz provides in cooperation with most mobile manufacturers. This means that R&S®CMUgo performs a test sequence and recognizes the mobile phone on the basis of its IMEI. R&S®CMUgo then takes the corresponding set of coupling factors to be applied during the test. After registration of the mobile phone in a test, a pop-up menu indicates the correct position for the mobile phone on the Antenna Coupler R&S®CMU-Z10/-Z11. Once this position has been confirmed, the test is performed.

Auto start of test sequences

To service mobile phones in high volumes, the service center must be able to test mobile phones from a variety of manufacturers and to handle a number of different test sequences in the final test. To satisfy this requirement, R&S®CMUgo makes it possible to automatically start test sequences based on the mobile phone model. The test sequences can be specified in the bar code of a service document. This makes it possible to introduce dedicated, optimized test sequences for each model as well as for each manufacturer.



This figure shows the grid system in the Antenna Coupler R&S®CMU-Z10/-Z11 with the coordinates on the x- and y-axis for a defined position of the mobile phone on the antenna coupler. After registration, the R&S®CMUgo remote control software recognizes the mobile phone model on the basis of its IMEI, indicating the corresponding position on the antenna coupler for the automatically configured coupling values in the R&S®CMU 200V10 tester.

GSM in the R&S®CMU 200V10

GSM today

Since its introduction in the early nineties, the GSM system has won acceptance and undergone an evolution that no one could have foreseen.

Currently, the following GSM systems are deployed in support of numerous applications worldwide:

- GSM850
- GSM900 including
  - P-GSM (primary GSM)
  - E-GSM (extended GSM)
  - R-GSM (railway GSM)
- GSM1800 (DCS)
- GSM1900 (PCS)

Whether the application is in service or production , the flexible concept of the R&S®CMU 200V10 can handle practically all requirements: from basic RF signal generation, frequency, power and spectrum analyzer measurements for the alignment of modules, to full GSM-specific signaling in any of the above-mentioned bands, as well as module tests on frequencies anywhere in the range from 10 MHz to 2.7 GHz.

Signaling mode

The R&S®CMU 200V10 simulates a GSM base station RF interface, providing the signaling flexibility necessary to test the performance of a mobile phone under the influence of different signaling parameters. These parameters are normally set by the network operator but can be reproduced by the R&S®CMU 200V10 for test purposes. The instrument supports the latest fast location update and direct paging features.

Non-signaling mode

This mode is used to generate a signal with GSM-specific midambles and modulation in the entire frequency range from 10 MHz to 2.7 GHz. The analyzer offers the same flexibility for GSM-specific transmitter measurements such as

- Modulation analysis
- Average and peak burst power
- Power versus time, power versus slot, power versus frame
- Spectrum due to switching/modulation

GSM data evolution – 2.5G

The amount of data traffic in GSM networks is growing rapidly. Multislot applications such as HSCSD, GPRS and the innovative 8PSK modulation scheme EDGE are needed to support the increase in data traffic. The R&S®CMU 200V10 platform is not only able to handle today's standards and systems but is also designed for the needs of tomorrow.

Multislot

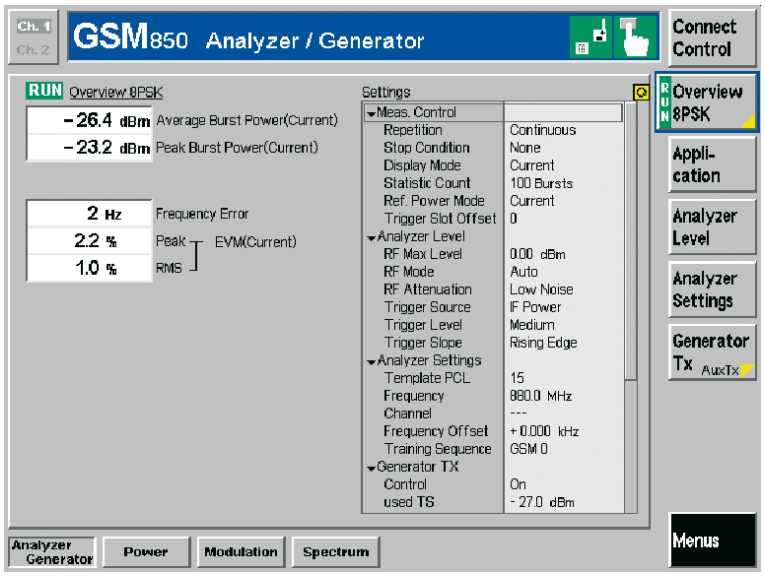
More and more, mobile phones will be able to use several timeslots simultaneously for data transmission and reception to further increase the data rate. The simultaneous transmission and reception of several timeslots (multislot) is the main technological challenge for circuit-switched and packet-switched applications. The following expansions of the GSM single-slot measurements enable maximum flexibility and reduced measurement times.

- Individual levels for all timeslots used in the downlink (DL). The R&S®CMU 200V10 generates up to eight timeslots per frame in the downlink; each timeslot can be assigned a separate level
- Transmitter and receiver measurements are possible on every timeslot used
- The R&S®CMU 200V10 combines high flexibility with great operating convenience. Based on the multislot capability information from the mobile phone, the R&S®CMU 200V10 selects the maximum possible number of timeslots for a specific application and, when changing between transmitter and receiver tests, automatically adapts the timeslot allocation
- Power-versus-time measurement (graphical display) for up to four timeslots in the uplink (UL). The templates of this application are evaluated independently for each timeslot; both GMSK and 8PSK modulated signals are recognized

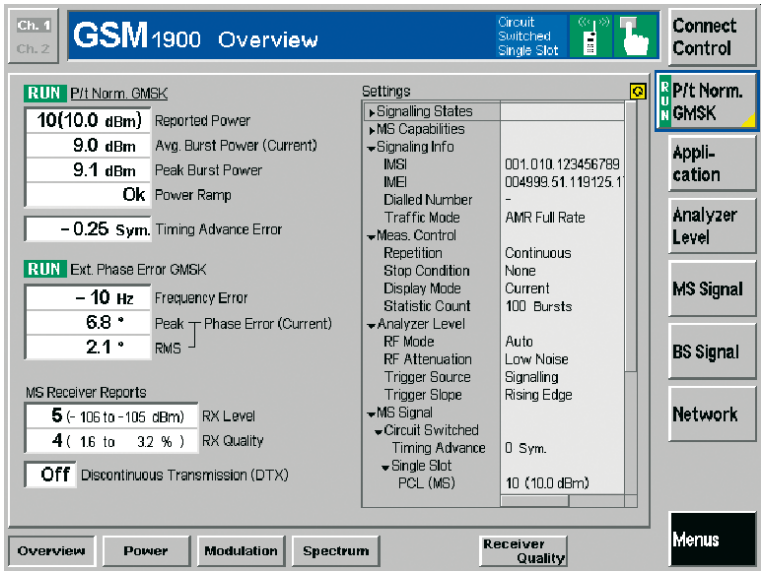
8PSK modulation – EDGE

In addition to multislot, a further step toward increasing the mobile radio data rate is 8PSK. By using the available GSM frame structure, the gross data rate is three times that obtained with GMSK. Error vector magnitude and magnitude error have been added to the range of modulation measurements. New templates for power-versus-time measurements ensure compliance with the specifications, as do the modified tolerance for spectrum measurements.

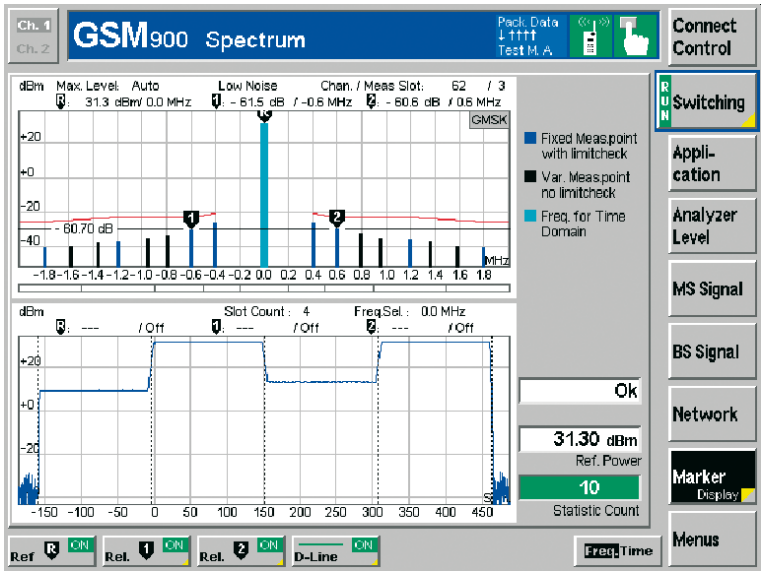
The GSM-specific non-signaling test provides generation and analysis of RF signals (GMSK or 8PSK modulated) for testing RX/TX modules or mobile phones in service mode.



The overview menu provides fast comprehensive information on the mobile phone's RF performance; the hotkeys at the bottom of the screen provide immediate access to specific and detailed GSM measurements.



The newly designed spectrum application allows the simultaneous measurement of spectra due to switching and modulation in realtime. Moreover, the user can select a frequency offset (spectral line) by means of a marker and display it in the time domain. Transient characteristics in spectrum-due-to-switching measurements can thus be shown as a function of time.



GSM in the R&S®CMU 200V10

GPRS/EGPRS

The introduction of packet-oriented transmission and the associated temporary assignment of radio resources require new test concepts. The R&S®CMU 200V10 provides the following test modes:

3GPP test mode A (GPRS/EGPRS)
In this mode, the mobile phone continuously transmits the associated UL timeslots. The R&S®CMU 200V10 can carry out all TX multislot measurements available, such as the power ramp measurement of up to four adjacent timeslots simultaneously, or modulation and spectrum measurements.

Selecting the coding scheme determines whether the mobile phone is to transmit GMSK- or 8PSK-modulated data. With GPRS/EGPRS, transmission resources are usually allocated temporarily.

Correct decoding of the highly protected uplink state flag (USF) sequence is an essential prerequisite for the "dynamic allocation" and "extended dynamic allocation" modes to work properly, and is verified by the R&S®CMU 200V10 by means of the USF BLER test (test modes A and B). Various routines, e.g. USF BLER and false USF detection, are available.

3GPP test mode B (GPRS/EGPRS)
This mode creates a loopback in the mobile phone so that the mobile phone retransmits data blocks received from the R&S®CMU 200V10. The transmitter and the receiver are active at the same time. The mobile phone returns the received data blocks to the R&S®CMU 200V10 unchanged, comparable to the loopback mode in circuit-switched operation. The data is looped back after channel coding, which means that the mobile phone's coder and decoder functions are tested as well.

In addition to the measurements available in the 3GPP test mode A, test mode B enables very fast receiver test, bit error ratio and Rohde & Schwarz-proprietary block error ratio measurements in parallel to transmitter tests (BER/DBLER).

3GPP (E)GPRS symmetrical and non-symmetrical loopback mode (EGPRS only)
Unlike in test mode B, the data blocks are looped back before they undergo channel coding, i.e. the coders are bypassed in favor of increased measurement speed. In the symmetrical (E)GPRS loopback mode, 8PSK-modulated data blocks are received in the downlink and returned unchanged in the uplink. In the non-symmetrical mode, 8PSK data blocks are received in the downlink and returned in the uplink as GMSK-modulated data spread over the next three data blocks. Similar to test mode B, the (E)GPRS loopback mode allows simultaneous transmitter and receiver tests to be performed at an even higher data throughput.

3GPP BLER measurements – acknowledge mode (GPRS/EGPRS)
The BLER measurement mode employs GPRS/EGPRS backward error correction. The R&S®CMU 200V10 sends data blocks in allocated timeslots in the downlink. The mobile phone checks the data blocks for errors (CRC check) and, instead of returning the data blocks, returns only the block acknowledgements in the uplink. The mobile phone transmitter is thus only temporarily active for sending uplink acknowledgements, which means that transmitter measurements are possible only to a limited extent in the BLER mode.

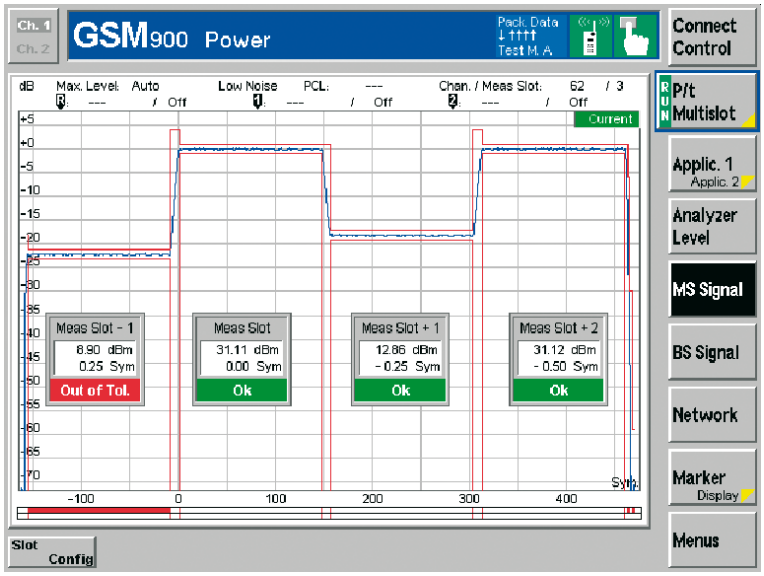
The R&S®CMU 200 furnishes an average result over all timeslots used, as well as the BLER and the actual data throughput for each timeslot.

GSM highlights of the R&S®CMU 200V10

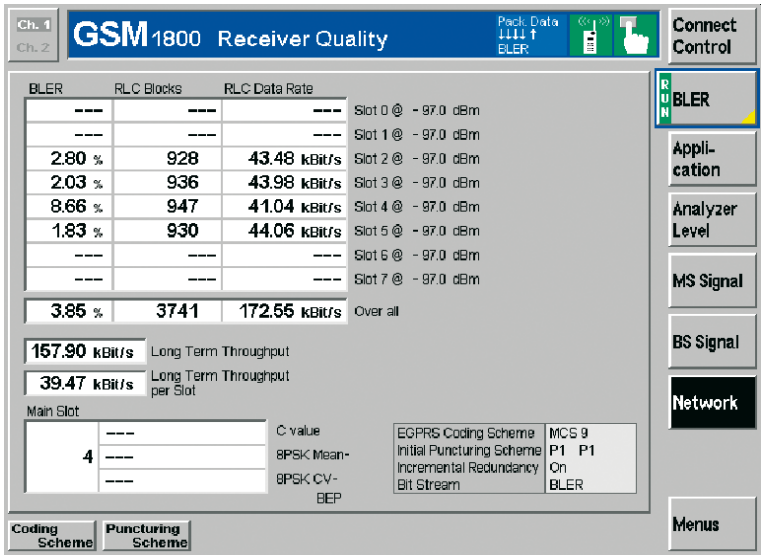
Benchmark-breaking IEC/IEEE bus speed
- Parallel measurements
- Optimized processing power and fast modulation spectrum measurement using latest DSP generations
- Statistical BER test based on confidence evaluation

GMSK/8PSK measurements
- Phase/frequency error, EVM, magnitude error, origin offset, I/Q imbalance GMSK for I/Q modulator tuning
- Timing error
- Power versus time
  - On up to 4 UL slots
  - Normal/access
  - Peak power/average, power versus frame, power versus slot
- High-speed ACP measurement (switching and modulation measurement in parallel) with additional time domain view
- BER/DBLER, RBER/FER, FastBER BLER@4DL (GPRS/EGPRS)
- Incremental redundancy support ((E)GPRS)
- Power versus PCL (on 3 or 7 channels)
- GPRS/EGPRS intra band handover

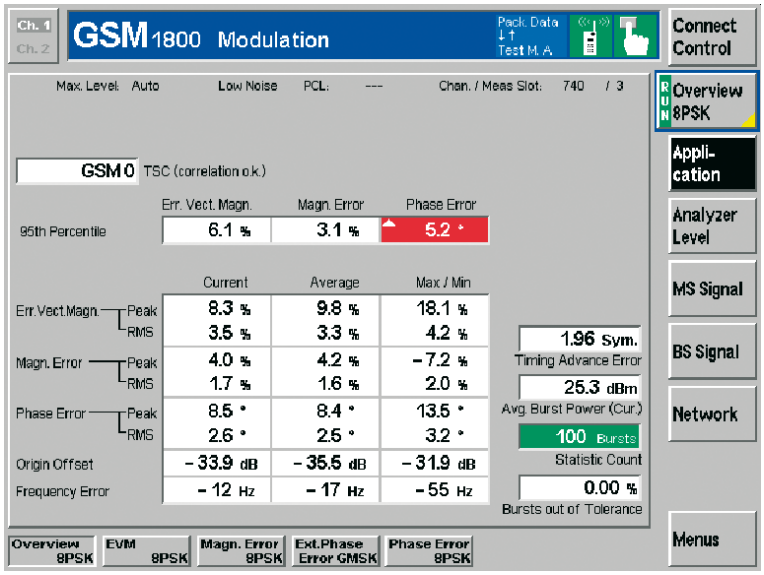
The power-versus-time multislot application can graphically display up to 4 adjacent timeslots, automatically detect GMSK- and 8PSK-modulated signals and activate the associated templates in realtime. A new zoom function allows full-screen display of up to four slots. Moreover, the user can zoom in anywhere along the time or power axis.



For GPRS/(E)GPRS, BLER measurements can be performed simultaneously on up to four downlink timeslots. The actual data throughput, the BLER and the resulting data rate (RLC/MAC layer) are displayed separately for each timeslot and as an average for all timeslots used. Furthermore an incremental redundancy performance test is performed, and the channel quality is indicated.



In the 8PSK mode, the modulation analysis is subdivided. The error vector magnitude (EMV), the magnitude error and the phase error can be displayed both numerically as shown above, or graphically.



WCDMA in the R&S®CMU 200V10

The need for higher data rates is the consequence of an information-oriented society in the new millennium. The enhancement of mobile devices takes this need into account. Third-generation wireless communication poses new challenges as a consequence. Driven by ideas of the first and second generation (SIM, global roaming, CDMA technology, data services), WCDMA takes all fundamentals to unprecedented levels and adds new application fields as well as application-tailored data security. Derived from Asian, American and European ideas, 3G networks are the mobile solution for future needs as well as the current mainstream.

WCDMA FDD functionality

The tests provided by the R&S®CMU 200V10 are currently based on the 3GPP/FDD Release 99 WCDMA radio link standards. Regular adaptations to new releases and baselines will be made available as the standard evolves; thus the R&S®CMU 200V10 today supports Release 5 and is already prepared for Release 6. Most of the measurements offered comply with the 3GPP specification TS 34.121, chapter 5 (Transmitter Characteristics), chapter 6 (Receiver Characteristics), and chapter 7 (Performance Tests). Due to the highly user-friendly menu concept, the R&S®CMU 200V10 provides quick access to all required measurements and optimizes the handling and thus the efficiency of complex measurement tasks with appropriate status messages and built-in statistical functions. Different handover capabilities within WCDMA/FDD such as inter-frequency handover are available in the R&S®CMU 200V10 WCDMA solution. Moreover, handover to other cellular networks such as GSM, i.e. inter-RAT handovers – blind or in compressed mode – are implemented.

Non-signaling mode

The non-signaling mode is for generating and analyzing WCDMA (3GPP/FDD) signals in the full frequency range of the R&S®CMU 200V10 base unit. The R&S®CMU 200V10 provides WCDMA-specific TX measurements on signals with up to six DPDCHs such as:

- ACLR (adjacent channel leakage power ratio): two measurement modes, filter (bar graph) and FFT (cont. spectrum) method; absolute or relative readout
- OBW (occupied bandwidth)
- SEM (spectrum emission mask)
- CDP (code domain power): CDP vs all codes, CDP vs DCH channels, RHO vs all codes, RHO vs DCH channels; all measurements in relative or absolute readout
- Modulation (for 3GPP or general QPSK): EVM (error vector magnitude), magnitude error, phase error, frequency error, I/Q offset, I/Q imbalance, peak code domain error, RHO (waveform quality), I/Q constellation/vector/eye diagram
- Power: MAX, MIN, OFF (UE test mode)
- Power versus slot, innerloop power
- Phase discontinuity

The non-signaling mode allows tests of all essential RF parameters of the connected UE, where autoranging for the received UE signal is also applied. The measurements are performed in unsynchronized mode. No call is set up to evaluate UE performance using this mode.

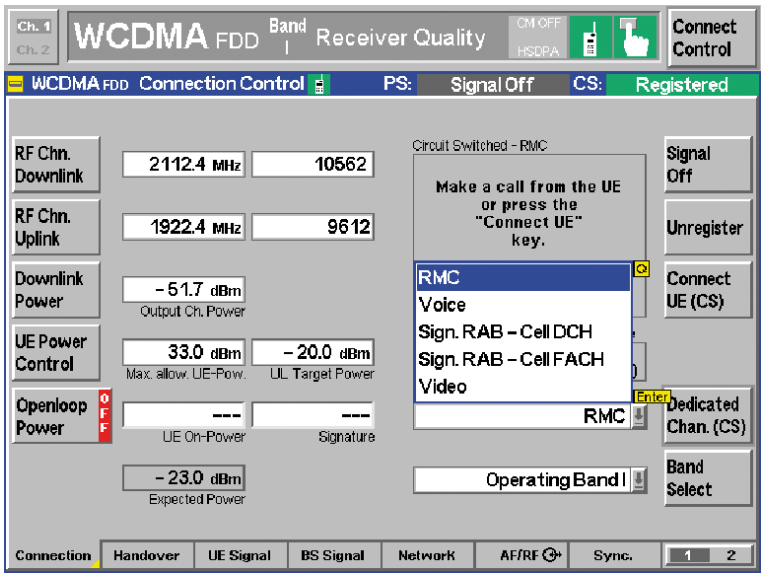
FDD signaling mode

Signaling tests are tests in an environment closer to a true live network. 3GPP currently specifies six different operating bands for FDD (bands 1 through 6). All six bands are optionally supported by the R&S®CMU 200V10.

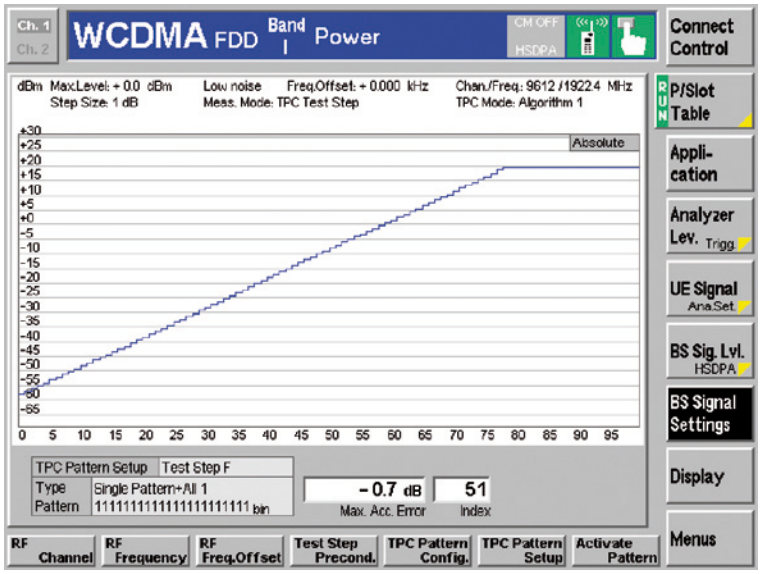
The measurements offered are largely the same as performed in synchronized mode. In signaling mode, the R&S®CMU 200V10 simulates one WCDMA base-station RF interface including the signaling protocol so that an FDD UE can be tested with regard to various signaling parameters. All necessary network and Node B (base station) parameters such as control and data channel configurations can be set. In addition to the non-signaling tests, R&S®CMU 200V10 provides features such as:

- Dynamic setting of signaling parameters
- RRC connection setup
- Readout of UE capabilities
- Authentication and security (integrity)
- Call setup (MOC, MTC)
- Call release (NIR, MIR)
- Measurements from non-signaling section
- Open-loop power control (on/off time mask for RACH preambles)
- Modulation quality measurements during the random access procedure (PRACH preambles)
- Phase discontinuity in line with 3GPP TS 31.121 chapter 5.3.13
- Innerloop power control (traffic power commands, TPC patterns A to H)
- Test mode/test loop activation command (test loop mode 1 transparent and test loop mode 2 with and without uplink CRC)

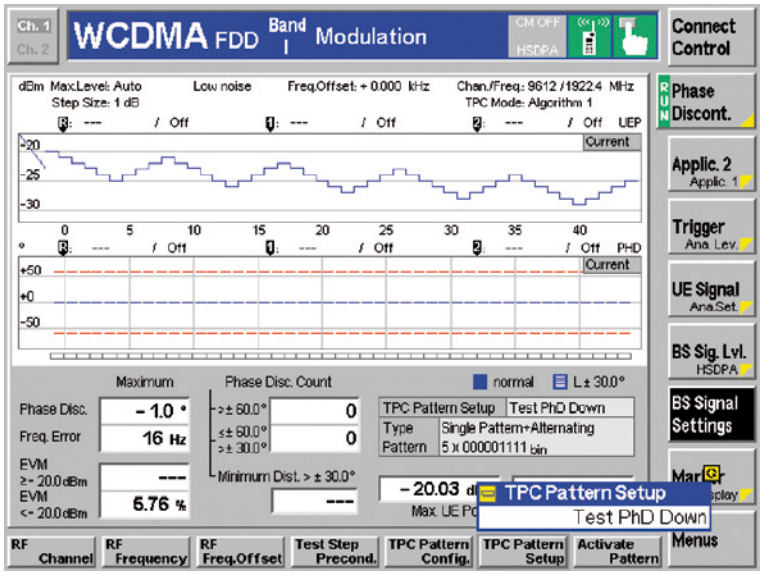
In the connection folder of the connection control menu, all relevant R&S®CMU 200V10 connection settings are displayed together with the reported UE capabilities. The main control buttons to initiate and release different connection types are located here.



This screenshot shows a typical UE output power response to the TPC patterns. The Power versus slot measurement can be used with the patterns A through H, a combination of algorithms 1 and 2 and different step sizes. Here pattern F is used. The inner loop measurement can be displayed as absolute and relative graphics or as a numeric power versus slot table.



In the phase discontinuity measurement, the upper diagram shows the measured UE power in up to 46 consecutive slots corresponding to the last TPC pattern sent to the UE. The lower diagram shows the phase discontinuity in the measured slots.



WCDMA in the R&S®CMU 200V10

- BTFD (blind transport format detection) with false transmit format detection ratio (FDR) and transport format indicator (UL TFCI)
- Receiver quality: BER, BLER and DBLER (RF loopback)
- Readout of UE measurement reports on current and neighbor cell (UTRA/GSM) (with activated compressed mode (CM))
- Several possibilities for handovers: from WCDMA to GSM (blind and compressed mode), and back from GSM to WCDMA (blind handover),

The measurements can be performed on different radio access bearers (RAB) such as:

- SRB at 2.5 kbit/s, 3.4 kbit/s and 13.6 kbit/s
- AMR at 12.2 kbit/s, 10.2 kbit/s, 7.95 kbit/s, 7.4 kbit/s, 6.7 kbit/s, 5.9 kbit/s, 5.15 kbit/s, 4.75 kbit/s (codec set A to H, M) with selectable audio loopback
- RMC at 12.2 kbit/s, 64 kbit/s, 144 kbit/s, 384 kbit/s
- Asymetric RMC at
  UL/144 kbit/s DL/64 kbit/s
  UL/384 kbit/s DL/64 kbit/s
  UL/384 kbit/s DL/144 kbit/s UL
- Video call in loopback mode at 64 kbit/s fixed data rate UL, DL

An optional AMR speech codec for WCDMA that supports the above-listed data rates is also available. It allows audio measurements to be performed with the R&S®CMU 200V10 audio board (option) or on an external audio analyzer, e.g. the R&S®UPL16.

The high flexibility of the signaling stack allows various parameters in the R&S®CMU 200V10 MMI to be changed or different Node B configurations to be simulated via remote control.

Quality assurance

Due to its high measurement repeatability and accuracy, the R&S®CMU 200V10 is the right choice to help ensure a consistently high level of quality. WCDMA-specific measurements such as BER/BLER and EVM, plus the full implementation of complementary (i.e. ACLR and OBW) measurements provide an excellent service platform for high-quality products.

Repair applications (manufacturing and service centers)

With its outstanding versatility, the R&S®CMU 200V10 is also a suitable tool for mobile phone troubleshooting. Four configurable RF ports and a built-in RF connector switch matrix (standard unit) are provided to enable flexible signal level ranges and switching. Since each R&S®CMU 200V10 measurement menu allows an independent setting for the input and output ports, a phone fixture and spectrum analyzer probe can remain permanently connected to the R&S®CMU 200V10.

Switching standards

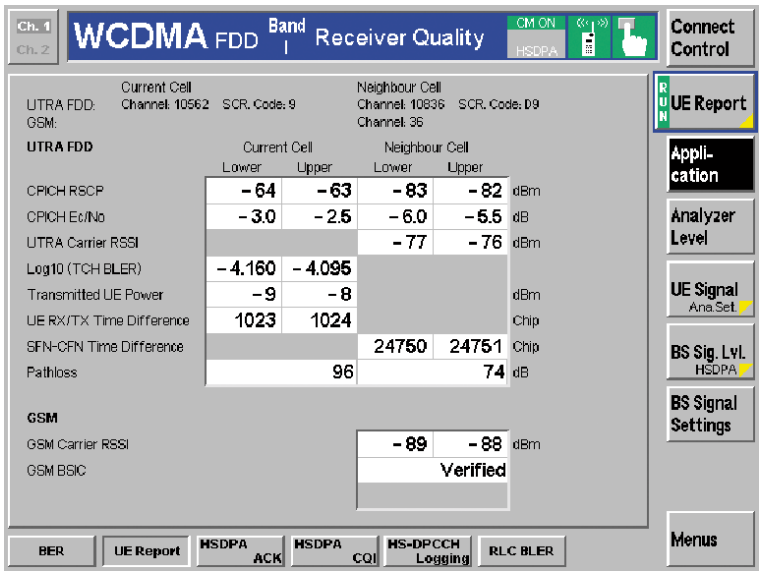
Fast switching between 3GPP FDD and any of the other numerous standards supported by the R&S®CMU 200V10 is part of the standard instrument and can be achieved by simply pressing a button.

Multimode UE applications are possible using the handover capabilities of the R&S®CMU 200V10 such as blind and compressed mode handover to GSM as well as blind handover from GSM back to WCDMA.

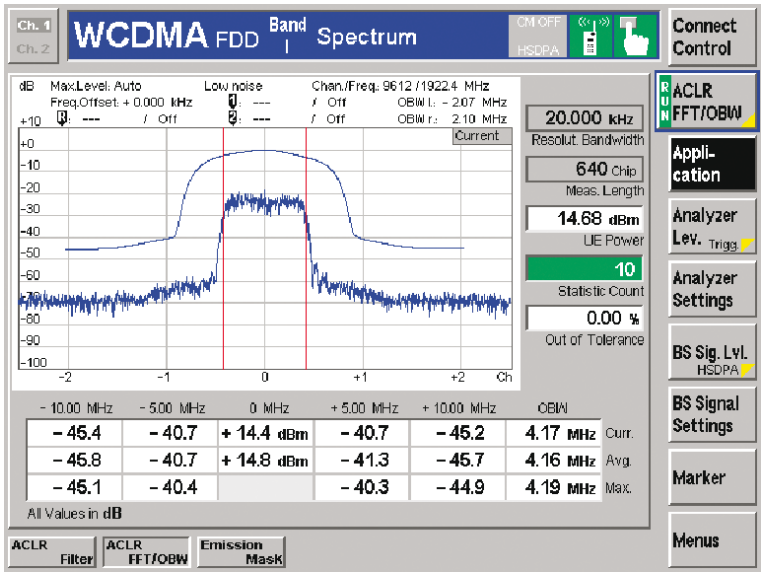
WCDMA highlights of the R&S®CMU 200V10

- Benchmark-breaking ICE/IEEE bus speed (see highlights of base unit)
- Combined measurements, many different measurement mode
- Multiband/multimode testing
- Powerful signaling capabilities available: MOC, MTC, MIR, NIR, inter-frequency handover, inter-RAT handover, cell reselection
- Large selection of radio access bearers (RABs) with various data rates including video call in loopback mode
- Display of UE capabilities
- Up to 384 kbit/s reference measurement channels (symmetrical and asymmetrical)
- Separate and highly accurate level setting for individual DL code channels
- Simple voice test using AB/echo by tester; dedicated audio tests available (option)
- User-defined settings of RF-relevant signaling parameters
- On/off time mask for open loop power measurements including the system info settings
- Power vs slot menu for realtime measurement of RMS UE transmit power in up to 100 consecutive slots
- Simple interactive operation in manual MMI
- Configuration of compressed mode for neighbor cell reports
- Handover and BER/BLER procedures during compressed mode

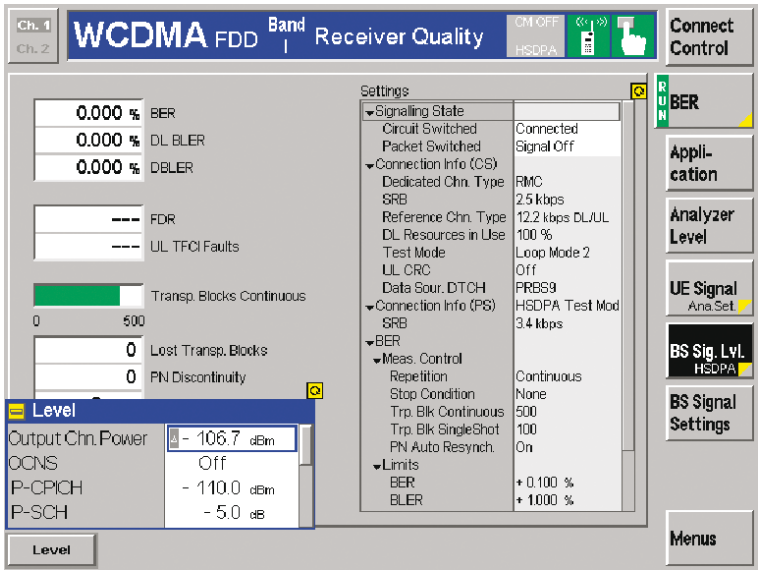
The UE reports for the current and neighbor FDD cell (can be obtained from an existing FDD cell on the air, for example) and from a neighbor GSM cell can be requested by activating the compressed mode patterns. Four predefined compressed mode patterns can be combined. The R&S®CMU200V10 also provides full flexibility with user-defined patterns.



The ACLR menu shows all adjacent-channel-related information in graphical as well as in scalar numeric form. Since the ACLR FFT and OBW measurement methods are closely related, results for occupied bandwidth are displayed simultaneously. The scalar display excluding the center channel (0 MHz) may be switched to absolute readout as well.



This measurement shows the receiver sensitivity measurement on a UE at –110 dBm P-CPICH in test-loop mode 2. In addition to the minimum DL power condition, the compressed mode can be selected to see if the same sensitivity is maintained with compressed mode. The R&S®CMU200V10 also provides a "lost transport blocks" counter for easier troubleshooting.



CDMA2000® 1X in the R&S®CMU 200V10

CDMA2000® overview

CDMA2000® arose from the further development of cdmaOne (TIA/EIA-95) and is an enormous step toward 3G. Besides higher data rates and considerably improved efficiency, CDMA2000® is particularly noteworthy for its downward compatibility with cdmaOne. Nine different configurations (radio configurations RC1 to RC9) in the forward link and six radio configurations in the reverse link define the different connections which are specified in the IS-2000 standard.

- RC1 and RC2 define cdmaOne connections for rate set 1 and rate set 2
- RC3 to RC5 in the forward link (or RC3 to RC4 in the reverse link) define CDMA2000® connections for spreading rate 1 (CDMA2000® 1X)
- RC6 to RC9 in the forward link (or RC5 to RC6 in the reverse link) are CDMA2000® connections for spreading rate 3 (CDMA2000® 3X) only

Compared to cdmaOne, CDMA2000® 1X doubles the capacity for pure voice transmission and provides a maximum packet data rate of 307 kbit/s on a single 1.25 MHz carrier. CDMA2000® 1X is a recognized IMT-2000 3G standard, already successfully deployed in multiple networks over several continents.

CDMA2000® 1X functionality

Similarity in physical conditions and downward compatibility make the CDMA2000® 1X T&M concept very similar to that of cdmaOne. There are, however, major differences in the protocols.

The R&S®CMU 200V10 supports connections in all radio configurations defined for CDMA2000® 1X, i.e. TIA/EIA-95 connections as well as the usual CDMA2000® 1X high-speed connections.

Code domain power is a new and highly important measurement for mobile phones in CDMA2000®. Since several code channels are now transmitted simultaneously in the reverse link, it is necessary to check whether the power distribution of the different channels complies with the test specification (TIA/EIA-IS-98-E) for CDMA2000®. The measurement concept in the R&S®CMU 200V10 is based on ProbeDSP™ technology, which permits high-speed measurement of the code domain power. The emphasis is on fast measurements and clear and concise representation.

Of course, the R&S®CMU 200V10 also supports the requirements placed on the gpsOne test application; the R&S®CMU 200V10 meets the high demands for frequency and phase accuracy.

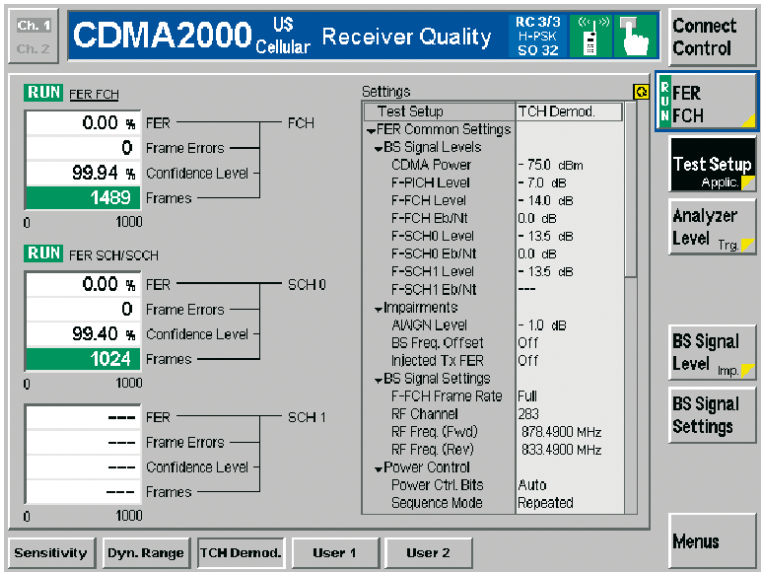
The CDMA2000® 1X implementation in the R&S®CMU 200V10 is based on the TIA/EIA IS-2000 Rev. 0 standard. However, features of Rev. A are partly implemented. The R&S®CMU 200V10 currently supports, for example, FER measurements on two supplemental channels (SCH0 and SCH1).

The R&S®CMU 200V10 provides a large set of different connection types (service options). The following are currently possible:

- Test loop service options: SO 2, SO 9, SO 55
- Speech service options: SO 1, SO 3, SO 17, SO 0x8000
- Test data service option: SO 32
- IP end-to-end data connection: SO 33
- Short message service (SMS): SO 6, SO 14

The R&S®CMU-B85 speech coder option is a unique feature within the R&S®CMU 200V10. The capability to encode external audio signals and to decode digital CDMA2000® signals to analog audio makes the R&S®CMU 200V10, in combination with an external audio analyzer such as the R&S®UPL16, suitable for high-precision acoustic measurements on CDMA2000® mobile phones.

Within a TDSO (SO 32) connection, the frame error ratio (FER) on the fundamental channel (FCH) as well as on the supplemental channels SCH0 and SCH1 can be evaluated (as soon as CDMA2000® handsets support SCH1).



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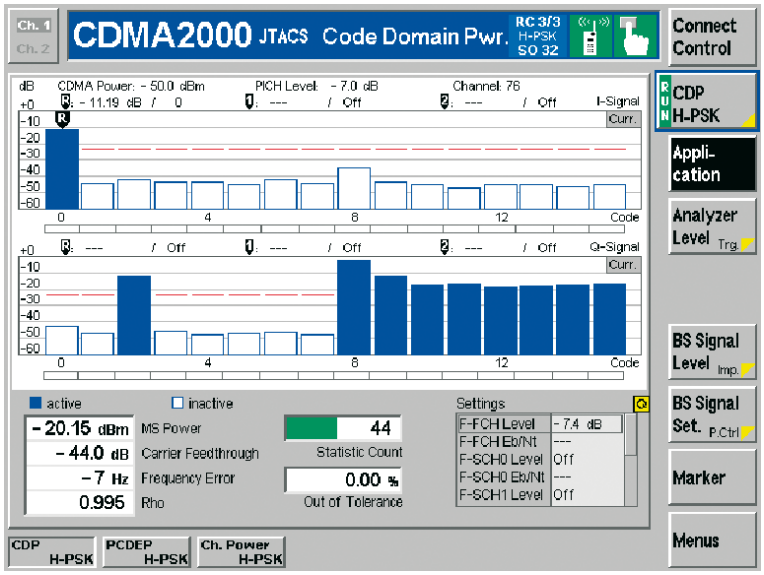
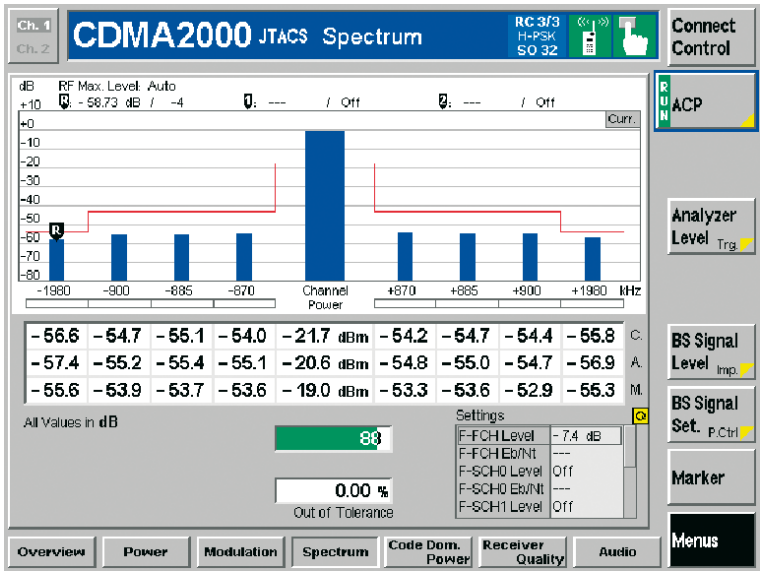


The spectrum measurement provides comprehensive ACPR measurements at four different user-definable frequencies in a ±2 MHz range.



CDMA2000® 1X in the R&S®CMU 200V10

As with all mobile radio networks supported by the R&S®CMU 200V10, two different measurement modes are available:

- On the one hand, there are tests in the non-signaling mode, which permit analysis of the mobile phone without registration in the base station and without actual call setup. For this purpose, the R&S®CMU 200V10 generates a base station signal with all the physical channels required, which are user-configurable. This measurement mode complies in particular with requirements for the calibration of mobile phones
- On the other hand, there are tests with complete signaling for the final test

Signaling mode

The range of functions is as follows:

- Power measurements
  - Minimum/maximum output power
  - High-speed channel power
  - Gated output power
  - Open-loop time response
  - Access probe power
  - Standby power
  - Range tests by using user-configurable power control bit patterns
- Receiver quality measurements
  - Frame error ratio (FER) on FCH, SCH0 and SCH1
  - Dynamic range, sensitivity and other user-selectable test environments: FER injection
    Forward power control measurement
- Modulation (both RC1/2 and RC3/4)
  - Error vector magnitude (EVM), magnitude error, phase error, waveform quality, carrier feedthrough, frequency error, eye diagram, constellation/vector diagram
- Code domain power
  - Code domain power
  - Peak code domain error power, channel power
- Handoffs
  - Implicit handoffs (RF channel, Walsh code, PN offset, frame offset)
  - Interband handoff
  - Handoff to AMPS
- Sideband suppression

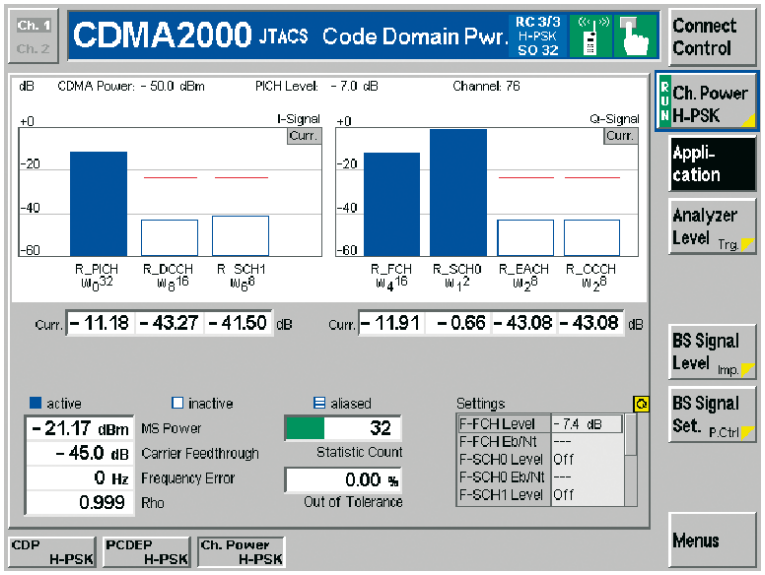
Non-signaling mode

- High-speed power measurement
- Frequency error
- Waveform quality (both RC1/2 and RC3/4)
- Carrier feedthrough
- Transmit time error
- Sideband suppression

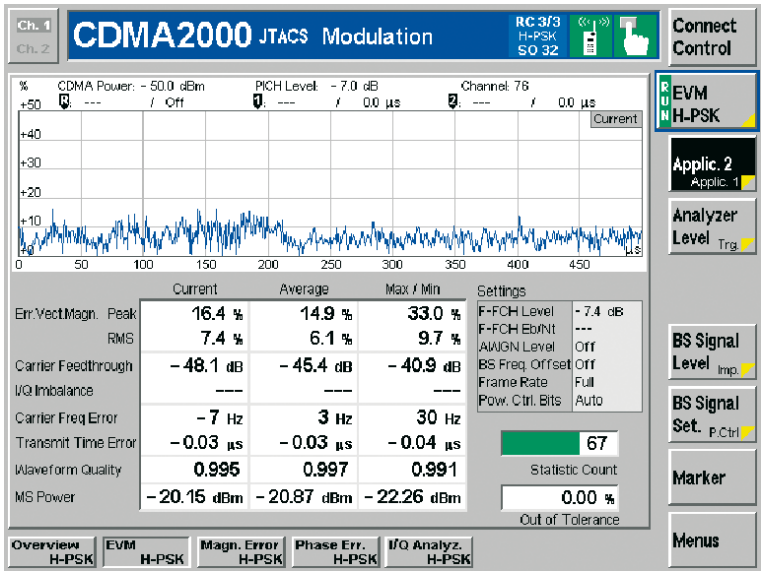
CDMA2000® highlights of the R&S®CMU 200V10

- CDMA2000® speech coder for high-precision acoustic measurements
- Forward closed-loop power control tests as specified in IS-98E sections 3.4.7, 3.4.8, 3.4.9 supported
- Quick paging channel implemented
- Handoffs possible between service options and between CDMA2000® and IS-95 connection types during an established call
- Voice loopback and comprehensive testing of mobile phones
- Full support of RC1/RC2 (cdmaOne measurements) and RC3/RC4 (CDMA2000®)
- Support of all band classes specified in IS-2000
- Innovative measurement of code domain power, code domain peak error power, channel power
- Readout and display of many mobile-phone-specific parameters (ESN, slot cycle index, etc)
- Extremely fast measurements
- Non-signaling and signaling mode
- Various handoffs supported (e.g. handoff to AMPS, interband handoff)

The channel power measurement displays the power in the channels used by the reverse link, separated into I and Q signals.



Modulation measurements allow users to check the MS transmitter. Parameters such as EVM, phase error and frequency error are displayed graphically.



AMPS in the R&S®CMU 200V10

AMPS overview

Analog AMPS (advanced mobile phone system) is a standard system for analog mobile phone service in the United States and is also used in other countries. It is based on the frequency spectrum allocation for cellular service established by the Federal Communications Commission (FCC) in 1970. Introduced by AT&T in 1983, AMPS became the most widely deployed cellular system in the United States. Although AMPS is a first generation analog standard, a substantial demand for mobile radio testers covering this standard will continue to exist in the future. Especially in the United States, dual-mode CDMA2000®/AMPS phones are still very common.

By combining the digital standards with analog AMPS, the network operators offer their customers the advantages of the digital standards and ensure nearly 100 % coverage in North America. As a consequence, Rohde & Schwarz is offering analog AMPS in addition to the digital standard CDMA2000®.

AMPS measurements and features

As for other standards, there are two categories of AMPS measurements:

- Transmitter tests
  for verifying the transmit part of a mobile phone
- Receiver tests
  for verifying the receive part of a mobile phone

AF level search routine

The AF level search routine in the TX test menu allows the user to set the desired frequency deviation of the mobile phone transmitter at a keystroke, the level of the R&S®CMU 200V10 audio generator being automatically corrected. The enhanced selectable search algorithm allows faster adjustment of the audio generator level, provided the compressor in the mobile phone has been activated.

Sensitivity search routine

The sensitivity search routine in the RX test menu automatically searches for the receiver input level at which a selectable SINAD of the demodulated signal can still be attained.

Transmitter measurements

- Carrier power
- Carrier frequency error
- SAT frequency error/peak deviation
- ST frequency error/peak deviation
- Modulation noise and distortion
- Hum and noise
- Electrical AF response
- Modulation distortion
- Residual AM
- Enhanced deviation range

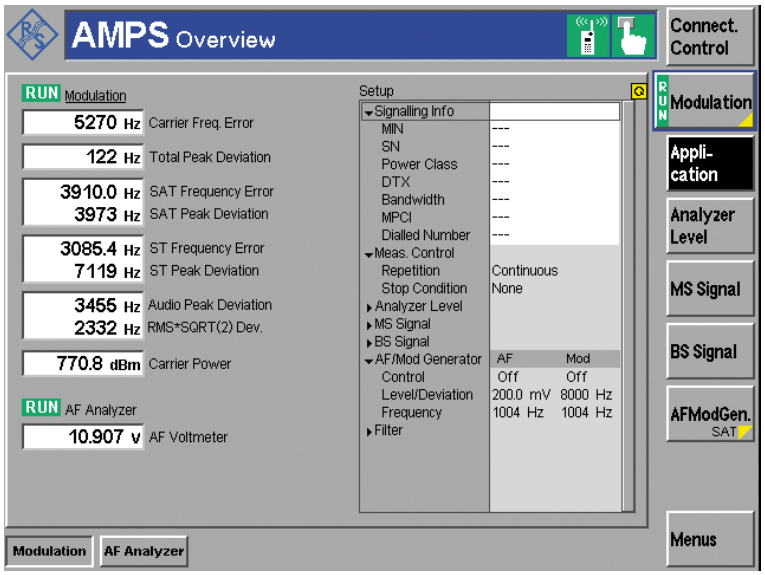
Receiver measurements

- Sensitivity
- Hum and noise
- SINAD
- Distortion
- AF voltage
- Electrical AF response
- Residual AM
- Audio deviation

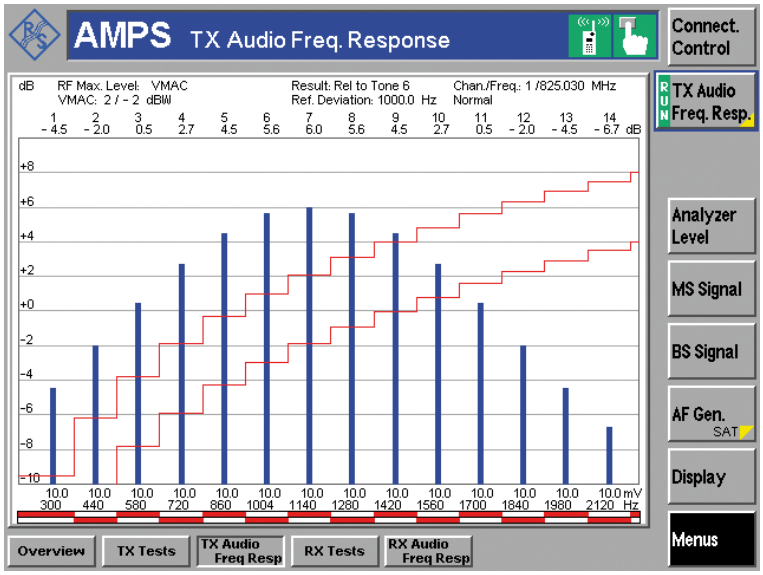
All the filters required for the measurements are of course preconfigured in line with specifications, but their settings can be modified for individual measurements. The RX and TX electrical AF response measurements in AMPS are usually defined as frequency sweep versus AF range. The R&S®CMU 200V10 offers a much faster and more modern alternative.

Using the TX and RX AF response menus of the R&S®CMU 200V10, the AF response is measured simultaneously at 20 test points with user-programmable level and frequency and then checked against specified tolerances. The enhanced selectable algorithm allows the phase of maximally 20 test tones to be shifted, thus minimizing the crest factor of the test signal.

The overview menu provides fast comprehensive information on the mobile phones´ RF performance. The hotkeys at the bottom of the screen provide immediate access to specific and detailed AMPS measurements.



TX AF response measurement: the pre-emphasis characteristic of the mobile phone transmitter is verified by a single-shot measurement.



AMPS highlights of the R&S®CMU 200V10

AMPS features

- Powerful signaling capabilities
- Base station simulation
- Mobile or base station originated call connect/disconnect
- Short measurement time ensuring high throughput
- Combined measurements
- Simple interactive operation, standardized MMI
- No specialized network knowledge required
- Comprehensive acoustic tests with external audio analyzer

R&S®CMU200V10 options and accessories

Type	Description	GSM/GPRS/EDGE	WCDMA	CDMA2000®	AMPS	Order No.
R&S®CMU 200V10	Base unit for high end service tester, including OCXO (R&S® R&S®CMU-B12), and software options for GSM/GPRS/EDGE, WCDMA CDMA2000® and AMPS. (The functionality becomes active by adding the corresponding hardware part)					1100.0008.10
R&S®CMU-B21	Universal signaling unit. Includes signaling module for AMPS, TDMA, GSM/GPRS/EGPRS	☑	☑	–	☑	1100.5200.54
R&S®CMU-B41	Audio generator and analyzer. Includes audio frequency (AF) generator, voltmeter and distortion meter	☺	☺	☺	☑	1100.5300.02
R&S®CMU-B52	Internal versatile multimode speech coder/decoder; R&S®CMU-B21 required	☺	☺	–	–	1100.5400.14
R&S®CMU-B56	WCDMA (3GPP FDD) signaling module for R&S®CMU-B21 model 14	–	☑	–	–	1150.1850.14
R&S®CMU-B68	Versatile baseband board for WCDMA (3GPP FDD) layer-1, DL and UL, non-signaling	–	☑	–	–	1149.9809.02
R&S®CMU-B83	CDMA2000® 1X signaling unit	–	–	☑	–	1150.0301.12
R&S®CMU-B85	8k/13k QCELP, 8k EVRC speech codec for CDMA2000® signaling unit R&S®CMU-B83	–	–	☺	–	1100.7002.12
R&S®CMU-B95	2nd Tx RF channel, covering the requirements of present BCCH by GSM/GPRS/EGPRS and application testing for (E)GPRS	☑	☺	–	–	1159.0504.02
R&S®CMU-DCV	Documentation of calibration values	☺	☺	☺	☺	0240.2193.08
R&S®CRT-Z2	GSM/GPRS test SIM for GSM900 and DCS1800 for loopback mode; required for BER and other applications	☺	–	–	–	1039.9005.02
R&S®CRT-Z3	3G UICC/USIM test card for UMTS	–	☺	–	–	1139.1005.02
R&S®CMU-Z1	256 Mbyte memory card for use with PCMCIA interface, flash ATA formatted (PC-Card ATA)	☺	☺	☺	☺	1100.7490.04
R&S®CMU-Z10	Antenna coupler 900 MHz/1700 MHz to 2200 MHz	☺	☺	☺	☺	1150.0801.10
R&S®CMU-Z11	RF-shielded cover, extension for R&S®CMU-Z10	☺	☺	☺	☺	1150.1008.02
R&S®CMU-Z13	USB feed through for R&S®CMU-Z10	☺	☺	☺	☺	1159.1200.02
R&S®ZZA-411	19" rack adapter	☺	☺	☺	☺	1069.3283.00

Comments on table:
☑ mandatory; ☺ optional – not applicable

Glossary

GSM/(E)GPRS	
8PSK	8 Phase Shift Keying
AMR	Adaptive Multi Rate
BCCH	Broadcast Control Channel
BER	Bit Error Rate
BLER	Block Error Ratio
CRC	Cyclic Redundancy Code
CS	Coding Scheme
DBLER	Data Block Error Rate
DL	Down Link
DTX	Discontinuous Transmission
EDGE	Enhanced Data for Global Evolution
EGPRS	Enhanced General Packet Radio Service
E-GSM	Extended GSM
EVM	Error Vector Magnitude
FER	Frame Error Rate
GMSK	Gaussian Minimum Shift Keying
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications
GSM1800 (DCS)	Digital Communications System 1800
GSM1900 (PCS)	Personal Communications System 1900
HSCSD	High Speed Circuit Switched Data
IMEI	International Mobile Equipment Identity
IMSI	International Mobile Subscriber Identity
LAC	Location Area Code
MAC	Medium Access Control
MCC	Mobile Country Code
MCS	Modulation and Coding Scheme
MNC	Mobile Network Code
MS	Mobile Station
NCC	Network Country Code
OCXO	Oven Controlled Crystal Oscillator
PCL	Power Control Level
P-GSM	Primary GSM
RAU	Routing Area Update
RBER	Residual Bit Error Rate
R-GSM	Railway GSM
RLC	Radio Link Control
RSSI	Radio Signal Strength Indicator
SIM	Subscriber Identity Module
SMS	Short Message Service
TAC	Type Approval Code (first 6 bits of IMEI)
TCH	Traffic Channel
TS	Traffic Slot
TSC	Training Sequence Code
UL	Uplink
USF	Uplink State Flag
WCDMA	
3GPP	3rd Generation Partnership Project
3G	Third Generation of wireless communication systems
ACLR	Adjacent Channel Leakage Power Ratio
AMR	Advanced Multi Rate Codec
BER	Bit Error Rate
BLER	Block Error Rate
BTFD	Blind Transport Format Detection
CDP	Code Domain Power
CM	Compressed Mode
CPICH	Common Pilot Channel
CPICH RSCP	CPICH Received Signal Code Power
CRC	Cyclic Redundancy Code
CS	Circuit Switched
DBLER	Data Block Errror Rate
DCH	Dedicated Channel
DPCCH	Dedicated Physical Control Channel
DPDCH	Dedicated Physical Data Channel
EVM	Error Vector Magnitude
FDD	Frequency Division Duplex
FDR	False transmit format Detection Ratio
FFT	Fast Fourier Transformation
GSM BSIC	GSM Base Station Identity Code
IF	Inter Frequency
MAC	Medium Access Control
MIR	Mobile Initiated Release
MOC	Mobile Originated Call
MTC	Mobile Terminated Call
NIR	Network Initiated Release
OBW	Occupied Band Width
OCNS	Orthogonal Channel Code Noise
P-CCPCH	Primary Common Control Physical Channel
P-CPICH	Primary Common Pilot Channel
PICH	Page Indicator Channel
PRACH	Physical Random Access Channel
PS	Packet Switched
P-SCH	Primary Synchronization Channel
QPSK	Quadrature Phase Shift Keying
RAB	Radio Access Bearer
RAT	Radio Access Technology
RLC	Radio Link Control
RMC	Reference Measurement Channel
RRC	Root -raised cosine (filter)
RSSI	Receiver Signal Strength Indicator
SEM	Spectrum Emission Mask
SFN	System Frame Number
SIM	Subscriber Identity Module
SRB	Signaling Radio Bearer
S-SCH	Secondary Synchronization Channel
TDD	Time Division Duplex
TPC	Transport Power Control
UE	User Equipment
UL TFCI	UL-Transport Format Indicator
USIM	Universal Subscriber Identity Module
UTRA FDD	UMTS Terrestrial Radio Access "FDD"
WCDMA	Wideband Code Division Multiple Access
CDMA2000®	
ACPR	Adjacent Channel Power Ratio
AWGN	Additive White Gaussian Noise
CDMA	Code Domain Multiple Access
CDP	Code Domain Power
ESN	Electronic Serial Number
EVM	Error Vector Magnitude
EVRC	Enhanced Variable Rate Codec
FCH	Fundamental Channel
FER	Frame Error Rate
Fwd. Link	Forward link
gpsOne	Global Positioning System (GPS in cdmaOne)
H-PSK	Hybrid Phase Shift Keying
JTACS	Japanese Total Access Communication System
PCS	Personal Communications Services
PICH	Pilot Channel
PN	Pseudo Noise
QCELP	Qualcomm Code Excited Linear Predictive coding
RC	Radio Configuration
Rev. Link	Reverse Link
SCH0, SCH1	Supplemental Channels 0 and 1
SMS	Short Message Service
SO	Service Option
TCH	Traffic Channel
TDSO	Test Data Service Option
TIA	Telecommunications Industry Association

Certified Quality System
ISO 9001

Certified Environmental System
ISO 14001

For specifications, see PD 5213.6041.22
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