Test Platform for Mobile Phone Production
R&S TS 7100/R&S TS 7180

Scalable solutions from low-cost standard system to turnkey production system

◆ **Versatile applications**
- For all common mobile radio standards
- For mass production and service
- For all production steps including PCB tests, functional tests, RF adjustment and final tests covering RF, acoustic, keypad and display functions
- Multiprotocol and multiband tests with Radio Communication Tester R&S CMU 200

◆ **Scalable solutions**
- Comprehensive modular test library for immediate use or easy customization
- Scalable from low-cost platform R&S TS 7180 using industrial PC to modular system platform R&S TS 7100 using PXI/CompactPCI
- Easy upgrade to 3rd generation mobile radios

◆ **Cost-effective solution**
- Low-cost solution R&S TS 7180 with industrial PC
- Maximum throughput owing to extremely short measurement times of R&S CMU 200 and real parallel testing using two independent IEC/IEEE bus systems
- Easy upgrading for upcoming mobile radio standards
- Test of several mobile radio standards with one R&S CMU 200
- All hardware and software components based on industry standards

ROHDE & SCHWARZ

Mobile radio – a dynamic market

The mobile radio market is undergoing dynamic changes and is characterized by rapidly increasing production volumes, extremely short product cycles and a variety of mobile radio standards. Special design tools and chip sets today simplify mobile radio development, which has resulted in many new manufacturers entering this market and offering attractively priced products of their own. This leads to increasingly fierce competition.

Important developments on the mobile phone market
◆ Reduction of time to volume
◆ Reduction of production costs
◆ Re-usable test solutions for new products and new mobile radio standards
◆ Outsourcing to contract manufacturers
◆ New mobile radio manufacturers
◆ Use of reference designs from different chip set manufacturers
◆ Large local markets, e.g. China
◆ Test solutions from global manufacturers used as standard worldwide
◆ Global projects involving development teams and production plants around the world

Demands on production test solutions
◆ Minimization of costs per mobile radio unit, i.e. high throughput
◆ Standardized, easily adaptable solutions
◆ Production at any location around the world
◆ Easy integration of a company's own core competences
◆ Local support on a global scale
◆ Continuous development and upgrading to include new mobile radio standards
◆ Constant optimization, updating and further development of test platform

◆ Ready-to-use solutions for different reference designs
◆ Global project management

Being one of the world's leading manufacturers in the field of communication T&M, Rohde & Schwarz has developed the R&S TS7180 and R&S TS7100 systems, which are optimal solutions for production tests on all types of mobile phones. They offer turnkey solutions for PCB tests, RF adjustment and final tests of mobile phones.

Wide range of services
The Rohde & Schwarz test systems are backed by a wide range of services. Customers are supported in selecting and configuring a system that best suits their application. On request, customized test programs are created and the system is fully integrated into the production process. System calibration and maintenance are provided too. You can rely on the expertise of Rohde&Schwarz to handle all tasks connected with the development and maintenance of your production test system.
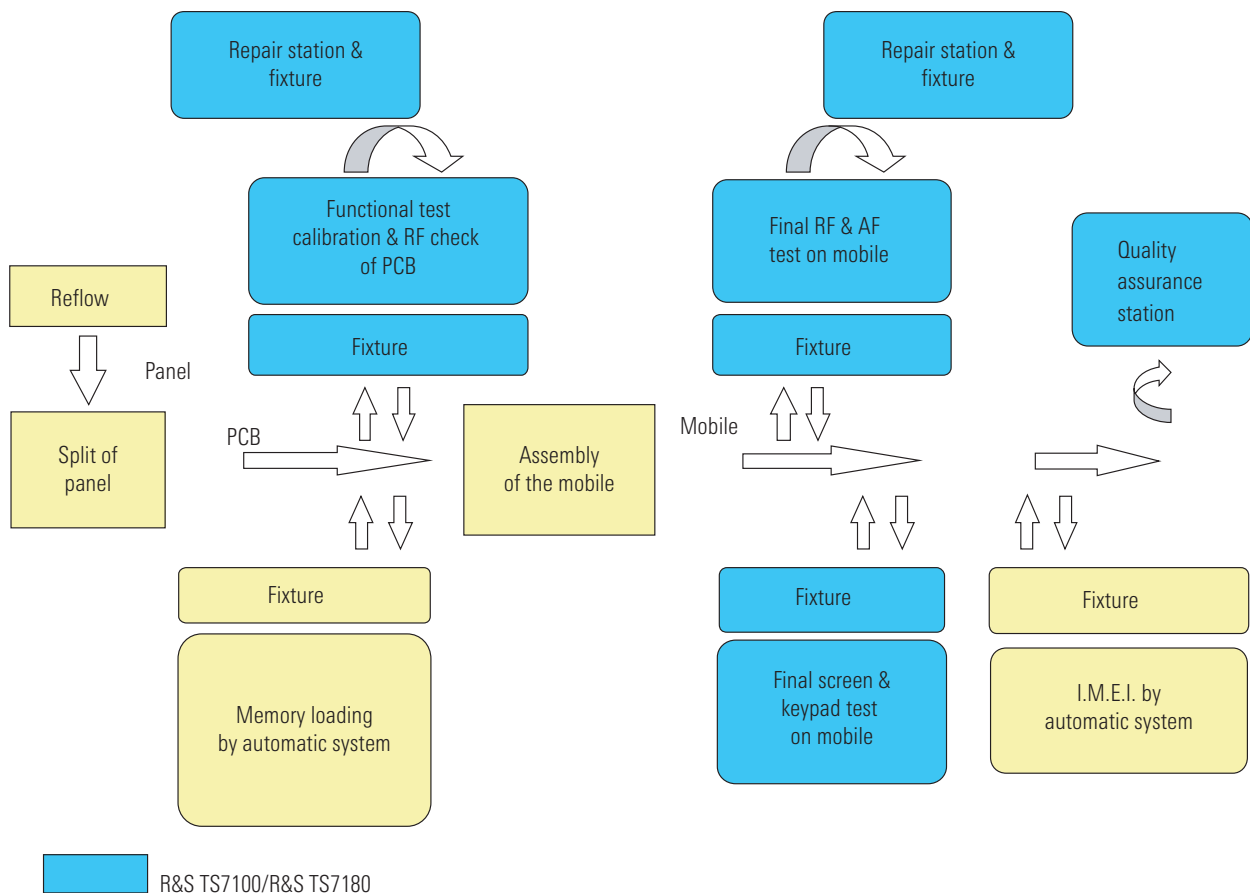
R&S TS 7100/R&S TS 7180
# – the solutions for mobile phone production tests

The R&S TS 7180 and R&S TS 7100 systems from Rohde & Schwarz are flexible solutions for mobile phone production tests. The low-cost version R&S TS 7180 satisfies the requirements of most mobile phone production tests. The R&S TS 7100 test platform incorporates a powerful CompactPCI/ PXI frame for the integration of a wide variety of additional test and switching modules. This is ideal for contract manufacturers, as it enables them to quickly and flexibly respond to widely differing customer requirements.

The systems can be used immediately or modified and extended to customer requirements. Constructed from standard components, they can be reproduced quickly and at low cost. They are easy to operate and can be smoothly integrated into any production environment.

Examples of test system application in a mobile phone production line

Low-cost production test system R&S TS 7180
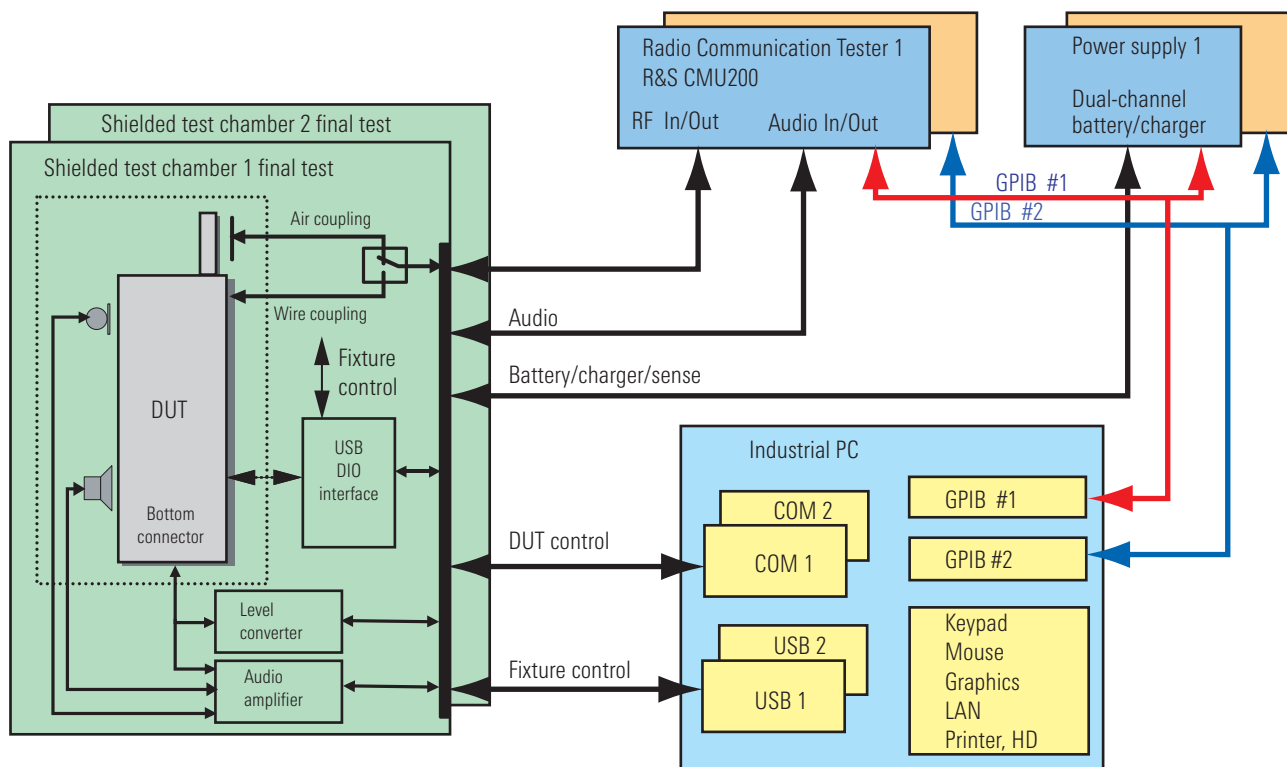
Block diagram of R&S TS 7180

Ideal for mass production and service

The R&S TS 7180 is a low-cost test system for the mass production of mobile phones. It supports all common mobile radio standards such as GSM, GPRS, CDMA(IS95), TDMA(IS136), AMPS, CDMA2000 and WCDMA as well as tests on terminals with *Bluetooth*™ capability.

The two-channel version is capable of simultaneously testing two mobile phones. It essentially comprises two Radio Communication Testers R&S CMU 200, two special power supplies and two fixtures. The system is controlled by an industrial PC.

The highly compact two-channel system is accommodated in a rack of only 23 HU, thus allowing room for expansions.

Alternatively, a low-profile rack is available. With a height of only 80 cm (13 HU), the complete system can be placed under the conveyor belt of a production line. It is therefore ideal for subsequent use in fully automatic inline systems.

For manual operation, an extra fixture kit is available that can be extended on a modular basis from a simple PCB test fixture to a complete shielded test fixture for final testing including antenna and acoustic tests. The manual fixture can be used both with the R&S TS 7180 and the R&S TS 7100.

Complete, ready-to-run test sequences make test program generation easy even for users without any programming expertise. The sequences are made up of function calls from the different generic test software libraries (GTSL) and can easily be modified and adapted using the TestStand editor.

GTSL supports all common mobile radio standards and is continually being expanded. User libraries can be added, for example to drive additional devices or the DUT.

GTSL also supports all functions relevant in a production test environment including signal switching, fixture control and RF path compensation.

Debugging, data storage and logging are performed by the TestStand test executive from National Instruments.

The GTSL software and the TestStand test executive run on both systems.

Low-cost production test system R&S TS 7180

R&S TS 7180 features

- Reduction of development time
- Use of standard solutions
- Low-cost system ideal for mass production and service
- Multiprotocol, multiband Radio Communication Tester R&S CMU 200 combines all common mobile radio standards in a single unit
- Easy programming of R&S CMU 200 due to GTSL (generic test software library)
- Multiprotocol test capability for one DUT with one test system (handover)
- Library concept allows integration into any production test software
- Customer libraries can be added
- Simultaneous, asynchronous testing of two DUTs
- Automatic RF and audio path compensation
- Software runs on R&S TS 7180 and R&S TS 7100 test systems and on PC
- Powerful TestStand design tool for test sequence generation

- Database interfaces and report generation
- Executable sequences for final testing and path compensation
- Simple operator interface (GTOP) for fully automatic test sequence runs in production
- Fixture concept covering antenna and acoustic tests
- Worldwide support by system support centers in Asia, Europe and the U.S.

High yield through parallel testing
To test two mobile phones simultaneously, all components (R&S CMU 200, power supply, plug-in boards) must be provided in duplicate. Also, two IEC/IEEE bus systems must be available to ensure that the two channels are operated independently and without mutually affecting each other while offering optimal performance and simple operation. The devices on the IEC/IEEE bus are driven simultaneously by a system controller in multitasking mode under Windows 2000.

High-profile rack

Extended system platform R&S TS 7100

Ideal platform also for complex test requirements

The R&S TS 7100 test system uses a CompactPCI/PXI frame with an embedded controller (PC) instead of the industrial PC employed by the R&S TS 7180. The remaining hardware components and the system software are identical. The CompactPCI/PXI frame allows for extra functionality by installing additional plug-in boards such as relay modules for path switching, AF generator, AF analyzer, A/B interface (e.g. for cordless telephones), digital multimeter, frame grabber for display tests, etc. The system can thus be adapted to complex test requirements and sequences quickly and flexibly.

High-profile rack

Low-profile rack: components can be installed on both sides

R&S TS 7100 features

◆ Software-compatible with R&S TS 7180
◆ PCB test with expanded AF, DC and digital testing requirements
◆ Simultaneous or multiplexed testing of several DUTs (modules) on one panel
◆ Multichannel systems comprising 4 channels for example, with 2 channels multiplexed in each case, for minimizing DUT handling times
◆ Control and test of additional interfaces
◆ Efficient selftest concept

Extended system platform R&S TS 7100

CompactPCI/PXI – a compact and flexible standard

The R&S TS 7100 test system incorporates the CompactPCI/PXI system platform TSVP (Test System Versatile Platform) from Rohde & Schwarz with a maximum configuration of 31 slots. Within a single unit of 4 HU, this platform accommodates the system controller, relay modules, digital inputs and outputs and test modules in cases where these are not yet provided by the radio communication tester. The universal module R&S TSPRL1, which offers relay, power relay and digital I/O functionality on a single module, already provides all basic functions required for mobile phone testing, including fixture control. Further measurement functions such as digital multimeters or relay matrix boards can be implemented as required.

The unique wiring concept of the R&S TSVP makes it possible to route and switch all signals of the various test and stimulus modules entirely within the R&S TSVP. Thus all signals can be tapped directly at the fixture interface, which allows simpler fixture and interface design. The PXI system architecture, now an industry standard, was developed from CompactPCI especially for industrial T&M applications. It sets a new standard in flexibility and compactness. A large number of very different PXI modules are already available on the market. CompactPCI boards can also be used.

Parallel test configuration

As in the case of the R&S TS 7180, parallel testing of two mobile phones requires all components (R&S CMU 200, power supply, plug-in boards) to be provided in a dual configuration. The IEC/IEEE bus must also be provided in duplicate to achieve optimal performance. Duplicating the CompactPCI/PXI platform is not necessary due to its high performance. The IEC/IEEE bus devices and the plug-in boards are therefore driven simultaneously in multitasking mode by an embedded system controller under Windows NT/2000.
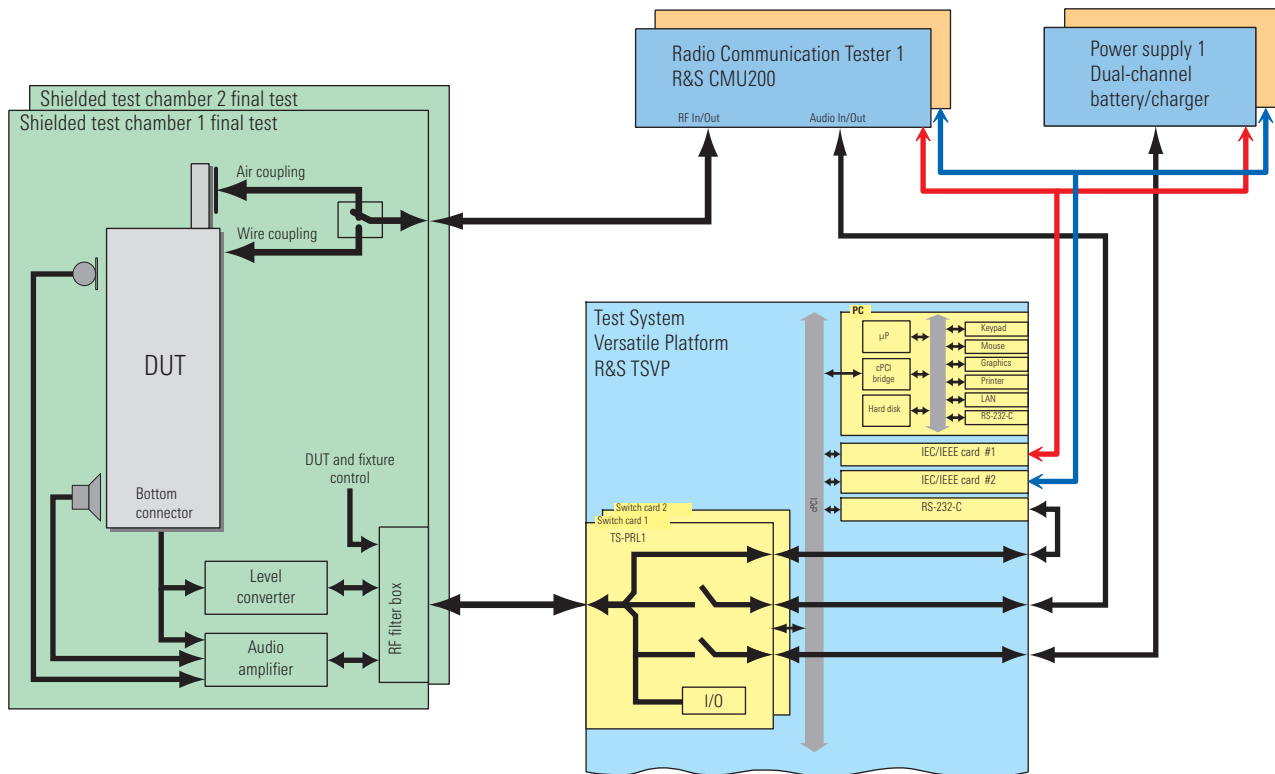
Block diagram of R&S TS 7100

R&S CMU 200 – the fast and universal radio communication tester

The Radio Communication Tester R&S CMU 200 performs most of the mobile phone tests such as audio tests, RF measurements, signalling and RF calibration. It supports all common mobile radio standards including 3rd generation standards such as WCDMA and CDMA2000. The R&S CMU 200 is thus ideally suited for testing dual- or triple-band as well as multimode mobile phones.

◆ Extremely high test speed
◆ High-precision measurements
◆ Future-proof modular design
◆ Extensive spectrum analyzer functions
◆ Rapid switching between networks

◆ Support of all relevant standards such as GSM, EDGE, GPRS, AMPS, cdmaOne, TDMA (IS136), *Bluetooth*, CDMA2000 and WCDMA

Extract from comprehensive test library:

```
AF
    Configuration
        Analyzer                        GSM_AF_Conf_Analyzer
        Generator                       GSM_AF_Conf_Generator
        Generator/Voltmeter Path        GSM_AF_Conf_Gen_Volt_Paths
        Multitone/Frequency             GSM_AF_Conf_Multsin_Freq
        Multitone/Level                 GSM_AF_Conf_Multsin_Lvl
        Multitone/State                 GSM_AF_Conf_Multsin_State
        SLR/RLR                         GSM_AF_Conf_SLR_RLR
        Switch AF Generator ON OFF      GSM_AF_Conf_Gen_OnOff
    Measure
        Buzzer                          GSM_AF_Meas_Buz
        Multitone/AllLevel              GSM_AF_Meas_Multitone
        ReceivingLoudnessRating         GSM_AF_Meas_RLR
        SendingLoudnessRating           GSM_AF_Meas_SLR
        SingleTone                      GSM_AF_Meas_Voltage
Non Signalling
    Configuration
        Trigger                         GSM_NonSig_Conf_Trigger
        Burst Analysis                  GSM_NonSig_Conf_Burst_Analysis
        Switch RF Generator ON OFF      GSM_NonSig_Conf_RF_Gen_OnOff
    Measure
        Mobile linked  (UUT)
            Burst Analysis              GSM_NonSig_Meas_Burst_UUT
            Frequency Error             GSM_NonSig_Meas_Freq_Error_UUT
            Phase Error Peak            GSM_NonSig_Meas_Phase_Error_PK_UUT
            Phase Error RMS             GSM_NonSig_Meas_Phase_Error_RMS_UUT
            Power Average               GSM_NonSig_Meas_Power_AVG_UUT
            Power Peak                  GSM_NonSig_Meas_Power_PK_UUT
            Power Time                  GSM_NonSig_Meas_Power_Time_UUT
            RSS                         GSM_NonSig_Meas_RSS_UUT
Signalling
    Call and Release
        Mobile Linked
            Call                        GSM_Sig_Call_UUT
            Release                     GSM_Sig_Release_UUT
    Configuration
        Trigger                         GSM_Sig_Conf_Trigger
        BER Configuration               GSM_Sig_Conf_BER
        BER power levels                GSM_Sig_Conf_BER_PowLev
        BER sent frames                 GSM_Sig_Conf_BER_SFrames
        BS RF Parameters                GSM_Sig_Conf_BS_RF
        BS Simulation Parameters        GSM_Sig_Conf_BS_Simulation_Param
        Burst Analysis                  GSM_Sig_Conf_Burst_Analysis
        Location Update                 GSM_Sig_Conf_Loc_Update
        Modulation                      GSM_Sig_Conf_Mod
```

Test program generation made easy

The software for the R&S TS7100 and TS7180 test systems was designed with easy system operation and speedy test program generation in mind. The user need not have expertise in IEC/IEEE bus programming. C programming and compiling at the test sequence level are also not required. The software is of modular design and comprises a test sequence controller and a comprehensive test case library for mobile phones of different stan-dards.

Everything well prepared

The generic test software library (GTSL) includes ready-to-run setup and measurement functions for all common mobile radio standards. Tests for all function blocks of mobile phones, such as audio and acoustic, RF and signalling, are included. The functions are implemented as dynamic link libraries (DLL) and can be customized via menu prompting. The limit values are compiled in an ASCII file. Limit values can thus be modified or adapted quickly and easily using a stan-dard text editor.

Features

◆ Programming of R&S CMU 200 made easy with GTSL
◆ Ready to run under TestStand test executive
◆ Data storage and report generation performed by TestStand test executive
◆ Complete example test sequences
◆ Support of all common mobile radio standards: GSM, GPRS, TDMA (IS136), AMPS, cdmaOne, CDMA2000, WCDMA
◆ Automatic compensation of RF path attenuation
◆ Sequence for highly accurate path characterization using only one power meter
◆ Comprehensive assistant for signal path and frequency range definition for path characterization
◆ In-depth selftest concept (R&S TS7100)
◆ Flexible switch manager for complex signal path control
◆ Simple debugging by tracing all GTSL calls
◆ Multithreading for parallel test concepts
◆ Device sharing or locking for parallel test systems

◆ Automatic assignment of system components to test channels
◆ Straightforward operator interface for use on production floor
◆ Example source code for GTSL extensions
◆ Easy integration of additional system components
◆ Libraries for multimeters, power supplies and switch managers; devices can be interchanged by IVI driver (interchangeable virtual instruments driver)

A wealth of functionality for production testing

The TestStand test executive from National Instruments is used for test sequence control. This software package combines setup and measurement functions to form an executable test sequence and adds all other functions important for the manufacturing process:
◆ User administration
◆ Execution of several test sequences in multithreading or parallel mode
◆ Collection and storage of results
◆ Report generation

TestStand offers an intuitive user interface and functions for executing and debugging test sequences. The integrated sequence editor makes it easy to generate a sequence by joining various tests and to modify it any time. The data measured during a test run is collected and can be used for the automatic generation of reports or stored in a database for post-evaluation.
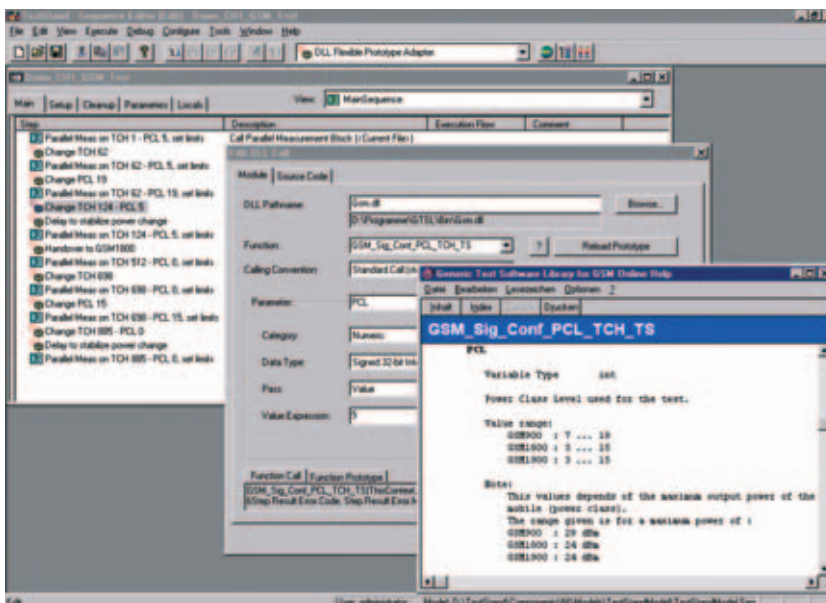
Sequence editor

Putting mobile phones through their paces

The R&S TS7180 and R&S TS7100 systems are equally suitable for functional tests on boards, RF calibration of mobile phones or final tests. Each function can be assigned test parameters under menu control. Sub-sequences can also be generated. This hierarchical structure makes it possible to set up even comprehensive test sequences conveniently and with high transparency. Each test step can be assigned result parameters and comparison operations for the conditional execution of actions, thus enabling program branching. At the end of each test run, a test report can automatically be generated from the results, or results can be stored in a database.
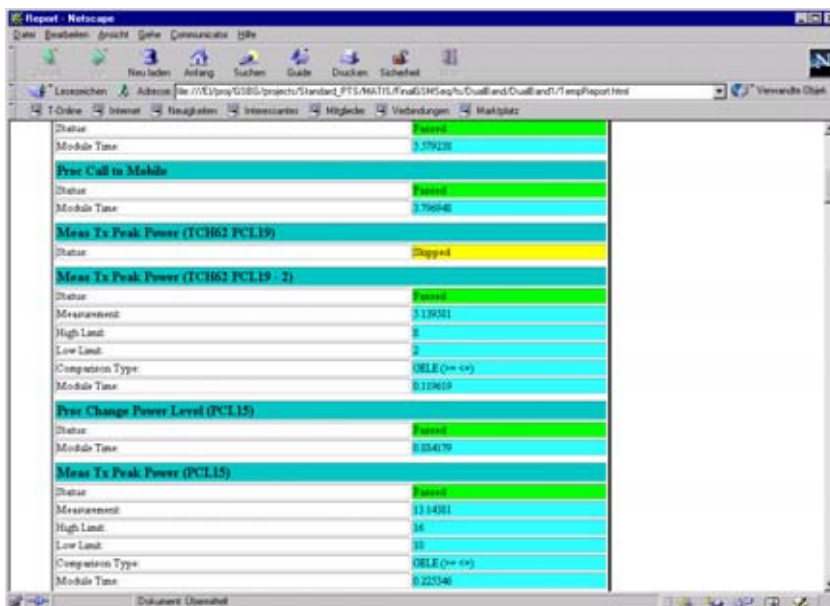

Test report in HTML

Example of GSM function test sequence:
◆ General tests
  – Short-circuit test
  – Current drain, etc
◆ Transmitter
  – RF power
  – Frequency error
  – Phase error, etc
◆ Receiver
  – AGC
  – RSSI
  – BER, etc

◆ Oscillator
  – AFC
  – VCO calibration, etc
◆ Audio
  – Frequency response
  – Distortion, etc
◆ Digital
  – Memory test
  – SIM interface, etc

Example of CDMA/AMPS final test sequence:
◆ Signalling
  – Location update
  – Call setup, etc
◆ CDMA RF test
  – Power level
  – Modulation
  – BER
  – FER, etc
◆ Handoff for AMPS
◆ AMPS RF test
  – Power level
  – Sensitivity, etc
◆ Other tests
  – Audio test
  – Keypad
  – Display
  – Current drain, etc
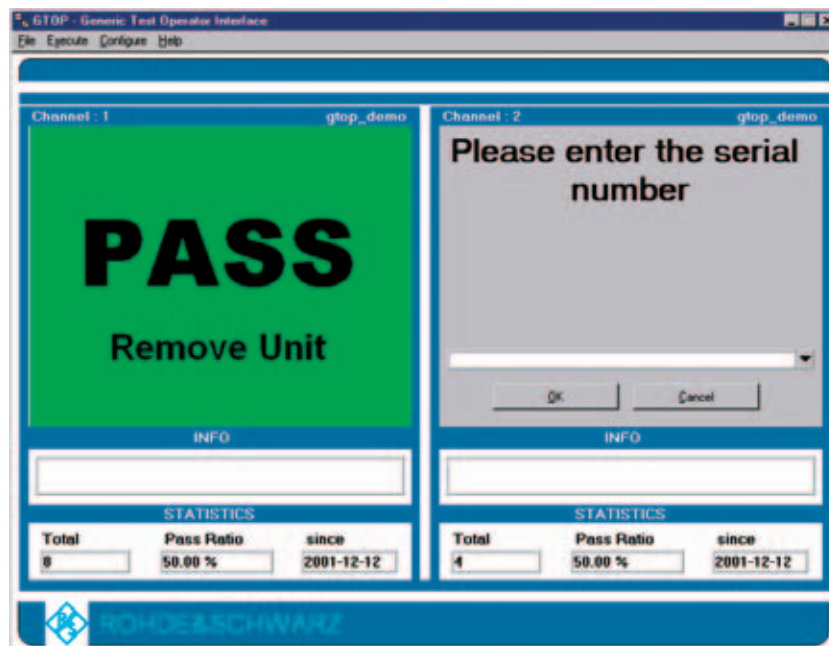
Sequences generated with the test sequence editor can also be run unmodified on the GTOP operator panel in two-channel mode in production.


GTOP operator panel

System calibration for maximum accuracy

High accuracy for maximum yield and low production cost

GTSL automatically takes into account RF path attenuation for each mobile radio standard. Therefore, the frequency response of each signal path must be measured and stored in advance. All signal paths are defined for a specific system configuration by means of the path characterization wizard. Signal paths and frequency ranges (scans) can be defined by the user and are limited only by the technical data of the instruments used. The frequency response of the individual signal paths is automatically determined and stored by means of a special sequence of the TestStand test executive, using the paths and scans previously set with the path characterization wizard. The resulting values are automatically used for compensating signal path attenuation in the measurements subsequently performed.
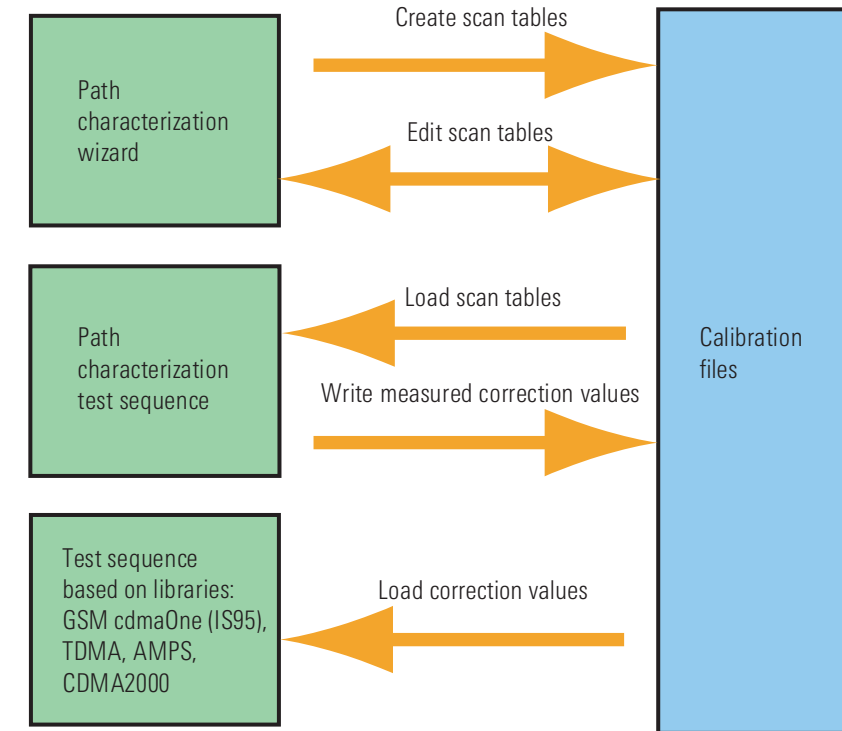
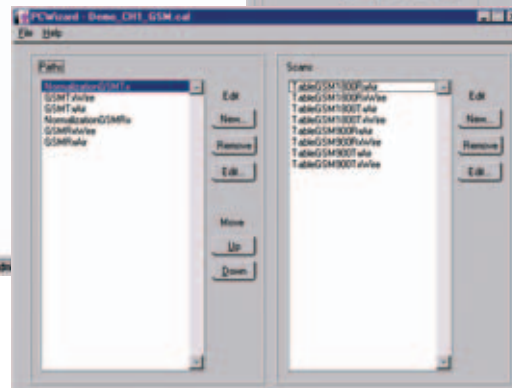*Generation of calibration files*
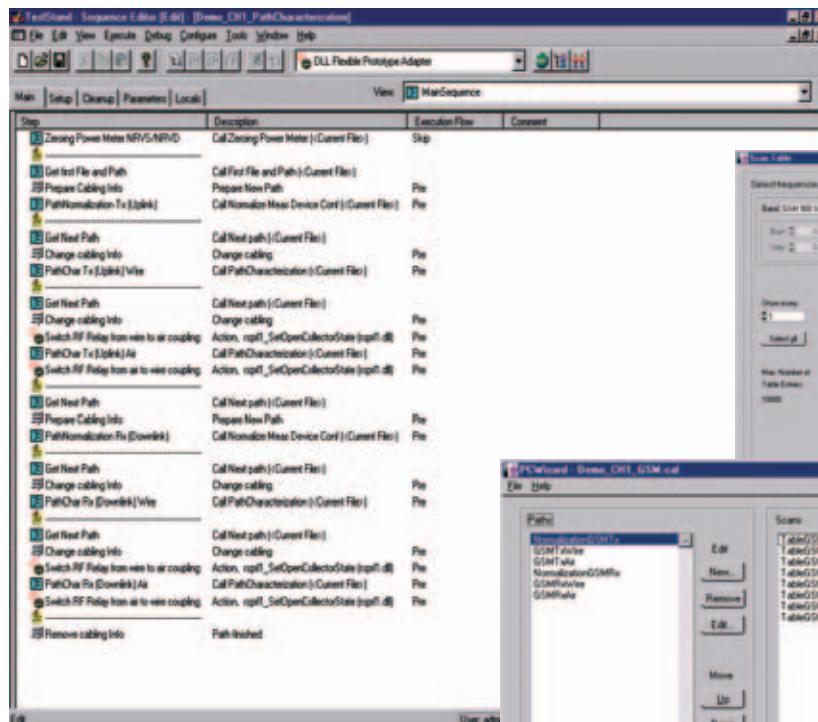
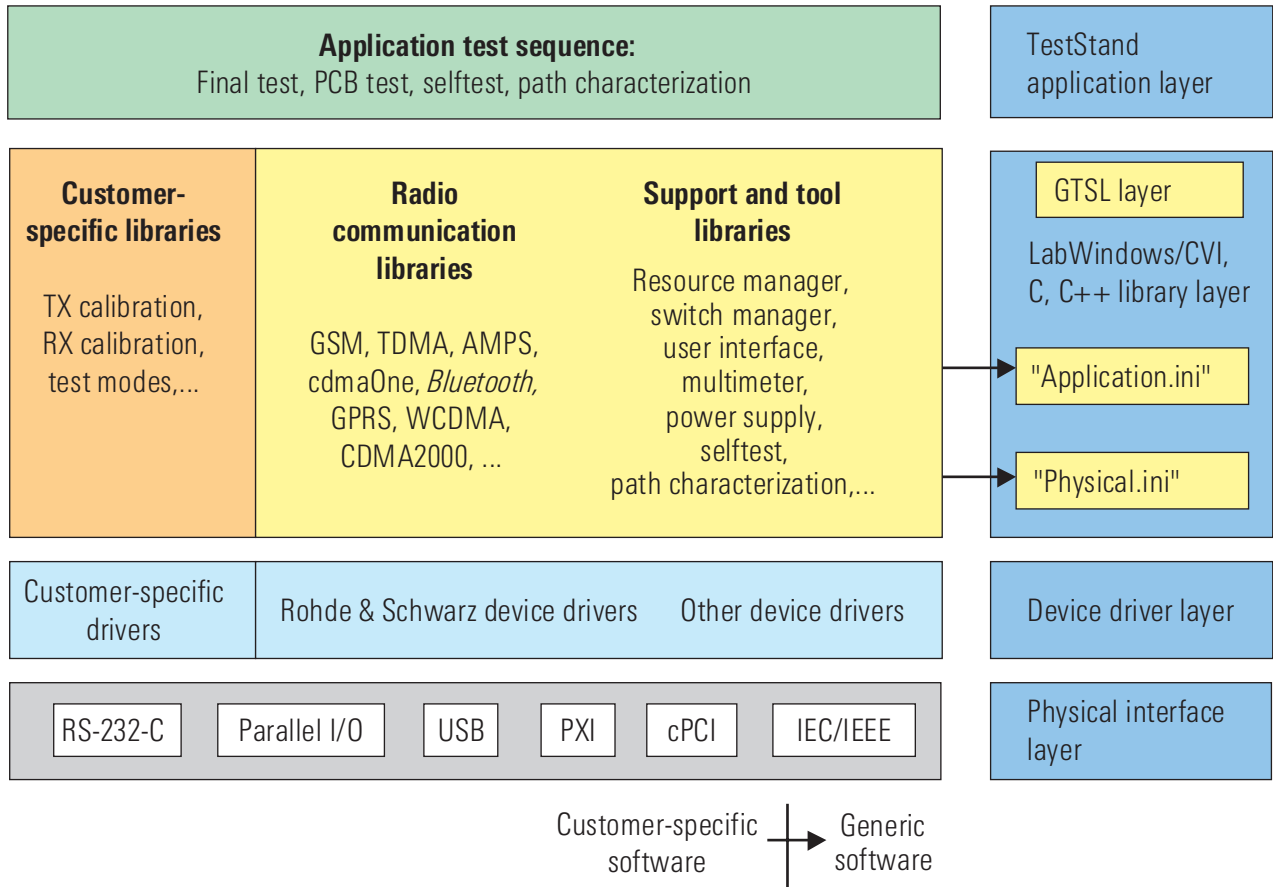*Test sequence for fully automatic path characterization*

Path characterization wizard: definition of frequency ranges for a scan

Path characterization wizard: definition of signal paths and associated scan tables

Open system architecture for flexible extension

Application test sequence: Final test, PCB test, selftest, path characterization	TestStand application layer

| Customer-specific libraries

TX calibration, RX calibration, test modes,... | Radio communication libraries

GSM, TDMA, AMPS, cdmaOne, *Bluetooth,* GPRS, WCDMA, CDMA2000, ... | Support and tool libraries

Resource manager, switch manager, user interface, multimeter, power supply, selftest, path characterization,... | GTSL layer

LabWindows/CVI, C, C++ library layer

"Application.ini"

"Physical.ini" |

| Customer-specific drivers | Rohde & Schwarz device drivers | Other device drivers | Device driver layer |

| RS-232-C | Parallel I/O | USB | PXI | cPCI | IEC/IEEE | Physical interface layer |

Customer-specific software ━ Generic software

GTSL architecture

In addition to the large number of libraries supplied with the test system, the customer can create libraries of his own that include typical GTSL features such as multithreading or RF path compensation. For this purpose, example source code for the LabWindows/CVI design environment from National Instruments is provided. Typical applications include DUT control in special test modes, special adjustment routines and the integration of additional system components.

ETSI MEMBER
...making the right connections.

Certified Environmental System
ISO 14001
REG. NO 1954

Certified Quality System
ISO 9001
DQS REG. NO 1954

BLUETOOTH is a trademark owned by Bluetooth SIG, Inc., USA, and licensed to Rohde & Schwarz.

From the standard system to the turnkey solution

Our regional support and system integration centers will be glad to assist you in selecting and configuring a system that best suits your application and also integrate the system into your production line. Rohde & Schwarz offers you a complete spectrum of solutions and services for mobile phone production testing, thus minimizing time-to-volume and test costs while providing comprehensive test coverage.

Test programs and fixtures

For mobile phone testing, Rohde & Schwarz also develops test programs and custom test and adjustment functions and supplies test fixtures. Depending on requirements, the fixtures incorporate built-in shielding for acoustic and RF measurements and a mechanical actuator for the keypad test. For RF tests, the fixtures are equipped with special antennas and an RF connection to the test system.

Because of our many years of experience in mobile phone production testing – including with a variety of reference designs from chip set manufacturers – Rohde & Schwarz can offer optimized solutions that cover the entire spectrum from adjustment up to final testing.

Fixture features
◆ RF and acoustic shielding
◆ Exchangeable DUT mount
◆ Simple DUT interfacing
◆ USB control, i.e. no extra interface cards needed in PC (only for Windows 2000)
◆ Fixture interface for R&S TS7180 and R&S TS7100
◆ Status display for operating personnel
◆ Suitable for any RF tests on DUTs
◆ Spring contacts
◆ Pneumatic control for closing the cover
◆ Built-in RF antenna
◆ Built-in artificial ear and mouth
◆ Pneumatic key actuation
◆ Unused feedthroughs for additional signals

To keep production running

Our regional system support and integration centers also provide system maintenance, repair and calibration as well as training of operating personnel. Maintenance contracts can be tailored to your specific requirements. Our experts assist you in optimizing new processes and also follow you when your production is relocated.

A competent and reliable partner

Rohde & Schwarz has a wealth of experience in project management and the implementation of turnkey T&M systems for applications in telecommunications. In addition to measuring instruments and systems for mobile radio, we offer solutions for *Bluetooth* and other wireless communication standards. Rohde & Schwarz is one of the world's leading T&M companies with more than 5000 employees worldwide and is represented in over 70 countries.
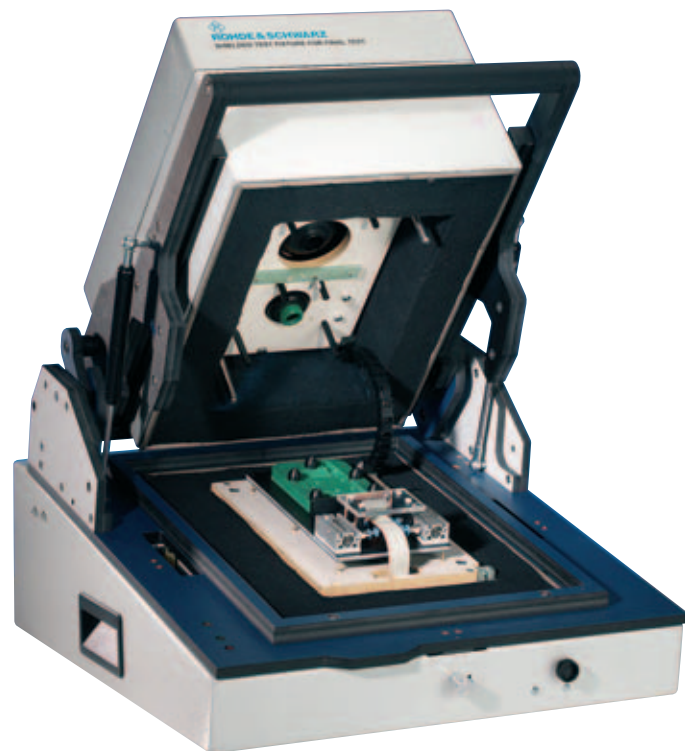
Shielded fixture with DUT mount

Our regional integration centers

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Service level

- ■ Backup service
- ● Area support center
  Local support center
- ● Calibration and maintenance with standardized automatic calibration system (ACS 100 Series)
- ● Calibration and maintenance
- ● Maintenance

➡ **System support center**
Munich, Beaverton, Dallas, Singapore

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