R&S®CMW500
Wideband Radio Communication Tester
UMTS LTE protocol test: one tester for all phases of development

75 Years of Driving Innovation

ROHDE & SCHWARZ

R&S®CMW500 Wideband Radio Communication Tester

At a glance

The R&S®CMW500 is ideal as a UMTS long term evolution (LTE) protocol tester, as it provides developers of wireless devices with a radio access network simulation.

Equipped with powerful hardware and various interfaces to wireless devices, the R&S®CMW500 can be used throughout all phases of LTE device development – from the initial software module test up to the integration of software and chipset, as well as for conformance and performance tests of the protocol stack of 3GPP standard compliant wireless devices.

Key facts about the hardware platform

◗ LTE protocol tester with a layer 1 to layer 3 protocol stack implementation in accordance with 3GPP Rel. 8 specifications TS 36.302, TS 36.321, TS 36.322, TS 36.323, TS 36.331
◗ Future-ready, powerful RF hardware that supports the 3GPP-defined LTE bandwidths from 1.4 MHz to 20 MHz and all 3GPP frequency bands up to 6 GHz
◗ Data rates up to 100 Mbps in the downlink and 50 Mbps in the uplink
◗ Integration of the DUT via an RF interface or digital I/Q interface (realtime, reduced clock); adaptation to customer-specific digital I/Q standards via an external adapter unit (future release)
◗ Digital baseband fading by means of the R&S®AMU200 fading simulator
◗ MIMO 2x2 and MIMO 4x2 (future release)
◗ Multi-cell and multi-RAT capability for LTE intra-cell, inter-cell and inter-RAT handover tests (future release)

Key facts about the software components

◗ Development environment for layer 1 to layer 3 signaling scenarios with automatic configuration of the layers below
◗ TTCN3 libraries and software tools for developing LTE signaling conformance test cases (future release)
◗ Extensive library with preconfigured messages and signaling scenarios for speeding up test development
◗ Practise proven software tools for carrying out, working on, automating and analyzing signaling scenarios
◗ Optional emulation of the physical layer for the development of layer 2 and layer 3 protocol software on PCs

R&S®CMW500 Wideband Radio Communication Tester
Benefits and key features

Developed for early LTE development

The LTE virtual software tester as well as the variable digital I/Q interface and the RF interface connect the tester to the DUT even in early phases of development. Special measurement functions are available for the L1 test.
▷ page 4

Shorter development time

The LTE virtual software tester and the digital I/Q interface support the parallel development of the LTE physical layer and protocol stack. Practise proven software tools permit efficient use and reuse when creating, carrying out and analyzing tests.
▷ page 6

Consistent hardware and software concept

The reuse of the tester hardware, tester software and test routines in all phases of the development process – from the first software module test to the conformance tests and regression tests, as well as for optimizing performance – delivers optimum results.
▷ page 8

Close look at protocol analysis

The R&S®CMW500 tester provides developers of LTE protocols with a specification-conforming reference implementation of the air interface. The comprehensive functions of the programming interfaces and the highly detailed representation in the analysis tools can be used to quickly detect discrepancies in the DUT protocol stack.
▷ page 9

Better test coverage through automation

Signaling tests can be fully automated if necessary. This approach allows users to perform a large number of tests for the various versions of the mobile phone software.
▷ page 10

Safe investment

The tester's hardware is ready for future features such as MIMO and scenarios involving multiple radio cells. Rohde & Schwarz is continuously implementing function expansions, which are made available to users as upgrades.
▷ page 11

Choose the right partner

As an active participant on standardization bodies, Rohde & Schwarz helps promote the development of LTE. This knowledge and experience is immediately incorporated into the company's products.
▷ page 12

Notes:
Some aspects of the functionality described on this page require additional hardware and/or software options.

The 3GPP Rel. 8 mobile radio standard is still being developed. The functionality of the R&S®CMW500 LTE protocol tester is continuously being developed further to reflect advancements in standardization as well as industry requirements. The actual scope of functions available for the R&S®CMW500 UMTS LTE protocol tester is provided on request.

Developed for early LTE development

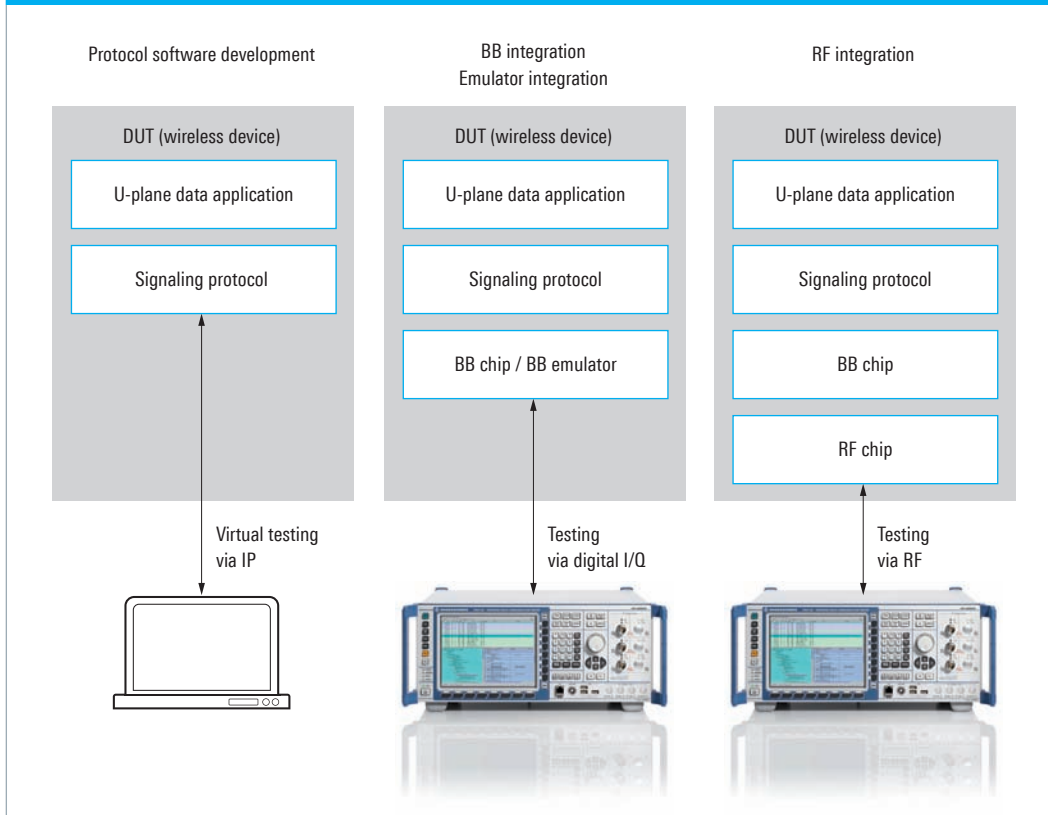**Multiple interfaces to the device under test [1]**

The R&S®CMW500 for LTE protocol tests offers multiple interfaces for communicating with the protocol layers to be tested in the wireless device (DUT). Depending on the DUT's level of integration, a purely software interface, a digital I/Q interface or an RF interface must be used. Multiple powerful Ethernet interfaces interconnect the R&S®CMW500 with application servers for testing user plane data services such as FTP, UDP, VoIP.

Software interface

The software interface requires the protocol software of a wireless device to be linked to the virtual physical layer supplied by Rohde&Schwarz by embedding a C++ library. This means that users can no longer discern from the protocol layers above whether a real or virtual physical layer is being used. The network simulation speed can be adjusted to the DUT's requirements by means of soft timers.

[1] Some aspects of this functionality require the addition of hardware or software options.

Interfaces

Protocol software development	BB integration Emulator integration	RF integration
DUT (wireless device)	DUT (wireless device)	DUT (wireless device)
U-plane data application	U-plane data application	U-plane data application
Signaling protocol	Signaling protocol	Signaling protocol
	BB chip / BB emulator	BB chip
		RF chip
Virtual testing via IP	Testing via digital I/Q	Testing via RF

Digital I/Q interface
The digital I/Q interface connects the tester to the DUT's baseband. The digital I/Q data is transmitted at variable speed in accordance with the Rohde & Schwarz digital I/Q standard. Thus, the data is compatible with other Rohde & Schwarz instruments such as signal generators and analyzers. The I/Q signal can be adapted to other specifications via external adapters.

RF interface
The RF interface is the most common and simplest way to connect the wireless device to the protocol tester. The air interface standardized in the 3GPP specification is used. Tests carried out with this interface require a protocol implementation that has been fully integrated into the baseband and the RF.

The interface used is transparent for the protocol layers above and the tester's software modules. The user can therefore switch between interfaces without having to modify test routines and software tools.

TCP/IP interface
Gigabit Ethernet supports high LTE data rate requirements, which means that IP data tests and performance tests (e.g. throughput) can be carried out without any problem. Comprehensive logging of IP traffic together with C-plane messages are integrated in a message analyzer tool.

Layer 1 test
To make functional testing of the LTE physical layer possible, future options will provide basic measurement functions. These functions are carried out in test scenarios that are either predefined or easily created by the user.

The functions will include the following:

❙ Tests for verifying physical layer procedures, e.g. CQI, timing and power control, RACH
❙ Tests for layer 1 performance measurements, e.g. receiver and throughput performance

Shorter development time

Efficient software tools

Practice-proven software tools for protocol tests help the user efficiently operate the R&S®CMW500. Signaling tests consist of three phases:

▮ Define test
▮ Run test
▮ Analyze test

A customized software application is available for each phase.

Defining tests

Signaling scenarios are defined in simple C++ routines. Two application programming interfaces (API) are available for this purpose: the low-level API (LLAPI) and the medium-level API (MLAPI).

The LLAPI provides users with direct access to the protocol layers. This means that users enjoy maximum flexibility especially required in protocol development.

Signaling scenarios built on the RRC protocol layer are defined using the MLAPI. To minimize the amount of programming involved, all protocol layers below are automatically configured from the contents of the layer 3 messages – thus saving a significant amount of time for the person creating test scenarios. This automatic configuration can be deactivated and all layers below configured manually.

The individual protocol messages are conveniently created by means of the message composer software tool both in the LLAPI as well as in the MLAPI. This tool displays the messages in a straightforward, easy-to-read manner.

A collection of signaling scenarios for developing layer 1 and the layers above is available in the source code, and the user may modify or expand them as required. The test scenarios may be applied no matter which DUT interface is used. This means that the R&S®CMW500 can be used throughout all phases of development.

LTE programming interfaces
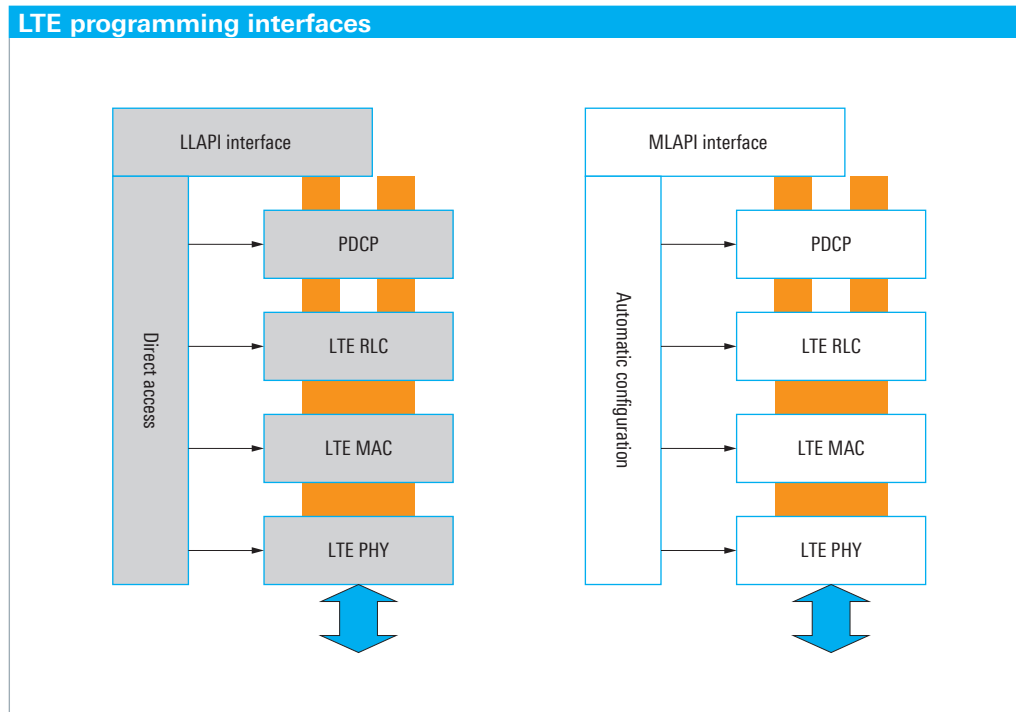
Performing tests

The project explorer controls the sequencing when test scenarios are run. This involves configuring and starting test campaigns as well as generating test reports.

❙ Graphical configuration of tests, also covering various software versions
❙ Hardware configuration
❙ Sequence control depending on results
❙ Display and archiving of results

Analysis of test results

The message analyzer displays the recorded protocol messages to be analyzed in a straightforward manner.

❙ Chronological display of the message sequence or message sequence chart representation; display of the message structure and decoding of the message contents
❙ Comprehensive search and filter capabilities as well as display of the dependencies between messages from different protocol layers
❙ Comparison of complete message sequences and the contents of individual messages
❙ Export of messages in HTML format
❙ Export of messages for reuse in the message composer; thus, new test cases can quickly be generated from log files

Parallel testing during each phase of development

The cost-effective virtual software tester enables users to perform tests on the protocol stack software at the same time hardware is being developed. Therefore, dependencies between the individual development teams can be reduced.

❙ Reuse of test equipment and test routines in all phases of development
❙ Functional tests and regression tests in parallel during all phases of development

Analysis of test results with the message analyzer

Consistent hardware and software concept

The R&S®CMW500 may be used throughout all phases of development owing to the following:

 ❚ Variety of DUT interfaces and reusable test scenarios
 ❚ Programming interfaces tailored to the purpose of the test
 ❚ Universal software tools

Both in the protocol as well as in the RF and application enabler conformance test, the R&S®CMW500 will play a leading role. The hardware and software used in the development of the protocol stacks is already prepared for use in conformance testing.

Testing at every phase

Regression test

Functional test

Performance test

Application test

Interoperability test

Conformance test
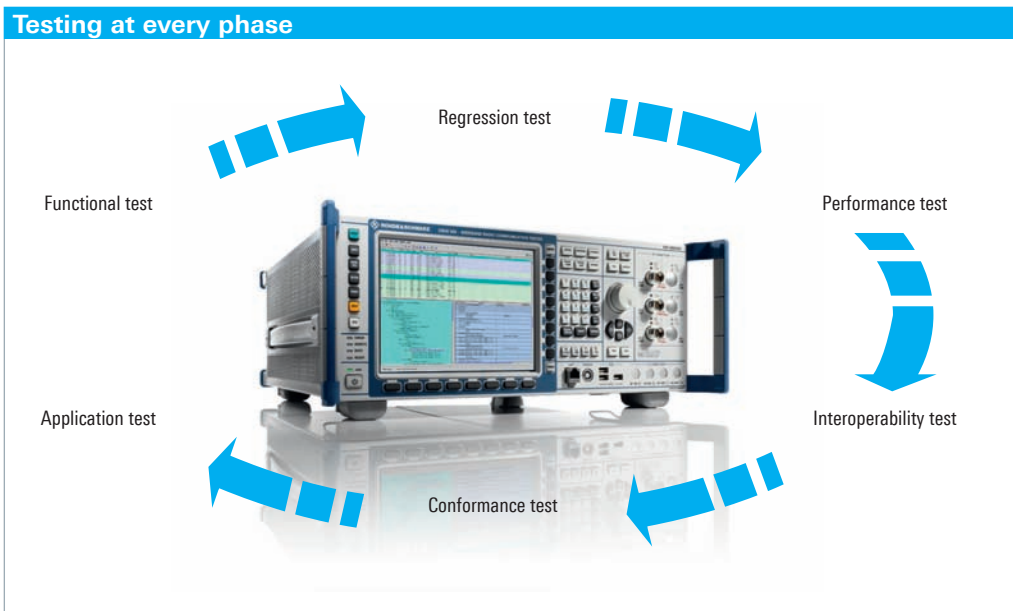
Close look at protocol analysis

Negative testing
The R&S®CMW500 provides a 3GPP-compliant reference implementation of layers 1, 2 and 3. Yet the LLAPI also allows users to simulate specific malfunctions on the network end in order to test the stability of the DUT under these conditions.

RF measurements simultaneously with signaling
Future options will enable users to utilize the RF measurement functionality of the R&S®CMW500 even as signaling scenarios are being run. For example, if the DUT malfunctions, basic functions and parameters may be analyzed at the physical layer.

Linking to other Rohde & Schwarz LTE measuring instruments
The RF interface can handle additional measurements if the R&S®CMW500 is combined with other LTE measuring instruments such as the R&S®FSQ or the R&S®SMU200A.

In addition to the RF interface, the I/Q interface may also be utilized since it uses the same standard. I/Q signals can then be exchanged between Rohde & Schwarz instruments without any problem.

Fading with the R&S®AMU200A [1]
For performance measurements under fading conditions, an R&S®AMU200A can be integrated via the digital I/Q interface.

[1] This functionality requires the addition of hardware or software options.
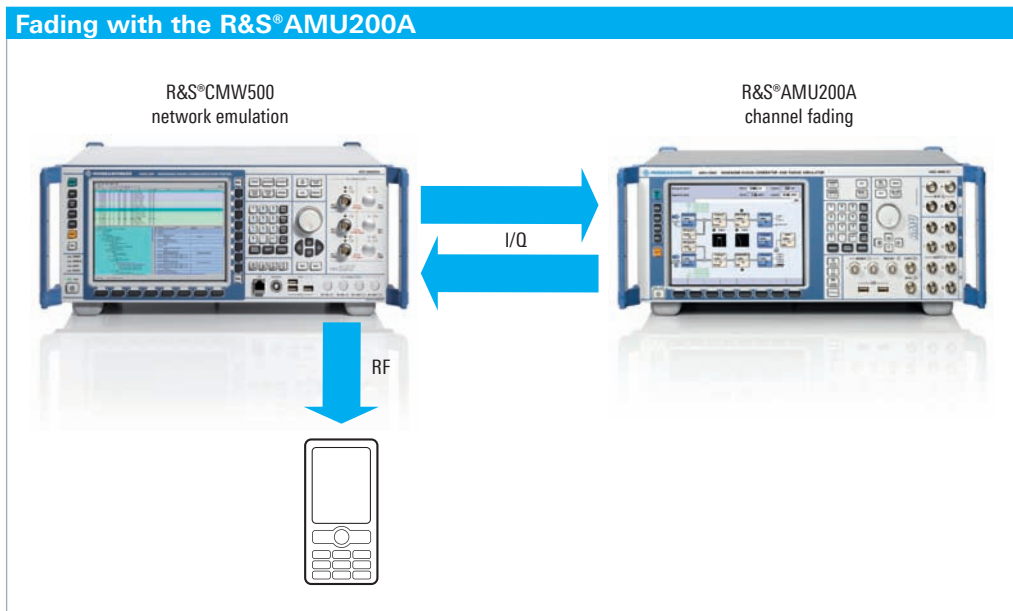
Fading with the R&S®AMU200A

R&S®CMW500
network emulation

R&S®AMU200A
channel fading

I/Q

RF

Better test coverage through automation

Signaling tests can be fully automated if necessary. This increases test throughput and allows the tester to be used very efficiently – particularly in the regression test.

Controlling the DUT by means of the automation manager directly from the test scenario
❚ USB, serial or LAN connection to the DUT
❚ Configurable AT commands for each DUT

Controlling the R&S®CMW500 test run by means of higher-order management systems
❚ Selecting test campaigns
❚ Starting and stopping tests
❚ Copying the results to a server

Project explorer functions such as listed above can all be conveniently remote-controlled by other programs or computers via the SOAP-standardized protocol. SOAP is supported by all common programming and scripting languages as well as by web browsers.

Controlling the DUT by means of the automation manager
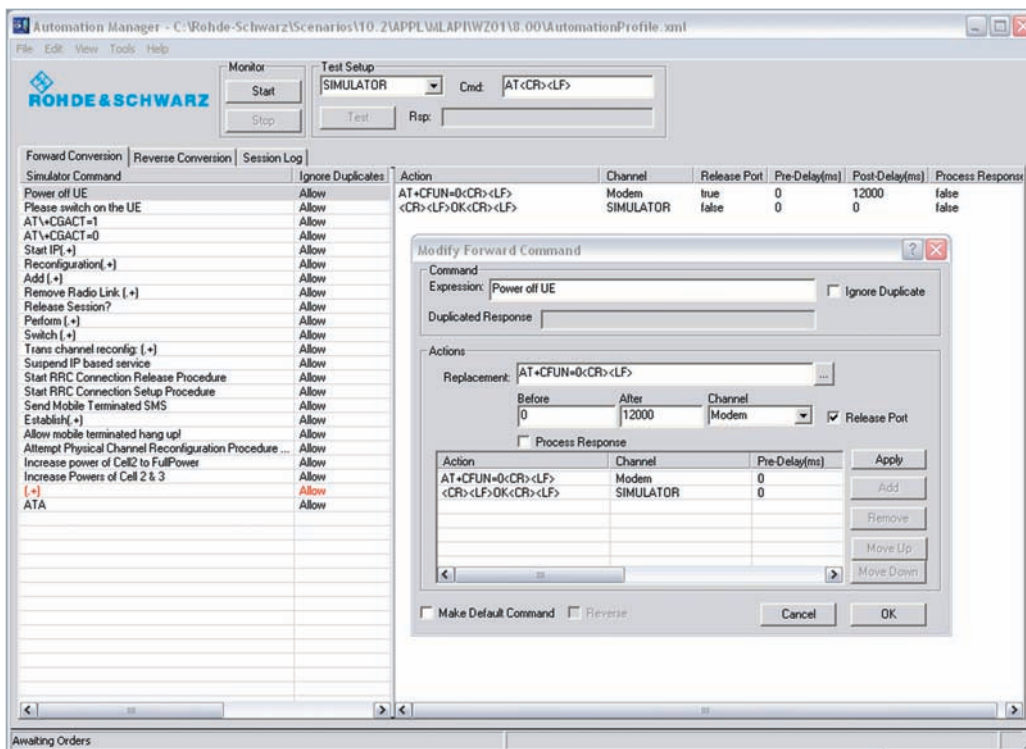
Safe investment

Just like existing mobile radio standards, UMTS LTE is continuously evolving. New features are implemented, existing ones are enhanced, and corrections are made.

The R&S®CMW500 hardware has already been developed with expandability in mind. The powerful hardware together with the easy-to-install software upgrades and the diverse alternatives for using the R&S®CMW500 help ensure that the investment is highly effective.

❙ All 3GPP-defined frequency bands up to 3.3 GHz are supported (in future, up to 6 GHz)
❙ Output level range from –130 dBm to +8 dBm (CW, rms)
❙ Output level dynamic range of 128 dB
❙ Input level range from –84 dBm to +34 dBm (power meter, CW, rms)
❙ Flexible frontend, ready for MIMO
❙ High dynamic range: 128 dB output
❙ Expandability with further signaling modules possible

Comprehensive RF frontend eliminates external hardware (front panel ready for future expansions)

Choose the right partner

Rohde&Schwarz supplies turnkey hardware and software solutions from a single source. The company's worldwide network of application engineers reduces the risks for users in all phases of development.

Rohde&Schwarz applies its many years of experience in the field of mobile communications testing – a truly valuable customer benefit.

❙ Solution finding/purchase
❙ Technical startup/application development/integration
❙ Training
❙ Operation/calibration/repair
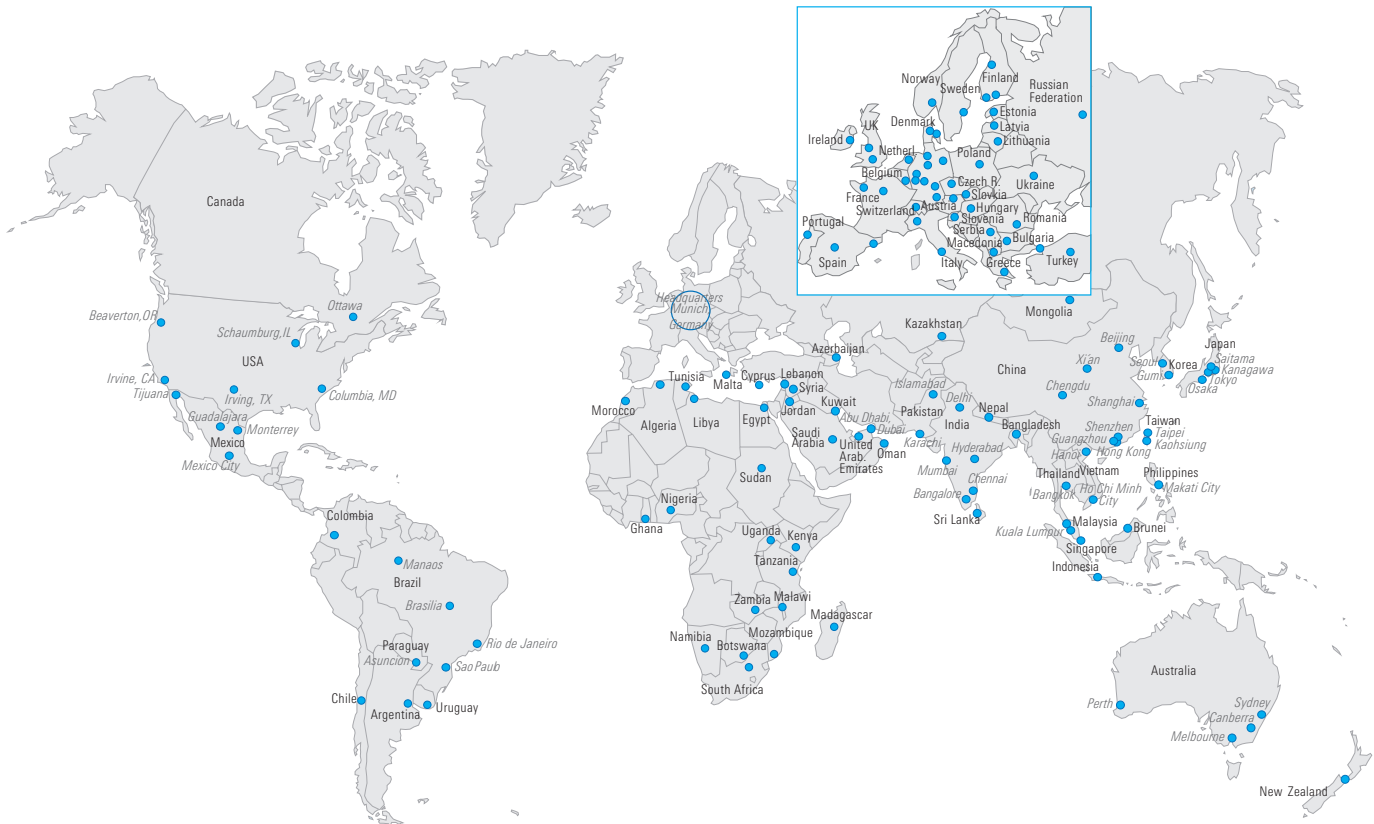
Specifications in brief

General data		
Dimensions	W × H × D	465.1 mm × 197.3 mm × 517.0 mm 18.31 in × 7.77 in × 20.35 in (19" 1/1, 4 HU, 450)
Weight	with typical options	approx. 18 kg (39.7 lb)

Physical layer		
Frequency range		all 3GPP frequency bands up to 6 GHz
Physical layer mode		SISO MIMO 2x2 from V1.30
Duplexing		FDD mode
Data rate		100 Mbps DL, 50 Mbps UL 25 Mbps DL, 25 Mbps UL in V1.00

Layer 2 MAC		
Transport channels		BCH, DL-SCH, UL-SCH, PCH, RACH, PDCCH, PUCCH, PCFICH (V1.10)
Logical channels		DTCH, BCCH, DCCH, PCCH, CCCH (V1.10)
Modes		unacknowledged mode, transparent mode, acknowledged mode (V1.10)
PDU operations		assembly, disassembly, multiplexing, demultiplexing padding
Procedures		duplicate detection, error detection and recovery, discard and reset procedure

For data sheets, see "R&S®CMW500 UMTS LTE protocol test: features and functions", PD 5213.9363.22,
and "R&S®CMW500 Wideband Radio Communication Tester", PD 5213.9211.22.

Glossary

Term	Explanation
3GPP	Third Generation Partnership Project
API	Application programming interface
AT Command	Serial modem command language
BB	Baseband
CQI	Channel quality indicator
CW	Continuous waveform
DUT	Device under test
FDD	Frequency division duplex
FTP	File transfer protocol
HTML	Hypertext markup language
IP	Internet protocol
L1	Layer 1
LAN	Local area network
LLAPI	Low-level application programming interface
LTE	Long term evolution
MIMO	Multiple input multiple output

Term	Explanation
MLAPI	Medium-level application programming interface
NAS	Non-access stratum
PDU	Protocol data unit
RACH	Random access channel
RAT	Radio access technology
Rel	Release
rms	root mean square
RRC	Radio resource control
TTCN3	Testing and test control notation 3
UMTS	Universal mobile telephone system
USB	Universal serial bus
VoIP	Voice over IP (Internet protocol)

Ordering information

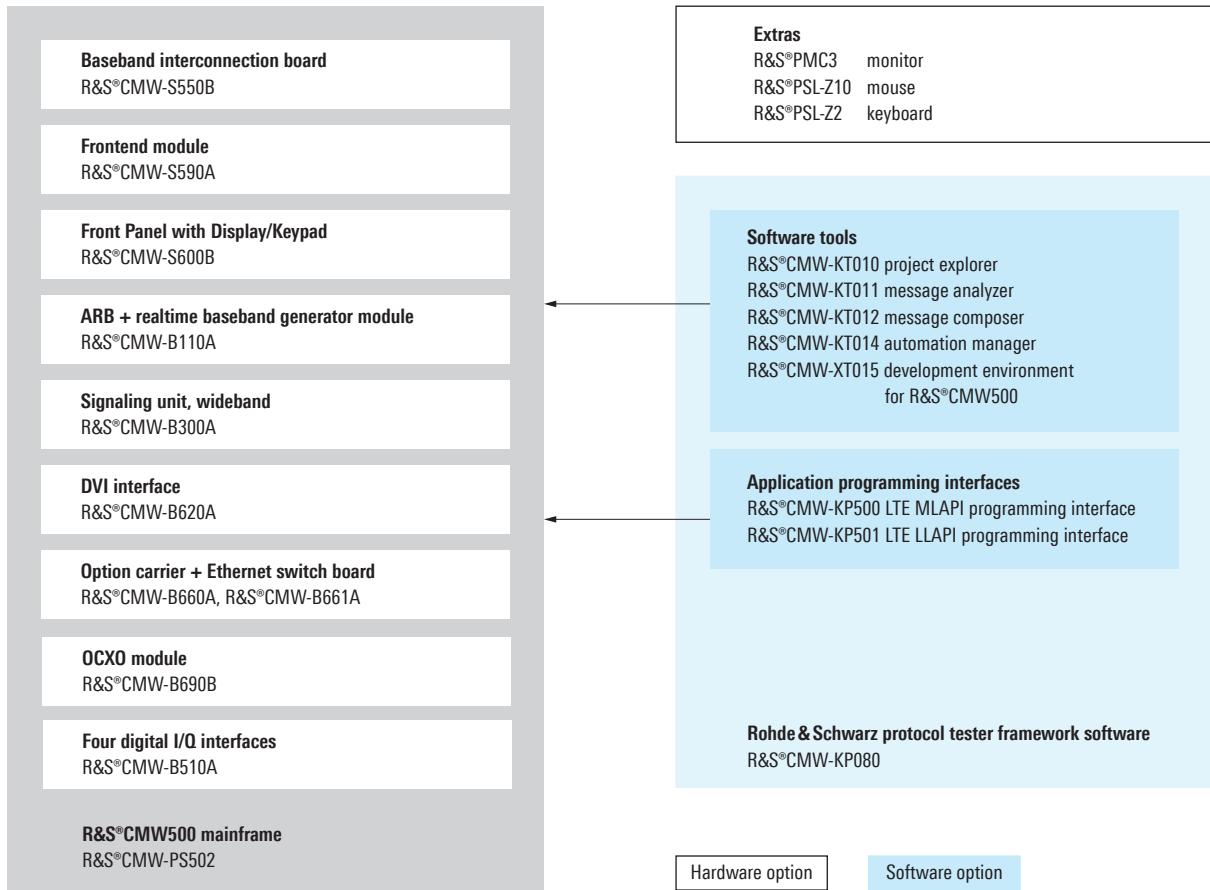| Designation	Type	Order No.
R&S®CMW500 Wideband Radio Communication Tester	R&S®CMW500	1201.0002K02
Mainframe configuration, mandatory		
R&S®CMW500 Wideband Radio Communication Tester, Mainframe 02	R&S®CMW-PS502	1202.5408.02
Baseband Interconnection Board (flexible link)	R&S®CMW-S550B	1202.4801.03
RF Frontend Module	R&S®CMW-S590A	1202.5108.02
Front Panel with Display/Keypad	R&S®CMW-S600B	1201.0102.03
ARB + Realtime Baseband Generator Module	R&S®CMW-B110A	1202.5508.02
Signaling Unit, Wideband (SUW)	R&S®CMW-B300A	1202.6304.02
Digital Video Interface (DVI) Module	R&S®CMW-B620A	1202.5808.02
Option Carrier	R&S®CMW-B660A	1202.7000.02
Ethernet Switch Board	R&S®CMW-B661A	1202.7100.02
OCXO Module (highly stable)	R&S®CMW-B690B	1202.6004.02
Mainframe configuration, optional		
Four Digital I/Q Interfaces (in/out/monitor), connectors 1 to 4	R&S®CMW-B510A	1202.8007.02
Software		
Protocol Tester Framework; Network Emulation	R&S®CMW-KP080	1203.2254.02
LTE (R8) LLAPI Interface for Network Emulation	R&S®CMW-KP501	1203.2702.02
LTE (R8) MLAPI Interface for Network Emulation	R&S®CMW-KP500	1203.2654.02
Project Explorer, Test Sequence Execution Management	R&S®CMW-KT010	1203.2302.02
Message Analyzer, Protocol Message Analysis	R&S®CMW-KT011	1203.2354.02
Message Composer, Protocol Message Editing	R&S®CMW-KT012	1203.2402.02
Protocol Testing Tool, Automation Manager	R&S®CMW-KT014	1203.3250.02
Development Environment for R&S®CMW500	R&S®CMW-XT015	1203.3309.02
Extras		
Mouse with USB Interface, optical, with wheel	R&S®PSL-Z10	1157.7060.04
Keyboard with USB Interface, US character set	R&S®PSL-Z2	1157.6870.04
LCD TFT Display, 17", 1280 × 1024; DVI-D and analog interface	R&S®PMC3	1082.6004.12

Virtual tester

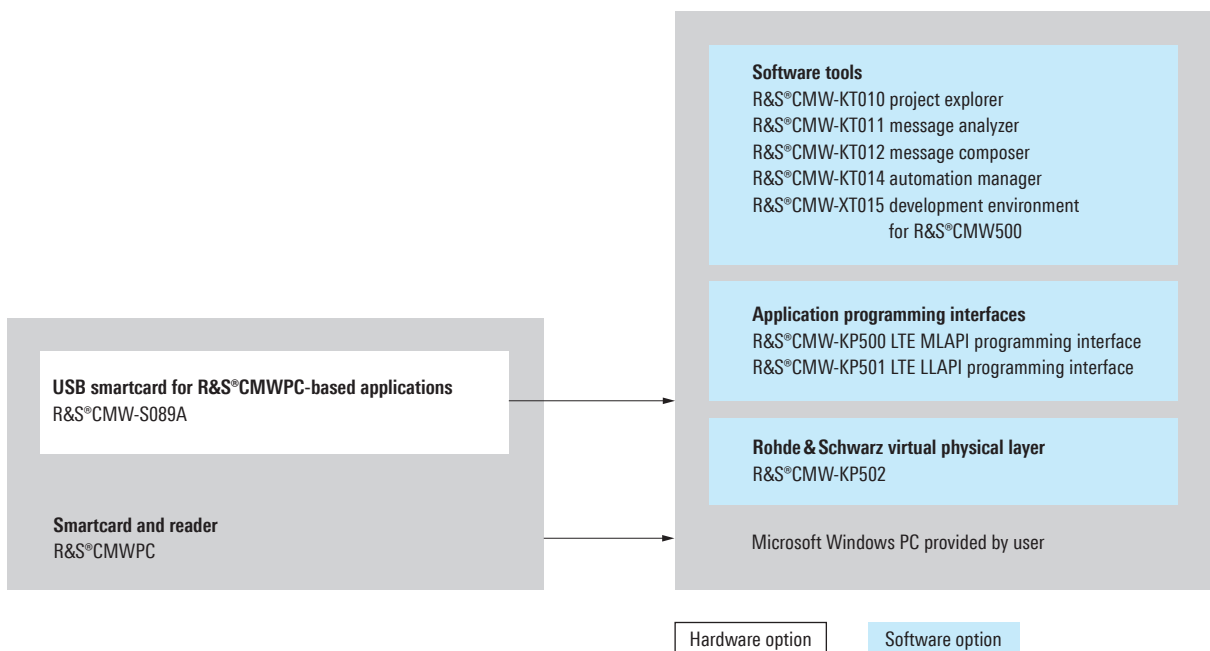| Designation	Type	Order No.
PC-Based R&S®CMW Applications	R&S®CMWPC	1201.0002.K90
Configuration, mandatory		
USB Smartcard for R&S®CMWPC-Based Applications	R&S®CMW-S089A	1202.7900.02
Software		
LTE (R8) Virtual Physical Layer with Software Interface	R&S®CMW-KP502	1203.2754.02
LTE (R8) LLAPI Interface for Network Emulation	R&S®CMW-KP501	1203.2702.02
LTE (R8) MLAPI Interface for Network Emulation	R&S®CMW-KP500	1203.2654.02
Project Explorer, Test Sequence Execution Management	R&S®CMW-KT010	1203.2302.02
Message Analyzer, Protocol Message Analysis	R&S®CMW-KT011	1203.2354.02
Message Composer, Protocol Message Editing	R&S®CMW-KT012	1203.2402.02
Protocol Testing Tool, Automation Manager	R&S®CMW-KT014	1203.3250.02
Development Environment for R&S®CMW500	R&S®CMW-XT015	1203.3309.02

Your local Rohde & Schwarz expert will help you determine the optimum solution for your requirements and will be glad to provide you with a customized quotation.

To find your nearest Rohde & Schwarz representative, visit www.sales.rohde-schwarz.com

Configuration guide

Baseband interconnection board R&S®CMW-S550B

Frontend module R&S®CMW-S590A

Front Panel with Display/Keypad R&S®CMW-S600B

ARB + realtime baseband generator module R&S®CMW-B110A

Signaling unit, wideband R&S®CMW-B300A

DVI interface R&S®CMW-B620A

Option carrier + Ethernet switch board R&S®CMW-B660A, R&S®CMW-B661A

OCXO module R&S®CMW-B690B

Four digital I/Q interfaces R&S®CMW-B510A

R&S®CMW500 mainframe
R&S®CMW-PS502

Extras
R&S®PMC3   monitor
R&S®PSL-Z10   mouse
R&S®PSL-Z2   keyboard

Software tools
R&S®CMW-KT010 project explorer
R&S®CMW-KT011 message analyzer
R&S®CMW-KT012 message composer
R&S®CMW-KT014 automation manager
R&S®CMW-XT015 development environment
                          for R&S®CMW500

Application programming interfaces
R&S®CMW-KP500 LTE MLAPI programming interface
R&S®CMW-KP501 LTE LLAPI programming interface

Rohde & Schwarz protocol tester framework software
R&S®CMW-KP080

Hardware option	Software option

Virtual test

Software tools
R&S®CMW-KT010 project explorer
R&S®CMW-KT011 message analyzer
R&S®CMW-KT012 message composer
R&S®CMW-KT014 automation manager
R&S®CMW-XT015 development environment
                          for R&S®CMW500

Application programming interfaces
R&S®CMW-KP500 LTE MLAPI programming interface
R&S®CMW-KP501 LTE LLAPI programming interface

Rohde & Schwarz virtual physical layer
R&S®CMW-KP502

Microsoft Windows PC provided by user

USB smartcard for R&S®CMWPC-based applications
R&S®CMW-S089A

Smartcard and reader
R&S®CMWPC

Hardware option	Software option

About Rohde & Schwarz

Rohde & Schwarz is an independent group of companies specializing in electronics. It is a leading supplier of solutions in the fields of test and measurement, broadcasting, radiomonitoring and radiolocation, as well as secure communications. Established 75 years ago, Rohde & Schwarz has a global presence and a dedicated service network in over 70 countries. Company headquarters are in Munich, Germany.

Regional contact

Europe, Africa, Middle East
+49 1805 12 42 42* or +49 89 4129 137 74
customersupport@rohde-schwarz.com
North America
1-888-TEST-RSA (1-888-837-8772)
customer.support@rsa.rohde-schwarz.com
Latin America
+1-410-910-7988
customersupport.la@rohde-schwarz.com
Asia/Pacific
+65 65 13 04 88
customersupport.asia@rohde-schwarz.com

Certified Quality System
ISO 9001
DQS REG. NO 1954 QM

Certified Environmental System
ISO 14001
DQS REG. NO 1954 UM

For data sheets, see
PD 5213.9363.22 and
PD 5213.9211.22 and
www.rohde-schwarz.com