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## Protocol Test Platform R&S®CRTU

Family of protocol testers for 2G/3G mobile radio standards

- ◆ Protocol analyzer and system simulator for
  - (E)GPRS/GSM
  - HSPA/WCDMA FDD
- ◆ Use in R&D and conformance testing
- ◆ Complete and convenient tool chain covering test generation through to result analysis
- ◆ Windows operating system
- ◆ Fully automatic test cycles

**ROHDE & SCHWARZ**

## Expertise and reliability

Smooth interaction between mobile phones and networks has become a major requirement in everyday life, because users rely on the proper functioning of their constant companion. To ensure that mobile phones operate reliably, highly complex technology is needed.

Rohde & Schwarz has been engaged in the development of protocol testers since the early days of digital mobile communications. The R&S®CRTU family of protocol testers from Rohde & Schwarz provides powerful and comprehensive functionality for the design and verification of protocol stacks. This family of testers covers an extensive range of applications and meets even the most exacting demands.

Companies that launch their products quickly and early will secure their share of this highly competitive market. Rohde & Schwarz is a strong partner with whom you can achieve your goals. Rohde & Schwarz actively participates in a variety of bodies and working groups (including GERAN, RAN5, GCF, PTCRB, OMA) and is thus in a position to implement features and make them available to the customers at an early stage.

Rohde & Schwarz is a leader in test solutions for mobile radio and supplies the required hardware and test software from a single source.

## Target markets

The Protocol Testers R&S®CRTU-G/S and R&S®CRTU-W/M from Rohde & Schwarz cover the entire range of GSM/(E)GPRS and WCDMA/HSPA protocol measurements required from the beginning to the end of a development project.

Due to the use of an intelligent and future-oriented platform concept, all testers can be combined to form multicell configurations, inter-RAT or RRM test systems without upgrading existing hardware.

Protocol testers from Rohde & Schwarz come with built-in scalability, so that existing GSM/(E)GPRS test systems can be expanded to yield WCDMA/HSPA test systems and vice versa. This makes protocol testers from Rohde & Schwarz a safe investment – whether you are a designer of GSM/WCDMA protocol stacks or chipsets, a certified test house, a network operator or involved in the design of mobile radio applications.

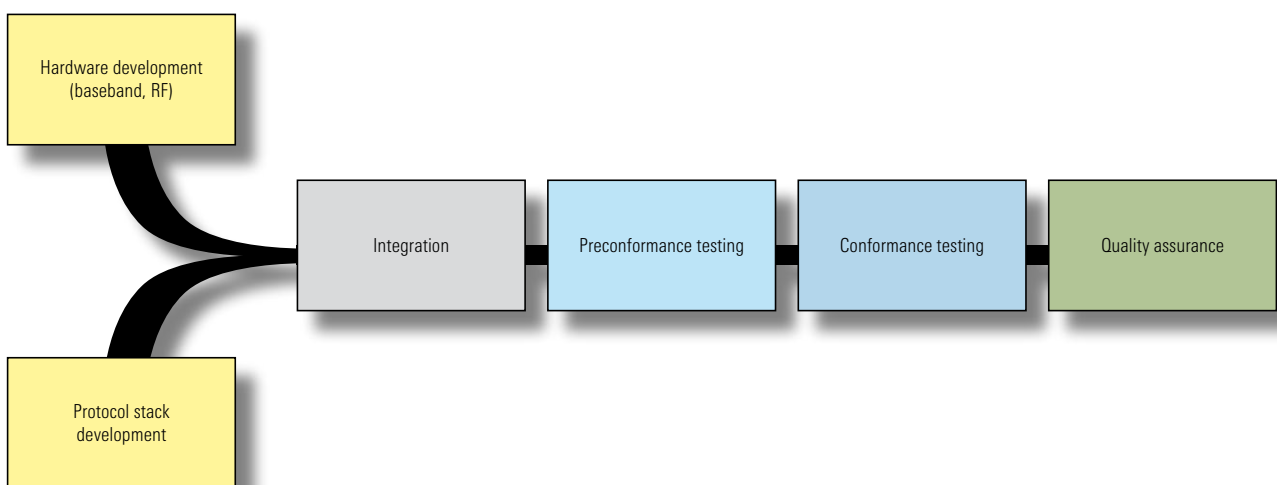
The R&S®CRTU protocol testers can be configured for virtually any type of application due to their flexible design concept.

## Complete set of validated GCF/PTCRB test cases

When it comes to type approval testing of mobile phones, it is of crucial importance to have all relevant 3GPP and OMA test cases available early and from a single source. Test houses and conformance/preconformance test departments rely on the high quality of the Rohde & Schwarz-implemented test cases prioritized by GCF, PTCRB and OMA. Rohde & Schwarz keeps up to date with the latest developments in the standardization bodies and brings its know-how to bear when test procedures for new technologies have to be defined. This is a major benefit for you.

Rohde & Schwarz supplies all approval-related test cases and features defined by 3GPP TS 51.010, 34.123, 34.121 at a very early stage, thus giving you a competitive edge.

(For abbreviations, see last page)



***The R&S®CRTU test platform provides test functionality covering the entire development cycle of a mobile phone, including layer 1 development, integration of the complete stack and application software through to mobile phone certification***

The test cases are available even prior to validation, after having undergone verification using different types of mobile phones. This is of interest for all applications outside the field of type-approval testing. For development engineers who are breaking new ground in their technologies and have an interest in implementing and testing new features right from the start, Rohde & Schwarz also offers test cases at a very early stage of implementation.

### **Fully automatic test sequences**

Protocol tests are very time-consuming. Several hundred different tests conforming to 3GPP TS 51.010 (or 34.123, 34.121, etc) have to be performed to obtain approval for a mobile phone. Testing alone may take several days.

If, in addition, statistics are generated or tests are repeatedly performed, testing may take several weeks. Considerable time is spent on carrying out manual operations on the mobile phone that are needed for continuing a test sequence, e.g. switching the phone on and off, dialing, initiating GPRS attach, or activating PDP context.

Rohde & Schwarz, therefore, developed a flexible concept for the automatic execution of test sequences. You simply use the Sequencer or Project Explorer to assemble test sequences and start them in the automatic mode. The R&S®CRTU controls the DUT using AT commands. It can also control other external equipment, e.g. the Vector Signal Generator R&S®SMU200A. Remote control can be implemented via the tester's serial, parallel, USB or Ethernet interface.

The R&S®CRTU thus performs entire type approval tests fully automatically, and can be operated unattended even at night or on weekends. This is an advantage that is highly appreciated not only by test houses, as it saves considerable time and cost in all areas.

Development engineers can perform automated tests of different software versions on different platforms; quality management can carry out automated statistical inspection, e.g. regression tests. A message log file is generated for each test and automatically stored in the defined directory, also on a LAN drive. Therefore, while the R&S®CRTU is executing test sequences, you can analyze the log files of previous tests at a workstation.

### **High flexibility**

Development engineers need tools that give them the freedom to be creative. Rohde & Schwarz understands this need. The R&S®CRTU is designed to enable access to every single bit at all protocol layers. Development engineers can access virtually any parameter. The protocol tester includes a library with example applications/scenarios that you can use to conveniently generate test scenarios. You can of course also program completely new test scenarios.

You can access and modify individual bits or messages by means of convenient software tools, without the need for time-consuming recompilation. Powerful tools are also available for troubleshooting. For example, you can directly access the source code from a test report.

### **I/Q interface**

Chip designers often have no RF module or reference implementation available when carrying out their tests, and therefore have to perform tests within the baseband. The R&S®CRTU includes an analog I/Q interface, allowing it to perform tests also in an analog test environment.

The I/Q interface can further be used to carry out tests under fading conditions using a Baseband Fading Simulator R&S®ABFS. The R&S®CRTU and R&S®ABFS instrument combination forms part of all R&S®TS89xx conformance test systems.

# The R&S®CRTU family of protocol testers

The protocol testers of the R&S®CRTU family are based on a flexible modular concept that covers 2G and 3G (WCDMA, HSPA) test requirements. This means that the R&S®CRTU is a future-proof investment, as the base units can be adapted to new test requirements.

The core elements of this family are the R&S®CRTU radio unit (RU) and the R&S®CRTU protocol unit (PU), which can be used in a variety of instrument configurations. Two standalone testers form the basis for all configurations:

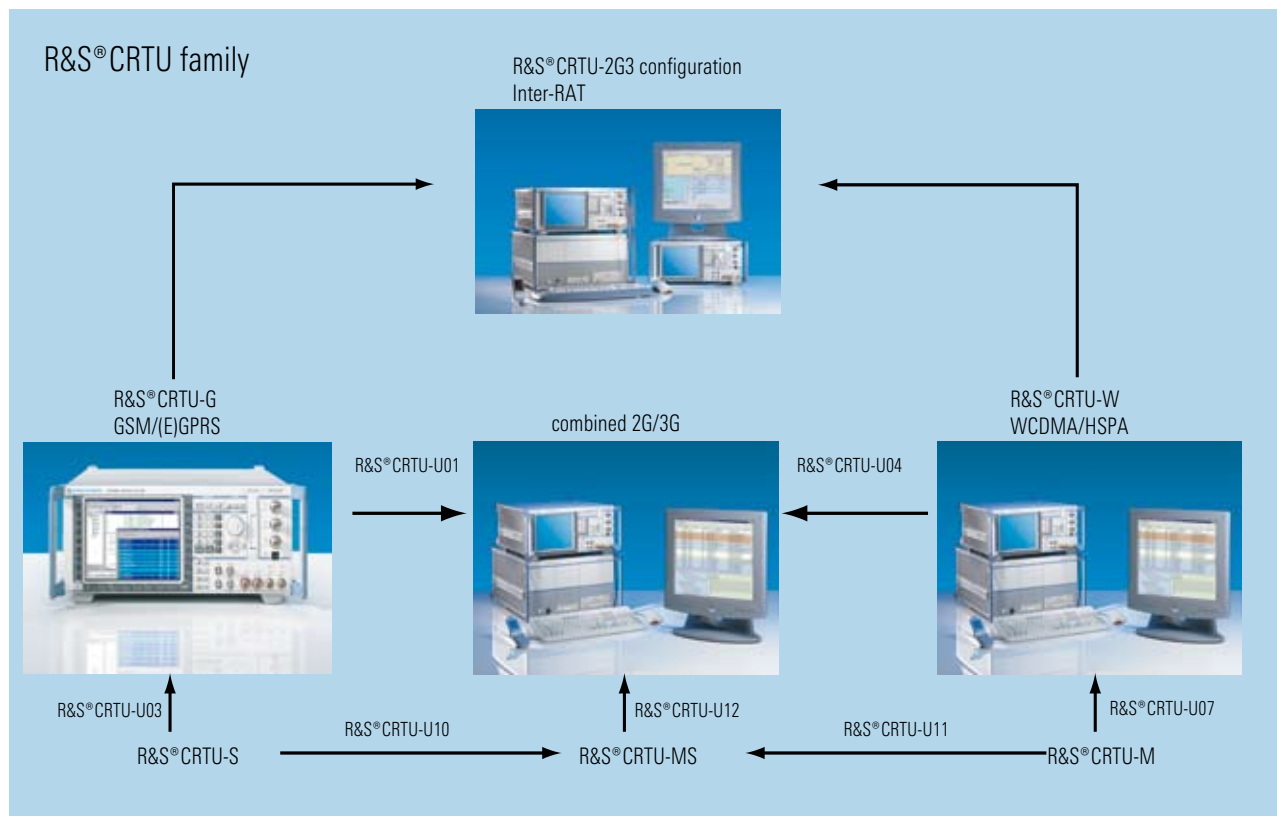
- ◆ R&S®CRTU-G for GSM/(E)GPRS
  - R&S®CRTU radio unit with two GSM signaling units

- ◆ R&S®CRTU-W
  - R&S®CRTU radio unit as RF frontend
  - R&S®CRTU protocol unit

One base unit in each case provides two channels (GSM) or cells (WCDMA) that you can configure completely independently of each other. Two more channels/cells can be added for multichannel/multicell tests by simply adding one more R&S®CRTU-G/S or R&S®CRTU-W/M.

You can also combine the two technologies in one unit: R&S®CRTU-GW or R&S®CRTU-MS. You can thus run WCDMA/HSPA or GSM/(E)GPRS protocol tests depending on your requirements. It does not matter whether your existing instrument is an R&S®CRTU-G/S or an R&S®CRTU-W/M – either tester can easily be upgraded to provide the combined functionality.

Inter-RAT handover tests require at least one R&S®CRTU-W and one R&S®CRTU-G that must be connected with each other. All test cases prioritized by GCF require two R&S®CRTU-G and three R&S®CRTU-W units.



Radio resource management is another category that requires test scenarios covering both radio access technologies. The RRM test cases require a spectrum analyzer and a fading simulator in addition to the R&S®CRTU-W and R&S®CRTU-G protocol testers.

### Systems

The R&S®CRTU forms the core of the R&S®TS8950G/W RF conformance test systems, which are used in the RF approval testing of a major part of all mobile phones currently on the world market (for more information see page 7).

### Test setups

To create the test setups described in the following, you simply interconnect the various instruments by means of the cables supplied as standard, and assign each instrument its role (e.g. master, slave) by means of a mouse click in the Configuration Manager. You can thus make flexible use of the instruments available in your lab and create the configuration you want in a short time.

#### GSM/WCDMA multibox/multicell setup

For most applications, one instrument is sufficient, as it provides two completely independent channels or cells. There are, however, many scenarios and defined test cases that require three, four or more channels or cells.

The R&S®CRTU family of protocol testers also handles such scenarios and test cases. Depending on the equipment available in your lab, you can use either a second, full-fledged protocol tester as a slave unit or, as a more favorably priced alternative, a dedicated slave unit – i.e. the R&S®CRTU-S (for GSM/GPRS), the R&S®CRTU-M (for WCDMA/HSPA) or the R&S®CRTU-MS (for both technologies).



*Test solution for 2G/3G intersystem handover*

The dedicated slave units are intended for use as two-channel hardware extensions rather than standalone protocol testers.

When application requirements change, these units can easily be upgraded to full-fledged R&S®CRTU-W or R&S®CRTU-G testers.

The R&S®CRTU-G as master can control up to seven R&S®CRTU-G/S slave units for GSM, which yields up to 16 channels. The R&S®CRTU-W as master can control up to three R&S®CRTU-W/M slaves, which yields up to eight cells.

Each unit is assigned its role as master or slave from the Configuration Manager. The master then automatically takes over and is operated in the same manner as in a standalone configuration. All signaling information is written to a log file on the master. In addition to their use as slaves, the R&S®CRTU-S and the R&S®CRTU-M can be used as full-fledged application testers (for more information, see pages 10 and 11).

#### Intersystem handover

The intersystem (inter-RAT) handover test cases verify the functionality of a mobile phone when it is handed over from one system to another. It is mainly here that it becomes evident how well the protocol has been implemented. For example, if a WCDMA mobile phone leaves the WCDMA-covered area, handover to GSM must function reliably. Otherwise the customer will not be satisfied, and acceptance of a new technology would be jeopardized.

The two full-fledged Protocol Testers R&S®CRTU-W and R&S®CRTU-G perform inter-RAT test cases without any limitation, as the complete protocol stack is implemented in these units. There is no restriction to handover testing by the R&S®CRTU, no matter whether simple circuit-switched (CS) handover commands, packet-switched (PS) cell change commands or HSPA/DTM handover commands are to be handled. For these tests, the R&S®CRTU-W controls the R&S®CRTU-G based on the master/slave concept of a multibox setup. The complete signaling information of the GSM and WCDMA protocols is written to a single log file on the master (R&S®CRTU-W).



## Radio resource management

An important aspect characterizing the behavior of a mobile phone in a network is the interaction between its RF section and the protocol implementation.

The 3GPP TS 34.123 signaling test cases are used to verify whether the mobile phone returns a formally correct answer in response to a signaling message, e.g. a measurement report in the correct format. The 3GPP TS 34.121 test cases, on the other hand, also test the mobile phone's RF characteristics. Chapter 8 of 3GPP TS 34.121 defines the RRM test cases. These test cases typically verify, for example, whether level values included in the mobile phone's measurement report are correct, i.e. in contrast to the corresponding signaling test cases, the mobile phone's response is checked for correct content rather than form. Other RRM test cases measure the time required by the mobile phone to respond to level changes in neighboring cells (for cell reselection, handover, etc).

The RRM test cases, which are in part quite sophisticated, are specified in plain text in the standard and implemented as TTCN test cases on the R&S®CRTU-W. The standard defines test cases with up to six WCDMA cells (two uplink and downlink cells plus four downlink cells) as well as test cases including both WCDMA and GSM cells. Tests have to be performed under different propagation conditions and network loads, for which OCNS, AWGN and fading profiles are defined.

The 3GPP TS 34.121 Chapter 8 test requirements are fully implemented in the RRM test system from Rohde & Schwarz. A complete RRM test system from Rohde & Schwarz consists of an R&S®CRTU-W as master (same as in the multicell configurations for signaling tests), a WCDMA extension unit (R&S®CRTU-W or R&S®CRTU-M), a GSM extension unit (R&S®CRTU-G or R&S®CRTU-S), an R&S®ABFS baseband fading simulator and an R&S®FSU spectrum analyzer. Since only one extension unit (WCDMA or GSM) is needed at a time, one of the two units can be

replaced by an R&S®CRTU-MS. The control and analysis tools for RRM test cases are the same as those used for the signaling test cases. Therefore, when executing RRM test cases and analyzing the results, you benefit from all the advantages of the convenient R&S®CRTU-W control concept.

## Remote control and automation, compatibility with other equipment

Rohde & Schwarz supplies not only protocol test equipment, but also all other T&M equipment required in the development, type approval testing, interoperability testing, quality assurance, etc of mobile phones. The R&S®CRTU family of protocol testers fully supports Rohde & Schwarz signal generators, spectrum analyzers and fading simulators, which can easily be integrated into an R&S®CRTU test setup.



*Full-fledged radio resource management measurement system*

## R&S®TS895xGW family of RF conformance test systems

Rohde & Schwarz has been the leading manufacturer of RF conformance test systems for mobile phones since the early days of GSM. With the R&S®TS895x family of single- and/or dual-mode GSM/WCDMA RF test systems, Rohde & Schwarz provides state-of-the-art test platforms supporting the latest developments in GSM and WCDMA.

The individual R&S®TS895x RF test systems provide modular solutions supporting high-level development, pre-conformance testing and ultimately conformance testing/type approval.

All members of the R&S®TS895x family use the same system operating software, R&S®PASS; they differ only in the technology-dependent application software for the test methods.

- ◆ The starter system is the R&S®TS8955GW as a scalable pre-compliance test system ranging from benchtop setups to rack-integrated solutions for more complex tests; this system uses the Digital single-channel Radio Communication Tester R&S®CMU200
- ◆ The R&S®TS8952G system is an officially validated GCF/PTCRB test platform focusing specifically on receiver tests
- ◆ The R&S®TS8952GW will add validated WCDMA receiver and performance tests
- ◆ The R&S®TS8950GW represents the top end of the R&S®TS895x family; it is an official GCF/PTCRB test platform with test cases thoroughly validated by highly esteemed independent test houses

All systems of the R&S®TS895x family are modular and upgradeable and use the same test methods and tools as the R&S®TS8950GW.

The R&S®TS8952xyz and R&S®TS8950xy systems use, as signaling sources, the R&S®CRTU-G protocol test platform for GSM and/or for WCDMA the R&S®CRTU-W, or the R&S®CRTU-GW for 2G/3G combined systems.

If you do not need to also run protocol tests on your R&S®TS895xx RF conformance test system, the lower-cost slave units of the R&S®CRTU can be used as signaling units:

- ◆ R&S®CRTU-S for GSM
- ◆ R&S®CRTU-M for WCDMA
- ◆ R&S®CRTU-MS for R&S®TS895xGW combined systems

A further feature of the R&S®TS895xGW systems is their ability to be combined with external R&S®CRTU platforms in order to form a test configuration for 3GPP TS 34.121 Chapter 8 tests. Such a combination is especially useful with R&S®TS8950W systems, because these systems already include the required R&S®CRTU-W and the Spectrum Analyzer R&S®FSU.

The RRM expansion can be added temporarily by using the existing Protocol Testers R&S®CRTU-G/S and R&S®CRTU-W/M. This allows the R&S®CRTU protocol test platforms to be used in a highly efficient manner: as a GSM protocol tester in one test session, as a 3G protocol tester in another test session, as part of an R&S®CRTU-2G3 inter-RAT test set or as an RF interferer for GSM Section 21 tests in yet another test session. Thus, investing in protocol test platforms of the R&S®CRTU family can mean significant savings, as many different combinations are possible in 2G and 3G protocol and RF conformance tests.



*2G/3G conformance testing with the R&S®TS895xGW family*

## Highlights of the R&S®TS895xx test systems

- ◆ Industry standard for GSM RF conformance testing in line with 3GPP TS 51.010-1 Version 6.1.0 (or later)
- ◆ Validated for GSM and WCDMA conformance testing by GCF and PTCRB
  - in line with 3GPP TS 51.010-1 Version 6.1.0 (or later) for GSM
  - and, for 3G, in line with 3GPP TS 34.121 V5.0.0 (or later)
  - Release 5 (terminal conformance specification, radio transmission and reception (FDD))
- ◆ Full dual-mode capability
- ◆ GSM quad band: 850/900/1800/1900
- ◆ GSM test cases from Sections 12, 13, 14, 16, 18, 21 and 22
- ◆ CS, GPRS, EGPRS, AMR and DARP supported
- ◆ WCDMA quad band: FDD I, II, V, VI
- ◆ WCDMA test cases from Sections 5, 6, 7 and 9
- ◆ Release 5 test cases
- ◆ HSPA
- ◆ WCDMA RRM test cases from Section 8 as upgrade or as standalone test setup

# GSM/WCDMA applications

## Layer 1 test software

The R&S®CRTU-WA01 layer 1 test software for the Protocol Tester R&S®CRTU-W/M is a powerful development tool for layer 1 test scenarios. UMTS channels are simulated without any signaling by higher protocol layers.

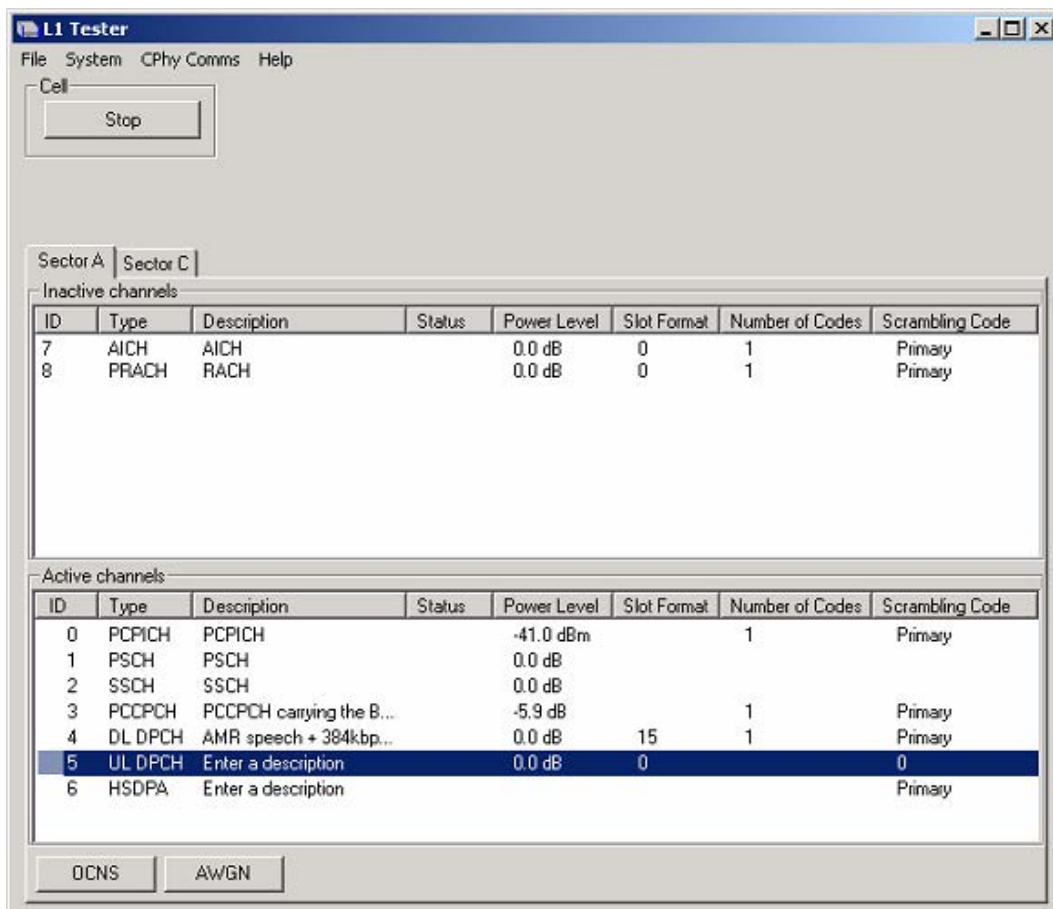
Mobile phones can thus be tested for compliance with standards at a very early stage in development.

The layer 1 test software has a GUI that allows simple and intuitive operation. All important layer 1 functions of a mobile phone can be tested in a short time. The layer 1 test software supports both 3GPP Release 99 and Releases 5 and 6 (HSPA) test configurations.

A feature particularly worth mentioning is the flexible parameterization of HSPA channels. You can use the software to run fully automatic test sequences and simulate layer 1 uplink/downlink procedures.

## Highlights of layer 1 test software

- ◆ Definition and (re)configuration of physical channels
- ◆ Transport channels
- ◆ Coded composite transport channels
- ◆ Examples of transport channel configurations, e.g. for AMR, RMC channels
- ◆ Compressed mode parameterization
- ◆ Power control parameterization
- ◆ HSPA tests
- ◆ Uplink/downlink timing measurements
- ◆ PRACH procedure
- ◆ Logging of transport channel uplink information
- ◆ Generation of project files and storage of channel information
- ◆ Scripting interface for fully automatic test projects



Layer 1 tester user interface



## Protocol testing in R&D

### Effective C++ programming interface

The R&S®CRTU-WT02 software option for the Protocol Tester R&S®CRTU-W is a powerful interface for the easy programming of signaling scenarios. The medium level C++ programming interface (MLAPI) provides numerous programming modules and example scenarios in source code that contain typical UMTS signaling sequences. This helps development engineers generate user-defined interoperability test scenarios or simulate incorrect operation.

In contrast to the official TTCN test cases, MLAPI allows automatic configuration of the lower UTRAN layers. When you send a layer 3 message from a scenario, MLAPI automatically extracts the information relevant to layers 1 and 2 and forwards it to these layers. This minimizes error-proneness as well as the effort involved in programming test scenarios without decreasing the interface's flexibility.

Moreover, a Message Composer is available. This is a graphical tool by means of which you can generate and edit layer 3 messages and their parameters. The dynamic sequence of the scenario in question need not be recompiled. You can change system information of the base station, for example, simply by editing the relevant XML files in the R&S®Message Composer. The unique concept of handling layer 3 messages separately also makes it possible to define RX templates for the easy analysis of received messages. MLAPI from Rohde & Schwarz also supports HSPA.

## TTCN interface

In addition to the protocol sequences for the radio access network (RAN), the 3G mobile radio standard defines the associated signaling conformance tests (3GPP TS 34.108, TS 34.123). The specified test cases are binding for 3G network operators and mobile radio manufacturers worldwide and are used for the certification of new 3G mobile phones. The test cases cover all protocol layers of layer 2 of the radio access network up to the higher layers 3 and 4 of the non-access stratum. Both circuit-switched and packet-switched services are tested.

Unlike with GSM, ETSI creates all UMTS signaling test cases in the TTCN programming language. The R&S®CRTU-W supports the test cases prioritized by GCF and PTCRB. By providing a complete TTCN development environment, the protocol tester offers a powerful tool for testing and analyzing 3G mobile phones.

In addition to pure UMTS test cases, the intersystem-handover and the RRM test cases of the R&S®CRTU platform are supported.

## Application enabler test

The application enabler test cases defined by OMA took effect with binding force for the certification of mobile phones in early 2005. The R&S®CRTU family of protocol testers can also handle these applications. All you need to do is install an additional software component, i.e. a serving scenario from Rohde & Schwarz. The R&S®CRTU then simulates a base station that provides the connection to the specific IP application. The mobile phone sends packets to the R&S®CRTU via a packet-switched link. In the R&S®CRTU, the packets are routed from the protocol stack via the operating system to the Ethernet switch.

Virtually all IP-based applications can be tested in this way. The R&S®CRTU-ATE application test environment test platform was validated by Rohde & Schwarz especially for application enabler tests in accordance with OMA. The test platform can communicate with the R&S®CMU 200, R&S®CRTU-W/M and R&S®CRTU-G/S.

The above instrument configuration is, however, only used for a special type of application testing, i.e. conformance testing, which employs the same principle as application testing.

You can also use the R&S®CRTU-ATE platform to create test cases of your own or carry out end-to-end tests. It is thus possible to perform interoperability tests of an application involving two mobile phones.

By integrating protocol testers of the R&S®CRTU family into the R&S®CRTU-ATE test platform, you will be able to perform the full range of conformance test cases by means of a single hardware platform.

# The members of the R&S®CRTU family

## R&S®CRTU-G

The R&S®CRTU-G simulates a GSM base station with two completely independent RF channels. Each of the GSM850, GSM900, GSM1800 and GSM1900 networks is supported. The R&S®CRTU hardware is designed for operation up to 2.7 GHz, which means that the R&S®CRTU will also support future frequency bands that may be allocated without requiring any hardware changes. The R&S®CRTU also supports the modulation modes commonly employed in GSM – GMSK and 8PSK. Existing testers can be upgraded to EGPRS simply by means of software options. The RF frontend includes four input and output connectors for different level ranges as well as a built-in two-way coupler for combining two RF signals. Even the base unit comes with ample functionality, affording great ease of operation for development engineers.

Standard features of the base unit include:

- ◆ Complete GSM protocol stack
- ◆ Microsoft Visual Studio .Net Compiler
- ◆ Library with extensive range of example programs
- ◆ Comprehensive toolbox

Functions can be added or expanded as required based on a flexible concept of software options. The following signaling expansions are available for the operating system:

- ◆ (E)GPRS
- ◆ AMR
- ◆ LCS
- ◆ Ciphering
- ◆ Data tests

The R&S®CRTU-G also covers the complete range of 3GPP TS 51.010 protocol test cases by means of software options. These test cases are combined into packages that reflect the contents of the main chapters of the test specification. It is our objective to offer all category A test cases validated in accordance with GCF and PTCRB.

The R&S®CRTU-G is intended for use as a standalone tester. In addition, it can take the role of a master or a slave in a multibox setup. It forms the core signaling unit in an R&S®TS8950G system. In conjunction with an R&S®CRTU-W, it forms an inter-RAT handover test system; in conjunction with a signal generator and an R&S®ABFS baseband fading simulator, it forms an RRM test system.

## R&S®CRTU-S

The R&S®CRTU-S was designed as a dual-channel RF expansion for an R&S®CRTU-G acting as master. It comes with all available frequency bands and signaling options and thus performs all functions supported by the master, requiring no extra options. To operate the R&S®CRTU-S, simply connect it to the R&S®CRTU-G by means of the cables supplied and configure it as slave from the Configuration Manager. The R&S®CRTU-G as the master controls the complete configuration. The R&S®CRTU includes a built-in coupler, which eliminates the need for extra components. Each built-in coupler can combine two RF signals. Thus, up to eight testers can be cascaded without requiring external equipment. The R&S®CRTU-S has exactly the same technical characteristics as the R&S®CRTU-G and can therefore be upgraded to a full-fledged protocol tester at any time. In addition to its use in a multibox configuration, the R&S®CRTU-S

can also be used as an application tester (see page 7).

### Operation

To ensure convenient operation, the R&S®CRTU-G comes with a complete software toolbox. Using the Configuration Manager, you can quickly switch between the following operating modes:

- ◆ Standalone
- ◆ Master
- ◆ Slave
- ◆ Slave clock
- ◆ System

The Configuration Manager is also used to assign the desired level ranges and reference signal source to the four RF connectors. When these basic settings have been made, you can control the R&S®CRTU-G via the Sequencer. In the Sequencer, you can select all desired test cases from lists. You group the test cases into test projects and define how these should be executed (in single steps, as repeated sequences, as endless loops, manually, automatically, etc). From the Configuration Editor, which you can start from the Sequencer, you configure all test parameters.

When the signaling tests are completed, the actual work for the development engineer begins – analyzing the generated log files. The R&S®CRTU-G generates two different log files: a report log containing a short summary of the test steps performed in accordance with the specification, including pass/fail information for each step, and a message log, which contains the actual signaling information. These log files can be stored on a local or network drive. To analyze the log files, the Message Viewer is available. This is a sophisticated, powerful analysis tool that is also started from the Sequencer. The Message Viewer displays all layer 1, 2 and 3 GSM/(E)GPRS signaling mes-

sages in the uplink and the downlink in a straightforward manner. Various filter options and export functions are available to help you work efficiently. The GUI can be adapted to suit your individual needs.

If you wish to modify individual messages or parameters for further tests in order to check the DUT's response to different conditions, you can do this conveniently using the R&S® Message Composer. From the R&S® Message Composer, you can access the R&S® CRTU message pool and modify individual parameters without modifying the source code and without the need for recompilation. You can thus change conditions in the test sequence quickly and easily and check the mobile phone's response before you actually change the source code.

If required, the DUT can be remote-controlled using the Send AT tool, by means of which mobile phones can be addressed via AT commands in accordance with 3GPP TS 07.07. In the remote mode no operator control of the mobile phone is required, which is useful, for example, when tests are performed in a shielded RF chamber. With (E)GPRS test cases, which involve initiating GPRS attach and activating PDP context, remote control is advantageous and also time-saving. The AutoDLL Traffic Viewer displays the commands and acknowledgments exchanged between the protocol tester and the mobile phone via the remote control interface.

### Generation of test scenarios

All test cases specified by 3GPP and all example scenarios (application programs) are available in C++ source code. This provides you with a convenient means of generating test scenarios of your own. In the simplest case, all you have to do is edit individual parameters to create a specific test scenario. To generate proprietary test scenarios, you can use the application programs

as building blocks. The application programs, which are available for any type of application, can be combined to form complete test scenarios, thus saving time and programming effort. Test scenario generation is always based on the same structure. Experienced C programmers will easily master operation of the R&S® CRTU testers.

## R&S® CRTU-W

The R&S® CRTU-W is a highly versatile signaling protocol tester for WCDMA and dual-mode mobile phones. Like the R&S® CRTU-G, the R&S® CRTU-W is based on the successful R&S® CRTU hardware platform. You can thus expand an existing R&S® CRTU GSM protocol tester easily and cost-effectively to create a UMTS protocol tester while maintaining its GSM test functionality. The RF modules of the R&S® CRTU-W can be used up to a frequency of 2.7 GHz. This unique characteristic makes it easy to implement new frequency bands, which means that the R&S® CRTU-W supports all specified UMTS frequency bands.

The wide range of software options available for the R&S® CRTU-W allows you to tailor the unit to your specific needs. The R&S® CRTU-W thus offers test functionality for non-signaling layer 1 chip development as well as for interoperability and certification tests.

The protocol tester can simulate two independent UMTS cells simultaneously. The two cells can be configured with the same frequency or with different frequencies. It is thus possible to simulate soft handover, intra-frequency handover or inter-frequency handover by means of a single protocol tester.

### Inter-RAT handover

The R&S® CRTU-W can also handle the critical 2G/3G intersystem handover scenarios by means of software options.

The Rohde & Schwarz measurement solution for 2G/3G intersystem handover consists of the Protocol Testers R&S® CRTU-W for WCDMA and R&S® CRTU-G for GSM.

You can use existing GSM protocol testers to perform intersystem handover test cases. The R&S® CRTU-G GSM protocol tester supports state-of-the-art GSM functionality such as DTM or (E)GPRS. The handover test system from Rohde & Schwarz is thus able to support, at an early stage, current test requirements, e.g. handover from HSPA to (E)GPRS, and offer certified test cases.

The R&S® CRTU-W is of course capable of handling HSPA. The R&S® CRTU-W in its standard configuration already supports the new 16QAM modulation mode. You can run HSPA certification test cases on the R&S® CRTU platform without any hardware expansions being required. In addition to pure signaling tests, the R&S® CRTU-W also performs application-specific tests with support of all categories (incl. 10).

## R&S® CRTU-M

Some test cases require more than two UMTS cells. The R&S® CRTU platform concept allows you to cascade up to three UMTS protocol testers.

An R&S® CRTU-W master can be connected to up to two R&S® CRTU-M slaves to form a multicell system that simulates as many as six UMTS cells. Connecting the R&S® CRTU-W and R&S® CRTU-M testers to a multicell system is very easy. The built-in passive coupler elements provide RF coupling between the various cells. Like the R&S® CRTU-S, the R&S® CRTU-M requires no extra software options. The R&S® CRTU-M includes as standard all that is needed for multicell operation.

# The R&S®CRTU software tool chain

## R&S®CRTU-W software tools

The R&S®CRTU-W includes a complete software toolbox for all required applications. R&S®Project Explorer is the main software tool for configuring and executing test projects.

Rohde & Schwarz also offers tools such as R&S®PICS/PIXIT Editor, R&S®TTCN Editor and R&S®TTCN Test Case Builder for configuring and editing test cases or creating new test cases. The software tools can also be operated on an external PC running on Windows 2000. This enables you to offload time-consuming analysis or compilation work to an external computer, thus increasing effective R&S®CRTU-W test time. Licenses for off-line use of software tools are available as software options.

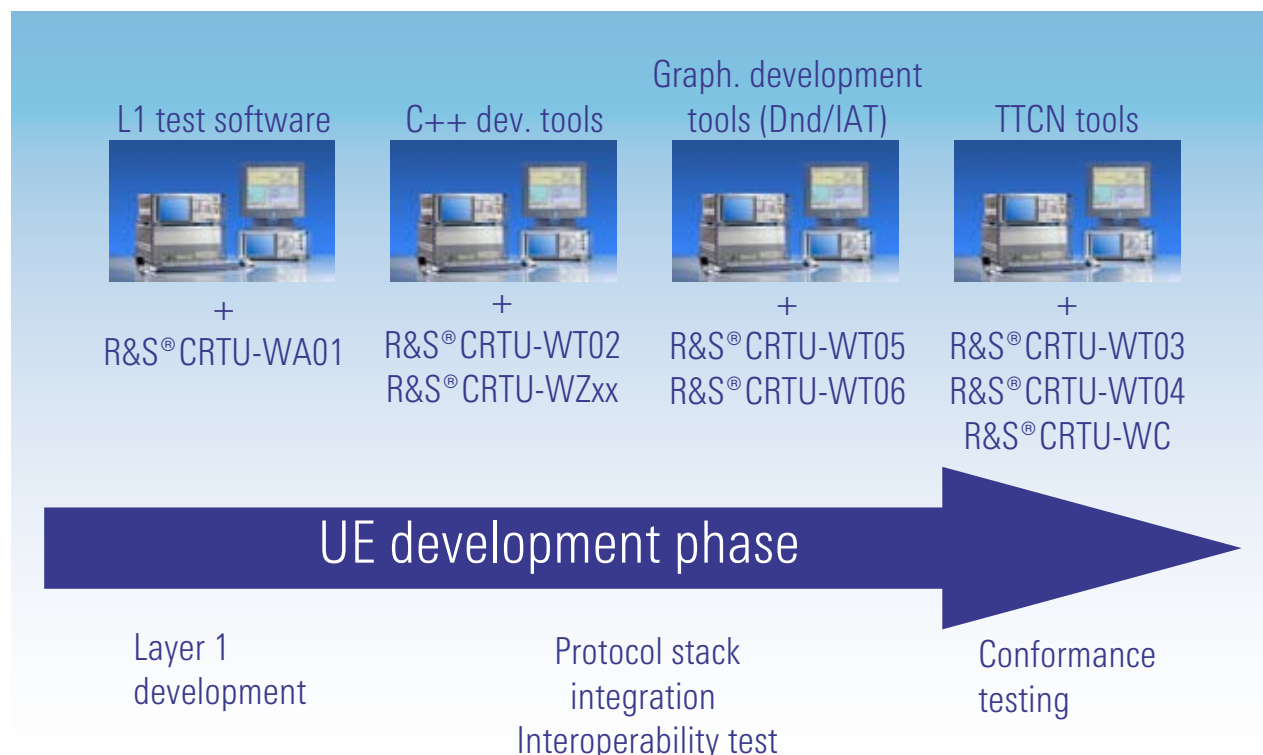
Rohde & Schwarz offers support contracts for all R&S®CRTU software products. Under such a contract, you can update your R&S®CRTU software at any time to the latest GCF, PTCRB or OMA validation status.

## R&S®Project Explorer

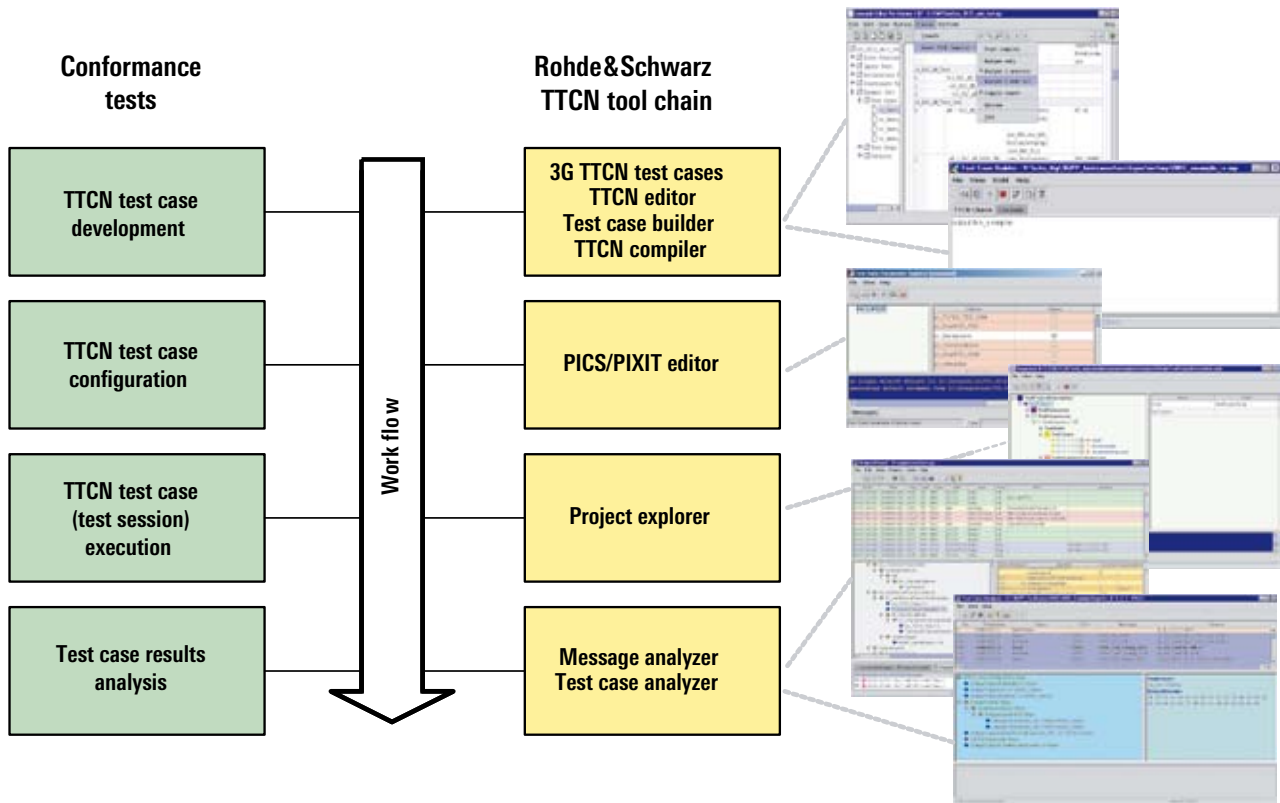
R&S®Project Explorer is the main software tool of the R&S®CRTU-W UMTS protocol tester. Using R&S®Project Explorer, you can select and start test cases from a test project. You can perform complete regression tests by combining test cases from several test projects and execute them automatically from start to finish.

R&S®Project Explorer is the main control element for the entire test project. It displays the current status of the test project and, on completion of a test case, indicates the result by means of a pass/fail verdict.

Another important task performed by R&S®Project Explorer is the management of all recorded log files. You can access test reports and the associated log files simply by clicking the mouse. Plus, you can remote-control R&S®Project Explorer via an Ethernet interface.



*The R&S®CRTU-W can be configured to meet any development requirements*



**R&S®CRTU-W TTCN toolchain**

### R&S®Message Analyzer

R&S®Message Analyzer is a highly convenient and powerful tool for the online and offline analysis of UMTS protocol messages. When you execute a TTCN or C++ test scenario, the R&S®CRTU-W stores all transmitted and received UMTS messages in a log file.

The log file can already be displayed while the scenario is running. Moreover, you can analyze all messages transmitted and received by the base station down to the last detail. This is possible because R&S®Message Analyzer allows both local configuration messages and peer-to-peer messages to be fully decoded and interpreted. The sophisticated GUI concept makes it possible to display the complete message flow, the structure of a single message, and even the details of a message down to the byte and bit level. Moreover, you can define special message filters or export message sequences to HTML.

### R&S®TTCN Test Case Analyzer and R&S®Test Case Builder

R&S®TTCN Test Case Builder supports the compilation of TTCN-based test cases. You can thus edit existing TTCN test cases or create completely new test scenarios and compile and execute them on the R&S®CRTU-W. R&S®TTCN Test Case Builder also provides a link to TTCN Editor. Thus, if an error message is output by the Compiler, you can go directly to the erroneous source code by just clicking the mouse.

Rohde & Schwarz uses the Leonardo Pro TTCN Editor from DaVinci to visualize the TTCN source code. Rohde & Schwarz also provides support for this product.





## Ordering information

### R&S®CRTU-G

Designation	Type	Order No.
Universal GSM Protocol Tester	R&S®CRTU-G	1140.0009.02
Protocol Tester for GSM and WCDMA	R&S®CRTU-GW	1140.0709K02
Multicell Expansion Unit for GSM and WCDMA	R&S®CRTU-MS	1140.2401K02
Dual-Channel IQ/IF Interface Card for R&S®CRTU-G	R&S®CRTU-B7	1139.0009.02
Upgrade of R&S®CRTU-G to R&S®CRTU-GW	R&S®CRTU-U01	1140.1105.02
Upgrade of R&S®CRTU-S to R&S®CRTU-G	R&S®CRTU-U03	1140.0209.02
Upgrade of R&S®CRTU-G Hard Disk to 80 Gbyte	R&S®CRTU-U05	1139.1105.03
Upgrade of PC Module to 933 MHz/512 Mbyte	R&S®CRTU-U06	1139.1940.02
Upgrade of R&S®CRTU-S to R&S®CRTU-MS	R&S®CRTU-U10	1139.2401.02
Upgrade of R&S®CRTU-MS to R&S®CRTU-GW	R&S®CRTU-U12	1139.3208.02

#### Software options for the R&S®CRTU-G/S

Additional operating software for: GSM850, LCS (Location-based-Services) including A-GPS, AMR, higher multislot classes (>14), application enabler test, A5/3 and GEA3 ciphering  
 Test cases in accordance with GCF/PTCRB/OMA for all sections of the test specifications: circuit-switched, additional services, SIM applications, (E)GPRS, AMR, LCS, DTM

#### Equipment supplied with the R&S®CRTU-G:

Radio unit, GSM signaling board, MAC/speech board, test SIM phase 2+ (GSM900/1800), test SIM phase 2+ (GSM850/1900), operating software, hardlock, all required RF, control and Ethernet cables

### R&S®CRTU-W

Designation	Type	Order No.
WCDMA Protocol Tester	R&S®CRTU-W	1140.0509.02
Protocol Tester for GSM and WCDMA	R&S®CRTU-GW	1140.0709K02
Multicell Expansion Unit for GSM and WCDMA	R&S®CRTU-MS	1140.2401K02
Upgrade of R&S®CRTU-G to R&S®CRTU-GW	R&S®CRTU-U04	1140.0309.02
Upgrade of R&S®CRTU-M to R&S®CRTU-W	R&S®CRTU-U07	1139.2102.02
Upgrade of R&S®CRTU-M to R&S®CRTU-MS	R&S®CRTU-U11	1139.3108.03
Upgrade of R&S®CRTU-MS to R&S®CRTU-GW	R&S®CRTU-U12	1139.3208.02
PPC Upgrade for Higher Data Rates (HSPA)	R&S®CRTU-U13	1139.3008.02

#### Equipment supplied with the R&S®CRTU-W

Radio unit (with R&S®CRTU-B7), protocol unit, test SIM phase 2+, operating software, hardlock, all required RF, control and Ethernet cables

### Recommended extras

Designation	Type	Order No.
Antenna Coupler for Mobile Phones	R&S®CMU-Z10	1150.0801.02
RF Shielding Cover 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
USB Optical Mouse	R&S®PSL-Z10	1157.7060.03
USB Keyboard	R&S®PSL-Z2	1157.6870.04
17" TFT Monitor	R&S®PMC3	1082.6004.10
USB DVD-RW Drive	R&S®PSP-B6	1134.8201.22
Application enabler test		
MMS Test Operating Software with Server Function	R&S®CRTU-AA01	1166.0958.02
PoC Test Software with Server Function	R&S®CRTU-AA02	1204.1200.02
Data Application Test Environment	R&S®CRTU-AP01	1204.0003.02
MMS Test Cases (in accordance with OMA)	R&S®CRTU-AC01	1166.0906.02

## Abbreviations

3GPP	3rd Generation Partnership Project
8PSK	8 phase shift keying
AMR	Adaptive multirate
AWGN	Additive white Gaussian noise
DARP	Downlink advanced receiver performance
DTM	Dual transfer mode
DUT	Device under test
ETSI	European Telecommunications Standards Institute
GCF	Global Certification Forum
GERAN	GSM EDGE radio access network
GMSK	Gaussian minimum shift keying
GUI	Graphical user interface
HSDPA	High speed downlink packet access
HSPA	High speed packet access

HSUPA	High speed uplink packet access
LCS	Location service
MLAPI	Medium Level C++ programming interface from Rohde & Schwarz
OCNS	Orthogonal channel noise source
OMA	Open Mobile Alliance
PTCRB	Personal Communication System Type Certification Review Board
RAN	Radio access network
RAT	Radio access technology
RRM	Radio resource management
SIM	Subscriber identity module
TTCN	Tree and tabular combined notation
UMTS	Universal mobile telecommunication system
UTRAN	UMTS terrestrial radio access network



For specifications, see PD 5213.5574.21  
and [www.rohde-schwarz.com](http://www.rohde-schwarz.com)  
(search term CRTU)



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