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**R&S® CMU200: THE tester for current and future Mobile Radio Networks with scalable multimode functionality**

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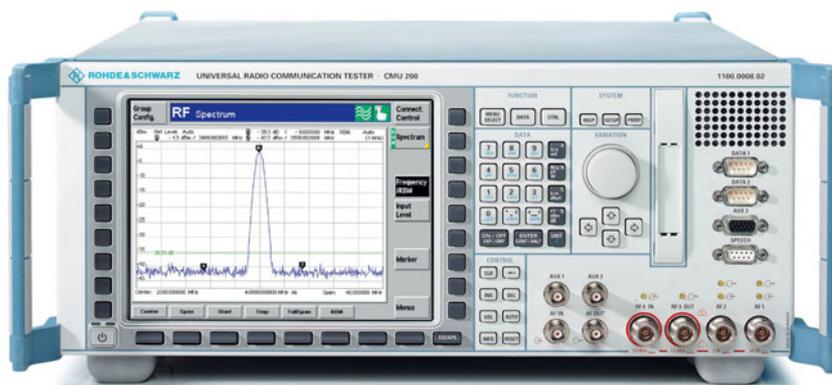
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## Universal Radio Communication Tester R&S®CMU200

**THE multiprotocol tester for current and future mobile radio networks with scalable multimode functionality**



### Brief description

The Radio Communication Tester R&S®CMU200 brings 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.

The base unit without any options installed can be used for testing general parameters of 1st, 2nd or 3rd generation mobile phones. The R&S®CMU200 base unit is the ideal solution for tasks at the module level, i.e. at the early production stages of all cellular standards. Integral parts of the R&S®CMU200 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.

The R&S®CMU200 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.

### Applications

- ◆ RF development
- ◆ Module design
- ◆ Module test in production
- ◆ Adjustment of mobiles
- ◆ Final test in production
- ◆ Functional test
- ◆ Feature test
- ◆ High-end service
- ◆ Quality inspections
- ◆ Basis for test systems
- ◆ Base station simulation

### Main features

- ◆ Extremely high-speed testing
- ◆ Highly accurate measurements
- ◆ Excellent result repeatability
- ◆ Fast switching between networks
- ◆ Comprehensive spectrum analyzer
- ◆ Modular hardware and software concept provides easy expansion to further functionality
- ◆ Easy migration to emerging standards
- ◆ Very flat menu structure with context-sensitive selection, entry and configuration pop-up menus
- ◆ Extremely low power consumption and effective heat conduction result in unparalleled reliability

### Characteristics

The base unit with its standard-independent module test provides many general-purpose measurement facilities for the development of all kinds of standards within its wide and continuous frequency range. If extended by the appropriate options, the R&S®CMU200 offers the hardware and software necessary to handle your 3G, 2.5G and previous-generation testing applications, including analog.

### GSM characteristics (option)

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

- ◆ GSM400
- ◆ GSM850
- ◆ GSM900 including
  - P-GSM (primary GSM)
  - E-GSM (extended GSM)
  - R-GSM (railway GSM)
- ◆ GSM1800 (DCS)
- ◆ GSM1900 (PCS)

Whether the application is in production, service or development, the flexible concept of the R&S®CMU200 can handle practically all requirements: from basic RF signal generation, frequency, power and

## Universal Radio Communication Tester R&S®CMU200

spectrum analyzer measurements for the alignment of modules in production or development, to full GSM-specific signaling in any of the GSM bands, as well as module tests on frequencies anywhere in the range from 10 MHz to 2.7 GHz.

### GMSK/8PSK measurements

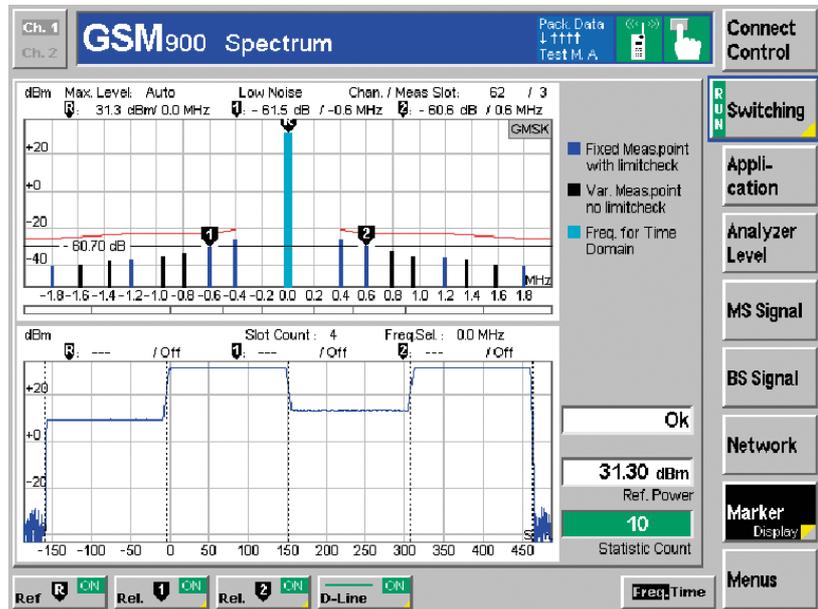
- ◆ Phase/frequency error, EVM, magnitude error, origin offset, I/Q imbalance GMSK for I/Q modulator tuning
- ◆ Power versus time
  - On up to 4 UL slots
  - Normal/access
  - Peak power/average, power versus frame, power versus slot
- ◆ High-speed ACP measurement (switching and modulation measurement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

### Benchmark-breaking IEC/IEEE bus speed due to

- ◆ Parallel measurements
- ◆ Fast production test mode (Rohde&Schwarz-proprietary)
- ◆ New fast modulation spectrum measurement (requires R&S®CMU-U65)
- ◆ Optimized processing power using latest DSP generations
- ◆ Statistical BER test based on confidence evaluation

### High flexibility for R&D

- ◆ Assignment on up to 8 UL and DL slots (TS 0 to 7)
- ◆ TX/RX on any transmit slot
- ◆ Individual level generation on any DL slot used



*The newly designed spectrum application allows the simultaneous measurement of spectra due to switching and modulation. With the R&S®CMU-U65 option, this can be done virtually 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*

- ◆ 3GPP packet data test mode supporting modes A, B and EGPRS loop
- ◆ GPRS/EGPRS TBF reconfiguration during established link
- ◆ GPRS/EGPRS intra-band handover

### TDMA characteristics (option)

The R&S®CMU200 simulates a TDMA base-station RF interface including the signalling protocol so that a mobile phone can be tested with regard to different signalling parameters. All necessary network and base-station parameters can be set, such as control and traffic channel configuration, neighbouring channels setup, etc. MAHO report can also be generated. The non-signalling mode is for generating and analyzing TDMA (IS-136) signals in the frequency range from 10 MHz to 2.7 GHz.

### Basic features

- ◆ Call to or from mobile phone
- ◆ Handoff to AMPS
- ◆ Dual-band handoff

### Signalling measurements

- ◆ MAHO report
- ◆ Power versus time
  - Short burst
  - Normal burst
- ◆ Modulation
  - Phase error
  - Magnitude error
  - EVM/EVM10
  - Overview of phase/magnitude and EVM simultaneously
- ◆ Spectrum
  - Adjacent channel power due to switching or modulation
- ◆ Overview
  - Signalling information

## Universal Radio Communication Tester R&S®CMU200

### Non-signalling measurements

- ◆ Modulation
- ◆ Spectrum
- ◆ Power versus time
- ◆ BER

### AMPS characteristics (option)

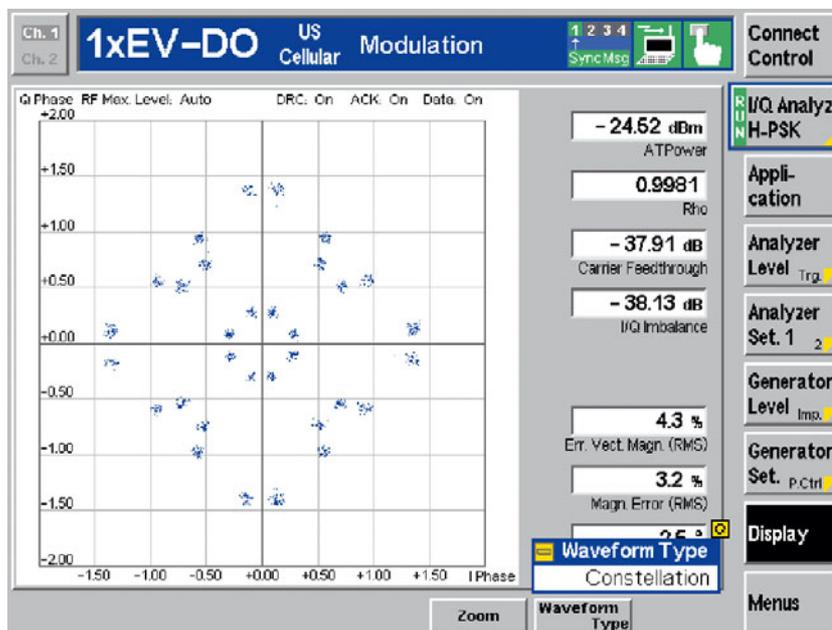
- ◆ Wide frequency range allowing dual-mode/dual-band testing
- ◆ Powerful signalling capabilities
- ◆ Base station simulation
- ◆ Mobile or base station originated call connect/disconnect
- ◆ Short measurement time ensuring high throughput
- ◆ Combined measurements
- ◆ Simple interactive operation, standardized MMI
- ◆ No specialized network knowledge required
- ◆ Various handoffs from cdma2000/TDMA and to TDMA supported

### 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

### Receiver measurements

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



The I/Q analyzer provides a constellation diagram as well as an eye pattern for the I and Q component.

### 1xEV-DO characteristics (option)

With the 1xEV-DO option, the R&S®CMU200 offers a very flexible all-in-one solution including a 1xEV-DO generator for receiver measurements of 1xEV-DO access terminals as well as an extensive list of transmitter measurements. The test concept is based on the factory test mode (FTM) which provides direct control of the DUT without complete signalling. The FTM is implemented via the serial diagnostic monitor interface which is already present in most 1xEV-DO terminal designs. The factory test mode minimizes test configuration and transition time between tests and allows simultaneous testing of different DUTs. Enhanced measurement times and optimized test sequences are a special benefit especially in production environments, yielding higher throughput.

### 1xEV-DO features

- ◆ Simultaneous testing of up to four access terminals
- ◆ Reduced test times in comparison to full signalling tests
- ◆ Extremely flexible 1xEV-DO generator allows vendor-specific tests and new test scenarios
- ◆ Channel filters allow the reverse link signal to be evaluated in eight different states
- ◆ Combines 1xEV-DO with cdma2000 test applications in one box for dual-mode cdma2000/1xEV-DO testing
- ◆ All band classes used are supported
- ◆ Code domain power includes time switching between RRI and pilot channel
- ◆ Different network conditions can be simulated by a user-definable number of additional users in the forward link



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### cdma2000 1X characteristics (option)

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®CMU200 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®CMU200 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®CMU200 also supports the requirements placed on the gpsOne test application; the R&S®CMU200 meets the high demands for frequency and phase accuracy.

The cdma2000 1X implementation in the R&S®CMU200 is based on the TIA/EIA IS-2000 Rev. 0 standard. However, features of Rev. A are partly implemented. The R&S®CMU200 currently supports, for example, FER measurements on two supplemental channels (SCH0 and SCH1).

### cdma2000 1X features

- ◆ cdma2000 speech coder for high-precision acoustic measurements
- ◆ Multiple connection types to cover most important test requirements in R&D, production and high-level service labs
- ◆ 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
- ◆ Measurements under fading conditions supported (baseband fading; requires option R&S®CMU-B17 in combination with a fading generator such as the R&S®ABFS)
- ◆ 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
- ◆ Parallel RX/TX measurements ensuring high throughput in production environments
- ◆ Graphical representation of measurement results best suited for R&D labs
- ◆ Readout and display of many mobile-phone-specific parameters (ESN, slot cycle index, etc)
- ◆ Extremely fast measurements
- ◆ Non-signalling and signalling mode
- ◆ Various handoffs supported (e.g. handoff to AMPS, interband handoff)

### WCDMA characteristics (option)

The tests provided by the R&S®CMU200 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®CMU200 is already prepared for Release 5. 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). The R&S®CMU200 can be fitted with an FDD transmitter tester, an additional FDD generator, and FDD signalling hardware. Depending on the application, only the first or the first two might be needed, allowing T&M budgets to be optimized. The three parts allow the R&S®CMU200 to be configured for non-signalling TX, TX/RX or signalling TX/RX measurements and functional testing on the UE (user equipment) according to 3GPP specification. Due to the highly user-friendly menu concept, the R&S®CMU200 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®CMU200 WCDMA solution. Moreover, handover to other cellular networks such as GSM, i.e. inter-RAT handovers, are implemented and will also be expanded depending on the specification progress.



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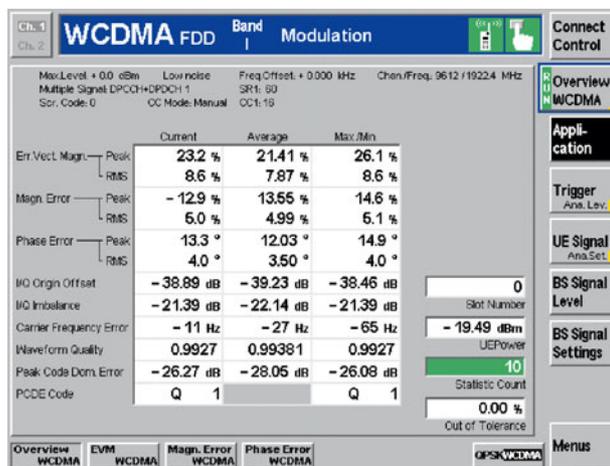
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### WCDMA features

- ◆ Shortest measurement time ensuring high throughput
- ◆ Benchmark-breaking ICE/IEEE bus speed (see highlights of base unit)
- ◆ Combined measurements, many different measurement modes
- ◆ Multiband/multimode testing
- ◆ Powerful signalling capabilities available: MOC, MTC, MIR, NIR, inter-frequency handover, inter-RAT handover, cell reselection
- ◆ Display of UE properties
- ◆ Large selection of radio access bearers (RABs) with various data rates
- ◆ Up to 384 kbit/s reference measurement channels (symmetrical and asymmetrical)
- ◆ 3GPP-conforming generation of OCNS (orthogonal noise signals)
- ◆ Separate and highly accurate level setting for each individual DL code channel
- ◆ Simple voice test using RAB/echo by tester; dedicated audio tests available (option)
- ◆ User-defined settings of RF-relevant signalling parameters
- ◆ 3G dedicated trigger options
- ◆ External message analyzer for reading signalling message log files (option)
- ◆ Simple interactive operation in manual MMI
- ◆ No specialized network knowledge required
- ◆ Stimulation of compressed mode patterns soon available
- ◆ Compressed mode measurements soon available



*The modulation overview menu provides fast, comprehensive information on the UE's RF performance. The hotkeys at the bottom of the screen provide immediate access to specific and detailed measurements*

### Bluetooth® characteristics (option)

The R&S® CMU 200 was the first *Bluetooth* test set on the market. It is the only radiocommunication tester worldwide to offer Bluetooth as well as all important mobile radio standards in a single instrument.

The R&S® CMU 200 with the *Bluetooth* option is the ideal instrument for the production, development and maintenance of any kind of device with an integrated *Bluetooth* interface. Due to its modular platform concept, the R&S® CMU 200 is the ideal solution for all cellular-standard mobile-phone production lines.

Due to the high measurement speed and large memory capacity of the R&S® CMU 200, transmitter and receiver measurements can be carried out simultaneously. When measurements are performed in frequency hopping mode, a significant test depth is rapidly attained. Only a few seconds are required between call setup, transmitter and receiver measurements and call detach. Fast test cycles ensure a fast return on investment.

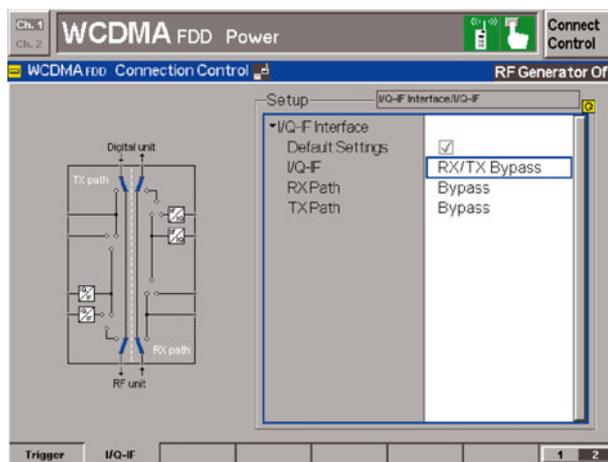
- ◆ *Bluetooth* Core Specifications Version 1.1 (DUTs to 1.2 can also be measured)
- ◆ RF Test Specification Version 0.92
- ◆ Measurements in *Bluetooth* test mode, non-test mode or without a connection
- ◆ Selectable channels and stop conditions for in-depth signal analysis
- ◆ Park, hold and sniff modes for power consumption tests
- ◆ Audio codec integrated (CVSD, A-law, μ-law) for test of audio equipment
- ◆ High measurement accuracy and speed
- ◆ Parallel TX and RX measurement of the RF interface in loopback mode
- ◆ Output of *Bluetooth*-specific clock signal
- ◆ IF signal output

### I/Q and IF interfaces (option)

The R&S® CMU-B17 option allows access to analog I/Q and IF signals in both communication directions (uplink and downlink). Once a radio link has been established, complex I/Q signals can be applied or transmitted for further analysis.

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Fitted with the R&S®CMU-B17 option, the R&S®CMU200, together with the Fading Simulator R&S®ABFS, provides a cost-effective solution for the specified measurement task. Optionally, the Signal Generator R&S®SMIQ with the option R&S®SMIQB14 can be used; the transmit module of the generator can also provide a faded RF signal.



*Menu in the R&S®CMU200 for setting the test paths (default setting: RX/TX bypass mode)*

### Specifications in brief

You will find detailed and binding data on the enclosed CD (./DATASHEET/CMU200.pdf), or, for the latest updates, visit [www.rohde-schwarz.com](http://www.rohde-schwarz.com), search term: **CMU200**

#### RF generator

Frequency range	100 MHz to 2700 MHz
Frequency resolution	0.1 Hz
Frequency settling time	<400 μs to Δf <1 kHz
<b>Output level range</b>	
<b>RF1</b>	
100 kHz to 2200 MHz	-130 dBm to -27 dBm
2200 MHz to 2700 MHz	-130 dBm to -33 dBm
<b>RF2</b>	
100 kHz to 2200 MHz	-130 dBm to -10 dBm
2200 MHz to 2700 MHz	-130 dBm to -16 dBm
<b>RF3<sub>OUT</sub></b>	
100 kHz to 2200 MHz	-90 dBm to +13 dBm
2200 MHz to 2700 MHz	-90 dBm to +5 dBm

#### RF analyzer

<b>Power meter (frequency-selective)</b>	
Frequency range/resolution	10 MHz to 2700 MHz/0.1 Hz
Resolution bandwidths	10 Hz to 1 MHz in 1/2/3/5 steps
Level range for rated data	
<b>RF1 (continuous power)<sup>1)</sup></b>	
10 MHz to 2200 MHz	-40 dBm to +47 dBm (50 W)
2200 MHz to 2700 MHz	-34 dBm to +47 dBm (50 W)
Max. peak power <sup>2)</sup> (PEP)	+53 dBm (200 W)
<b>RF2 (continuous power)<sup>1)</sup></b>	
10 MHz to 2200 MHz	-54 dBm to +33 dBm (2 W)
2200 MHz to 2700 MHz	-48 dBm to +33 dBm
Max. peak power <sup>2)</sup> (PEP)	+39 dBm (8 W)
<b>RF4<sub>IN</sub> (continuous power and PEP)</b>	
10 MHz to 2200 MHz	-80 dBm to 0 dBm
2200 MHz to 2700 MHz	-74 dBm to 0 dBm

#### Spectrum analyzer

Frequency range	10 MHz to 2.7 GHz
Span	zero span to full span
Frequency resolution	0.1 Hz
Resolution bandwidths	10 Hz to 1 MHz in 1/2/3/5 steps

#### Audio option R&S®CMU-B41

<b>AF sine generator</b>	
Frequency range	20 Hz to 20 kHz
Frequency resolution	0.1 Hz
Level range	10 μV to 5 V
<b>AF voltmeter</b>	
Frequency range	50 Hz to 20 kHz
Level range	50 μV to 30 V

#### General data

Rated temperature range	+5 °C to +45 °C
Storage temperature range	-25 °C to +60 °C
Power supply	100 V to 240 V ±10% (AC), 3.1 A to 1.3 A, 50 Hz to 400 Hz, -5% to +10% power factor correction
Power consumption	
Base unit	130 W
with typical options	180 W
Dimensions (W × H × D)	465 mm × 193 mm × 517 mm (19"; 4 height units)
Weight base unit	14 kg
Weight with typical options	18 kg

- 1) 50 W in the temperature range +5°C to +30°C, linear degradation down to 25 W at 45°C.
- 2) Mean value of power vs time must be equal or less than allowed continuous power.

## Universal Radio Communication Tester R&S® CMU 200

Ordering information (continued on the next page)

Type	Description	GSM/GPRS/EDGE/HSCSD	TDMA	AMPS	cdma2000	WCDMA	Bluetooth	Order No.
R&S® CMU200	Base unit with following accessories: power cord, operating manual, service manual for instrument	✓	✓	✓	✓	✓	✓	1100.0008.02
R&S® CMU-B11 <sup>1)</sup>	Reference OCXO, aging $2 \times 10^{-7}$ /year; ensures high absolute accuracy, minimum temperature-dependent drift and especially high long-term stability; used for measurements with exact frequency stability requirements	☺	☺	☺	☺	☺	☺	1100.5000.02
R&S® CMU-B12 <sup>1)</sup>	High-stability OCXO, aging $3.5 \times 10^{-9}$ /year. Oven crystal with highest long-term stability; ensures compliance with tolerances specified by GSM; used for highly demanding frequency stability requirements to GSM 11.20	☺	☺	☺	☺	☺	☺	1100.5100.02
R&S® CMU-B17	Analog I/Q IF interface	☺	☺	–	☺	☺	–	1100.6906.02
R&S® CMU-B21	Universal signalling unit; provides multistandard signalling hardware; required for WCDMA 3GPP FDD	✓	✓	✓	–	✓	✓	1100.5200.14
R&S® CMU-B41	Audio generator and analyzer; includes audio frequency (AF) generator, voltmeter, distortion meter	☺	☺	✓	☺	☺	☺	1100.5300.02
R&S® CMU-B52	Internal versatile multimode speech coder/decoder; R&S® CMU-B21 necessary	☺	☺	–	–	☺	☺	1100.5400.14
R&S® CMU-B53	Bluetooth extension; R&S® CMU-B21 necessary	–	–	–	–	–	✓	1100.5700.14
R&S® CMU-B54	Signalling module for AMPS, TDMA, GSM/GPRS/EGPRS; R&S® CMU-B21 necessary	☺	☺	☺	–	–	–	1150.2604.14
R&S® CMU-B56	WCDMA (3GPP FDD) signalling module; R&S® CMU-B21 necessary	–	–	–	–	✓	–	1150.1850.14
R&S® CMU-B66 <sup>1)</sup>	Versatile baseband board for WCDMA (3GPP FDD) Layer 1, DL, non-signalling	–	–	–	–	✓	–	1149.9509.02
R&S® CMU-B68 <sup>2)</sup>	Versatile baseband board for WCDMA (3GPP FDD) Layer 1, DL and UL, non-signalling	–	–	–	–	✓	–	1149.9809.02
R&S® CMU-B69	Option package WCDMA (3GPP/FDD) complete for band 1, signalling	–	–	–	–	✓	–	1150.2304.02
R&S® CMU-B73	Analog telephone line interface	–	–	☺	–	–	–	1150.2004.02
R&S® CMU-B83	cdma2000 1x signalling unit	–	–	–	✓	–	–	1150.0301.12
R&S® CMU-B85	8k/13k QCELP, 8k EVRC speech codec for cdma2000 1 × Signalling Unit R&S® CMU-B83	–	–	–	☺	–	–	1100.7002.12
R&S® CMU-B87	Message monitor for cdma2000 1x Signalling Unit R&S® CMU-B83	–	–	–	☺	–	–	1150.2404.02
R&S® CMU-B88	cdma2000 1xEV-DO (HDR) extension board for cdma2000 1 × Signalling Unit R&S® CMU-B83	–	–	–	☺	–	–	1158.9908.02
R&S® CMU-B95	2nd TX RF channel; BCCH always present with GSM/GPRS/EGPRS	☺	–	–	–	–	–	1159.0504.02
R&S® CMU-B99	RF1 level range identical to RF2	☺	☺	☺	☺	☺	☺	1150.1250.02
R&S® CMU-DCV	Documentation of calibration values	☺	☺	☺	☺	☺	☺	0240.2193.08
R&S® CMU-K20	GSM400 mobile station signalling/non-signalling test software	✓	–	–	–	–	–	1115.5900.02
R&S® CMU-K21	GSM900, R-GSM and E-GSM mobile station signalling/non-signalling test software	✓	–	–	–	–	–	1115.6007.02
R&S® CMU-K22	GSM1800 (DCS) mobile station signalling/non-signalling test software	✓	–	–	–	–	–	1115.6107.02
R&S® CMU-K23	GSM1900 (PCS) mobile station signalling/non-signalling test software	✓	–	–	–	–	–	1115.6207.02
R&S® CMU-K24	GSM850 mobile station signalling/non-signalling test software	✓	–	–	–	–	–	1115.6307.02
R&S® CMU-K27	IS-136/cellular (800 MHz band) mobile station signalling/non-signalling test software	–	✓	–	–	–	–	1115.6607.02
R&S® CMU-K28	IS-136/PCS (1900 MHz band) mobile station signalling/non-signalling test software	–	✓	–	–	–	–	1115.6707.02
R&S® CMU-K29	AMPS mobile station signalling/non-signalling test software	–	–	✓	–	–	–	1115.6807.02
R&S® CMU-K42	GPRS test software extension for all GSM test software packages	☺	–	–	–	–	–	1115.4691.02

## Universal Radio Communication Tester R&S®CMU200

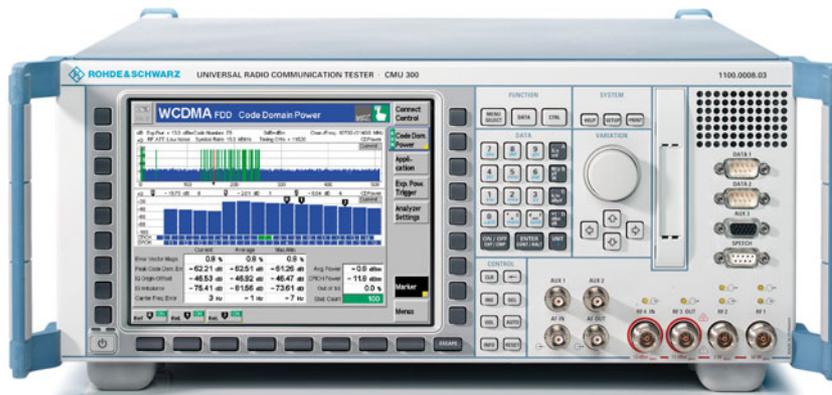
Type	Description	GSM/GPRS/ EDGE/HSCSD	TDMA	AMPS	cdma2000	WCDMA	Bluetooth	Order No.
R&S®CMU-K43	EGPRS classic (EDGE) signalling test software for all GSM test software packages	☺	–	–	–	–	–	1115.6907.02
R&S®CMU-K45	AMR test software extension for all GSM software packages	☺	–	–	–	–	–	1150.3100.02
R&S®CMU-K53	Bluetooth test software; R&S®CMU-B53 necessary	–	–	–	–	–	✓	1115.5000.02
R&S®CMU-K65 <sup>1)</sup>	WCDMA (3GPP/FDD) UL user equipment TX test, non-signalling test software	–	–	–	–	✓	–	1115.4891.02
R&S®CMU-K66 <sup>3)</sup>	WCDMA (3GPP/FDD) DL generator, non-signalling test software; R&S®CMU-U66 or R&S®CMU-B66 necessary	–	–	–	–	✓	–	1115.5100.02
R&S®CMU-K67	WCDMA (3GPP FDD) band 3, UE test signalling software; R&S®CMU-K65 and R&S®CMU-K66 necessary	–	–	–	–	✓	–	1150.3000.02
R&S®CMU-K68	WCDMA (3GPP FDD) band 1, UE test signalling software; R&S®CMU-K65 and R&S®CMU-K66 necessary	–	–	–	–	✓	–	1115.5300.02
R&S®CMU-K69	WCDMA (3GPP FDD) band 2, UE test signalling software; R&S®CMU-K65 and R&S®CMU-K66 necessary	–	–	–	–	✓	–	1115.5400.02
R&S®CMU-K83	cdma2000 1× (450 MHz band) mobile station signalling/non-signalling test software	–	–	–	✓	–	–	1150.3500.02
R&S®CMU-K84	cdma2000 1× (cellular band) mobile station signalling/non-signalling test software	–	–	–	✓	–	–	1150.3600.02
R&S®CMU-K85	cdma2000 1× (PCS band) mobile station signalling/non-signalling test software	–	–	–	✓	–	–	1150.3700.02
R&S®CMU-K86	cdma2000 1× (IMT2000 band) mobile station signalling/non-signalling test software	–	–	–	✓	–	–	1150.3800.02
R&S®CMU-K88	cdma2000 1xEV-DO (HDR) test software; R&S®CMU-B88 necessary	–	–	–	☺	–	–	1150.3900.02
R&S®CMU-U65	3G measurement DSP and performance accelerator	–	–	–	✓	✓	–	1100.7402.04
R&S®CMU-U80	Trigger output connector for gpsOne	–	–	–	☺	–	–	1150.1750.02
R&S®CMU-Z1	256 Mbyte memory card for use with PCMCIA interface; flash ATA formatted, also named PC Card ATA	☺	☺	☺	☺	☺	☺	1100.7490.04
R&S®CMU-Z6	Enhancement of wideband modulation (WCDMA 3GPP FDD) analyzer accuracy	–	–	–	–	☺	–	1150.0001.02
R&S®CMU-Z10	Antenna coupler 900 MHz/1700 MHz to 2200 MHz	☺	☺	☺	☺	☺	☺	1150.0801.02
R&S®CMU-Z11	RF shielded cover for R&S®CMU-Z10	☺	☺	☺	☺	☺	☺	1150.1008.02
R&S®CMU-Z12	Bluetooth antenna extension for R&S®CMU-Z10	–	–	–	–	–	☺	1150.1043.02
R&S®CMU-Z13	USB feed through for R&S®CMU-Z10	☺	☺	☺	☺	☺	☺	1159.1200.02
R&S®CMU-Z46	WCDMA (3GPP FDD) message analyzer and recorder	–	–	–	–	☺	–	1159.0804.02
R&S®CMU-Z49	GSM message viewer	☺	–	–	–	–	–	1150.2704.02
R&S®CMU-Z50	Handset for R&S®CMU200	☺	☺	☺	☺	☺	☺	1159.0104.02
R&S®CRT-Z12	GSM850/PCS1900 GSM/GPRS test SIM for loopback mode, required for BER and other applications	☺	–	–	–	–	–	1139.1205.02
R&S®CRT-Z2	GSM900/DCS1800 GSM/GPRS test SIM 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®ZZA-411	19" rack adapter	☺	☺	☺	☺	☺	☺	1096.3283.00

1) R&S®CMU-B11 or R&S®CMU-B12 possible. One or two OCXOs should be installed to ensure high frequency accuracy, or an external frequency reference may be used, if available.  
 2) For new units only. Factory installation only.  
 3) R&S®CMU-U65 necessary.

**Definition of table symbols:**  
 ✓ mandatory; ☺ optional; – not applicable

## Universal Radio Communication Tester R&S®CMU300

**Base station tester for development, production, system test, installation and service**



### Brief description

The Universal Radio Communication Tester R&S®CMU300 represents a new generation of compact test solutions for testing the RF interface of base stations. The tester, which follows the specifications of the standardization bodies, is suitable for performing transmitter and receiver tests.

The R&S®CMU300 features all the highlights of a modern tester: maximum measurement accuracy and speed combined with extremely high reliability and repeatability. The R&S®CMU300 from Rohde&Schwarz is a versatile platform for all applications in base station testing: development, production, system test, installation and service.

The tester keeps pace with all steps in the evolution of modern digital mobile radio. It supports GSM, GPRS, EDGE and WCDMA.

### Main features

- ◆ Wide frequency range from 10 MHz to 2.7 GHz
- ◆ Modular future-proof design
- ◆ Flexible RF input/output structure
- ◆ Spectrum analyzer function

- ◆ Measurements on first-, second- and third-generation base stations with a single instrument
- ◆ Manual operation or IEC/IEEE bus control
- ◆ Bright, high-resolution TFT colour display
- ◆ Realtime automatic temperature correction for maximum accuracy
- ◆ Low power consumption
- ◆ Low heat dissipation
- ◆ Optimized cooling concept for higher reliability and less production down times
- ◆ Compact box of only 4 height units
- ◆ Flexible configuration for compatibility with various test environments

### GSM/GPRS/EDGE functionality

In the non-signalling mode, the instrument consists of a GSM/EDGE generator and analyzer which can be operated independently of each other. As soon as an RF signal is applied to the test input, measurement can be started independently of external trigger signals or signalling sequences. This mode is ideal for testing RF boards and modules with little or no signalling activity.

In the signalling mode, however, the R&S®CMU 300 operates synchronously

with the base station, which is a prerequisite for BER measurements and real-time signalling. The signalling mode is suitable for final testing of TRX modules or the complete base station. In most cases, the instrument can be synchronized via the pilot channel (BCCH) of the base station. It is also possible to trigger the R&S®CMU300 via the frame clock.

### GMSK/8PSK transmitter measurements

The following measurements are available in signalling and non-signalling mode:

- ◆ Power/power ramp
- ◆ Modulation analysis
- ◆ Spectrum measurements

In the signalling mode, the following enhanced functions are available in addition:

- ◆ Selective choice of timeslot to be measured in frame
- ◆ Analysis of CCH information
- ◆ Analysis of SACCH information
- ◆ Measurement of power ramp of up to 4 successive bursts
- ◆ Fast measurement of average power of 8 bursts per frame in approx. 5 ms

## Universal Radio Communication Tester R&S®CMU300

### GSM/GPRS/EDGE receiver measurements

This is where the strengths of the R&S®CMU300 as a compact tester become obvious. The capability to generate and analyze different channels in realtime is the key prerequisite for continuous bit error rate (BER) measurement and for automatic search of the sensitivity limit. The R&S®CMU300 supports various measurement paths (PN generator/device under test (DUT)/BER evaluation). For the majority of channels to be measured, the test path can be routed via various closed loops within the base station or via the A<sub>bis</sub> interface. The R&S®CMU300 itself can be used as an RF loop. Bit error rate measurements can be performed on the following traffic channels:

- ◆ **GSM:** TCH/FS, TCH/HS, TCH/EF3, TCH/F14.4, TCH/F9.6, TCH/F4.8, TCH/H4.8, TCH/H2.4
- ◆ **GPRS:** PDTCH-CS1, PDTCH-CS2, PDTCH-CS3, PDTCH-CS4,
- ◆ **ECSD:** E-TCH/F43.2 NT
- ◆ **EGPRS:** PDTCH-MCS1, PDTCH-MCS2, PDTCH-MCS3, PDTCH-MCS4, PDTCH-MCS5, PDTCH-MCS6, PDTCH-MCS7, PDTCH-MCS8, PDTCH-MCS9

The RACH signalling channel can also be tested. For conformance tests, the R&S®CMU300 provides the following uplink signalling channels modulated with PSR data (option R&S®CMU-K38):

- ◆ FACCH/F
- ◆ SACCH
- ◆ SDCCH/4, SDCCH/8

The PSR data must be evaluated in the BTS or its controller. Further information on the test environment of the base station required to perform customer-specific BER tests can be obtained on request. Another special feature of the R&S®CMU300 is its capability of performing tests on hopping base stations.

### WCDMA functionality

#### 3GPP FDD receiver measurements

For receiver tests on WCDMA base stations, the R&S®CMU300 can be equipped with an RF generator (3GPP FDD, release 99). The instrument is thus able to generate all reference test channels specified in 3GPP TS 25.141 from 12.2 kbps up to 2048 kbps in real-time.

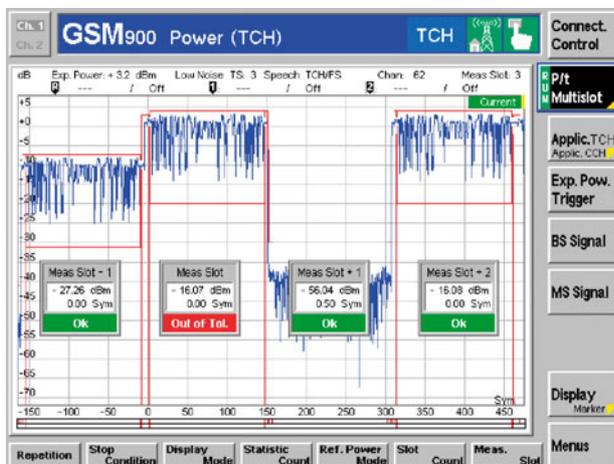
Test data sequences from PN9 to PN16 are supported. The R&S®CMU300 is triggered by the transmission time interval (TTI) signals of the base station. Moreover, it is able to feed measured data into the following physical channels:

- ◆ 15 kbps, 30 kbps, 60 kbps, 120 kbps, 480 kbps, 1 × 960 kbps, 2 × 960 kbps, 3 × 960 kbps, 4 × 960 kbps, 5 × 960 kbps, 6 × 960 kbps

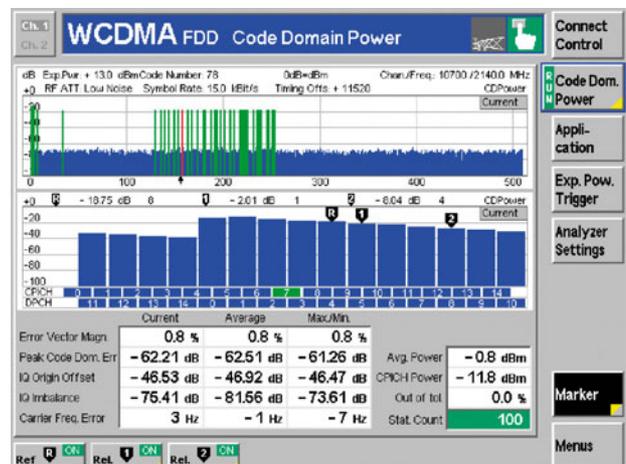
#### 3GPP FDD transmitter measurements

The newly developed transmitter measurements in non-signalling mode are based on the 3GPP TS 25.141 FDD WCDMA specification. In implementing this solution, special emphasis was placed on high precision and measurement speed. The R&S®CMU300 measurements are based on the DL test models, including CPICH channel as defined in the specification.

- ◆ Power measurement
  - Power meter (wideband or frequency selective)
  - Code domain power (CDP)



8PSK power versus Multislot measurement menu



3GPP FDD code domain power measurement with test model 3.32

## Universal Radio Communication Tester R&S®CMU300

### Options, software, modification kits, extras and ordering information

Type/Option	Description	Comments on table: ✓ mandatory; ☺ optional; – not applicable 1) Depending on the required frequency band.	BERT GSM	BERT GPRS	BERT EGPRS	GMSK TX tests	8PSK TX tests	FDD UL-generator	FDD DL TX test	Order No.
<b>Hardware options</b>										
R&S®CMU-B12	Reference oscillator OCXO, aging $3.5 \times 10^{-8}$ /year		☺	☺	☺	☺	☺	–	–	1100.5100.02
R&S®CMU-B17	I/Q/IF interface, analog, one channel, (R&S®CMU300 factory installation only)		☺	☺	☺	☺	☺	☺	☺	1100.6906.02
R&S®CMU-B21	Versatile signalling unit for R&S®CMU		✓	✓	✓	✓	✓	–	–	1100.5200.02
R&S®CMU-B71	A <sub>bis</sub> interface unit; E1/T1 protocol; for BER test only		☺	–	–	–	–	–	–	1100.6406.02
R&S®CMU-B76	Layer1 board for WCDMA		–	–	–	–	–	✓	–	1150.0601.02
<b>SW options</b>										
R&S®CMU-K30	GSM400 BTS measurement software, R&S®CMU-B21 required		✓ <sup>1)</sup>	–	–	1115.4004.02				
R&S®CMU-K31	GSM900 BTS measurement software, R&S®CMU-B21 required		✓ <sup>1)</sup>	–	–	1115.4104.02				
R&S®CMU-K32	GSM1800 BTS measurement software, R&S®CMU-B21 required		✓ <sup>1)</sup>	–	–	1115.4204.02				
R&S®CMU-K33	GSM1900 BTS measurement software, R&S®CMU-B21 required		✓ <sup>1)</sup>	–	–	1115.4304.02				
R&S®CMU-K34	GSM850 BTS measurement software, R&S®CMU-B21 required		✓ <sup>1)</sup>	–	–	1115.4404.02				
R&S®CMU-K38	Signalling channels (GSM/UL) with PSRB pattern modulation, R&S®CMU-K30 to -K33 requ.		☺	–	–	–	–	–	–	1150.3400.02
R&S®CMU-K39	GSM signalling procedure MOC/MTC (circuit-switched), R&S®CMU-K30 to -K33 required		☺	–	–	☺	☺	–	–	1115.4791.02
R&S®CMU-K41	EDGE/8PSK extension for GSM Hardware/Software (8PSK TX tests and EGPRS channel coders), R&S®CMU-K30 to -K33 required		–	–	✓	–	✓	–	–	1115.4504.02
R&S®CMU-K75	WCDMA TX test (3GPP FDD/DL), R&S®CMU-U75 required		–	–	–	–	–	–	✓	1150.3200.02
R&S®CMU-K76	WCDMA generator (3GPP FDD/UL), R&S®CMU-B76 required		–	–	–	–	–	✓	–	1150.3300.02
R&S®CMU-K77	AWGN generator and BER/BLER simulation (3GPP FDD/UL), R&S®CMU-K76 required		–	–	–	–	–	☺	–	1150.4107.02
<b>Further options</b>										
R&S®CMU-U10	HW modification: memory extension for 64 MByte CMU		☺	☺	☺	☺	☺	☺	☺	1159.0404.02
R&S®CMU-U74	Upgrade kit for units delivered before July 2003: high dynamic WCDMA spectrum measurements		–	–	–	–	–	–	☺	1159.0704.02
R&S®CMU-U75	Upgrade kit: measurement DSP module for WCDMA		–	–	–	–	–	–	✓	1150.0501.02
R&S®CMU-U76	Upgrade kit: layer 1 board for WCDMA (to be used for upgrade of existing units instead of R&S®CMU-B76)		–	–	–	–	–	☺	–	1150.0701.02
R&S®CMU-DCV	Documentation of calibration values		☺	☺	☺	☺	☺	☺	☺	0240.2193.08
R&S®CMU-DKD	R&S®CMU200/300 DKD calibration incl. ISO9000 calibration (order only with device)		☺	☺	☺	☺	☺	☺	☺	1159.4600.02
R&S®CMU-Z1	Accessory: 256 Mbyte memory card, PCMCIA type 3		☺	☺	☺	☺	☺	☺	☺	1100.7490.04
R&S®CMU-Z6	Accessory: enhancement of wideband modulation analysis		–	–	–	–	–	–	☺	1150.0001.02
R&S®ZAA-411	19"rack adapter		☺	☺	☺	☺	☺	☺	☺	1096.3283.00

- ◆ Modulation analysis
  - Error vector magnitude (EVM), magnitude error, phase error
  - Carrier frequency error
  - I/Q origin offset
  - I/Q imbalance
  - Waveform quality
  - Peak code domain error power (PCDEP)
- ◆ Spectrum measurement (inband)
  - Adjacent channel leakage power ratio (ACLR)
  - Occupied bandwidth (OBW)
  - Spectrum emission mask (SEM)

Performing these often very complex measurements, the R&S®CMU300 ventures into new speed ranges: The CDP measurement with channel model 3.32, for example, takes only about 0.3 seconds/frame – without even requiring additional external triggering.

### Options

The base unit of the R&S®CMU300 provides the functionality of two RF measuring instruments – an RF signal generator and an RF spectrum analyzer.

### GSM/EDGE

The base unit is converted into a radio-communication tester for GSM/GPRS by incorporating the Signalling Unit R&S®CMU-B21 and at least one of the five GSM software options R&S®CMU-K30 through -K34. The GSM functions can be enhanced to EDGE by software option R&S®CMU-K41. Software option R&S®CMU-K39 allows channel setup using the GSM signalling procedures MOC/MTC (mobile originated/terminated call).

## Universal Radio Communication Tester R&S®CMU300

The optional A<sub>bis</sub> Board R&S®CMU-B71 is required for BER tests if the bit pattern sent by the R&S®CMU300 cannot internally be looped back by the base station.

### WCDMA

By adding the hardware option R&S®CMU-B76 (WCDMA Layer 1 Board) and the 3GPP FDD software option R&S®CMU-K76, the R&S®CMU300 is

converted into a source for all the required reference test channels up to 2048 kbps. For WCDMA TX measurements the options R&S®CMU-K75 and R&S®CMU-U75 must be fitted. The options GSM/EDGE and WCDMA can be installed independently of one another. If existing instruments are to be retrofitted, the option R&S®CMU-U76 must be ordered instead of R&S®CMU-B76.

The Software Option R&S®CMU-K77 provides an AWGN generator and the possibility to simulate bit errors. In this way more receiver tests according to specification 3GPP TS25.141 FDD can be performed.

Additional IQ/IF inputs/outputs (option R&S®CMU-B17) allow bit error rate measurements under fading conditions in conjunction with the R&S®SMIQ or R&S®ABFS.

### Specifications in brief

**You will find detailed and binding data on the enclosed CD (./DATASHEET/CMU300.pdf), or, for the latest updates, visit [www.rohde-schwarz.com](http://www.rohde-schwarz.com), search term: CMU300**

#### RF generator

Frequency range	100 kHz to 2700 MHz
Frequency resolution	0.1 Hz
Frequency uncertainty	same as timebase + resolution
Frequency settling time	<400 µs to Δf <1 kHz
<b>Output level range (RF1)</b>	
RF1	
100 kHz to 2200 MHz	-130 dBm to -27 dBm
2200 MHz to 2700 MHz	-130 dBm to -33 dBm
RF2	
100 kHz to 2200 MHz	-130 dBm to -10 dBm
2200 MHz to 2700 MHz	-130 dBm to -16 dBm
RF3 <sub>OUT</sub>	
100 kHz to 2200 MHz	-90 dBm to +13 dBm
2200 MHz to 2700 MHz	-90 dBm to +5 dBm

#### RF analyzer

<b>Power meter (frequency-selective)</b>	
Frequency range; resolution	10 MHz to 2700 MHz; 0.1 Hz
Resolution bandwidth	10 Hz to 1 MHz in 1/2/3/5 sequence
<b>Level range</b>	
RF1, continuous power <sup>1)</sup>	
10 MHz to 2200 MHz	-40 dBm to +47 dBm (50 W)
2200 MHz to 2700 MHz	-34 dBm to +47 dBm (50 W)
Peak envelope power <sup>2)</sup> (PEP)	+53 dBm (200 W)
RF2, continuous power	
10 MHz to 2200 MHz	-54 dBm to +33 dBm (2 W)
2200 MHz to 2700 MHz	-48 dBm to +33 dBm
Peak envelope power <sup>2)</sup> (PEP)	+39 dBm (8 W)
RF4 <sub>IN</sub> (continuous power and PEP)	
10 MHz to 2200 MHz	-80 dBm to 0 dBm
2200 MHz to 2700 MHz	-74 dBm to 0 dBm

<sup>1)</sup> 50 W (+5°C to +30°C), linear degradation down to 25 W at 45°C.

<sup>2)</sup> Mean value of power versus time must be equal or less than allowed continuous power.

#### Spectrum analyzer

Frequency range	10 MHz to 2.7 GHz
Span	zero span to full span
Frequency resolution	0.1 Hz
Resolution bandwidths (RBW)	10 Hz to 1 MHz in 1/2/3/5 sequence

#### General data

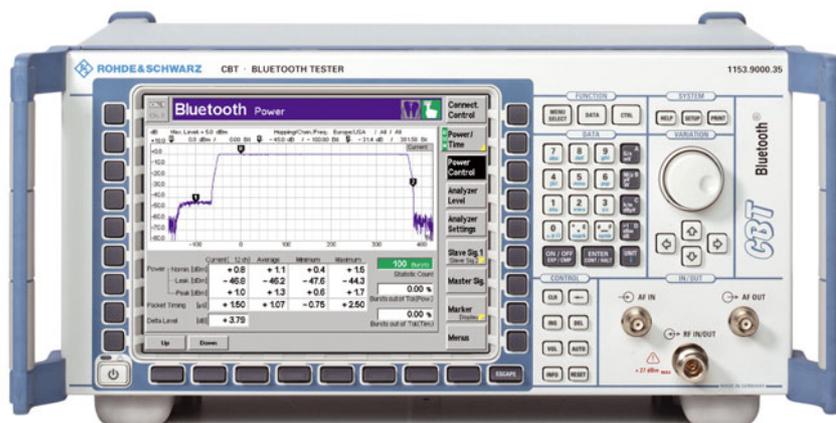
Operating temperature range	+5°C to +45°C
Storage temperature range	-25°C to +60°C
Display	21 cm TFT colour display (8.4")
Resolution	640 × 480 pixels (VGA resolution)
Power supply	100 V to 240 V ± 10% (AC), max. 500 VA, 50 Hz to 400 Hz -5% to +10%
Power consumption	
Base unit	130 W
With typical options	180 W
Dimensions (W × H × D)	465 mm × 193 mm × 517 mm, (19"; 4 HU)
Weight	
Base unit	14 kg
With typical options	18 kg

### Ordering information

<b>Radio Communication Tester</b>	R&S®CMU 300	1100.0008.03
<b>Accessories supplied</b>	power cord, operating manual, service manual	
<b>Options, software, modification kits, and extras</b>	see table on page before	

## Bluetooth® Testers R&S® CBT/CBT32

**Fast and versatile for development, production and verification**



### Brief description

The *Bluetooth* Tester R&S® CBT offer a large number of statistical monitoring and measurement functions. It is compliant with the *Bluetooth* Core Specifications Version 1.1. The *Bluetooth* test mode (Core Spec. Part I:1) is implemented with all commands needed to perform the TX/RX measurements. In addition, the R&S® CBT is capable of testing all DUTs that support the new *Bluetooth* Core Specifications Version 1.2, since the test mode specified in the new version does not include any changes relevant to the R&S® CBT.

All remote scripts generated for the Bluetooth/signalling functional group of the R&S® CMU200 can also be used for the R&S® CBT and R&S® CBT32 without any modifications. The only prerequisite for compatibility is that in the R&S® CMU200 remote script one of the shared inputs/outputs RF1 or RF2 of the R&S® CMU200 is used for the measurement.

#### Setting up a *Bluetooth* connection

The R&S® CBT acts as the master of a *Bluetooth* piconet, the DUT as a slave. The R&S® CBT is able to perform the inquiry procedure for the identification of all *Bluetooth* devices within range of the

**Bluetooth Tester R&S® CBT with large display for R&D and production**

R&S® CBT. All devices found are listed on the display and one of them can be selected for the paging procedure. The R&S® CBT then establishes the connection to the DUT and switches it to test mode operation. The inquiry procedure can be skipped, if the *Bluetooth* device address of the DUT is already known.

#### Audio mode

In the audio mode, the R&S® CBT establishes a synchronous connection-oriented (SCO) link to the DUT in addition to the ACL link. The R&S® CBT's built-in *Bluetooth* audio codec supports CVSD as well as A-law and  $\mu$ -law coding. External audio generators and analyzers can be connected.

### Main features

- ◆ *Bluetooth* RF tests on all channels
- ◆ Full dirty transmitter for BER tests
- ◆ Speech codec integrated
- ◆ Cost-effective rack version R&S® CBT32 for production applications
- ◆ Very short cycle time for high production throughput

### TX measurements

The current measurement values for each parameter are displayed on the R&S® CBT screen. Additionally, average, maximum and minimum values are displayed as a result of a statistical evaluation of a definable number of *Bluetooth* packets (bursts).

#### Power measurements (output power)

- ◆ Nominal power (measured as the part of the burst starting at the detected first bit of the preamble (bit 0) to the last bit of the burst)
- ◆ Peak power (shows the highest power level within a burst)
- ◆ Leakage power (measured within defined areas before and after the burst)
- ◆ "Power up" and "Power down" commands
- ◆ Check the power control function of a *Bluetooth* DUT

#### Timing measurements

- ◆ Packet alignment (distance between ideal master receiver slot and detected bit 0 of the received burst)



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R&S Addresses



## Bluetooth® Testers R&S® CBT/CBT32

### Modulation measurements

- ◆ Frequency accuracy/initial carrier frequency tolerance (ICFT, difference between measured frequency and intended transmitted frequency, measured in the preamble at the beginning of a packet)
- ◆ Carrier frequency drift (difference between the frequency at the start of the packet and the frequency in the payload)
- ◆ Maximum drift rate (maximum drift rate anywhere within the packet payload)
- ◆ Average, maximum and minimum frequency deviation (calculated over the packet payload)

### RX measurements

For RX measurements, the built-in signal generator generates a selectable bit sequence, which is looped back in the DUT and demodulated and processed by the R&S®CBT again. The TX level of the R&S®CBT can be adjusted for this measurement. The BER application allows up to five test programs to be defined. Each program can independently set settings such as control parameters, limits, repetition or statistical cycles.



*Bluetooth Tester R&S® CBT32: Cost-effective rack version of the R&S® CBT with identical features but without display*

### Sensitivity

- ◆ BER (percentage of bit errors that have occurred within the current statistical cycle)
- ◆ BER search function (sensitivity level for a predefined BER level)
- ◆ PER (percentage of packet errors that have occurred within the current statistical cycle)

### Dirty transmitter

- ◆ Dynamic dirty TX using the value table from the specification; drift superimposition switched on
- ◆ Dynamic dirty TX using a user-defined value table; drift superimposition either switched on or off
- ◆ Static dirty TX; the values for frequency offset, modulation index and symbol timing error can be set in any combination with respect to each other; drift superimposition either switched on or off

### Bluetooth RF test cases

The R&S®CBT and R&S®CBT32 can be used for the evaluation of the following *Bluetooth* test purposes as described in the *Bluetooth* RF test specification 0.92:

- ◆ TRM/CA/01/C (output power)
- ◆ TRM/CA/03/C (power control)
- ◆ TRM/CA/07/C (modulation characteristics)
- ◆ TRM/CA/08/C (initial carrier frequency tolerance)
- ◆ TRM/CA/09/C (carrier frequency drift)
- ◆ RCV/CA/01/C (sensitivity – single-slot packets)
- ◆ RCV/CA/02/C (sensitivity – multislots packets)
- ◆ RCV/CA/06/C (maximum input level)



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## Specifications in brief

You will find detailed and binding data on the enclosed CD (../DATASHEET/CBT.pdf), or, for the latest updates, visit [www.rohde-schwarz.com](http://www.rohde-schwarz.com), search term: CBT

### RF generator

RF channel definition	
Bluetooth menu	2402 MHz + k × 1 MHz, k = 0 to 93
Frequency range	
RF menu	2398 MHz to 2499 MHz
Bluetooth menu	2402 MHz to 2495 MHz
Frequency resolution	
channel spacing according to standard	1 MHz
Frequency offset range	±250 kHz
Frequency offset resolution	1 kHz
Hopping scheme	
modes according to standard	Europe (except France), USA France RX/TX single frequency Reduced hopping
Output level range	
RF IN/OUT	-90 dBm to +0 dBm
Output level resolution	0.1 dB
Generator RF output level repeatability	
typical values after 1 h warmup time at constant ambient temperature	<0.03
Attenuation of harmonics	
RF IN/OUT	f <sub>0</sub> = 2398 MHz to 2499 MHz, up to 7 GHz >30 dB
Attenuation of nonharmonics	>50 dB
Modulation	
GFSK	1 Mbps, B × T = 0.5
Dirty TX	according to Bluetooth RF test specifications

### RF analyzer

RF channel definition	
Bluetooth menu	2402 MHz + k × 1 MHz, k = 0 to 93
Frequency range	
RF menu	2398 MHz to 2499 MHz
Bluetooth menu	2402 MHz to 2495 MHz
Frequency resolution	
channel spacing according to standard	1 MHz
Hopping scheme	
modes according to standard	Europe (except France), USA France RX/TX single frequency Reduced hopping

### Power meter (frequency-selective) and power versus time

Measurement bandwidth	
filter definition: passband	
Bluetooth menu	
Filter Bandwidth → wide	2.0 MHz
Filter Bandwidth → narrow	1.3 MHz
RF menu	10 Hz to 1 MHz in 1/2/3/5 steps
Level range	
RF IN/OUT	
continuous power	-40 dBm to +22 dBm
peak envelope power <sup>1)</sup> (PEP)	+26 dBm (300 mW)
Level resolution	
in manual mode	0.1 dB
in remote control mode	0.01 dB

Reference level for full dynamic range	GFSK signal
RF IN/OUT	
continuous power	-25 dBm to +22 dBm
peak envelope power <sup>1)</sup> (PEP)	+26 dBm (300 mW)
Dynamic range	
Filter bandwidth → wide	>55 dB, rms
RF level measurement repeatability	
typical values after 1 h warmup time at constant ambient temperature	<0.03 dB

### Modulation analyzer

Measurement bandwidth	
filter definition: passband	
Filter Bandwidth → wide	2.0 MHz
Filter Bandwidth → narrow	1.3 MHz
Level range	
RF IN/OUT	GFSK signal from full scale down to -25 dB
Total measurement range for frequency offset and frequency deviation	-250 kHz to +250 kHz

### Timing measurement

Range	±20 μs
Resolution	0.25 μs

<sup>1)</sup> Mean value of power vs time must be equal to or less than allowed continuous power.

### Interfaces

IEC/IEEE bus	IEC 60625-2 (IEEE 488.2)
Serial interface	COM 1 RS-232-C (COM)
Printer interface	LPT parallel (Centronics compatible)

### General specifications

Operating temperature range	+5°C to +45°C, meets EN 60068-2-1 and -2
<b>Power supply</b>	
Input	100 V to 240 V ±10% (AC), max. 220 VA, 50 Hz to 60 Hz, -5% to +10%
Power consumption	
R&S® CBT	approx. 60 W
R&S® CBT32	approx. 50 W
Display not included in model	
R&S® CBT32	21 cm TFT colour display (8.4") (VGA resolution)
<b>Dimensions W × H × D</b>	
R&S® CBT	411 mm × 193 mm × 317 mm (7/8 × 19"; 4 HU)
R&S® CBT32	465 mm × 93 mm × 417 mm (19"; 2 HU)
<b>Weight</b>	
R&S® CBT	approx. 7 kg
R&S® CBT32	approx. 6 kg

### Ordering information

<b>Bluetooth® Tester</b> with display, 4 HU	R&S® CBT	1153.9000.35
<b>Bluetooth® Tester</b> without display, 19", 2 HU, for remote control	R&S® CBT32	1153.9000.32

## Digital Radiocommunication Tester R&S® CMD57

**For production, installation and service of GSM 900/1800/1900 base stations**



### Brief description

Digital Radiocommunication Tester R&S® CMD57 is designed for measurements in line with:

- ◆ GSM 900
- ◆ GSM 1800
- ◆ GSM 1900 optionally
- ◆ E-GSM
- ◆ UIC – European train radiotelephony

The main applications are:

- ◆ Production
- ◆ Final testing
- ◆ Installation
- ◆ Service with test mobile functionality

R&S® CMD is the first compact radiocommunication tester worldwide allowing measurements on transmitters and receivers of base stations without affecting telephone calls in progress.

This tester combines compact size with high measurement accuracy and speed. It is suitable both for stationary and mobile use and feature great ease of operation and high reliability.

Operation is extremely easy and requires no detailed GSM knowledge. The high-contrast LCD display with softkeys on both sides allows menu-guided convenient callup of test routines.

### The key features at a glance

Characteristic/function	Benefit/application
<b>Transmitter measurements</b>	
Dynamic range >72 dB	Checking power ramps and output spectrum of BTS transmitter for compliance with the dynamic range specified by GSM
Measurement of power ramps	Checking the switching characteristics of the BTS transmitter
Phase and frequency error	Testing the modulation characteristics of the BTS transmitter including statistical function
Extremely fast measurement of spectrum due to modulation or switching	Detecting interference to the BTS transmitter at adjacent frequencies, due to modulation or switching
<b>Receiver measurements</b>	
Measurement of bit error rate (BER) via A <sub>bis</sub> /IEEE bus/RS-232-C interface, BTS loopback or R&S® CMD loopback	Testing the BTS receiver characteristics by adaptation to specific implementation in the BTS
Measurement of adjacent timeslot rejection with up to 50 dB higher level	Measuring the automatic gain control (AGC) of the BTS with high level difference between used and adjacent timeslot; simulation of different BTS receive levels
Level error <1 dB at -104 dBm	Reproducible and conclusive measurements even at low output levels especially at the sensitivity limits of the receiver
<b>Other measurements</b>	
Echo test	Subjective test of speech quality with call established
Module test	Complete transmitter measurements even without signalling or time synchronization
Multifunction RF generator	Ideal for alignment of receiver modules
DC current and voltage measurement	Optimized for pulsed signals; replaces external measuring instruments
AF measurement facilities and 60-MHz frequency counter (optional)	Replaces external frequency counter; ideal for measuring reference frequencies
RF monitor with bandwidths of 30, 100 kHz	Replaces external spectrum analyzer
Simulation of fading effects	On request



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## Digital Radiocommunication Tester R&S®CMD57

Characteristic/function	Benefit/application
<b>Flexible use</b>	
Various BTS synchronization facilities as to time and frequency	Easy integration of measuring instrument into operational environment and problem-free adaptation to the specific synchronization signals of a BTS
Remote control via RS-232-C and IEC/IEEE bus	SCPI-compatible for easy generation of user-specific control programs
<b>Low cost of ownership</b>	
Software update via interface	No need to open the instrument; simple download of the latest software version via the RS-232-C interface
3 years of warranty	The optional warranty allows the instruments to be utilized at calculable costs

### Overview of options and extras

Designation	Brief description, recommendation	Option	Order No.
<b>I/Q Modulator Output</b>	For BER measurement on BTS receivers under conditions of fading (application note 1MA04_0E available on request). Generator/fading simulator R&S®SMIQ can be connected. Not useable with R&S®CMD-B8 and R&S®CMD-B2 together, but with R&S®CMD-B8 or R&S®CMD-B2 (only R&S®CMD59)	<b>R&amp;S®CMD-B17</b>	1099.3003.02
<b>GSM 1900 Base Station Test</b>	For testing GSM 1900 base stations	<b>R&amp;S®CMD-B19</b>	1059.6201.02
<b>OCXO Reference Oscillator</b>	For highly demanding requirements on frequency stability. Oven crystal with highest long-term stability. Aging $3.5 \times 10^{-8}$	<b>R&amp;S®CMD-B2</b>	1059.8604.02
<b>Reference Frequency Inputs/Outputs</b>	For synchronizing DUT and measuring instrument with internal or external frequencies	<b>R&amp;S®CMD-B3</b>	1051.6202.02
<b>AF Measurement Unit with Frequency Counter</b>	This option includes an AF generator, a voltmeter, a distortion meter and a frequency counter for measurements on the audio interface or on modules. R&S®CMD-B41 permits measurements up to 60 MHz as are required for LO alignment	<b>R&amp;S®CMD-B41</b>	1051.6902.02
<b>Realtime Speech Coder/Decoder</b>	This option converts digital speech signals into analog signals (and vice versa) (in conjunction with R&S®CMD-K1x, R&S®CMD-K30 or R&S®CMD-B8)	<b>R&amp;S®CMD-B52</b>	1115.8800.02
<b>Adapter for R&amp;S®CMD-B6x Options</b>	Required for operating the options R&S®CMD-B61 and R&S®CMD-B62	<b>R&amp;S®CMD-B6</b>	1051.7409.02
<b>IEC/IEEE bus Interface</b>	Alternative to standard RS-232-C interface for remote control of R&S®CMD	<b>R&amp;S®CMD-B61</b>	1051.7609.02
<b>Memory Card Interface</b>	Memory cards are a versatile medium for storing instrument settings	<b>R&amp;S®CMD-B62</b>	1051.8205.02
<b>A<sub>bis</sub> Interface</b>	For sensitivity measurements; required for A <sub>bis</sub> control. A <sub>bis</sub> card for BER measurements at this interface	<b>R&amp;S®CMD-B71</b>	1115.8500.02
<b>Modification Kit High-Level 2nd RF Output (9 dBm or 11 dBm)</b>	For off-air measurements. The standard output level range of the second output is approx. -35 dBm to -120 dBm; the level range +9 dBm/+11 dBm to -60 dBm is offered alternatively (not usable with R&S®CMD-U13)	<b>R&amp;S®CMD-U3</b>	1059.6501.02
<b>Handset</b>	Together with R&S®CMD-B8 + R&S®CMD-B5 allows to talk using R&S®CMD in the same way as a mobile	<b>R&amp;S®CMD-Z50</b>	1059.4250.02
<b>Transit Case</b>	Robust case for transport R&S®CMD with Rucksack R&S®CMD-Z40	<b>R&amp;S®ZZK-014</b>	1013.9595.00



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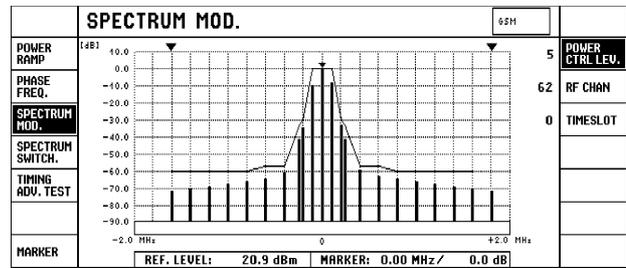
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## Digital Radiocommunication Tester R&S® CMD57

ADDIT. MEAS.	TRAFFIC CHANNEL TEST		DCF 1800	
POWER RAMP	Peak Power:	44.8 dBm	TRAFFIC CHANNEL:	45 dBm EXPECTED POWER
PHASE FREQ.	Avg. Burst Power:	44.4 dBm	RF Channel:	740
SPECTRUM MOD.	Power Ramp:	PASS	Timeslot:	0
SPECTRUM SWITCH.	Timeslot:	0		-35.0 dBm MS SIGNAL RF LEVEL
BER TEST	Freq. Error:	15 Hz		HANDSET SPEECH MODE
	Phase Error (PK):	7.2 °		RF LOOPBACK BER MODE
	Phase Error (RMS):	2.1 °		CALL RELEASE

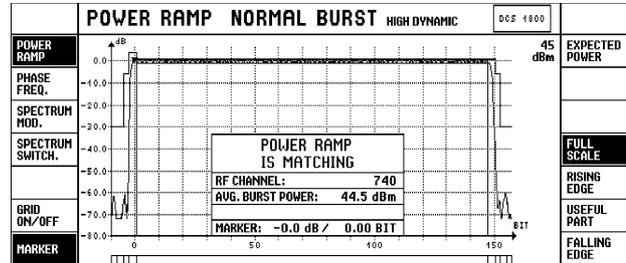
After synchronization to the base station and setting up of a traffic channel, all relevant RF parameters are immediately measured and displayed; this menu also allows a quick change of channel, power and timeslot as well as setting of R&S® CMD transmission parameters



The spectrum due to modulation and switching can be measured in line with GSM specifications within a minimum of time and graphically displayed; the built-in marker function allows the digital value of each individual spectral line to be called up

SINGLE BER MEAS.	CONTINUOUS BIT ERROR RATE		GSM	
RESTART	CLASS	RBER	TRAFFIC CHAN. LEVEL:	-103.0 dBm USED TIMESLOT
	II	0.321 %	(relative to USED TS)	0.0 dB UNUSED TIMESLOT
	Ib	0.000 %		
	CLASS	FER		
	ERASED FRAMES	0.000 %		
	MS RECEIVER REPORTS			
	RxLev	9 (-102 to -101 dBm)		
	RxQual	1 (0.2 to 0.4 %)		
	CRC ERRORS:	0		
MEAS. MODE	BER	RBER		
AVERAGE	20 Frame	INDICATOR		

Sensitivity of a transceiver module of the base station is verified by means of a bit error rate (BER) test in RF loopback mode



R&S® CMD 57 allows the power ramp to be measured with high dynamic range; with graphic display, the zoom function enables application-oriented resolution of parts of the displayed curve

### Specifications in brief

You will find detailed and binding data on the enclosed CD (./DATASHEET/CMD57.pdf), or, for the latest updates, visit [www.rohde-schwarz.com](http://www.rohde-schwarz.com), search term: CMD57

RF generator	
Frequency range	GSM900: 890.2 MHz to 914.8 MHz E-GSM900: 880.2 MHz to 890.0 MHz GSM1800: 1710.2 MHz to 1784.8 MHz GSM1900 <sup>1)</sup> : 1850.2 MHz to 1909.8 MHz
Resolution	GSM channel spacing 200 kHz
Settling time	<3 ms for phase error <2°
Output level (RF IN/OUT)/(OUTPUT 2)	-35(-37 <sup>1)</sup> ) to -120 dBm
Modulation	GMSK, B × T = 0.3
Phase error	<4° rms, <10° peak
Peak power meter (RF IN/OUT)	
Frequency range	800 MHz to 1000 MHz 1700 MHz to 1900 MHz
Measurement range	0 dBm to 47 dBm
Maximum RF power	47 dBm pulsed, 45 dBm CW 47 dBm CW at room temperature

Phase and frequency error measurement	
Frequency range	GSM900: 935.2 MHz to 959.8 MHz E-GSM900: 925.2 MHz to 935.0 MHz GSM1800: 1805.2 MHz to 1879.8 MHz GSM1900 <sup>1)</sup> : 1930.2 MHz to 1989.8 MHz
Level range	
RF IN/OUT	0 dBm to 47 dBm
RF IN 2	-57 dBm (-51 dBm <sup>1)</sup> ) to 0 dBm
Burst power measurement	
Frequency range	GSM900: 935.2 MHz to 959.8 MHz E-GSM900: 925.2 MHz to 935.0 MHz GSM1800: 1805.2 MHz to 1879.8 MHz GSM1900 <sup>1)</sup> : 1930.2 MHz to 1989.8 MHz
Reference level for full dynamic range	
RF IN/OUT	GSM900: 10 dBm to 47 dBm GSM1800/1900: 0 dBm to 47 dBm
RF IN 2	-37 dBm (-31 dBm <sup>1)</sup> ) to 0 dBm
High-dynamic burst analysis	
Relative error of individual test samples	≤1.5 dB to 72 dB below peak power
Dynamic range	>72 dB
Measurement limit RF IN/OUT	GSM900: <-36 dBm GSM1800: <-48 dBm GSM1900: <-42 dBm
Measurement limit RF IN 2	GSM: <-83 dBm GSM1800: <-85 dBm GSM1900: <-79 dBm

## Digital Radiocommunication Tester R&S®CMD57

<b>GSM-specific measurements</b>	
<b>Spectrum due to modulation</b>	
Test method	relative measurement, averaging
Resolution filter bandwidth	30 kHz
Measurement at an offset of	100/200/250/400/600/800/1000/1200/1400/1600 and 1800 kHz
Dynamic range	better than specified by GSM
for offset >400 kHz	max. 80 dB
Error	<±1.5 dB
<b>Spectrum due to switching</b>	
Test method	relative measurement, Max Hold over several measurements
Resolution filter bandwidth	30 kHz
Measurement at an offset of	400/600/1200 and 1800 kHz
Dynamic range	better than specified by GSM
for offset >400 kHz	max. 80 dB, with SW correction max. 76 dB, without SW correction
Error	≤1.5 dB (dynamic range <50 dBc) ≤2.5 dB (dynamic range 50 dBc to 80 dBc)
<b>Multi-Reference Frequency Inputs</b>	
Output Option R&S®CMD-B3	
Synchronization input	GSM bit clock (270.8 kHz), 2/4/16 times GSM bit clock, 1 to 13 MHz in 1 MHz steps, 2.048/16.384/26/39/52 MHz
Synchronization output 1	10 MHz with internal reference or frequency at synchronization input with external reference
Synchronization output 2	GSM bit clock, 2/4/16 times GSM bit clock, 1/2/4 or 13 MHz
<b>A<sub>bis</sub> Interface</b>	
Option R&S®CMD-B7	
Receive channel (traffic/speech)	75 Ω/high-impedance, unbalanced; 120 Ω/high-impedance, balanced; 16 kbit/s, timeslot selectable
<b>DC voltmeter</b>	0 V to ±30 V
<b>DC ammeter</b>	current averaging with GSM-adapted time constant, current peak measure- ment (maximum and minimum)
<b>Measurement range</b>	0 A to ±10 A
Common-mode rejection	±30 V
<b>AF Measurement Unit</b>	Option R&S®CMD-B41
<b>AF generator</b>	
Frequency range	50 Hz to 10 kHz
Level range	10 μV to 5 V
<b>AF voltmeter</b>	
Frequency range	50 Hz to 10 kHz
Measurement range	0.1 mV to 30 V
<b>Distortion meter</b>	
Frequency range	300 Hz to 3 kHz
Input level range	100 mV to 30 V
<b>AF counter</b>	
Frequency range	20 Hz to 10 kHz
Input level range	10 mV to 30 V
Resolution	≤1 Hz
<b>IF counter</b>	
Frequency range	10 kHz to 60 MHz
Input level range	100 mV rms to TTL
Resolution	1 Hz

<sup>1)</sup> In GSM 1900 mode with option R&S®CMD-B19 fitted.

### Multicarrier mode (Option R&S®CMD-B8)

The specifications apply to all cases, in which interfering carriers (up to 30 dB above useful level) are more than 30 GSM channels away. If there are interfering signals close to the useful carrier, an additional IF filter is switched in (multicarrier mode).

#### Typical filter characteristics in multicarrier mode

Offset from useful channel (kHz)	Filter suppression (dB)
0	0 (reference)
200	<3
400	>20
600	>33
800	>41
1000	>48

This filter increases the measurement error for phase and power measurements.

#### Phase and frequency error measurement

Inherent phase error ≤2° (rms), ≤7.5° (peak)

#### Measurement of peak power/burst power

Level error ≤1.5 dB

#### GSM-specific spectrum measurements

The dynamic range specified for the basic model refers to the sum of all input voltage components. The additional GSM carriers appear as strong spurious emissions in the spectrum measurement and have to be taken into account accordingly when evaluating the tolerances.

### General data

Rated temperature range	0°C to +45°C to DIN IEC 68-2-1/2
Storage temperature range	-40°C to +60°C
Power supply	100 V to 120 V AC ±10% 200 V to 240 V AC ±10% 50 Hz to 400 Hz ±5%
Power consumption (without options)	approx. 85 W
Dimensions (W × H × D)	435 mm × 192 mm × 363 mm
Weight (without options)	approx. 14 kg

### Ordering information

<b>Digital Radiocommunication Tester</b>	R&S®CMD57	1050.9008.57
<b>Accessories supplied</b>	power cable, operating manual, fuses	
<b>Options</b>	see overview of options on page 22	

## Universal Protocol Tester R&S®CRTU-G

**Protocol simulation and analysis at the GSM air interface (Um) for development and conformance testing of GSM terminal equipment**



### Brief description

#### Development of GSM mobiles

The R&S®CRTU-G simulates a GSM base station and records all messages sent to and received from a mobile station. This allows detailed analysis of the protocol stack in the mobile station. Protocol stack functions can also be modified by the user. So it is possible to simulate network errors, for instance, and analyze a mobile station's response. Parts of the protocol stack can be bypassed by appropriate programming. In this way, even protocol stacks implemented only partly in the mobile station can be tested.

#### Conformance testing of GSM mobiles

The conformance test of GSM mobiles is based on the test cases defined by 3GPP in specification 51.010. A large number of these test cases have been validated for Rohde&Schwarz by independent test houses and are available for the R&S®CRTU-G. Easy-to-use tools, automated testing and detailed log files speed up conformance testing and error elimination. Log files can be analyzed on a separate PC for the most efficient use of the R&S®CRTU-G.

*The message viewer clearly displays the message log file recorded during a test*

Additional conformance tests in line with user's own standards, e.g. network operators, can be implemented with the aid of user-defined tests.

#### Development of GSM chip sets

In the development of GSM chip sets, detailed analysis of customized test cases is as important as the requirement for several interfaces with the device under test, since an RF connection is not possible in all phases of development. The DUT can be contacted via analog I/Q and IF signals (option R&S®CRTU-B7).

#### Controlling further measuring instruments – multimode tests

The R&S®CRTU-G can assume controller functions in test systems comprising several measuring instruments. Control of further instruments via IEEE, COM or Ethernet can be incorporated in test programs.

#### Multicell/multichannel systems

Up to five R&S®CRTU-G testers can be interconnected for tests requiring more than two channels. Multichannel systems capable of handling even complex test scenarios are thus easily configured.

Dir	Name	phys. Channel	Base Station	log Channel	Frame Number	Block
RX	DL-RA-Ind	1	1	RACH	3335	[13,20]
RX	CM Service Req	1	1	SDCCH	3406	[14,40]
TX	CM Service Accept	1	1	SDCCH	3493	[16,25]
RX	Register	1	1	SDCCH	3559	[17,40]
TX	SS Release Complete	1	1	SDCCH	3697	[20,25]
TX	Channel Release	1	1	SDCCH	3952	[25,25]
RX	DL-Release-Ind	1	1	SDCCH	3967	[25,40]
RX	DL-RA-Ind	1	1	RACH	4211	[14,19]
RX	CM Service Req	1	2	FACCH	4769	[30,11]
TX	Authentication Req	1	2	FACCH	4707	[31,3]
RX	Authent Response	1	2	FACCH	4956	[37,16]
TX	Ciphering Mode Command	1	2	FACCH	4973	[38,7]
RX	Ciphering Mode Complete	1	2	FACCH	5025	[40,7]
RX	CC Setup	1	2	FACCH	5051	[41,7]
TX	CC Call Proceeding	1	2	FACCH	5068	[41,24]
TX	Alerting	1	2	FACCH	5094	[42,24]
TX	CC Connect	1	2	FACCH	5783	[18,11]
RX	CC Connect Ack	1	2	FACCH	5835	[20,11]
RX	CM Service Req	1	2	FACCH	7122	[18,24]
TX	CM Service Accept	1	2	FACCH	7140	[19,16]
RX	Register	1	2	FACCH	7222	[22,20]
TX	SS Release Complete	1	2	FACCH	7274	[24,20]
TX	CC Disconnect	1	2	FACCH	7582	[36,16]
RX	CC Release	1	2	FACCH	7630	[38,20]
TX	CC Release Complete	1	2	FACCH	7655	[39,11]



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## Universal Protocol Tester R&S®CRTU-G

All channels are fully synchronized. RF signal routing and transmitter power control are already integrated in the testers so that no extra hardware is required. All testers are controlled via a single test application (see R&S®CRTU-S for more details).

### Tests under fading conditions using Baseband Fading Simulator R&S® ABFS

Using the optional I/Q/IF interface card, a baseband fading simulator (e.g. the R&S®ABFS) can be inserted into the signal path to perform fading tests on the DUT. Use of the R&S®CRTU-G frontend ensures high level accuracy.

### Main features

- ◆ Simulation of a GSM cell with two independent channels
- ◆ Up to four GSM timeslots per RF channel for GPRS
- ◆ Enhancement to multicell systems
- ◆ EDGE and software-controlled modulators/demodulators
- ◆ Predefined ETSI test cases available
- ◆ Platform for validated 3GPP 51.010 test cases
- ◆ Programming interface for user-defined tests
- ◆ Detailed analysis of messages at various protocol layers
- ◆ Customized solution can be further enhanced
- ◆ Individual software configuration
- ◆ High broadband RF accuracy
- ◆ Fit for the future
  - Upgradable to new standards
- ◆ Compact single-box, single-supplier solution with Windows2000 operating system
- ◆ Standard PC interfaces and software installation
- ◆ Easy and fast calibration
- ◆ Upgradable to WCDMA

### Tools

The tools supplied with the tester considerably facilitate routine work. For more efficient use of the tester, the tests can be pre- and postprocessed offline on a standard Windows PC, using optionally the tools described below.

- ◆ Configuration editor to generate basic information during the test
- ◆ Sequencer for the conformance test
- ◆ Message viewer for clear display of the message log file recorded during a test
- ◆ Message composer supports the programmer in easily composing the messages
- ◆ Hardware diagnostic tool confirms to the user proper functioning of the hardware modules in the R&S®CRTU-G

### GSM Phase 2+ Operational Software R&S®CR02P2P

The Operational Software R&S®CR02P2P contains the protocol stack and the channel/speech coders required to simulate a GSM base station. The protocol stack function can be modified in the test program to simulate faulty behaviour of the base station for instance. The individual entities of the protocol stack can be addressed separately. The operational software is continuously updated in line with modifications to 3GPP specifications. It comprises customary services and functions (not test cases), and optional services and functions can be installed. Detailed information on optional products can be found on Rohde&Schwarz's website.

### The tester comes with

- ◆ Speech HR/FR/EFR
- ◆ GMSK, 8PSK channel coder for EDGE
- ◆ Supplementary services
- ◆ ASCII
- ◆ Cell handover and multiband handover
- ◆ Ciphering
- ◆ BER measurements
- ◆ EGSM, RGSM

### That software options can be added

- ◆ GPRS including EDGE (incremental redundancy, link adaptation)
- ◆ AMR
- ◆ Circuit-switched single-slot data transfer NTDS (RLP)
- ◆ GSM850
- ◆ LCS

### Upgrade service

The GSM specifications forming the basis of the GSM operational software and of the test cases are subject to continuous updating. To ensure being always up-to-date, Rohde&Schwarz is offering a software upgrade service for the R&S®CRTU-G GSM software. Current information on all protocol test products is available under

[www.protocol-testing.rohde-schwarz.com](http://www.protocol-testing.rohde-schwarz.com).



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## Universal Protocol Tester R&S®CRTU-G

### Specifications in brief

You will find detailed and binding data on the enclosed CD (./DATASHEET/CRTU-G.pdf), or, for the latest updates, visit [www.rohde-schwarz.com](http://www.rohde-schwarz.com), search term: CRTU-G

#### Inband GSM specifications

RF generator	
Modulation	GMSK, $B \times T = 0.3$ , 8PSK
Frequency range	GSM400/850 to GSM1900 band
Attenuation of inband spurious emissions	>50 dB
Inherent phase error (GMSK)	<1°, rms, <4°, peak
Inherent EVM (8PSK)	<2%, rms
Frequency settling time	<500 µs to res. phase of 4°
Output level range (GMSK)	-130 dBm to +5 dBm
Output level range (8PSK)	-130 dBm to +1 dBm
Output level uncertainty inband (+23°C to +35°C)	
RF1, RF2 at >-117 dBm	<0.7 dB
RF receiver	
Frequency range	GSM400/850 to GSM1900 band
Inherent phase error (GMSK)	<0.6°, rms, <2°, peak
Inherent EVM (8PSK)	<1.0%, rms
Reference level range for full dynamic range	
GMSK	-22 dBm to +53 dBm
8PSK	-26 dBm to +49 dBm

#### Base unit specifications

RF generator	
Frequency range	100 kHz to 2700 MHz
Frequency settling time	<400 µs to $\Delta f < 1$ kHz
Output level uncertainty (+23°C to +35°C)	
RF1, RF2	>-117 dBm
450 MHz to 2200 MHz	<0.8 dB
RF3 <sub>OUT</sub>	
450 MHz to 2200 MHz	<1.0 dB
Output level settling time	<4 µs
Generator RF level repeatability	
(RF1, RF2, RF3 <sub>OUT</sub> , typical values after 1 h warmup)	
Output ≥ -80 dBm	<0.01 dB
Attenuation of harmonics ( $f_0 = 10$ MHz to 2200 MHz, up to 7 GHz)	
RF1, RF2	>30 dB
RF3 <sub>OUT</sub> ( $P \leq +10$ dBm)	>20 dB
Attenuation of nonharmonics, 10 MHz to 2200 MHz, >5 kHz from carrier	>40 dB
Phase noise (single sideband, $f < 2.2$ GHz)	
Carrier offset ≥ 250 kHz	<-110 dBc (1 Hz)
Residual FM	
30 Hz to 15 kHz	<50 Hz (rms), <200 Hz (peak)
ITU-T	<5 Hz (rms)
Residual AM, ITU-T	<0.02% (rms)
I/Q modulation, data for frequency offset range 0 Hz to ±135 kHz	
Carrier suppression	>40 dB

RF receiver	
Phase noise (single sideband, $f < 2.2$ GHz)	
Carrier offset ≥ 400 kHz	<-118 dBc (Hz)
Residual FM	
30 Hz to 15 kHz	<50 Hz (rms), <200 Hz (peak)
CCITT	<5 Hz (rms)
Residual AM, CCITT	<0.02% (rms)
Power splitter (400 MHz to 2200 MHz)	
Insertion loss, SC/S1, SC/S2	<7 dB
Isolation, S1/S2	>17 dB
Max. continuous power	
SC	4 W
S1, S2	21 dBm
Inputs and outputs (rear panel)	
Remote control interface	IEC 625-2 (IEEE 488.2)
Serial interface COM1, COM2	RS-232-C (COM), 9-pin sub-D connector
Printer interface LPT	parallel (Centronics-compatible)
Mouse/keyboard connector	USB
Connector for ext. monitor (VGA)	15-pin sub-D connector
USB	double connector
Ethernet	RJ45

#### General data

Rated temperature range	+5°C to +45°C
Display	21 cm TFT colour display (8.4"), VGA
Power supply	100 V to 240 V ±10% (AC), 50 Hz to 400 Hz -5% to +10%
Power consumption	max. 500 W, base unit 200 W typ.
Dimensions (W × H × D); weight	465 mm × 193 mm × 517 mm (19"; 4 height units); 20 kg

### Ordering information

Universal Protocol Tester	R&S®CRTU-G	1140.0009.02
<b>Equipment supplied</b>		
Radio Unit	R&S®CRTU-RU	
Link Handler (2 pieces)	R&S®CRTU-B5	
MAC/Speech Board	R&S®CRTU-B6	
Test SIM Phase 2+	R&S®CRT-Z2	
Operational Software	R&S®CR02P2P	
<b>Accessories supplied</b>		
Hardlock		
<b>Option</b>		
2-channel I/Q/IF Interface Card	R&S®CRTU-B7	1139.0009.02

For information about software options, please contact the nearest Rohde&Schwarz office.

## Protocol Tester R&S®CRTU-S

**Cost-effective multibox and data application testing**

### Brief description

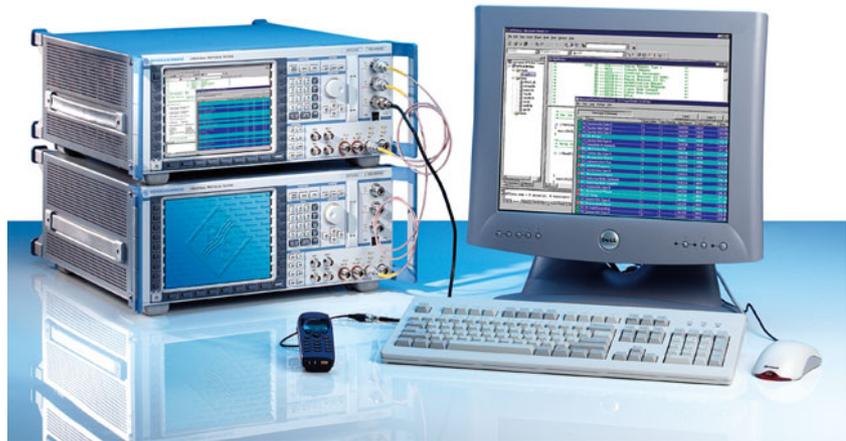
The R&S®CRTU-S enhances the R&S®CRTU-G by another R&S®CRTU radio unit with two additional RF channels. It is also suitable as a cost-effective stand-alone unit for data tests. Our service centers can upgrade any R&S®CRTU-S to an R&S®CRTU-G, if required.

### Conformance testing of GSM mobiles

The conformance test of GSM mobiles is based on the test cases defined by 3GPP in specification 51.010. Using an R&S®CRTU-G/R&S®CRTU-S multichannel solution, the test cases can be expanded to handover, cell selection and cell reselection as well as to other multichannel tests. A large number of these test cases have been validated for Rohde&Schwarz by independent test houses and are available for the R&S®CRTU-G. Easy-to-use tools, automated testing and detailed log files speed up conformance testing and error elimination.

### Main features

- ◆ Enhancement for multichannel tests on R&S®CRTU-G
- ◆ Platform for data application testing
- ◆ Simulation of a GSM cell with two independent channels
- ◆ Detailed analysis of messages at various protocol layers
- ◆ Fit for future mobile radio standards
- ◆ Upgradable to R&S®CRTU-G
- ◆ Cost-effective solution for multichannel tests
- ◆ Platform for reproducible data tests



- ◆ User-friendly network simulation for cost-saving application tests
- ◆ GSM 850, 900, 1800, 1900
- ◆ GPRS, EGPRS
- ◆ Message viewer for analysis of layer 1, 2, 3
- ◆ Layer 1 EDGE tool supporting all EDGE coding schemes
- ◆ Compact single supplier solution with Windows 2000 operating system
- ◆ Upgradable to R&S®CRTU-G

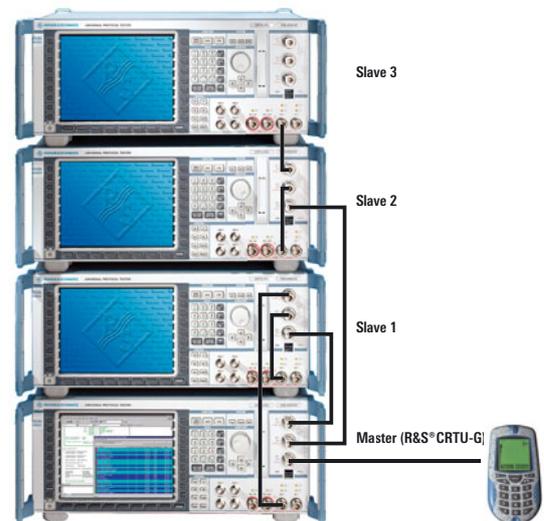
use external RF components. The messages of the protocol stack can be modified by the user. It is possible, for example, to simulate network errors and analyze a mobile station's response. To test partially implemented protocol stacks in the mobile, the R&S®CRTU-G allows sections of the stack to be bypassed.

### Data application testing

The R&S®CRTU-S is a cost-effective platform for application testing. Through the use of an additional software module for the R&S®CRTU-G/S units, the R&S®CRTU-S becomes a network simulator

### Multibox scenarios

In conjunction with the R&S®CRTU-G, the R&S®CRTU-S is a cost-effective test solution for up to 10 RF channels. The R&S®CRTU-G simulates a GSM base station and records all messages sent to and received from a mobile station. This allows detailed analysis of the protocol stack in the mobile station even under complex multichannel conditions. The R&S®CRTU-S is entirely controlled by the R&S®CRTU-G and needs no additional control. One R&S®CRTU-G unit can control up to four R&S®CRTU-S units. The testers are interconnected via the integrated and calibrated RF combiners and TCP/IP cables. There is no need to



## Protocol Tester R&S® CRTU-S

that is able to enable services such as I-Mode, WAP, MMS, SMS and Internet access requested by mobile phone. Neither mobile radio nor programming

knowledge are thus required to test applications and their performance in the mobile phone. The reproducible conditions under which the mobile phone can

be tested are the only crucial factor. This application eliminates the need for dialling into a real network and thus the associated costs.

### Specifications in brief

You will find detailed and binding data on the enclosed CD (./DATASHEET/CRTU-S.pdf), or, for the latest updates, visit [www.rohde-schwarz.com](http://www.rohde-schwarz.com), search term: CRTU-S

#### Inband GSM specifications

RF generator	
Modulation	GMSK, B × T = 0.3, 8PSK
Frequency range	GSM400/850 to GSM1900 band
Attenuation of inband spurious emissions	>50 dB
Inherent phase error (GMSK)	<1°, rms, <4°, peak
Inherent EVM (8PSK)	<2%, rms
Frequency settling time	<500 µs to res. phase of 4°
Output level range (GMSK)	-130 dBm to +5 dBm
Output level range (8PSK)	-130 dBm to +1 dBm
Output level uncertainty inband (+23°C to +35°C)	RF1, RF2 at >-117 dBm <0.7 dB
RF receiver	
Frequency range	GSM400/850 to GSM1900 band
Inherent phase error (GMSK)	<0.6°, rms, <2°, peak
Inherent EVM (8PSK)	<1.0%, rms
Reference level range for full dynamic range	GMSK -22 dBm to +53 dBm 8PSK -26 dBm to +49 dBm

#### Base unit specifications

RF generator	
Frequency range	100 kHz to 2700 MHz
Frequency settling time	<400 µs to Δf <1kHz
Output level uncertainty (+23°C to +35°C)	RF1, RF2 at >-117 dBm <0.8 dB 450 MHz to 2200 MHz <1.0 dB RF3 <sub>OUT</sub> (450 MHz to 2200 MHz) <4 µs
Output level settling time	<4 µs
Generator RF level repeatability (RF1, RF2, RF3 <sub>OUT</sub> , typical values after 1 h warmup)	Output ≥-80 dBm <0.01 dB
Attenuation of harmonics (f <sub>0</sub> = 10 MHz to 2200 MHz, up to 7 GHz)	RF1, RF2 >30 dB RF3 <sub>OUT</sub> (P ≤+10 dBm) >20 dB
Attenuation of nonharmonics, 10 MHz to 2200 MHz, >5 kHz from carrier	>40 dB
Phase noise (single sideband, f <2.2 GHz)	Carrier offset ≥250 kHz <-110 dBc (1 Hz)
Residual FM	
30 Hz to 15 kHz	<50 Hz (rms), <200 Hz (peak)
ITU-T	<5 Hz (rms)

Residual AM, ITU-T	<0.02% (rms)
I/Q modulation, data for frequency offset range 0 Hz to ±135 kHz	Carrier suppression >40 dB
RF receiver	
Phase noise (single sideband, f <2.2 GHz)	Carrier offset ≥400 kHz <-118 dBc (1 Hz)
Residual FM	
30 Hz to 15 kHz	<50 Hz (rms), <200 Hz (peak)
CCITT	<5 Hz (rms)
Residual AM, CCITT	<0.02% (rms)
Power splitter (400 MHz to 2200 MHz)	
Insertion loss, SC/S1, SC/S2	<7 dB
Isolation, S1/S2	>17 dB
Max. continuous power	
SC	4 W
S1, S2	21 dBm
Inputs and outputs (rear panel)	
Remote control interface	IEC 625-2 (IEEE 488.2)
Serial interface COM1, COM2	RS-232-C (COM), 9-pin sub-D connector
Printer interface LPT	parallel (Centronics-compatible)
Mouse/Keyboard connector	USB
Connector for ext. monitor (VGA)	15-pin sub-D connector
USB	double connector
Ethernet	RJ45

#### General data

Display	21 cm TFT colour display (8.4"), VGA
Rated temperature range	+5°C to +45°C
Power supply	100 V to 240 V ±10% (AC), 500 VA, 50 Hz to 400 Hz -5% to +10% power factor correction, 200 W
Dimensions (W × H × D); weight	465 mm × 193 mm × 517 mm (19"; 4 height units); 20 kg

### Ordering information

Test equipment for Protocol verification of GSM Mobiles	R&S® CRTU-S	1140.0009.82
Equipment supplied		
Radio Unit	R&S® CRTU-RU	
Link handler (2 pieces)	R&S® CRTU-B5	
MAC/speech board	R&S® CRTU-B6	
Test SIM phase 2+	R&S® CRT-Z2	
Operational software	R&S® CRO2P2P	
Hardlock		
Option		
2-channel I/Q/IF interface card for R&S® CRTU-S	R&S® CRTU-B7	1139.0009.02

For information about software options, please contact the nearest Rohde & Schwarz office



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## Protocol Tester R&S®CRTU-W

**Protocol test solution for 3G user equipment (UE)**



### Brief description

The R&S®CRTU-W is the unique signalling and protocol test solution for 3G and multimode terminals. This new member of the R&S®CRTU family provides the highest possible level of flexibility from early design and development through to comprehensive conformance and certification testing.

Powerful tools enable the user to define and execute TTCN test cases according to 3GPP test specification TS34.123, and to visualize the test results. In addition, customer-specific test scenarios can be implemented in TTCN or C++.

The message analyzer tool displays message logs in various formats (sequence, structured and detailed view) including parent/child message linking across protocol layers (incl. ASN.1 decoding).

Two independent RF channels allow the simulation of 2 WCDMA (FDD) cells at the same or at different RF frequencies, which is an indispensable prerequisite for performing WCDMA intrasystem handovers. Moreover, the R&S®CRTU-W is prepared for intersystem handover to GSM/GPRS systems, thus setting new standards in testing.

### Main features

- ◆ 2 RF channels/simulation of 2 WCDMA (FDD) cells
- ◆ Platform for official 3GPP signalling test cases acc. to TS34.123
- ◆ Implementation of test cases according to GCF priority
- ◆ Application testing
- ◆ Detailed analysis of all protocol layers at U<sub>i</sub> interface
- ◆ TTCN toolbox support
- ◆ C/C++ API for test script development
- ◆ Upgradable to GSM/GPRS
- ◆ Upgrading of existing R&S®CRTU-G to WCDMA possible
- ◆ Intersystem handover testing

### Characteristics

#### Medium level C++ application programming interface

The highly flexible medium level C++ application programming interface enables the user to create individual test scenarios. Embedded in an easy-to-use environment and offering a wide range of configuration options, it is particularly suitable for use in development.

#### Layer 1 test software option

The layer 1 test software option is the optimum solution for layer 1 testing of WCDMA user equipment. Providing a realtime downlink signal generator and a realtime uplink analyzer, the layer 1 test software option offers an intuitive graphical user interface and extensive configuration possibilities for physical and transport channels. Due to the high degree in flexibility, this tool is particularly suitable for testing HSDPA (high speed downlink packet access) capable user equipment.

#### High speed downlink packet access (HSDPA)

The R&S®CRTU-W supports layer 1 as well as full UTRAN protocol testing for high speed downlink packet access (HSDPA)<sup>1)</sup> according to 3GPP release 5.

Based on this functionality, conformance and application testing for HSDPA are supported. Example signalling scenarios for HSDPA are provided by means of the flexible medium level C++ interface.

<sup>1)</sup> Feature not yet released, for more details contact customersupport@rohde-schwarz.com



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## Protocol Tester R&S®CRTU-W

### R&S®CRTU-W Tools

The R&S®CRTU-W contains a complete tool chain satisfying all requirements such as test case management, test case modification, test session configuration as well as full analysis of the test results.

Since the tools are implemented in Java, they can be installed on any operating system. For full analysis of the test results and configuration of test sessions, the complete tool chain is also available offline. So the R&S®CRTU-W can effectively be used for WCDMA protocol testing.

### Project Explorer

The Project Explorer contains full functionality for configuring test sessions. With the aid of the Project Explorer, test cases for a test session can be selected from a test suite. Complete regression tests can be generated by combining test cases from different test suites.

In addition to handling test cases, the Project Explorer can be used to configure the hardware or reference implementations. The Project Explorer also controls the complete run of the test session.

While a test session is running, the Project Explorer displays online the current status of the complete test session and of the individual test cases. Immediately upon completion of a test case, the final verdict of that test case is displayed.

### Message Analyzer

Thanks to the mature architecture of the R&S®CRTU-W software, all messages sent via the service access points in line with 3GPP specifications can be stored in a central log file. The decoding function

of the Message Analyzer ensures convenient analysis of this information.

Another powerful feature of the Message Analyzer is the message sequence chart. The Message Analyzer allows all messages to be displayed in a message sequence chart in conformity with official specifications. This function makes it very easy for the user to analyze the logic data flow within a test case.

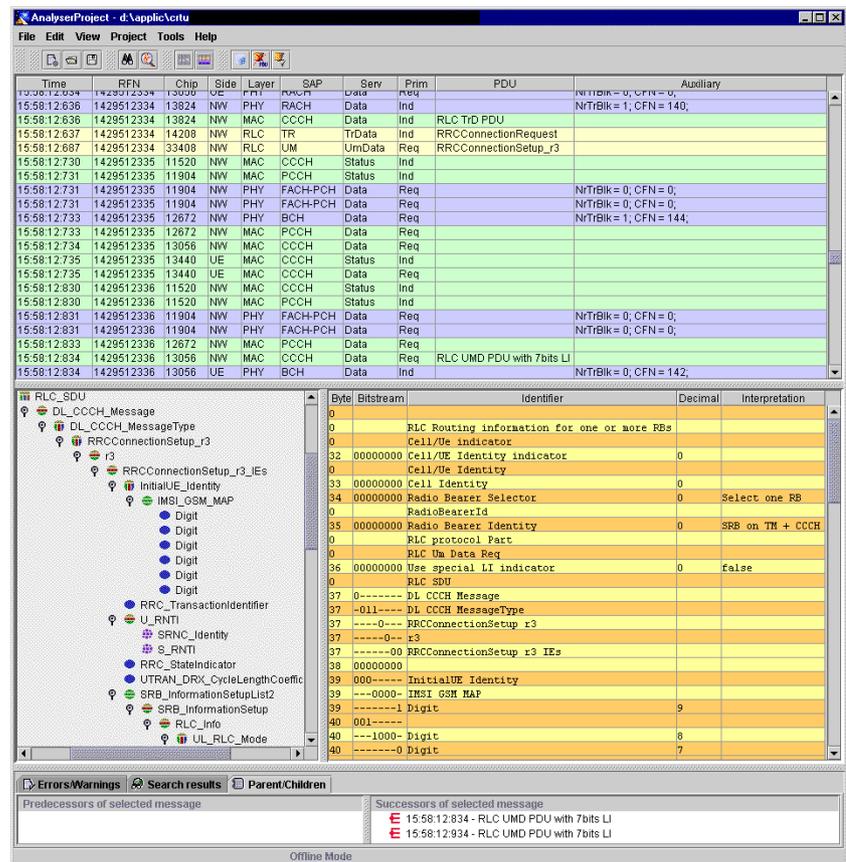
### Test Case Analyzer

The Test Case Analyzer allows analysis of the automatically generated test case result file. This file contains all information about the messages sent or received by the test case, as well as all information about timer and configuration. The TTCN

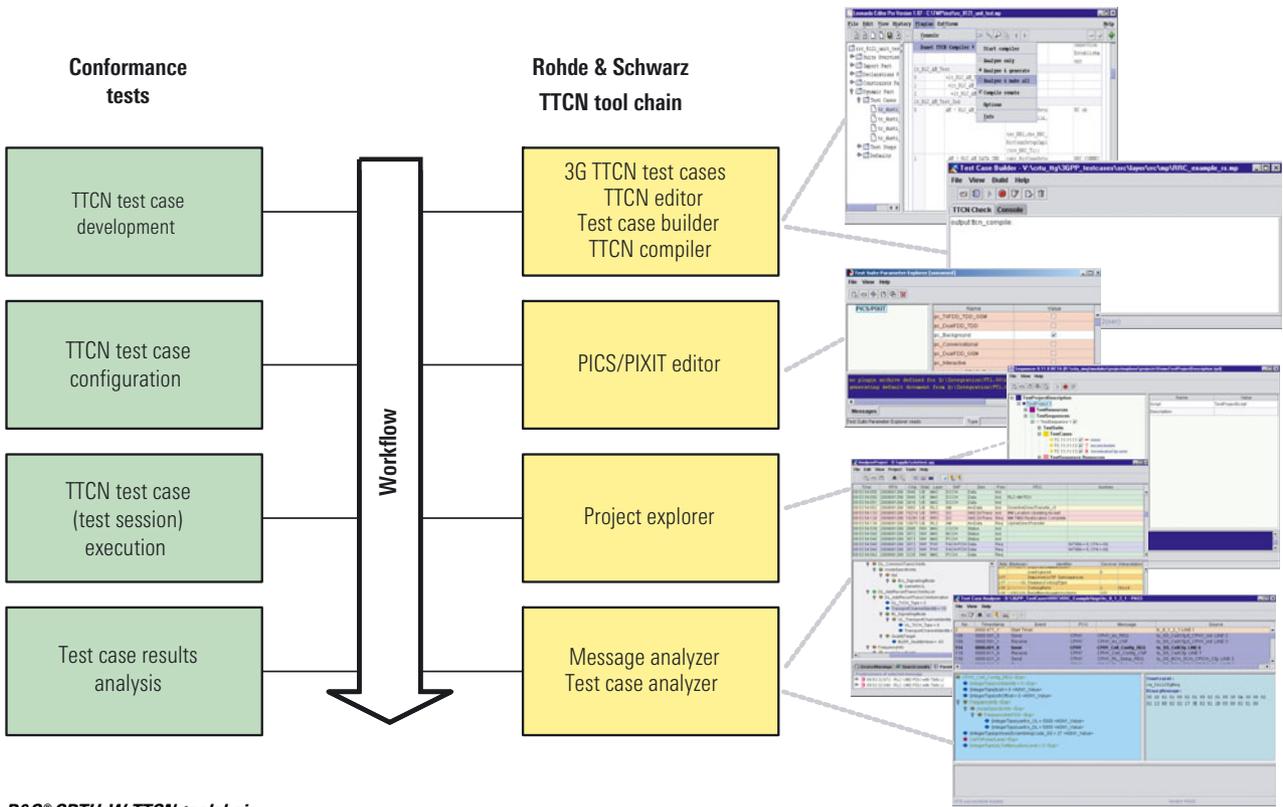
Editor can be started with a hyperlink during the analysis. The corresponding TTCN source code is displayed within the TTCN Editor. Full and in-depth analysis of the test case result file is possible.

### TTCN Editor

In addition to the tools developed by Rohde&Schwarz, the TTCN Editor Leonardo from Da Vinci Communications Ltd is available in the R&S®CRTU-W tool chain. The TTCN Editor enhances the analysis functions of the Test Case Analyzer and enables simple modification of existing test cases or generation of new ones. The TTCN Editor comprises an integrated version manager allowing the use and management of different versions of a test suite.



## Protocol Tester R&S®CRTU-W



*R&S®CRTU-W TTCN toolchain*

### Technical details

#### RF

- ◆ Two independent RF channels
- ◆ Simulation of 2 cells on same or different frequency
- ◆ RF frequency range: 10 MHz to 2.7 GHz
- ◆ 3.84 Mchip/s

#### DL physical channels

- ◆ Up to 16 physical channels in parallel per cell
- ◆ CPICH
- ◆ P-/S-SCH
- ◆ P-CCPCH
- ◆ S-CCPCH
- ◆ PICH

- ◆ AICH
- ◆ n \* DPCH + OCNS with m channels
- ◆ HS-PDSCH
- ◆ Power level can be set for each physical channel separately

#### UL physical channels

- ◆ PRACH
- ◆ DPCCCH
- ◆ 6 \* DPDCH

#### Physical layer – transport channels

- ◆ DL transport channels
  - BCH, PCH, FACH
  - Up to 8 DCH with 384 kbit/s (single code and multicode) Service multiplexing
  - HS-DSCH

- ◆ UL transport channels
  - RACH
  - Up to 8 DCH with 384 kbit/s (single code, service multiplexing)

#### Reference implementations of

- ◆ MAC
- ◆ RLC
- ◆ RRC

## Protocol Tester R&S®CRTU-W

### Specifications in brief

You will find detailed and binding data on the enclosed CD (./DATASHEET/CRTU-W.pdf), or, for the latest updates, visit [www.rohde-schwarz.com](http://www.rohde-schwarz.com), search term: CRTU-W

<b>Standard</b>	
Standard	3GPP-FDD, 3.84 Mcps
<b>RF Generator</b>	
Modulation	According to standard 3.84 MHz RRC, $\alpha = 0.22$
Frequency range	2110 MHz to 2170 MHz
Channel spacing	5 MHz
Channel raster	200 kHz
<b>RF Receiver</b>	
Demodulation	Receiver filter according to standard 3.84 MHz RRC, $\alpha = 0.22$
Frequency range	1920 MHz to 1980 MHz
Channel spacing	5 MHz
Channel raster	200 kHz

### General data

#### Radio Unit R&S®CRTU-PU

Operating temperature range	+5°C to +45°C
-----------------------------	---------------

#### Radio Unit R&S®CRTU-RU

<b>Power supply</b>	100 V to 240 V 10% (AC), 500 VA, 50 Hz to 400 Hz -5% to +10%
Power consumption	Approx. 160 W
Dimensions (W × H × D)	465 mm × 193 mm × 517 mm, 19", 4 height units
Weight	Approx. 18 kg

#### Protocol Unit R&S®CRTU-PU

<b>Power supply</b>	100 V to 120 V 10% (AC) or 220 V to 240 V 10% (AC), 600 VA, 50 Hz to 60 Hz -5% to +10%
Power consumption	Approx. 180 W
Dimensions (W × H × D)	465 mm × 238 mm × 617 mm, 19", 5 height units
Weight	Approx. 21 kg

### Ordering information

#### Test Equipment for Protocol Verification of WCDMA Mobiles

Included in package:  
Radio Unit R&S®CRTU-RU (incl. R&S®CRTU-B7), Protocol Unit R&S®CRTU-PU,  
hardlock, Operational Software R&S®CRTUW001,  
spare fuses (two for Protocol Unit)

R&S®CRTU-W 1140.0509.02

#### Recommended accessories

Antenna Coupler for Handheld Telephones	R&S®CMU-Z10	1150.0801.02
Shielded Chamber for R&S®CMU-Z10	R&S®CMU-Z11	1150.1008.02
19" Rack Adapter (for Radio Unit)	R&S®ZZA-411	1096.3283.00
19" Rack Adapter (for Protocol Unit)	R&S®ZZA-511	1096.3290.00

## Digital Radio Testers R&S® CTS55/60/65 for mobile phones

**New**  
Now for  
GSM850!

Tester family for fast and conclusive GSM/GPRS and DECT measurements in service

Digital Radio Tester R&S® CTS65



### Brief description

Digital Radio Tester R&S® CTS from Rohde & Schwarz comes in three models:

- ◆ **R&S® CTS55**  
for mobile phones to GSM850/900/1800/1900
- ◆ **R&S® CTS60**  
for DECT phones (portable part and fixed part)
- ◆ **R&S® CTS65**  
for GSM and DECT

Digital Radio Tester R&S® CTS is an extremely compact, modular yet powerful measuring instrument. It combines great ease of operation and the necessary test depth for use in all service areas for GSM/GPRS mobile and DECT cordless phones: from a simple functional test to repairs. Both the newcomer and the service specialist will be able to conveniently carry out fast automatic functional tests as well as complex and comprehensive manual measurements down to component level.

### Main features

- ◆ User-friendly menu-guided control via softkeys

- ◆ Logical user prompting without interleaved submenus
- ◆ Brilliant TFT colour display: an own dimension in this class of instruments
- ◆ operating menus in seven different languages
- ◆ Compact and robust design, low weight
- ◆ Eye-strain-free working
- ◆ Dynamic range for measuring the power ramp: GSM >55 dB, DECT >60 dB
- ◆ Built-in reference oscillator TCXO or OCXO (option R&S® CTS-B1)
- ◆ Combined RF input/output for GSM and DECT
- ◆ DECT off-air measurements via additional input/output
- ◆ Remote control via RS-232-C (option R&S® CTS-K6)
- ◆ Location update
- ◆ Call setup (incoming/outgoing)
- ◆ Call clear-down (incoming/outgoing)
- ◆ Dualband handover
- ◆ Control and measurement of transmitter power
- ◆ Access class control
- ◆ Handover (channel change)
- ◆ Sensitivity
  - Bit error rate BER and RBER
  - RxLev and RxQual
- ◆ Phase and frequency error
- ◆ Power ramp versus time
- ◆ Timing error
- ◆ Echo test (voice test, includes also testing of loudspeaker and microphone)
- ◆ Function test of mobile's keypad through display of dialled number
- ◆ Display of
  - IMSI (international mobile subscriber identity)
  - IMEI (international mobile equipment identity)
- ◆ AM suppression (only with option R&S® CTS-K7)

### GSM measurement functions

R&S® CTS55 simulates a GSM base station for testing mobile phones. The following measurements and tests can be performed by automatic test routines or manually.

- ◆ Synchronization of mobile phone with base station (which is simulated by R&S® CTS)

### GPRS

The R&S® CTS also supports GPRS-compatible mobile phones. The R&S® CTS-K4 signalling option will make

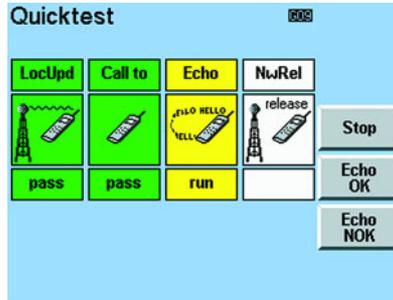
## Digital Radio Testers R&S® CTS55/60/65 for mobile phones

it possible to perform a GPRS attach/detach as well as block error rate (BLER) measurements in a timeslot.

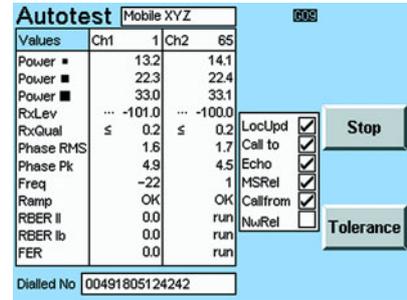
- ◆ Attach/detach
- ◆ BLER measurement

### DECT measurement, test and adjustment capabilities

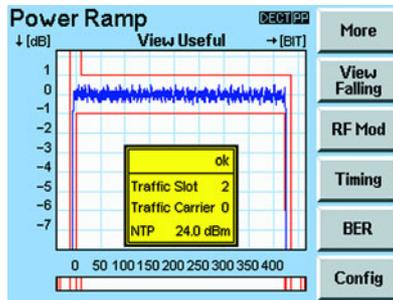
- ◆ Synchronization of DUT with the R&S® CTS
- ◆ Call setup
- ◆ Call release
- ◆ Echo test
- ◆ Detection and display of RFPI (FP)
- ◆ Normal transmit power (NTP)
- ◆ Power ramp versus time
- ◆ Modulation characteristics versus time
- ◆ Frequency offset
- ◆ Maximum modulation deviation
- ◆ Frequency drift
- ◆ Timing (jitter, packet delay)
- ◆ Bit error rate (BER), frame error rate (FER)



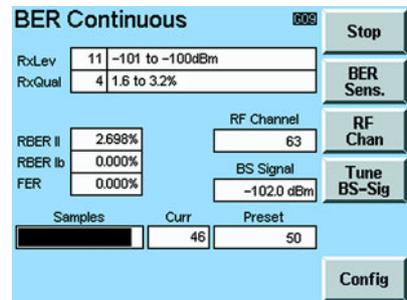
The quick test provides an extremely fast Go/NoGo information covering all essential parts of the mobile phone. A speech test (echo test) is carried out immediately after the call setup (GSM)



The autotest routines allow complete functional tests to be started at a keystroke. The tests cover all essential signalling functions as well as the transmitter and receiver characteristics of the mobile phone (GSM)



The R&S® CTS measures the power ramp of the signal sent by an FP or PP with a dynamic range of >60 dB (DECT)



The BER is an essential criterion for evaluating the receiver characteristics of the mobile phone. The CTS measures these characteristics with the aid of various test routines such as RBER (class Ib; II; FER) and BER (class Ib; II) (GSM)

### Specifications in brief

You will find detailed and binding data on the enclosed CD (./DATASHEET/CTS.pdf), or, for the latest updates, visit [www.rohde-schwarz.com](http://www.rohde-schwarz.com), search term: CTS

#### GSM

GSM signal generator	
Frequency range	GSM850 to GSM1900 bands
Resolution	GSM channel spacing 200 kHz
Output level	
RF IN/OUT with 0 dB ext. attenuation	-50 dBm to -110 dBm
RF OUT2 GSM with 0 dB ext. attenuation	-15 dBm to -75 dBm
Level error RF IN/OUT	≤1.5 dB
Modulation	GMSK, B × T = 0.3
Narrowband Spectrum Monitor Option R&S® CTS-B7	
Span	300 kHz
Resolution bandwidth	4/10/20/50/100 kHz
Dynamic range	(P >5 dBm) typ. 50 dBc
Markers	3 markers and delta-marker

GSM peak power meter	
Frequency range	GSM850 to GSM1900 bands
Measurement range	
with 0 dB ext. attenuation	-20 dBm to +39 dBm (peak values up to 41 dBm)
with 15 dB ext. attenuation	0 dBm to +39 dBm (peak values up to 41 dBm)
GSM measurement of phase and frequency error	
Frequency range	GSM850 to GSM1900 bands
Level range	-15 dBm to 39 dBm (peak values up to 41 dBm)
GSM measurement of burst power	
Frequency range	GSM850 to GSM1900 bands
Reference level for full dynamic range with 0 dB ext. attenuation	0 dBm to +39 dBm (peak values up to 41 dBm)
Dynamic range (P >5 dBm)	≥55 dB
Resolution	0.1 dB

## Digital Radio Testers R&S® CTS55/60/65 for mobile phones

### DECT

<b>DECT signal generator</b>	
Frequency range	1876.608 MHz to 1935.360 MHz and half channels
Frequency drift	same as reference oscillator
<b>Output level</b>	
RF IN/OUT	-100 dBm to -40 dBm
RF OUT2 DECT	-40 dBm to 0 dBm (-20 dBm to 0 dBm if RF IN2 DECT is active), useable up to 5 dBm
Level error RF IN/OUT	≤1.5 dB
Modulation	GFSK (B × T = 0.5)
<b>DECT analyzer</b>	
Frequency range	same as signal generator
Measurement range	with 0 dB external attenuation
RF IN/OUT	30 dBm to -30 dBm
RF IN2 DECT	-35 dBm to -55 dBm
<b>FM demodulator</b>	
Frequency range	0 Hz to 450 kHz
Resolution	1 kHz
DC offset	<3 kHz
<b>Residual FM</b>	
RF IN/OUT (30 dBm to 15 dBm)	<5 kHz, peak, 95% confidence
RF IN2 DECT (-35 dBm to -40 dBm)	<5 kHz, peak, 95% confidence
<b>Level meter</b>	
Range	30 dBm to -55 dBm
Dynamic range	60 dB (for P = 24 dBm)
Resolution	0.5 dB
<b>Accuracy</b>	
RF IN/OUT	<1 dB + resolution (30 dBm to 5 dBm) <2 dB + resolution (<5 dBm)
RF IN2 DECT	<2 dB + resolution (-35 dBm to -51 dBm) <2.5 dB + resolution (<-51 dBm)
<b>Audio Interface</b>	
Output	
Range	558 mV, 300 Hz to 3 kHz
S/N + THD	30 dB at max. level
Passband ripple	0.5 dB
Input	
Range	80 mV, 300 Hz to 3 kHz
S/N + THD	35 dB at max. level
Passband ripple	0.5 dB
DECT applications	averaging 10 bursts
<b>Modulation section 1, 2, 4</b>	
Error	approx. 11 kHz with min. (202 kHz) permissible deviation approx. 13 kHz with max. (403 kHz) permissible deviation
Frequency drift	approx. 1 kHz/ms (over 200 bursts)
<b>Transmit power</b>	
Measurement accuracy	
RF IN/OUT	<1 dB + resolution (30 dBm to 5 dBm) <2 dB + resolution (<5 dBm)
RF IN2 DECT	<2 dB + resolution (-35 dBm to -51 dBm) <2.5 dB + resolution (<-51 dBm)

### General data

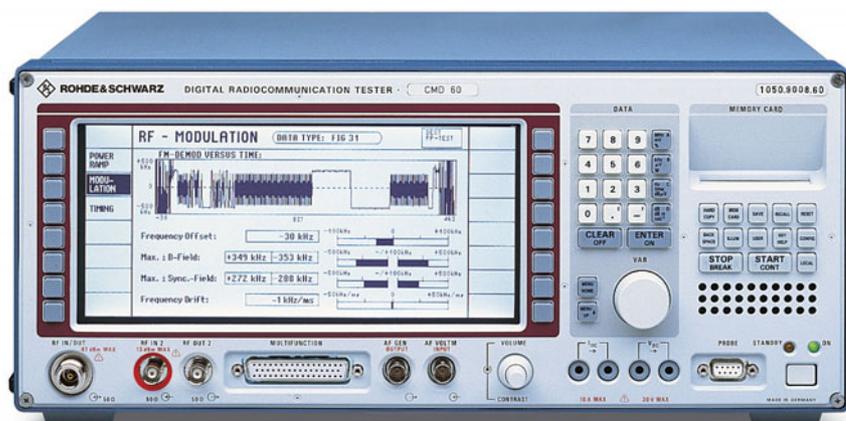
VSWR at all RF connectors	≤1.5
Rated temperature range	+5°C to +40°C
Operating temperature range	0°C to +45°C
Storage temperature range	-25°C to +60°C
Power supply	200 V to 240 V AC ±10%, 100 V to 120 V AC ±10%, 50 Hz to 60 Hz ±5%
Power consumption	approx. 60 W
Dimensions (W × H × D)	319 mm × 177 mm × 350 mm
<b>Weight</b>	
R&S®CTS55, R&S®CTS60	approx. 7.8 kg
R&S®CTS65	approx. 8.8 kg

### Ordering information

<b>Digital Radio Tester</b>		
GSM	R&S®CTS 55	1094.0006.55
DECT	R&S®CTS 60	1094.0006.60
GSM and DECT	R&S®CTS 65	1094.0006.65
<b>Options</b>		
OCXO Reference Oscillator Aging $0.2 \times 10^{-6}$ /year	R&S®CTS-B1	1079.0809.02
GPRS Signalling	R&S®CTS-K4	1079.1905.02
GSM Remote Control (with Application Software for Windows)	R&S®CTS-K6	1079.2001.01
GSM Module Test	R&S®CTS-K7	1079.2501.02
GAP Signalling	R&S®CTS-K62	1079.2601.01
<b>Extras</b>		
Universal shielded Chamber	R&S®CTS-Z12	1079.1470.02
Antenna Coupler	R&S®CMU-Z10	1150.0801.02
RF Shielding Cover for R&S®CMU-Z10	R&S®CMU-Z11	1150.1008.02
DECT-Antenna with N connector		1086.3116.00
GSM Test SIM	R&S®CRT-Z2	1039.9005.02
Compact keyboard		
German	R&S®PSP-Z1	1091.4000.02
US	R&S®PSP-Z2	1091.4100.02
Production Calibration	R&S®DCV-1	0240.8733.08
Service Manual		1094.3405.24

## DECT Tester R&S®CMD60

**Speedy and cost-effective measurements on DECT communications devices**



### Brief description

Reliability, measurement speed and cost effectiveness are the characteristics a test equipment must have to succeed in the field of the widely used DECT communication devices.

The great experience gained with preceding DECT measurement instruments such as signal generators, analyzers, communication testers and DECT type-approval systems as well as cooperative development work with several key end-users have contributed towards creating a well-balanced tester for production and service according to all aspects.

### Benefits at a glance

#### Production

- ◆ The R&S®CMD60 can be remote controlled via the RS-232-C or IEC/IEEE bus interface using SCPI-compatible commands. In the remote-control mode R&S®CMD60 is designed for fast speed to yield high throughputs in production
- ◆ High production output at low investment for test equipment
- ◆ Comprehensive test capabilities implemented in one single unit

#### Development

- ◆ Comprehensive in-depth measurements under a convenient user interface
- ◆ A lot of complex test setups with conventional equipment become redundant with the use of this special DECT tester
- ◆ Automatic regression and stress tests
- ◆ The tester supplies a great number of DECT-specific signals such as bit clock, TX/RX enable, to control the module under test

#### Servicing

- ◆ Relaxed manual operation due to a large bright LCD in conjunction with an extremely simple user interface (requires no DECT-specific knowledge) strictly separated from the expert user interface for configurations
- ◆ Integrated tools such as a scope display for power and FM demodulation versus time ease troubleshooting

#### Main features

- ◆ For production, service and development
- ◆ RF measurements to CTR06
- ◆ Comprehensive audio tests
- ◆ Extremely fast measurements for high production throughput

- ◆ Ergonomic user interface for service applications
- ◆ Selfcontained, lightweight, compact tester

### Menu structure

The power ramp measurement permits in-depth analysis of the burst power transmitted by the FP or PP. The measurement is synchronized to bit P0, thus giving precise information not only about the power transmitted but also about timing parameters.

The RF modulation measurement menu presents the demodulated signal in a scope display for easy and quick recognition of typical data forms, and accurate measurement results as numbers and bargraphs for further analysis.

Timing parameters such as the absolute timing accuracy as well as the jitter between two bursts are measured and displayed in an easy-to-read format.

User-defined tolerances for parameters like BER, modulation, timing, power and power ramp (burst) as are shown here can easily be entered via the configuration menu. If any of the set limits are exceeded, the measurement will be shown in inverse video for easy identification.

## DECT Tester R&S®CMD60

The module test offers RF signal generator and RF burst analyzer features for testing DECT modules without signalling, i.e. when troubleshooting or adjustments are required.

### Interface description

#### R&S®CMD60 transmitter part

In a very busy DECT environment most DECT frequencies may be in use for communication and therefore influence the measurement in production and development. Besides the channels 0 to 9 the R&S®CMD60 enables the use of an extended frequency range for testing. Channels -3, -2, -1 and 10, 11, 12 are outside the normal DECT specification and therefore free for testing.

The DECT standard requires two levels: -83 dBm and -73 dBm. The R&S®CMD60 provides an extra level range of up to 30 dB to overcome external coupler and cable attenuation.

The R&S®CMD60 provides 1 up to 12 consecutive TDMA slots for rapid BER measurements for PP tests (2 slots for FP test). The measuring time in production can be considerably cut down if more than one timeslot is used for BER measurements.

Modulation is GFSK with  $B \times T = 0.5$  according to DECT specifications. In addition, constant envelope, signals with or without modulation or DECT bursts with various bit patterns for module test are possible.

These bit patterns can easily be recognized while testing receiver and demodulator modules.

#### R&S®CMD60 receiver part

It is similar to the transmitter part above: there are 10 DECT frequency channels No. 0 to 9. Additionally, 6 extended DECT frequency channels No. -3, -2, -1 and 10, 11, 12 in DECT channel spacing are provided.

Should the standard DECT output level of 24 dBm be attenuated due to couplers and cable attenuation, the R&S®CMD60 provides more than 30 dB measurement range.

There are two independent receive paths: For DECT signalling and BER a signalling path is incorporated in the R&S®CMD60. For TX tests the R&S®CMD60 provides a measurement path. The FM and envelope detector are both taken to external connectors and post-processed for power ramp and modulation measurements. The FM and envelope detector output permits monitoring of the DUT transmit signal.

#### RF input/output

The R&S®CMD60 transmitter and receiver are connected to a bidirectional N connector (RF in/out). All mentioned specifications are valid for this connector. Moreover, there is a high-level output for the R&S®CMD transmitter (level range like N connector + approx. 40 dB) as well as a high-sensitivity input for the R&S®CMD receiver on the front panel.

#### Demodulator interface

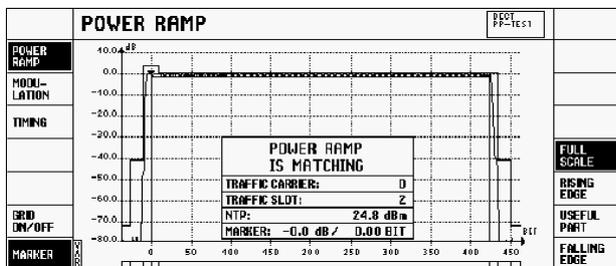
R&S®CMD60 provides a linear, analog FM demodulator output (DC-coupled) and a logarithmic analog RF envelope demodulator output (DC-coupled).

#### Wideband input/output

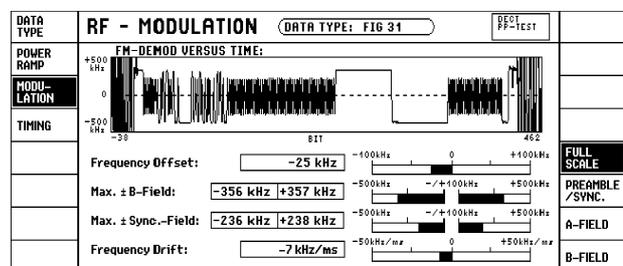
The second wideband input/output (100 MHz to 2.5 GHz) is on the rear panel. The input signal from the front connector is provided at this connector with an attenuation of 12 dB. It can be monitored with a spectrum analyzer for spurious measurements. Furthermore, this connector can be used to introduce an interferer into the RF connection without reconnecting the test setup for the in-channel tests.

#### R&S®CMD60 audio part

In addition to the DECT RF interface on the R&S®CMD60 front panel, there is an analog DECT voice interface for a speaker and the appropriate microphone (analog ADPCM interface). Alternatively it can be connected to the AF Measurement Unit R&S®CMD-B41.



Power ramp measurement



RF modulation measurement

## Overview of options

Designation, functions	Option	Order No.
<b>OCXO Reference Oscillator:</b> Improves aging and frequency drift of the internal reference source	R&S®CMD-B1	1051.6002.02
<b>Reference Frequency Input/Output, Frequency Synchronization:</b> Provides a 10 MHz interface as a common frequency reference	R&S®CMD-B3	1051.6202.02
<b>DSP/Adapter for R&amp;S®CMD-B4x options:</b> DSP system carrying out applications for GSM RF and audio tests as well as DECT audio tests. In contrast to GSM, this option is not required for DECT BER measurements	R&S®CMD-B4	1051.6654.02
<b>AF Measurement Unit with Frequency Counter (R&amp;S®CMD-B4 needed):</b> Provides an audio measurement unit with AF generator and AF analyzer. The parameters measured are level (peak and rms), frequency, and distortion on selectable frequencies. In addition, the option incorporates a 60-MHz TTL counter to verify the DUT's reference frequency	R&S®CMD-B41	1051.6902.02
<b>IEC/IEEE bus Interface:</b> in addition to the standard RS-232-C interface, the R&S®CMD can be fitted with this remote-control interface (R&S®CMD-B6 required)	R&S®CMD-B61	1051.7609.02
<b>Adapter for R&amp;S®CMD-B6x options</b>	R&S®CMD-B6	1051.7409.02
<b>Frequency Extension DECT CH +12 to -22</b> for Latin America and other countries	R&S®CMD-K61	1082.3840.02

## Specifications in brief

You will find detailed and binding data on the enclosed CD (./DATASHEET/CMD60.pdf), or, for the latest updates, visit [www.rohde-schwarz.com](http://www.rohde-schwarz.com), search term: **CMD60**

<b>DECT signal generator</b>	specifications valid for N connector
Frequency	10 DECT channels 0 to 9
Additional DECT channels	-3 to -1, 10 to 12 and half channels
Level range	-100 dBm to -40 dBm
Burst switch-off	>30 dB
Modulation	GFSK (B × T = 0.5)
<b>DECT analyzer</b>	specifications valid for N connector
Frequency	same as signal generator
Level (setting for external attenuation and expected power shall be matching: -10 dBm to +30 dBm)	-65 dBm to +30 dBm (for level meter) -30 dBm to +30 dBm (for broadband FM demodulator and signalling), values shifted by about -40 dB for input 2
<b>FM demodulator</b>	for TX postprocessing and analog output
Range	0 Hz to 450 kHz deviation
Resolution	1 kHz
Level meter (transient response)	for TX postprocessing and analog output
Range	-65 dBm to 30 dBm
Dynamic	70 dB
<b>Analog DECT ADPCM interface</b>	
Output	balanced
Range	1 V, 300 Hz to 3 kHz
S/N + THD	50 dB at full-range level
Input	balanced
Range	50 mV, 300 Hz to 3 kHz
S/N + THD	50 dB at full-range level
<b>DC measurements</b>	
DC voltmeter	0 V to ±30 V
DC ammeter	0 A to ±10 A

## Option R&S®CMD-B4 with R&S®CMD-B41

<b>AF meter</b>	
Frequency range	50 Hz to 10 kHz
Input voltage	0.1 mV to 30 V
<b>AF distortion meter</b>	
Frequency range	300 Hz to 3 kHz
Input voltage	100 mV to 30 V
<b>AF counter</b>	
Frequency range	20 Hz to 10 kHz
Input voltage	10 mV to 30 V
Resolution	1 Hz
<b>60 MHz counter</b>	
Frequency range	10 kHz to 60 MHz
Input signal	min.: 100 mV; max.: TTL signal
Resolution	1 Hz
<b>AF generator</b>	
Frequency range	50 Hz to 10 kHz
Output voltage	10 μV to 5 V

## General data

Power supply, AC	100 V to 120 V ±10%, 200 V to 240 V ±10%, 50 Hz to 400 Hz ±5%
Power consumption	approx. 60 VA
Dimensions (W × H × D)	435 mm × 192 mm × 363 mm
Weight (without options)	approx. 12 kg

## Ordering information

<b>Digital Radiocommunication Tester</b>	R&S®CMD60	1050.9008.60
<b>Options</b>	see overview of options	



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## DECT Signalling Test Unit R&S®PTW 15

### Support in installation and maintenance of DECT networks



### Brief description

The powerful DECT Protocol Tester R&S®TS 1220 is seconded by the extremely favourably priced DECT Signalling Test Unit R&S®PTW 15. This unit can be used wherever the full functionality of R&S®TS 1220 is not required: in installation and maintenance of DECT WLL and PABX systems, in DECT audio tests according to CTR 10 and in the field of DECT software development.

In the installation of DECT WLL networks or test networks, R&S®PTW 15 produces data about the occupancy of the DECT frequency band including relevant statistics to support antenna positioning and assessment of various parameters of the DECT equipment (e.g. dynamic channel selection algorithm). Since most tests are carried out on site directly in the network, the unit was designed for mobile use through its compact size and optional battery powering. For DECT audio tests to CTR 10, R&S®PTW 15 can be used as a DECT signalling unit that supports call setup to portable and fixed DECT radio terminations both in normal operation (generic access profile GAP according to

EN 300 444) and in test standby mode by providing voice data at an analog and a digital interface. The required DECT reference implementations can also be used for DECT software development.

The DECT Signalling Test Unit comes with channel-occupancy software covering all DECT activities at the air interface as well as with a monitor mode for recording and analyzing selected DECT activities between user-defined fixed radio terminations (FT) and the associated portable radio terminations (PT).

The implemented DECT protocol stack is mapped on the hardware as follows: the time-critical physical layer (PHL) and medium access control layer (MAC) are implemented in the DECT-specific module. The data received between PHL and MAC at the point of observation are imaged in the processor kernel and displayed. The data link control layer and network layer, used for reference implementations, run as independent processes in the processor kernel.

All layers communicate via points of control and observation (PO/PCO).

### Main features

#### Main applications

- ◆ DECT coverage measurement (installation and test)
- ◆ DECT network control (maintenance and optimization of WLL networks and PABX systems)
- ◆ DECT software and hardware development
- ◆ Signalling unit for DECT audio tests according to CTR 10
- ◆ Designed for mobile and stationary operation

#### Main functions

- ◆ Channel occupancy measurement: scanning and visualization of the air interface in the DECT frequency ranges Europe, China, South and Latin America; analysis of the scanned data by scanner postprocessing
- ◆ Built-in PT and FT reference implementation according to EN 300 444 (Generic Access Profile)

Protocol monitoring and analysis between the DECT layers according to EN 300 444.



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## Specifications in brief

You will find detailed and binding data on the enclosed CD (../DATASHEET/PTW15.pdf), or, for the latest updates, visit [www.rohde-schwarz.com](http://www.rohde-schwarz.com), search term: PTW15

### Basic instrument

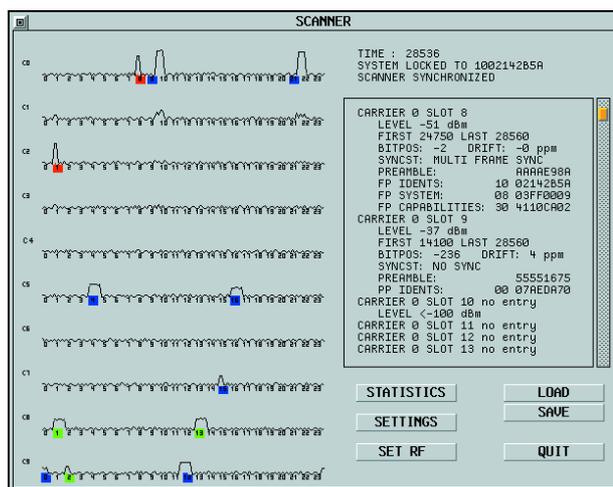
CPU	AMD K5 (586), 133 MHz
Display	8,4" TFT colour display, VGA
Graphics for external monitors	max. 1024 × 768 pixels
Storage	Hard disk, FDD 3½"
Interfaces	4 × ISA
Serial	2 × RS-232-C
Parallel	1 × LPT (Centronix) for printer
Keyboard	DIN and PS/2
Operating system	LynxOS
User interface	MGR
Operating temperature range	0°C to + 40°C
Power supply	100 V to 120 V ±10%, 50 Hz to 400 Hz ±5%, and 220 V to 240 V ±10%, 50 Hz to 60 Hz ±5%
Power consumption	max. 120 W
DC	10 V to 32 V
Dimensions (W × H × D)	412 mm × 198 mm × 380 mm
Weight	8 kg

### RF Parameters

<b>Operating frequency Europe</b>	1881.792 MHz to 1897.344 MHz
<b>Optional (exclusive options)</b>	
China	1902.528 MHz to 1918.080 MHz
South America	1911.168 MHz to 1926.720 MHz
Latin America	1912.896 MHz to 1928.448 MHz
Carrier spacing	1.728 MHz
Carrier multiplex	TDMA
Duplexing	TDD
Bit rate	1152 kbps
Modulation method	GFSK (B × T = 0.5)
<b>TX specifications</b>	
Normal transmitter power	21 dBm ± 2 dBm
Nominal peak deviation (modulation)	288 kHz (acc. to CTR06)
Carrier frequency (acc. to CTR06)	DECT carrier frequency ± 30 kHz
Synthesizer	transmitter burst acc. to CTR06 (slow synthesizer => 'blind slots'); hardware signalling (R&S®PTW15 DECT Sig. Board)
<b>RX Specifications</b>	
Sensitivity (acc. to CTR06)	-73 dBm for BER <0.00001
RSSI	-33 dBm to -93 dBm
Maximum level (without damage)	25 dBm
Maximum level (for measurements)	0 dBm

### Channel occupancy measurement

<b>RSSI (permanent)</b>	
Resolution time	<14 ms
Resolution level	1 dB
Range	0 dBm to -93 dBm
Data indication	graphically online, update rate 1/s
Scanning rate	min. 3 RSSI scanning loops covering all DECT channels per second.



For channel monitoring purposes the activities on all DECT channels/slots are indicated numerically and graphically including information on fieldstrength, identities, drift, offset etc; the information is automatically stored in a database

### Database

Continuous recording of data packages
Classification: locked, coordinated, uncoordinated, not classified
Permanent scan, simultaneous for fixed (FT) and portable radio termination (PT)
Contents of database record: time of recordings, number of recordings, preamble, level, bit position, drift, identities, system parameters, etc
Assignment of database records to the graphical RSSI indication under consideration of system identities, coordinated and uncoordinated fixed radio terminations
<b>Statistics</b>
Channel occupancy statistics
Graphical indication (coloured)
Statistics referring to EN300 175 Common Interface 'Channel selection algorithm'
<b>GPS data</b>
NMEA 0183 Interface Standard can be connected to the serial interface; GPS data will be displayed and included in the database file

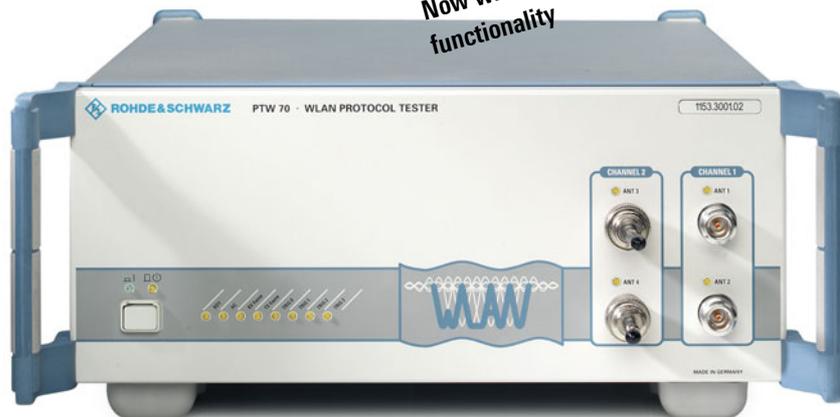
## Ordering information

<b>DECT Signalling Test Unit</b>		
Light	R&S®PTW 15L	1074.6009.04
China	R&S®PTW 15CN	1074.6009.03
South and Latin America <sup>1)</sup>	R&S®PTW 15LA	1074.6009.05
<b>Options</b>		
Comfort package (ext. keyboard + adapter)	R&S®PTW-B1	1074.6509.02
Battery module for mobile operation	R&S®PSP-B3	1091.3740.02
Frequency range China (replaces module Europe)	R&S®PTW-B3	1115.2501.02
Frequency range South and Latin America (replaces module Europe)	R&S®PTW-B4	1115.2701.02

<sup>1)</sup> Frequency channel difference between adjustable in the software.

## Wireless Protocol Tester R&S®PTW70

- IEEE 802.11 multimode protocol tester for development, integration and verification
- Bluetooth® wireless technology protocol tester for qualification and verification



WLAN Protocol Tester R&S®PTW70

### Brief description (WLAN)

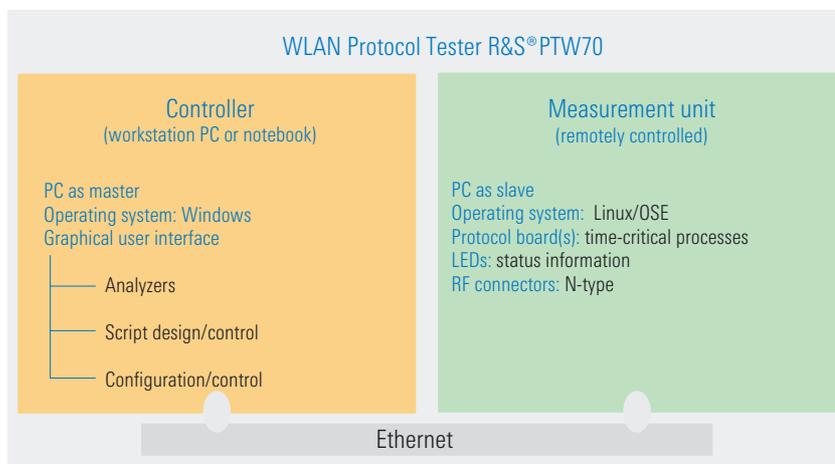
The WLAN Protocol Tester R&S®PTW70 is an indispensable error diagnostics tool for wireless LAN system components from chip set to complete infrastructure. By accommodating wireless LAN software and hardware modules, the R&S®PTW70 can be used to evaluate how different system components interact and to test cross-technology compatibility. Due to its special design, the R&S®PTW70 allows the performance and quality features of wireless LAN system components to be objectively evaluated for the first time.

The WLAN Protocol Tester R&S®PTW70 represents a considerable enhancement in speed, accuracy and cost-effectiveness in the complex measurement tasks involved in multi-standard wireless LAN systems.

Since it supports controlled error simulation in the protocol sequence, manipulation of test sequences, realtime analysis and complete documentation of results, the WLAN Protocol Tester R&S®PTW70 is an indispensable tool in the development, integration and verification of wireless LAN systems.

R&S® PTW70	Bluetooth wireless technology	Wireless LAN
Specification/Standard	1.1 & 1.2	IEEE802.11a/b/g
Applications	Conformance and verification tests	Development, integration and verification tests
Test Suites	BB, LM, L2CAP, GAP, SDP & SPP	Customized (e.g. to pass tests at Wi-Fi Alliance)
GUI / Control	Highly optimized to meet the requirements of the Bluetooth SIG's qualification process	Online tools, monitor mode and analyzer mode, multi-choice operating concept
Operating System/GUI	Windows2000/XP	

*The Protocol Tester R&S®PTW70 is available for the standards Bluetooth® 1.1 and 1.2 as well as for WLAN IEEE802.11a/b/g. Both functions may be ordered separately or combined in one single unit*



Design of the WLAN Protocol Tester R&S®PTW70



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## Wireless Protocol Tester R&S®PTW70

### Main features (WLAN)

- ◆ Analyzer mode – The IEEE 802.11 reference model of the R&S®PTW70 simulates a wireless LAN access point or a station
- ◆ Sniffer or monitor mode – the R&S®PTW70 records data communications in a wireless LAN cell
- ◆ The multi-choice operating concept features graphical and programmable user interfaces
- ◆ Online analysis tools provide the user with reliable data exactly when needed
- ◆ Hardware-based timers and realtime processing make it possible to analyze protocol sequences in detail in all operating modes
- ◆ The measurement unit is detached from the controller and can be remotely driven from different workstations
- ◆ The modular design allows flexible tester configurations specific to a given measurement task – from the single-channel model to versions networking several R&S®PTW70 testers
- ◆ Its predefined set of applications is tailored to specific user groups
- ◆ Its powerful hardware platform makes the tester a future-proof investment

### Characteristics (WLAN)

#### What does IEEE 802.11 multimode protocol tester mean?

IEEE 802.11 currently specifies wireless LAN systems for the 2.4 GHz ISM frequency band (802.11b and 802.11g) and the 5 GHz U-NII frequency band (802.11a). The R&S®PTW70 supports the 802.11a and 802.11g systems, i.e. it offers a wide range of functions from the RF frontend, the physical protocol layer, the MAC protocol layer through to applica-

tions. As to 802.11b functionality, the focus is on interoperability measurements, particularly the monitor mode and analysis functions for testing 802.11b and 802.11g interoperability.

#### Modular design

The WLAN Protocol Tester R&S®PTW70 consists of a measurement unit and a controller (workstation PC or notebook). The two components are connected via Ethernet directly or as part of a network. The detached measurement unit of the R&S®PTW70 can be configured and monitored via a graphical user interface. The measurement data is returned to the controller and can be evaluated conveniently using graphical analysis tools.

#### Measurement unit

Using a standard PC architecture, the R&S®PTW70 measurement unit can simultaneously carry out measurements, record measured data and, in the background, send the data to the detached controller. The baseband architecture is oriented to the realtime requirements of the PHY layer and the MAC layer. The baseband board is designed to support future requirements of the WLAN standards by installing software updates.

#### Software concept

The R&S®PTW70 uses three operating systems. All time-critical processes run on the OSE realtime operating system and are executed by accessing a reliable Rohde&Schwarz protocol stack model. The PC of the measurement unit runs on the Linux operating system, which is also used to communicate with the controller. The user interface is designed for 32-bit Windows operating systems. Three tools are available to enable optimal configuration of the R&S®PTW70 for a given measurement task.

- ◆ Graphical script editor: the direct way to measurement results
- ◆ Script-based programming interface: time-saving in automatic tests
- ◆ C++ library: error simulation for quality assurance at all stages of development

### Brief description (Bluetooth®)

Rohde & Schwarz has been involved in *Bluetooth®* Wireless Testing since the very beginning of Bluetooth® itself. The Protocol Tester PTW60 for Bluetooth® 1.1 is the most widely used protocol tester for Bluetooth® qualification testing.

The Bluetooth® option for the R&S®PTW70 allows automatic performance of conformance test cases for Bluetooth® protocols and profiles, according to the Bluetooth® qualification test case reference (TCRL), both for 1.1 and 1.2 implementation.

### Main features (Bluetooth®)

- ◆ Based on the official 1.1 and 1.2 TTCN test cases for BB, LM, L2CAP, GAP, SDP and SPP/RFCOMM
- ◆ R&S®PC based platform
- ◆ Friendly graphic user interface (GUI)
- ◆ Manual/automatic test cases selection
- ◆ ICS/IXIT edition
- ◆ Test case mapping, according to official TCRL
- ◆ Static conformance review
- ◆ Verdict handling
- ◆ Test log analysis
- ◆ Decoding, filtering and debugging
- ◆ EUT(equipment under test) database
- ◆ Automatic test report generator



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## Wireless Protocol Tester R&S®PTW70

### Characteristics (Bluetooth®)

- ◆ The R&S®PTW70 basic unit consists of a Rohde&Schwarz industrial PC board that is commonly used in all recent Rohde&Schwarz measurement instruments. Running on Windows2000, it hosts the control and test software
- ◆ The hardware option for Bluetooth® consists of all necessary components for RF modulation, demodulation and the lower layers functionality. It is implemented as a PCI card fitted into the R&S®PTW70 basic unit
- ◆ The R&S®PTW70 Bluetooth® option uses the ISO standard as a basis for the methodology of conformance testing (ISO/IEC 9646, parts 1 to 7)
- ◆ The implemented test cases are based on the Bluetooth® abstract test suites written in TTCN

In order to comply with the Bluetooth® abstract test suites, the R&S®PTW70 Bluetooth® option contains the following interfaces:

- ◆ LC-PL
- ◆ LM-LC
- ◆ L2CAP-SAR
- ◆ LM-A
- ◆ LM-B
- ◆ LM-C
- ◆ RFCOMM-L2CAP
- ◆ SDP-L2CAP
- ◆ TCI-HCI

The following test suites are covered:

- ◆ Base band test cases
- ◆ Link manager test cases
- ◆ Logical link control and adaptation protocol test cases
- ◆ Service discovery protocol test cases
- ◆ Generic access profile test cases
- ◆ Serial port profile and RFCOMM test cases

### Measurement capabilities

The graphical user interface of the R&S®PTW70 Bluetooth® Option is easy to use, but powerful and flexible at the same time.

The user will create a test project where all the information related to the manufacturer or IUT hardware/software version will be stored. A database will allow easy registration and recovery of already performed campaigns. Then, the ICS/IXIT information has to be filled and it will provide all the data necessary for the Test Case selection and information for the execution. The test operator can fill this data in a normal Microsoft Office Excel Sheet (using a template which is provided), and the system will import this data automatically. Another possibility is to fill and edit the ICS/IXIT directly in the Graphical User Interface.

The ICS information is checked automatically for the tester (Static Conformance Review), and in case of errors, the system will indicate the problem. When all the ICS are correct, the software will produce the Test Case Mapping Table containing all the applicable Test Cases. Those Test Cases can be executed individually or in batch.

The results of the execution, information through PCOs (Points of Control and Observation), timers, preliminary verdicts, etc, can be analysed.

### Filtering capabilities

- ◆ Start Test Case: shows/hides the test case identifier and the start execution time
- ◆ Test Case Ended: shows/hides the test case identifier and the end execution time

- ◆ Start PTC: shows/hides the test step identifier and the start execution time
- ◆ PTC Ended: shows/hides the test step identifier and the end execution time
- ◆ Assignment: shows/hides the assignments to TTCN variables (PDUs, etc.)
- ◆ Send Event: shows/hides the events sent via coordination points to a parallel test component
- ◆ Receive Event: shows/hides the events received via coordination points from a parallel test component
- ◆ Otherwise Event: shows/hides the information of an event which followed the "otherwise" condition in the test case
- ◆ Start Timer: shows/hides the start of a timer
- ◆ Cancel Timer: shows/hides the cancellation of a timer
- ◆ Stop Timer: shows/hides the stop of a timer
- ◆ Time Out: shows/hides the expiry of a timer
- ◆ Preliminary Verdict: shows/hides preliminary verdicts
- ◆ Final Verdict: shows/hides the final verdict of the test case

Finally, with the automatic report generator, the test case results and information relative to the manufacturer and IUT will be included in a Microsoft Office Word document automatically. The test report format follows the recommendations given in the standard ISO9646 (including Static Conformance Test Reports, PICS, PIXIT and test logs), although customer can customize some aspects of the report template.

## Wireless Protocol Tester R&S®PTW70

### Specifications in brief

You will find detailed and binding data on the enclosed CD (./DATASHEET/PTW70.pdf), or, for the latest updates, visit [www.rohde-schwarz.com](http://www.rohde-schwarz.com), search term: PTW70

Data for *Bluetooth*® model on request

#### TX/RX

Frequency range	
– Band 1 IEEE802.11b	2400 MHz to 2500 MHz
– Band Japan IEEE802.11a	4910 MHz to 5080 MHz
– Band 2 IEEE802.11a	5150 MHz to 5350 MHz
– Band 3 EU HiperLAN2	5470 MHz to 5725 MHz
– Band 3 US IEEE802.11a	5725 MHz to 5825 MHz
RF frequency response (band 1)	1 dB

#### TX

Modulation	
EVM ( $P_{out} = 0$ dBm)	>28 dBm
Spurious (10 kHz to 200 MHz offset)	–40 dBc
Harmonics (2nd and 3rd order)	–30 dBc
Output level	
Max.	+6 dBm
Range	20 dB

#### RX

Immunity to interference	
Image rejection	>30 dB
IF rejection	>30 dB
IF1: 1150 MHz	>30 dB
IF2: 20 MHz	>50 dB
Sensitivity (packet error rate PER: 10%, according to S/N)	–82 dBm at 6 Mbit/s (~S/N = 12 dB) –65 dBm at 54 Mbit/s (~S/N = 29 dB)
Max. input level	–30 dBm

#### Interfaces

LAN, USB, VGA
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#### General data

Operating temperature range	+5°C to +45°C
Power supply	100 V to 240 V AC, max. 310 VA, 50 Hz to 60 Hz
Dimensions (W × H × D)	310 mm × 140 mm × 430 mm
Weight	10 kg

### Ordering information

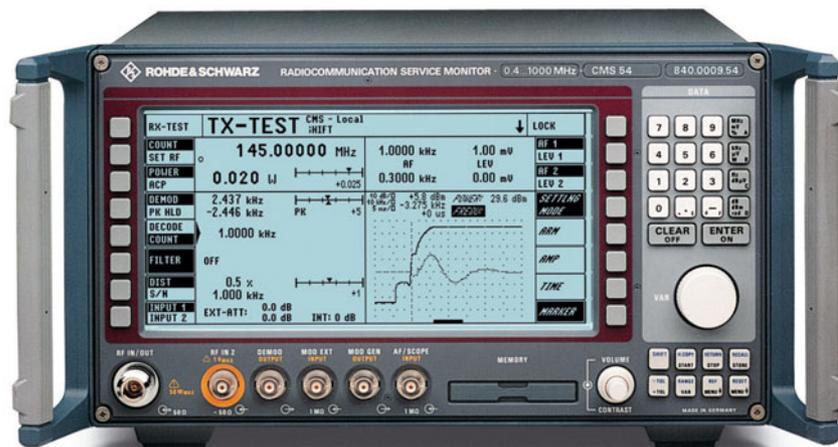
<b>Basic Unit</b>	R&S®PTW70	1153.3001.02
Case, PC architecture, boot manager		
<b>Options</b>		
WLAN Hardware: Protocol board, RF module (interim version), operating system, cabling, CD, dongle, user manual	R&S®PTW70-WLA (interim)	1501.2108.02
WLAN Hardware: Protocol board, RF module (final version), operating system, cabling, CD, dongle, user manual	R&S®PTW70-WLA	1501.2108.03
WLAN Software – Sniffer: Operational software for 802.11b/g/a, passive mode = sniffer/monitor; option file	R&S®PTW70-Sn 802.11 B/G/A PA	1501.2408.02
WLAN Software – Reference for 802.11b/g and Sniffer: Operational software for 802.11b/g, active mode = reference simulating STA or AP; passive mode = sniffer/monitor; option file	R&S®PTW70-BG 802.11 B/G PA/AC	1501.2350.02
WLAN Software – Reference for 802.11b/g/a and Sniffer: Operational software for 802.11b/g/a, active mode = reference simulating STA or AP; passive mode = sniffer/monitor; option file	R&S®PTW70-ABG 802.11 B/G/A PA/AC	1501.2308.02
WLAN Software – Programming Interface: C++ Library and SAP control interface; Option file; Programming manual	R&S®PTW70-SAP C++ SAP Interface	1501.2250.02
<b>Software service and maintenance for 1 year including GLORIS problem report database and software download account</b>		
Sniffer	R&S®PTW70-Sn Service	
MANDATORY FROM THE BEGINNING		
B/G Reference/Sniffer	R&S®PTW70-BG Service	
B/G/A Reference/Sniffer	R&S®PTW70-ABG Service	
SAP C++ Programming Interface	R&S®PTW70-SAP Service	
<b>Hardware/software upgrades for Bluetooth®</b>		
Bluetooth HW/SW Upgrade (Core Specification 1.1 & 1.2)	R&S®PTW70-BTU	1501.1801.02
For customers owning a R&S®PTW60 Bluetooth Protocol Tester only!	R&S®PTW70-BT	1501.1801.03
Bluetooth HW/SW (Core Specification 1.1 & 1.2)		

## Radiocommunication Service Monitors R&S® CMS 50/54

### 0.4 MHz to 1000 MHz

Radio testers for service, production and development

*Radiocommunication Service Monitor R&S® CMS 54*



### Brief description

The Radiocommunication Service Monitors R&S® CMS can alone perform transmitter and receiver testing, measurements on antennas, diplexers, filters and frequency-converting modules as well as modulation spectrum analysis. The signalling unit supports all important mobile radio standards. With its full-feature configuration offering enhanced measurement capabilities, this light-weight and compact tester, which is suitable for mobile and stationary use alike, satisfies all requirements of radio measurements.

### Main features

- ◆ AM, FM or  $\phi$ M and SSB
- ◆ Analog and digital signalling
- ◆ Large, high-contrast LCD
- ◆ Operation via softkeys
- ◆ Clear menu structure
- ◆ Simultaneous and easy-to-read display of settings and results
- ◆ Manual and automatic measurements
- ◆ Tracking generator
- ◆ Cable fault test
- ◆ Spectrum monitor
- ◆ Stationary and mobile use
- ◆ Low weight, compact size

### Overview of models

#### R&S® CMS50 – the budget-priced model for service applications

- ◆ Transmitter and receiver testing
- ◆ Spectrum monitor
- ◆ Fully automatic testing
- ◆ SSB test
- ◆ ERMES coder

#### R&S® CMS54 – the high-end tester for demanding requirements in production and development

- ◆ Radio measurements same as R&S® CMS50
- ◆ Basic model additionally with:
  - ◆ Full-span tracking generator from 0.4 MHz to 1000 MHz
  - ◆ Adjacent-channel power meter with standard ETSI filters
  - ◆ Duplex modulation meter
  - ◆ Automatic harmonic measurement
  - ◆ Cable fault test

### Operation

- ◆ All functions are clearly displayed; 16 softkeys allow direct access to individual parameters
- ◆ The large, backlit LCD screen provides clear and simultaneous readout of all test results, entries and functions

- ◆ Hardcopy of screen display, entry of tolerance and reference values are made at a keystroke
- ◆ Settings can be varied in selectable steps using the spinwheel
- ◆ Programs, instrument settings and test results can be stored on memory cards
- ◆ Additional inputs and outputs allow independent and versatile use of signal sources and test facilities

### Automatic tests

Automatic test routines are indispensable for high throughput and reproducible results in service and production: in the learn mode, the Radiocommunication Service Monitor R&S® CMS stores all manual settings and measurements and produces from them ready-to-start automatic test routines. The user need not have any programming knowledge or learn equipment-specific command sets. Tolerances, comments and conditions (loops, jumps, queries and control commands) can additionally be inserted into the test routines. Programs can also be activated directly from the memory card. The test report format may be user-specified and can be clearly structured by transferring control characters to the printer, such as blank line, paragraph and bold-face.

## Radiocommunication Service Monitors R&S®CMS50/54

### R&S®CMS – a test set replacing many individual measuring instruments

Due to the comprehensive standard configuration of the individual models and the optional extensions tailored to specific applications, external measuring instruments in addition to the R&S®CMS are not required.

#### Signal sources

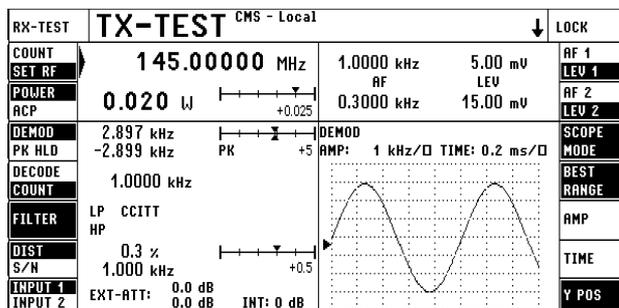
- ◆ RF synthesizer with AM, FM, φM and multitone modulation capabilities
- ◆ Two independent modulation generators
- ◆ Selective-call encoder to all standards (also user-programmable)
- ◆ CDCSS coder
- ◆ DTMF coder
- ◆ Reference frequency input/output

#### Signalling

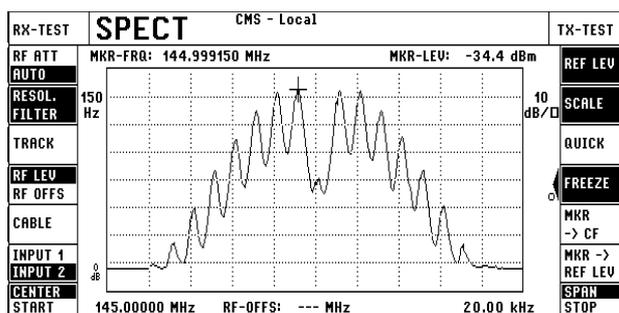
- ◆ NMT 450/900, E-AMPS, R2000
- ◆ E-TACS, J-TACS, TACS Issue 4
- ◆ POCSAG, ZVEI digital, VDEW digital
- ◆ ERMES pager test

#### Measuring facilities

- ◆ RF frequency counter, RF frequency-offset counter
- ◆ Power meter
- ◆ Selective RF power meter
- ◆ RF spectrum monitor with wide dynamic range and filters which also allow modulation analysis (AM, FM, SSB)
- ◆ Tracking generator
- ◆ Adjacent-channel power meter with standard ETSI filters
- ◆ Modulation meter for AM, FM and φM; weighting: +PK, -PK, PK HOLD, ±PK/2, RMS, RMS √2
- ◆ Duplex modulation meter for duplex spacings of any size



*RF measurements, evaluation of demodulated signals and setting of modulation generators*



*150 Hz filter allowing direct modulation analysis for AM, FM and SSB*

- ◆ AF voltmeter with peak and true RMS weighting
- ◆ SINAD meter with variable test frequency
- ◆ S/N/distortion meter with variable test frequency
- ◆ AF frequency counter with period and gate-time counting
- ◆ Selective-call decoder for all standards (also user-programmable)
- ◆ DTMF decoder
- ◆ Oscilloscope
- ◆ DC ammeter/voltmeter
- ◆ Transient recorder for analysis of power and frequency transients
- ◆ Cable fault test

- ◆ Highpass and lowpass filters for band limiting and measurement of subaudio tones

#### Other facilities

- ◆ Second RF input with high sensitivity for off-air measurements, can be used independently for module testing
- ◆ Built-in 600 Ω AF transformers for modulation generator and AF voltmeter
- ◆ Connector for battery (11 V to 32 V)
- ◆ 13 dBm RF output for off-air measurements
- ◆ Memory for storing complete instrument setups

#### Filters

- ◆ ITU-T or C-message filters for weighting to relevant standards
- ◆ Continuously tunable bandpass filter with high skirt selectivity for selective modulation and AF measurement
- ◆ Continuously tunable notch filter for signal suppression

## Radiocommunication Service Monitors R&S®CMS50/54

Extensions for basic model	Option	R&S® CMS50	R&S® CMS54	Order No.	Specifications
OCXO Reference Oscillator For long-term stability	R&S®CMS-B1	○	○	0840.9406.02	See timebase Aging $2 \times 10^{-7}/\text{year}$
<b>OCXO Reference Oscillator</b> For extremely high long-term stability	R&S®CMS-B2	○	○	1001.6809.02	Specs same as R&S®CMS-B1, except for aging $\leq 1 \times 10^{-7}/\text{year}$
<b>Duplex Modulation Meter</b> For operation of RF frequency counter and modulation meter independent of RF generator (two-port measurements, also on frequency-converting modules)	R&S®CMS-B59	○	—	1032.0990.02	Specs same as basic model, except residual FM $\leq 10 \text{ Hz}$
<b>Duplex Modulation Meter</b> Same as R&S®CMS-B59, plus adjacent-channel power meter for measurements on duplex radio, cellular mobile phones and frequency-converting modules	R&S®CMS-B9	—	●	0840.9506.02	Specs same as basic model, adjacent-channel power meter with ETSI filters Channel spacings Dynamic range $10/12.5/20/25 \text{ kHz}$ and user-selectable up to 1 MHz $\geq 70 \text{ dB}$ (channel spacing 25 kHz)
<b>10 MHz Reference Frequency Input/Output</b> External synchronization for measuring systems	R&S®CMS-B22	○	○	1001.6750.02	Output Input TTL signal, $Z_{\text{out}} \approx 50 \Omega$ , $f = 10 \text{ MHz}$ level $> 1.5 \text{ V (V}_{\text{pp}})$ , $Z_{\text{in}} \approx 50 \Omega$ , $f = 10 \text{ MHz} \pm 500 \text{ Hz}$
<b>100 W RF Power Meter</b> Measurement of high RF input power	R&S®CMS-B32	○	○	1001.7905.02	Maximum input power: 100 W for 3 min, then 10 min power off; continuous power: 80 W; max. output level and measurement sensitivity at input 1 reduced by 3 dB; additional error: $\leq 0.15 \text{ dB}$ ( $P > 40 \text{ mW}$ , $\text{AM} = 0\%$ )
<b>13 dBm Output</b>	R&S®CMS-B34	○	○	1032.1350.02	Additional power output for off-air measurements
<b>IEC/IEEE bus Interface</b>	R&S®CMS-B54	○	●	1032.0748.02	Use of R&S®CMS50 in automatic test systems
<b>Signalling units for models with Duplex Modulation Meter R&amp;S®CMS-B9 or R&amp;S®CMS-B59</b>					
<b>Signalling Unit for Cellular Radio</b> NMT 450/900, E-AMPS, E-TACS, J-TACS, TACS Issue 4 (opt.), R 2000	R&S®CMS-B53 <sup>1)</sup>	○	○	1032.0890.02	Simulation of base station for testing cellular mobile phones, e.g. call setup, call clear-down, channel and power change
<b>Signalling for POCSAG, ZVEI/VDEW digital for R&amp;S®CMS-B53</b>	R&S®CMS-B26	○	○	1031.9993.10	

<sup>1)</sup> R&S®CMS-B59 also required.

- fitted as standard
- option
- not possible

## Radiocommunication Service Monitors R&S® CMS50/54

Optional control interfaces <sup>1)</sup>					
Order No.	R&S® CMS-B5 0841.0502.10	R&S® CMS-B55 1032.0790.02	R&S® CMS-B20 0841.1209.02	R&S® CMS-B39 1032.0090.02	Specifications
<b>DTMF Decoder</b>	●	●	●	●	Decoding of DTMF dual tones and VDEW direct dialling
<b>CCITT Filter</b>	●	●	●	●	
<b>Centronics Interface</b>	●	●	●	●	
<b>Relays</b>	8	–	–	4	With max. 1 W switching power, $V_{max}=30\text{ V}$ , $I_{max}=0.1\text{ A}$
<b>TTL Input/Output</b>	12	–	–	8	Outputs: 25 mA
<b>DC Ammeter/Voltmeter, floating</b>	–	–	●	–	Voltage measurement Range Resolution Error Current measurement Range Resolution Error
<b>600 Ω AF Transformers</b>	–	–	–	●	Output impedance of AF generator Frequency range Output voltage Max. output current Input impedance of AF voltmeter Frequency range
<b>VSWR Measurements</b>	R&S®CMS-Z37 <sup>2)</sup>	–	–	R&S®CMS-Z37 <sup>2)</sup>	Connection of Insertion Units R&S®NAS-Z1, -Z3, -Z5, -Z6 (GSM900), -Z7 (GSM 1800) with direct reading of VSWR as well as forward and reflected power

<sup>1)</sup> Choice of one option.

<sup>2)</sup> R&S®CMS-B5 or -B39 required for Insertion Units R&S®NAS-Z1/-Z3/-Z5/-Z6/-Z7.

- fitted as standard
- not possible

## Radiocommunication Service Monitors R&S®CMS50/54

### Specifications in brief (all R&S®CMS models)

You will find detailed and binding data on the enclosed CD (./DATASHEET/CMS.pdf), or, for the latest updates, visit [www.rohde-schwarz.com](http://www.rohde-schwarz.com), search term: CMS

**Bold-faced** values in brackets refer only to R&S®CMS54.

#### Receiver measurements

<b>Signal generator</b>	
Frequency range	0.4 MHz to 1000 MHz <b>(usable from 100 kHz)</b>
Frequency resolution	50 Hz <b>(10 Hz)</b>
Level	
FM, φM, CW	−134 dBm to 0 dBm
AM	−134 dBm to −3 dBm
Level resolution	0.1 dB
Accuracy	±2 dB
Harmonics	≤−20 dBc (≤− <b>25 dBc</b> )
Nonharmonics	≤−50 dBc
Phase noise	≤−110 dBc (20 kHz from carrier, referred to 1 Hz test bandwidth)
<b>Modulation</b>	
Frequency range	2 MHz to 500 MHz <b>(0.4 MHz to 1000 MHz)</b>
AM depth	0% to 99%
Mod. frequency range	DC to 20 kHz
FM deviation	0 hZ to 100 kHz (50 Hz to 50 kHz)
Resolution	1 Hz
Mod. frequency range	20 Hz to 20 kHz
Mod. distortion	≤1%
φM deviation (internal)/resolution	0 rad to 10 rad/1 mrad
Mod. frequency range	100 Hz to 6 kHz
Mod. distortion	≤1%
<b>AF voltmeter</b>	
Frequency range	50 Hz to 20 kHz
Measurement range/resolution	0.1 mV to 30 V/100 μV
Input impedance	approx. 1 MΩ

#### Transmitter measurements

<b>RF power meter</b>	
Frequency range	1.5 MHz to 1000 MHz (2 MHz to 1000 MHz)
Measurement range	5 mW to 50 W (100 W optional)
Accuracy (P > 20 mW, AM=0%)	0.4 dB + resolution
Selective level measurement	in frequency range 1 MHz to 1000 MHz
Level range	−60 to +47 dBm w/o weighting filter, −80 dBm to +47 dBm with 2 kHz resonance filter
<b>RF frequency counter</b>	
Frequency range	0.5 MHz to 1000 MHz (usable from 100 kHz, IF narrow)
Input level range (CW, FM)	
Input 1	0 dBm to +47 dBm
Input 2	−40 dBm to +7 dBm

<b>Frequency deviation meter</b>	
Operating modes	+PK, −PK, ±PK/2, PK HOLD, RMS, RMS√2
Measurement range	0 Hz to 50 kHz <b>(0 Hz to 100 kHz)</b>
AF frequency range	20 Hz to 15 kHz <b>(20 Hz to 20 kHz)</b> (DC-coupled at demodulator output)
Resolution	1 Hz
<b>Phase deviation meter</b>	
Operating modes	+PK, −PK, ±PK/2, RMS, RMS√2
Measurement range/resolution	0.001 rad to 5 rad/0.001 rad
AF frequency range	300 Hz to 6 kHz
<b>AM depth meter</b>	
Operating modes	+PK, −PK, ±PK/2, RMS, RMS√2
Measurement range/resolution	0.01% to 99%/0.01%
AF frequency range	50 Hz to 10 kHz <b>(50 Hz to 20 kHz)</b>
RF spectrum monitor	1 MHz to 1000 MHz
Display dynamic range	>60 dB
Span	0 (zero span) to 50 MHz
Filter (3 dB bandwidth)	150 Hz, 6/16/50/300 kHz, 1/3 MHz (coupled to span)
<b>RF spectrum monitor (R&amp;S®CMS50)</b>	
Frequency range	1 to 1000 MHz, usable from 100 kHz
Span	0 Hz (zero span) to 50 MHz
Reference level	+47 dBm to −47 dBm (input 1)
Display dynamic range	>60 dB (for reference level >−7 dBm at input 1)
Resolution filter (3 dB bandwidth)	150 Hz, 6/16/50/300 kHz/1/3 MHz (coupled to span)
Resolution	0.4 dB
<b>RF spectrum monitor (R&amp;S®CMS54)</b>	
Frequency range	1 to 1000 MHz, usable from 100 kHz
Span	0 Hz (zero span) to 50 MHz; full span for frequency range 10 MHz to 1000 MHz
Reference level	+47 dBm to −47 dBm (input 1)
Sensitivity	<−110 dBm (for resolution filter 6 kHz and reference level ≤−37 dBm at input 2, f ≥10 MHz)
Inherent spurious response	<−50 dBc (for reference level >10 dBm and f >50 MHz)
Display dynamic range	>65 dB (for reference level >−7 dBm at input 1)
Scaling	2/5/10 dB/div
Display range	≤80 dB
Resolution filter (3 dB bandwidth)	150 Hz (for modulation analysis), 6/16/50/300 kHz/1/3 MHz (for full span), coupled to span
Error	<3 dB + resolution
Resolution	0.4 dB
<b>Transient recorder (R&amp;S®CMS54)</b>	
Measurement of power and frequency as a function of time with graphical display and selectable zoom	
Time scale	50 μs/div to 1 s/div, maximum recording time 40 s
Frequency transients	
RF frequency range	1 MHz to 1000 MHz
Measurement range (FM dev.)	0 to ±100 kHz
Scaling	0.5 kHz to 50 kHz/div
Triggering	internal, automatic (frequency changes >8 kHz)

## Radiocommunication Service Monitors R&S® CMS 50/54

<b>Power transients</b>	
RF frequency range	1 MHz to 1000 MHz
Display dynamic range	60 dB (for 47 dBm at input 1)
Scaling	2/5/10/20 dB/div
Triggering	internal, automatic (power 10%)
<b>Harmonic measurements (R&amp;S® CMS 54)</b>	
Display of 1st to 4th harmonic	
Max. harmonic frequency	1000 MHz
Dynamic range	>60 dB >90 dB in frequency range 26.965 MHz to 27.405 MHz (CB radio)
<b>Tracking generator (with R&amp;S® CMS-B59/-B9)</b>	
Frequency range	400 kHz to 1000 MHz
Reference level	-67 dBm to -27 dBm
Display dynamic range	50 dB
Span	0 to 50 MHz (full span for R&S® CMS 54)
Output level	-128 dBm to 0 dBm
Frequency offset	0 Hz to -999 MHz (depending on span and center frequency)
<b>Transmitter measurements at 2nd RF input</b>	
Measurement of RF frequency, modulation (AM, FM, φM), modulation frequency and RF spectrum (level) of small RF signals, e.g. in off-air or module measurements, for input levels from approximately	
RF frequency counter	30 μV (selective frequency counter with presetting)
Modulation meter	5 μV (IF narrow) 1 μV (IF narrow, selective meas.)
Selective level measurement	-75 dBm to -35 dBm without weighting filter, -100 dBm to -35 dBm with 2 kHz resonance filter
<b>Transmitter measurements at 2nd RF input (R&amp;S® CMS 54)</b>	
Additional, internally switchable 0/24 dB attenuator pad, for high-level measurements at input 2	

### Transmitter and receiver measurements

<b>Modulation generator I and II</b>	
Frequency range	0.1 Hz
Output voltage range	10 μV to 5 V
Output impedance	≤4 Ω
<b>Distortion meter</b>	
Frequency	100 Hz to 5 kHz (100 Hz to 3 kHz)
Measurement range	0.1% to 50%
<b>SINAD meter</b>	
Frequency	100 Hz to 5 kHz (1 kHz ±10Hz)
Measurement range	1 dB to 46 dB
<b>AF frequency counter</b>	
Operating modes	demodulation, AF, beat (frequency offset)
Frequency range	20 Hz to 500 kHz (20 Hz to 20 kHz) (superimposed RF)
Resolution	1 Hz/0.1 Hz
<b>Oscilloscope</b>	
Bandwidth	
DC	DC to 20 kHz
AC	10 Hz to 20 kHz

Horizontal deflection	20 to 0.1 ms/div
Vertical deflection	scaled in kHz (FM), rad (φM), % (AM), mV/V (AF)
Input voltage range	0 V to 40 V (V <sub>D</sub> )
Input impedance	approx. 1 MΩ
<b>AF filters</b>	
Highpass	f <sub>cutoff</sub> = 300 Hz
Lowpass	f <sub>cutoff</sub> = 3.4 Hz
<b>Bandpass</b>	
broadband	highpass + lowpass
narrowband	100 Hz to 3 kHz (50 Hz to 5 kHz)
Notch filter	100 Hz to 3 kHz (100 Hz to 5 kHz)
CCITT filter	see option R&S® CMS-B5 or R&S® CMS-B20
<b>Selective-call coder/decoder</b>	
Tone sequences	ZVE1/ZVE2/CCIR/EIA/EEA/EURO/NATEL/CCITT/VDEW/DTMF/VDEW direct dialling/user-defined sequences (DTMF decoding see Control Interfaces R&S® CMS-B5 and R&S® CMS-B55); CDCSS decoder and ATIS see option R&S® CMS-B27
<b>Audio monitor</b> (loudspeaker)	demodulated signal, AF signal, beat (frequency offset)

### General data

<b>Power supply</b>	
AC	100/120/220/240 V ±10%, 47 Hz to 420 Hz (50 VA)
DC	11 V to 32 V
Dimensions (W × H × D)	320 mm × 175 mm × 375 mm
Weight (without options)	13 kg

### Ordering information

<b>Radiocommunication Service Monitor</b>	R&S® CMS 50 R&S® CMS 54	0840.0009.50 0840.0009.54
<b>Extras</b>		
Documentation of Calibration Values	R&S® CMS-DCV	0240.2193.08
Memory Card 32 kByte	R&S® CMS-Z1	0841.1609.02
Memory Card 128 kByte	R&S® CMS-Z2	0841.1509.02
Battery Connector for external DC Supply	R&S® CMS-Z7	0841.1350.02
Adapter for VSWR Sensors R&S® NAS-Z1/-Z3/-Z5/-Z6/-Z7	R&S® CMS-Z37	1065.4907.02
Carrier-bag	R&S® CMS-Z40	1065.5603.02

## Antenna Coupler, RF Shielding Cover, *Bluetooth*<sup>®</sup> Antenna R&S<sup>®</sup> CMU-Z10/-Z11/-Z12, USB feed-through R&S<sup>®</sup> CMU-Z13

### Simple coupling and interference-free testing of mobile phones in all frequency bands

#### Brief description

Anyone engaged in mobile phone testing is only too familiar with problems such as getting hold of a suitable RF adapter or keeping RFI away which would otherwise falsify the measurement results. The R&S<sup>®</sup> CMU-Z10/-Z11/-Z12 is the solution to these problems for all mobile phones – whether GSM, US Cellular or WCDMA.

The broadband Antenna Coupler R&S<sup>®</sup> CMU-Z10 is the basis, which in conjunction with the RF Shielding Cover R&S<sup>®</sup> CMU-Z11 can be upgraded to a fully enclosed RF shielded chamber.

#### Antenna Coupler R&S<sup>®</sup> CMU-Z10

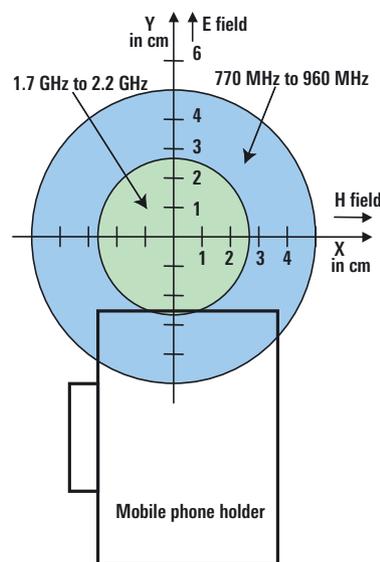
With increasing efforts to miniaturize mobile phones, the antenna disappears inside the enclosure. In recent mobile phone models, the antenna is replaced by a metallic-printed ceramic rod on the PC board or a printed structure in the cover. This radiating element is usually accommodated in the upper rear part of the phone. The fields emitted from there can ideally be picked up by an extensive coupling structure like that of the R&S<sup>®</sup> CMU-Z10.

#### Polarization

A  $\lambda/4$  radiator vertically mounted on the mobile phone generates a vertically polarized electromagnetic field. The coupling element in the R&S<sup>®</sup> CMU-Z10 is arranged so that a mobile phone with vertically mounted  $\lambda/4$  radiator achieves minimum coupling attenuation. The coupler is of asymmetrical design to allow also measurements on mobile phones with horizontal polarization.

#### Position

The blue circle shows the active coupling zone for frequencies from 770 MHz to 960 MHz, the green circle that for frequencies from 1.7 GHz to 2.2 GHz (see illustration). Depending on the radiation center of the phone, the optimum position is different for every model. Since the coupling zone is an area, the phone can be shifted somewhat out of the optimum position without dramatic increase in coupling attenuation (see diagram top right). These zones are marked on the coupler by the antenna elements which



## Antenna Coupler, RF Shielding Cover, *Bluetooth*® Antenna R&S®CMU-Z10/-Z11/-Z12, USB feed-through R&S®CMU-Z13

are visible through the transparent base plate. To facilitate handling of the DUT, a holder is mounted on the base plate for fixing the mobile phones directly above the optimum coupling zone. For applications in which this holder is disturbing, a second absolutely flat base plate is supplied, which can be used instead of the base plate mounted as standard. This base plate can accommodate DUTs of up to 280 mm × 50 mm × 200 mm in size.

### Data connection

A 15-pin sub-D feed-through is installed as standard to connect a data cable. A USB feed-through can optionally be ordered.

### Mismatch

In order to minimize RF power loss on the way to the radiocommunication tester (e.g. R&S®CMU200), the high-quality cable that comes with the R&S®CMU-Z10 should be used.

### Radiated interference

Interference from other transmitters falsifies the measurement results. Interfering transmitters may be neighbouring base stations as well as other mobile phones and test sets in the same service shop or repair line. Distinctly differing results of bit error rate measurements (BER) in different channels are a clear sign of interference.

### Shielding Cover R&S®CMU-Z11

With the shielding cover, the coupler is upgraded to a high-grade RF shielded chamber which prevents unwanted interference radiated by base stations or other neighbouring test and service sets from affecting the measurement results of the DUT. This is particularly important for BER measurements. The effective closing mechanism can conveniently be managed with only one hand and ensures a very high shielding effectiveness of >50 dB by producing a defined contact pressure.

## Specifications

R&S®CMU-Z10	
VSWR without R&S®CMU-Z11, without DUT, with cable supplied	
0.77 GHz to 0.87 GHz	<5.0
0.87 GHz to 0.96 GHz	<3.5
1.7 GHz to 2.0 GHz	<3.5
2.0 GHz to 2.2 GHz	<3.5
Coupling factor	
770 MHz to 960 MHz	5 dB to 8 dB <sup>1)</sup>
1.7 GHz to 2.2 GHz	10 dB to 15 dB
Connectors	
RF IN/OUT	N female/N female
RF THROUGH	N female/N female
DATA THROUGH	15-pin HDD female filter adapter/ 15-pin HDD male filter adapter
R&S®CMU-Z11	
Shielding effectiveness (in conjunction with R&S®CMU-Z11)	
Antenna coupler	>50 dB
<i>Bluetooth</i> Antenna R&S®CMU-Z12	>30 dB
R&S®CMU-Z12	
VSWR	
2.4 GHz to 2.5 GHz	<2.5
Connector	N female
The <i>Bluetooth</i> antenna can be integrated into the R&S®CMU-Z10 or used separately.	
General data	
Operating temperature range	-10°C to +60°C
Dimensions (W × H × D)	
R&S®CMU-Z10	230 mm × 100 mm × 320 mm
R&S®CMU-Z10 with R&S®CMU-Z11	250 mm × 180 mm × 430 mm

Usable test space	
(2nd plate without holder)	280 mm × 50 mm × 200 mm
R&S®CMU-Z12	56 mm × 56 mm × 50 mm
Weight	
R&S®CMU-Z10	2.7 kg
R&S®CMU-Z10 with R&S®CMU-Z11	4.8 kg
R&S®CMU-Z12, R&S®CMU-Z13	0.1 kg

<sup>1)</sup> The specified coupling factor is based on measurements carried out on several mobile phones of different manufacturers. The values cannot be warranted since they also depend on the antenna pattern of the mobile part.

## Ordering information

Antenna Coupler	R&S®CMU-Z10	1150.0801.02
RF Shielding Cover for R&S®CMU-Z10	R&S®CMU-Z11	1150.1008.02
<i>Bluetooth</i> Antenna	R&S®CMU-Z12	1150.1043.02
USB feed-through	R&S®CMU-Z13	on request
Spare RF sealing cord for R&S®CMU-Z11		1158.9514.00

If you order the Antenna Coupler R&S®CMU-Z10 plus the Shielding Cover R&S®CMU-Z11 and/or the *Bluetooth* Antenna R&S®CMU-Z12, the shielded chamber comes ready mounted. All components are also available individually for upgrading. If the options R&S®CMU-Z11 and/or -Z12 are not to be factory-fitted to the Antenna Coupler R&S®CMU-Z10, please use a separate order for these options.

### Equipment supplied

**R&S®CMU-Z10:** coupler (basis for shielded chamber), cable RG-214 with 2 N male connectors, length approx. 120 cm, 2nd base plate made of plexiglass without holder for optional use instead of the mounted base plate with holder.

**R&S®CMU-Z11:** shielding cover for the antenna coupler, hinges for fixing it to the coupler.