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Competence in Test and Measurement, Radiocommunications and Broadcasting

From our principles

We are an independent manufacturer of electronic equipment and systems. Our name is synonymous with innovation, precision and quality. A leading position on the European market and worldwide presence are the solid basis to our success.

Who we are and what we do

Rohde&Schwarz is an internationally active company in the fields of and test and measurement, information technology and radiocommunications. For nearly 70 years the company group has been developing, producing and marketing a wide range of electronic products for the capital goods sector. The company is headquartered in Munich. With 5900 employees worldwide and subsidiaries and representatives in over 70 countries around the world, the Rohde&Schwarz group achieves an annual turnover in excess of 829 million Euro.

The company is highly export-oriented: More than 70% of the total turnover is achieved outside Germany. Due to the comprehensive know-how and the innovative strength of its employees, Rohde&Schwarz is among the technological leaders in all of its business fields.

Today the Rohde&Schwarz group of companies is active in the following fields:

- Test and measurement
- Radiocommunications systems
- Mobile radio
- Broadcasting
- Radiomonitoring and radiolocation
- Information and communication security
- Services

The quality and environmental management system of Rohde&Schwarz has been certified to DIN EN ISO 9001 and 14001 and complies with the standards of AQAP 110 and 150. The company has approval for the development, production, installation and servicing of avionic communication equipment and is the first German transmitter manufacturer authorized to carry out BZT (Federal Approvals Office for Telecommunications) approval testing for radio transmitter systems.

Our business fields and products

Test and Measurement

Rohde&Schwarz is the largest manufacturer of electronic test and measurement equipment in Europe. Our T&M instruments and systems are setting standards worldwide in research, development, production and service. We are the key partner for the industry and network operators as far as all measurement tasks in the field of analog and digital communications.

Mobile radio measurements

- Complete range of measuring instruments, test sets and systems for mobile and base stations of analog and digital mobile communication networks
- Radiocommunication testers for use in service, production and development
- Go/NoGo testers
- Signal generators and analyzers as well as power meters
- Protocol testers
- Coverage and interference measurement systems
- Type-approval test systems

EMC measurements

- Complete EMC test centers
- Turnkey systems for measurement of electromagnetic interference (EMI) and electromagnetic susceptibility (EMS)
- Test receivers and EMI spectrum analyzers for compliance and precompliance measurements
- Full range of accessories:
  - Artificial mains networks
  - Antennas and masts
  - Field probes
  - Transducers
- Software

General-purpose and RF measurements

- RF and microwave signal generators
- ARB generators
- Spectrum and network analyzers
- Audio and modulation analyzers
- Voltmeters and power meters
- Field-strength test receivers
- Process controllers
- Power supply units

Automatic test systems

- Type-approval and certification test systems
- Production test systems for communication terminal equipment
- Coverage measurement systems for all modern radio networks
- EMC test systems and test centers

Competence in Test and Measurement, Radiocommunications and Broadcasting

- Board test systems (in-circuit and functional testers)
- Monitoring, coverage and transmitter test systems for both analog and digital sound and TV broadcasting

Radiocommunications Systems

Rohde&Schwarz is one of the leading international suppliers of professional HF, VHF and UHF radio systems for use in stationary and mobile ground stations, on ships and in airplanes. Embassies, governmental authorities and armed forces worldwide use our radio equipment for voice, data and image transmission. We support our customers by providing product-related consulting, logistics concepts and services.

With the new digital software radio generation for tactical, mobile, stationary, as well as shipborne use, we have created a means of communication that ensures interoperability within national task forces and with allied nations in UN and NATO missions.

ATC systems
- VHF and UHF radio systems for ground-air communications
- Radio direction finding systems
- Remote monitoring and control of ATC systems
- Mobile ATC towers

Air defence systems
- VHF/UHF radio systems for voice and data transmission
- Integrated methods for secure and protected transmission
- Network management including frequency and key management

Avionics
- HF, VHF, UHF airborne transceivers for secure and protected voice and data transmission

Naval communication systems
- Systems for internal and external communications
- Integrated control and message handling systems
- HF broadband systems

Army communication systems
- Tactical multiband radio equipment
- HF transmitting /receiving systems or stationary and mobile use
- Network integration and radio link to internet

Mobile radio

Rohde &Schwarz ranks among the leading suppliers of MPT-1327 and TETRA mobile radio systems for the professional user. Worldwide installations at Ministries of the Interior, commuter traffic enterprises, at railway stations and airports as well as or public network operators speak or the effectiveness of our solutions.

Trunked radio systems
- Network engineering
- Switching systems
- Base stations
- Network management and applications
- Turnkey systems

Broadcasting

For 50 years sound and TV broadcasting has been one of the key activities of Rohde&Schwarz. We are the only supplier of a complete range of transmission, monitoring and measurement equipment in the world. We are international leaders as regards equipment and T&M systems and instruments for the new digital transmission methods DAB, DVB and MPEG2.

Sound and TV broadcast transmitters
- VHF FM sound broadcast transmitter systems from 20 W to 20 kW
- Analog TV transmitter systems from 20 W to 40 kW
- Digital audio broadcast (DAB) systems from 50 W to 1 kW
- Digital video broadcast (DVB-T, ATSC) systems from 10 W to 15 kW

Measurement and monitoring systems
- Monitoring systems for terrestrial transmitter stations
- Measurement systems for development, production and maintenance of transmitters

Video and broadcast measurements
- Generators and analyzers for MPEG2, DVB and ATSC transport streams, for use in development, production and monitoring
- Generator, Recorder and Analyzer for MPEG2/ATM
- Picture quality analyzers
- Analog baseband generators and analyzers
- Signal generators and test receivers, modulators and demodulators for analog sound and TV broadcasting standards as well as for DVB-C/S, DVB/T and DTV-ATSC

Competence in Test and Measurement, Radiocommunications and Broadcasting

- TV network analyzers
- Studio measurement equipment

Datacasting
- Inserter for inserting additional data in Internet format for DVB and DAB
- Software for cyclical provision of contents and for transmission of Internet-based TV and radio programs
- Software for data service management
- Software for data processing at the receiver end

Radiomonitoring and Radiolocation

Rohde&Schwarz is worldwide a leading manufacturer of equipment and systems for detection, location and analysis of radiocommunication signals in the following fields of application:

- Internal and external security
- National and international radiomonitoring by postal authorities
- Frequency management

We are leading in the design and implementation of full-coverage automatic radiomonitoring and frequency management systems. Many years of experience and ultramodern technology are the sound basis of our receivers, direction finders, signal analyzers and antennas:

Receivers
- Fast search receivers
- Stationary and portable monitoring receivers
- Computer-controlled receiving systems

Direction finders
- Extremely fast, broadband, digital radiomonitoring direction finders for stationary and mobile/portable use
- Automatic radiolocation networks using direction finders

Signal analyzers
- Versatile signal analyzers for flexible use
- Automatic signal classifiers
- Signal decoders, demodulators

Antennas
- Receiving and transmitting antennas
- Test antennas
- Complex antenna systems

Information security

Rohde &Schwarz SIT GmbH provides solutions for secure and reliable utilization of information and communication technology. Key activities are in the development of crypto products and systems for the protection of information in modern data processing and communication systems as well as consulting and information security analyses or industry and government authorities.

- Hardware and software crypto products
- Customized crypto systems
- Consulting and IT security analyses

Services

With its Central Service in Munich and its Cologne Plant, Rohde&Schwarz maintains two of Europe's largest service centers for T&M and communications equipment. We offer our customers a powerful global service network comprising more than 50 service centers worldwide.

- Calibration, maintenance and repair
- Customized service contracts
- Planning, development, system integration
- Development of customer-specific systems
- Technical documentation and logistics
- Electronic information systems, multimedia applications

Our training centers in Cologne and Munich offer a comprehensive choice of courses on T&M and communications topics, which on request can also be held at the customer's.

Technical Milestones

1938	World's first portable crystal clock
1948	Europe's first VHF sound broadcast transmitter
1964	Europe's first air-traffic-noise monitoring system
1967	Europe's first automatic IC test system
1974	First microprocessor-controlled radio measurement system
1975	World's first quality monitoring system for TV signals
1980	Europe's first stereo/dual-sound TV transmission system
1984	First processor for automatic setup of shortwave links
1986	Introduction of radio data system RDS for sound broadcasting in Germany
1990	First compact test set for GSM transmitters and receivers
1992	Exclusive supplier of reference test equipment for type-approval testing of GSM mobile phones
1992	World's fastest digital radiomonitoring system

Competence in Test and Measurement, Radiocommunications and Broadcasting

1995 Technical equipment for world's largest pilot project for digital audio broadcasting (DAB)

1996 First integrated HF voice/data radio for use in commercial aircraft for fully automatic worldwide transmission of flight data

1997 Order for nationwide DVB-T transmitter network in Great Britain (largest DVB project worldwide)

1999 World's first operational universal software radios for use on military platforms

2001 World´s first tap-proof GSM mobile phone

Plants

Munich
Company headquarters in Munich house the R&D departments, systems engineering and assembly, training and service center, central divisions and administration.

Memmingen
The plant in Memmingen is responsible for the final production and delivery of all Rohde& Schwarz equipment.

Teisnach
The Rohde&Schwarz plant in northern Bavaria produces the mechanical and electrical parts for the equipment production in Memmingen.

Cologne
Rohde&Schwarz Cologne Plant is one of Europe's largest service centers for electronic T&M and communications equipment. Services include maintenance

and repair, training, technical documentation and logistics (also in conjunction with multimedia applications), system integration and adaption as well as services for information and communications technology projects. The Cologne Plant is an accredited calibration laboratory of the German Calibration Service.

Subsidiaries

ROHDE&SCHWARZ Vertriebs-GmbH (RSV)
Founded in Berlin in 1946 and relocated to Munich in 1961, RSV is responsible for domestic sales of Rohde&Schwarz products as well as products of other make marketed on behalf of RSE. RSV has a marketing network throughout Germany.

ROHDE&SCHWARZ International GmbH (RUSIS)
Since the end of 1993, RUSIS has been responsible for sales of Rohde&Schwarz products outside Europe. The company coordinates agencies, representatives and other business partners in the Asia-Pacific region, Middle East, Africa, North and Latin America.

ROHDE&SCHWARZ Engineering and Sales GmbH (RSE)
Founded as a subsidiary in 1972 and headquartered in Munich, RSE is primarily involved in marketing complementary products from other manufacturers. The objective of RSE is a vertical completion of the Rohde&Schwarz product line in close cooperation with headquarters and the representatives abroad. The companies represented by RSE include renowned manufacturers such as the Rohde&Schwarz cooperation partner Advantest from Japan.

Competence in Test and Measurement, Radiocommunications and Broadcasting

ROHDE&SCHWARZ
BICK Mobilfunk GmbH
R&S BICK Mobilfunk GmbH with headquarters in Bad Münder specializes in the development and implementation of professional mobile radio systems.In particular, the company supplies TETRA and MPT-1327 mobile radio networks and applications.

ROHDE&SCHWARZ FTK GmbH
ROHDE &SCHWARZ FTK GmbH with headquarters in Berlin develops and supplies products and systems in the field of analog and digital audio broadcasting as well as solutions or the transmission of ancillary data via digital broadcast channels (datacasting). The variety of services offered also includes development services for radiocommunication and broadcasting equipment.

ROHDE&SCHWARZ SIT GmbH
ROHDE&SCHWARZ SIT GmbH provides solutions for security in information technologies. Key activities are in the development of crypto products and systems or the protection of information in modern data processing and communication systems as well as consulting and IT security analyses or industry and government authorities.

Our Partners

To secure a complete market presence in the technological key regions North America and Japan, we are cooperating with successful local partners who guarantee customer-oriented consultation and competent servicing - Tektronix in North America and Advantest in Japan.

Tektronix
The company was founded in 1946 and with its headquarters in Beaverton/Oregon is now fully devoted to test and measurement products after selling its line of printers and video/network equipment in 1999. In the fiscal year 2001, Tektronix achieved a turnover of 1235 million US$. In North America, the Tektronix product range is enhanced by almost the full range of T&M products from Rohde&Schwarz. The two companies also cooperate in the development of test and measurement instruments for special applications.

Advantest
Advantest, a Tokyo-based company founded in 1954, is the world's leading supplier of semiconductor test systems. The second most important business field is test and measurement equipment. In the fiscal year 2000, Advantest had a total turnover of 262 billion Yen. Advantest and Rohde& Schwarz have concluded a mutual sales agreement for T&M products: Advantest sells Rohde&Schwarz equipment in Japan and Rohde&Schwarz markets Advantest test and measurement instruments in Europe, the Middle East, in Brazil, Australia, South Africa and other countries. The two companies also cooperate in the development of T&M equipment for the Japanese market.

THE tester for current and future Mobile Radio Networks with scalable multimode functionality (photo 43 238-11)

Contents of Chapter 1

Universal Radio Communication Tester R&S CMU200

THE tester for current and future Mobile Radio Networks with scalable multimode functionality

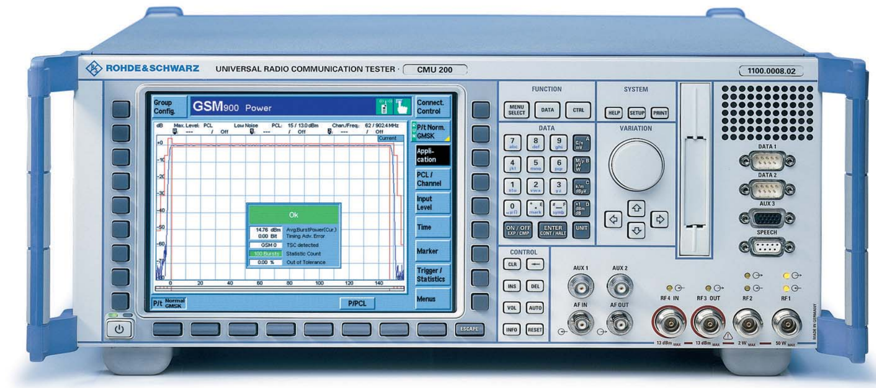

Photo 43238

Brief description

Radio Communication Tester R&S CMU200 brings premium cost effectiveness with a set of features where extremely fast measurement speed plus very high accuracy are the two most important ones. Complementing these, the secondary remote addressing of the unit's modular architecture makes for intelligent and autonomous processing of complete measurement tasks and fast control program design.

Whether the application is in production, service or development, it calls for different tests and measurements to be performed, and the flexible concept of the R&S CMU200 provides the user with a tailored solution. R&S CMU200 functionality extends from basic RF signal generation, frequency, power and spectrum analyzer measurements for alignment of modules in production or development applications, to an instrument simulating a base station for testing that requires the support of standard-specific signalling in either of the above-mentioned bands, as well as module tests on frequencies anywhere in the range of 10 MHz to 2.7 GHz.

The flat menu structure enables fast and efficient entry in dedicated measurement menus directly after a call setup, as well as an easy and quick change between the different measurement menus, in signalling and non-signalling mode alike.

Applications

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

Main features

- Multi-protocol support
- Extremely high speed testing
- Highly accurate measurements
- Modular future-proof design
- Comprehensive spectrum analyzer
- Testing of 1st, 2nd and 3rd generation mobile radio possible in a single unit
- Standard-specific software packages available for tests in accordance with present and future standards
- Platform with multimode modular design
- Network-independent non-signalling test for the development of new or existing standards
- Flexible input/output structure
- Wide frequency range from 10 MHz to 2.7 GHz suitable for all mobile radio standards
- Simultaneous RX/TX measurements
- Time domain analyzer built in
- Simple operation either manual or via IEC/IEEE bus
- Benchmark-breaking IEC/IEEE bus speed due to parallel measurements, secondary addressing, optimized processing power
- Bright high-resolution TFT colour display
- Unrivalled repeatability
- Realtime automatic temperature correction for best accuracy
- Low power consumption
- Low heat dissipation
- Optimized cooling concept for higher reliability and decreased production down time
- Worldwide service network
- Standardized calibration system for the instrument
- Easy 19" rackmounting, compact box of only 4 rack units height

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Universal Radio Communication Tester R&S CMU200

GSM/GPRS measurements

GSM development

As an all-round tool for GSM development engineers, the R&S CMU 200 is an unsurpassed solution. The RF interface provides four input and output connectors offering a wide range of signal levels for generation and analysis of RF signals.

Production of mobile phones

The R&S CMU200 concept is optimized for IEC/IEEE-bus speed, measurement accuracy and reproducibility as well as cost of ownership. Thanks to the multitasking feature and parallel measurements, previously unobtainable test times can be achieved.

Signalling mode

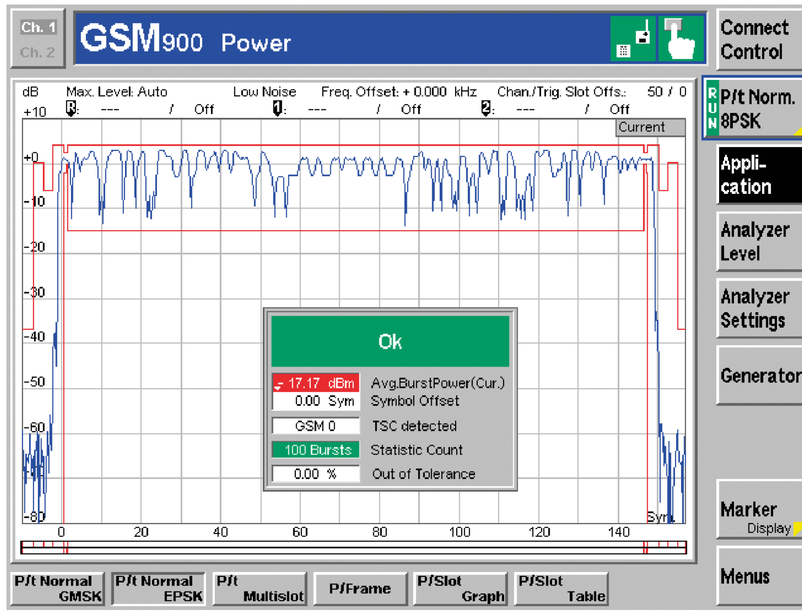
The R&S CMU200 simulates a GSM/GPRS base station RF interface providing the signalling flexibility necessary to test the behaviour of the mobile under the influence of different signalling parameters.

GSM evolution – 2.5G

The amount of data traffic in GSM networks is growing rapidly. Multislot applications such as HSCSD or GPRS together with the innovative 8PSK modulation scheme EDGE are needed to cater for the increase in data traffic.

Multislot

In the future, mobile phones will be able to use several timeslots simultaneously for data transmission and reception to further increase the data rate. The simultaneous transmission and reception of several timeslots (multislot) is the technological challenge for circuit-switched and packet-switched applications. Multislot measurements are required for HSCSD and ECSD technologies as well as for GPRS and EGPRS.



In the GSM non signalling function groups the possibility to switch between GMSK and 8PSK (EDGE) is already implemented. Thus EDGE bursts as shown here can easily be analyzed

8PSK modulation – EDGE

The CMU200 can already perform 8PSK on GSM bursts. Error vector magnitude and magnitude error have been added to the range of modulation measurements. 8PSK will transform HSCSD technologies into ECSD and GPRS into EGPRS.

GPRS/EGPRS

GPRS uses a combination of several timeslots (multislots) and higher-level modulation in the form of 8PSK (EGPRS) to push up the data rate.

- ETSI Test Mode A: The mobile is induced to continuously transmit the associated UL timeslots. The R&S CMU can carry out all TX measurements available, i. e. power ramp measurement of up to four adjacent timeslots simultaneously, or modulation and spectrum measurements
- ETSI Test Mode B: Creates a loopback in the mobile and enables bit and block error rate measurements (BER/DBLER).

GSM/GPRS highlights

Benchmark-breaking IEEE-bus speed

- Parallel measurements
- Secondary addressing
- Optimized processing power

High flexibility for R&D

- Assignment on up to 8 DL slots
- TX/RX on any transmit slot
- Individual level generation on any DL slot used

GMSK/8PSK measurements

- Phase/frequency error, EVM, magnitude error, origin offset, I/Q imbalance for I/Q modulator tuning
- Power versus time on up to 4 UL slots
- Peak power/average, power versus frame, power versus slot
- General spectrum measurements
- Timing error
- BER/DBLER, RBER/FER, FastBER
- Power versus PCL (on 3 or 7 channels)

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Universal Radio Communication Tester R&S CMU 200

TDMA (IS-136) measurements

The wide acceptance of TDMA (IS-136) is based on a very flexible and powerful technology as well as on its compatibility with AMPS, which is widespread and one of the major wireless communication standards. Derived from analog AMPS, the TDMA standard is now ready for a step-by-step evolution into the third generation of mobile technology. For TDMA (IS-136) signalling functionality, the R&S CMU200 requires the versatile signalling unit (R&S CMU-B21) as well as the software option R&S CMU-K27 for the cellular band or R&S CMU-K28 for the PCS band.

Signalling mode

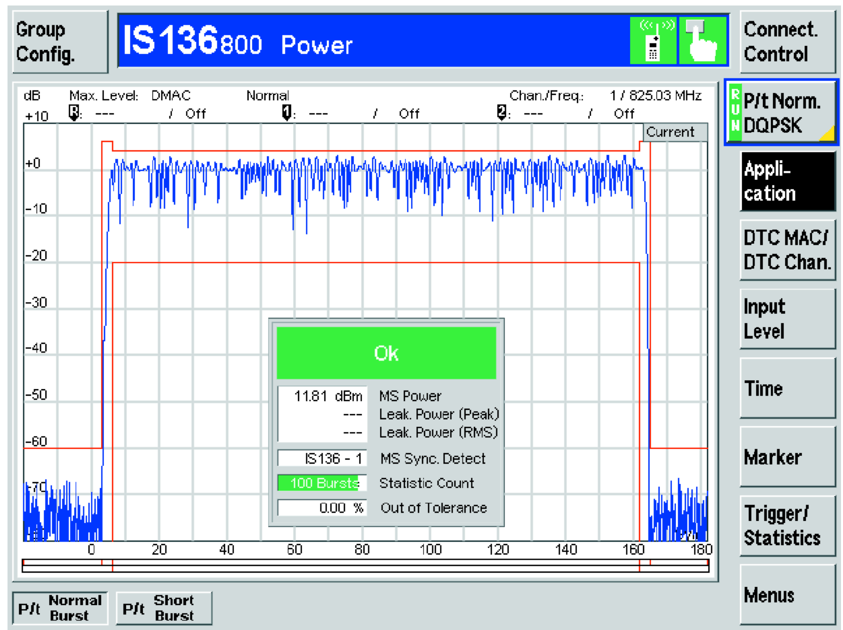
The R&S CMU 200 simulates a TDMA basestation RF interface including the signalling protocol so that a mobile can be tested with regard to different signalling parameters. All necessary network and base-station parameters can be set, such as control and traffic channel configuration, neighbouring channels setup etc. A MAHO report can also be generated.

Non-signalling mode

The non-signalling mode is for generating and analyzing TDMA (IS-136) signals within the frequency range from 10 MHz to 2.7 GHz.

Handoffs

Handoffs are part of the IS-136 specification. Handoffs between PCS and cellular bands as well as from and to AMPS are defined and have to be tested. R&S CMU 200 supports handoffs from IS-136 800 MHz to 1900 MHz (inter-band handoff) and vice versa. Handoffs from 1900 MHz or 800 MHz to AMPS and back are also possible (inter-mode handoff) with R&S CMU 200.



In the power menu, the mobile output power of the short burst or the normal burst is displayed. R&S CMU also enables leakage power measurements which inform on the mobile power output in unused time slots

Switching standards

The flexibility of R&S CMU 200 makes for quick and simple switching between two different standards. This is very important for IS-136, which is a dual-mode standard containing a digital (TDMA) and an analog mode (AMPS). The handoff between TDMA and AMPS can be achieved by simply pressing a button. This results in a very versatile test concept to improve the flexibility and throughput of your production line.

Acoustic measurements

Equivalent to the GSM implementation of the R&S CMU 200 the TDMA speech coder provides analog inputs and outputs and a connector for an external handset.

Basic features

- Call to/from mobile
- Handoff to AMPS
- Dual-band handoff

Signalling measurements

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

Non-signalling measurements

- Modulation
- Spectrum
- Power versus time
- BER

Universal Radio Communication Tester R&S CMU200

AMPS measurements

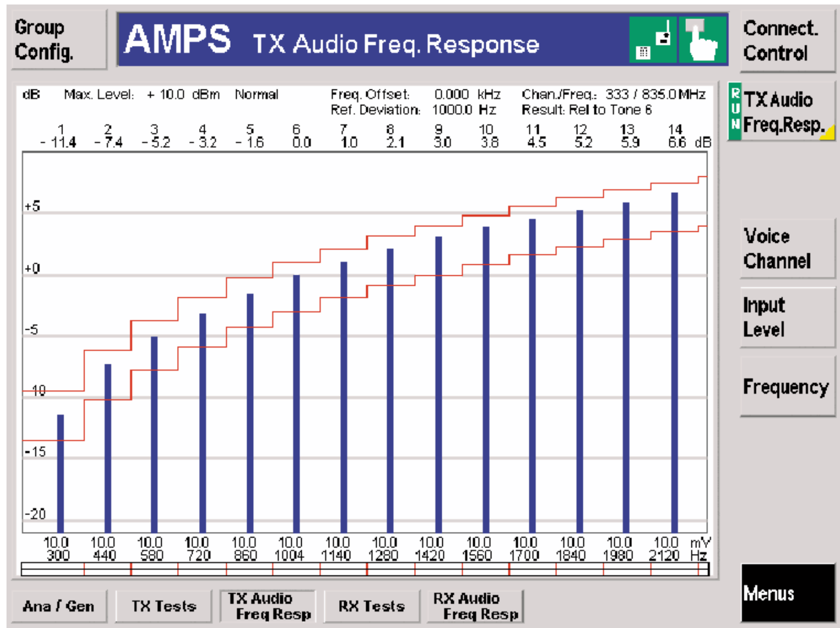
Although AMPS is a 1st generation analog standard, a great demand for mobile radio testers covering this standard will continue to exist in the future. Especially in the United States, dual-mode CDMA/AMPS and TDMA/AMPS phones are very common. By combining the digital standards with analog AMPS, the network operators offer their customers the advantages of the digital standards and ensure nearly 100% coverage in North America. As a consequence, Rohde&Schwarz is extending the range of R&S CMU200 options by introducing analog AMPS in addition to the digital standards TDMA and CDMA. These options add analog AMPS functionality to the R&S CMU200 base unit:

- R&S CMU-B21 (versatile link handler)
- R&S CMU-B41 (audio generator/analyzer)
- R&S CMU-K29 (AMPS test software)

The hardware options R&S CMU-B21 (versatile link handler) and R&S CMU-B41 (audio generator/analyzer) are suited for other standards as well. As for other standards, there are two categories of AMPS measurements:

- Transmitter tests for assessing the transmit part of a mobile
- Receiver tests for assessing the receive part of a mobile
- AF Level Search routine
- Sensitivity Search routine

The AF Level Search routine in the TX test menu allows the user to set the desired frequency deviation of the mobile transmitter at a keystroke, the level of the R&S CMU200 modulation generator is automatically corrected.



TX audio frequency response measurement. The pre-emphasis characteristic of the mobile transmitter is verified by a single-shot measurement

The Sensitivity Search routine in the RX test menu automatically searches the receiver input level at which a selectable SINAD of the demodulated signal can still be attained. The following list provides an overview of the most important tests implemented in option R&S CMU-K29.

Transmitter measurements

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

Receiver measurements

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

Audio frequency response measurements

All the filters required for the measurements are of course preconfigured in line with specifications, but their settings can be modified for individual measurements. The RX and TX electrical audio frequency response measurements in AMPS are usually defined as frequency sweep versus AF frequency range. The R&S CMU 200 offers a much faster and more modern alternative. Using the TX and RX audio frequency response menus of R&S CMU200, the AF frequency response is measured simultaneously at 20 test points with user-programmable level and frequency and then checked against specified tolerances (see screenshot above).

Universal Radio Communication Tester R&S CMU200

cdmaOne measurements

All supported CDMA standards

- US Cellular (800 MHz)
  - TIA/EIA-IS-95
- Japan Cellular
  - ARIB-T53/IS-95
- China Cellular
  - TIA/EIA-IS-95
- US PCS (1900 MHz)
  - ANSI-J-STD008, UB-IS-95
- Korea PCS (1800 MHz)
  - J-STD008, UB-IS-95

Instead of using frequencies or timeslots as traditional technologies like TDMA and AMPS do, cdmaOne uses mathematical codes to transmit and distinguish between multiple wireless conversations. Depending on the level of mobility, cdmaOne provides 8 to 10 times the capacity of AMPS and 4 to 5 times the capacity of TDMA systems. cdmaOne can efficiently utilize the spectrum and serve many subscribers without requiring extensive frequency planning.

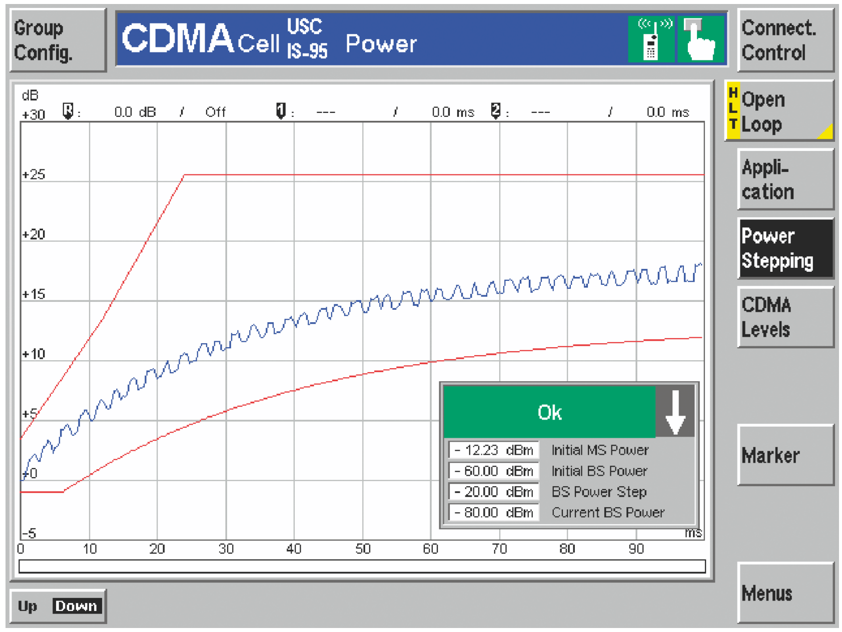
cdmaOne options

The following options make the R&S CMU200 a compact radio communication tester for all TIA/EIA-95-based cdmaOne mobile phones:

- R&S CMU-B81 (cdmaOne link handler)
- R&S CMU-K81 (cdmaOne, cellular)
- R&S CMU-K82 (cdmaOne, PCS)

cdmaOne functionality

The tester emulates a code division multiple access base station, makes a call to the mobile, and tests all essential parameters of a cdmaOne mobile station. The tester can measure the following key parameters among other tests:



Open-loop time response: The open-loop power control test shows the response of the mobile station to an increase or decrease in base-station total power. The default increase or decrease for this test is 20 dB. Power stepping and CDMA levels are user-definable

- Power control measurements:
  - Open-loop time response
  - Gated output power
  - Min/max output power
- Receiver quality measurements:
  - Frame error rate (FER)
  - With additional AWGN generator to simulate noise caused by other CDMA calls at the same frequency
  - Predefined configurations for sensitivity and dynamic range
- Transmitter quality measurements:
  - Waveform quality
  - Error vector magnitude
  - Phase error
  - Magnitude error
  - Carrier feedthrough and I/Q imbalance
  - Frequency accuracy
- Non-signalling measurements:
  - Power, waveform quality
  - Frequency error
  - Carrier feedthrough
  - I/Q imbalance

cdmaOne related features

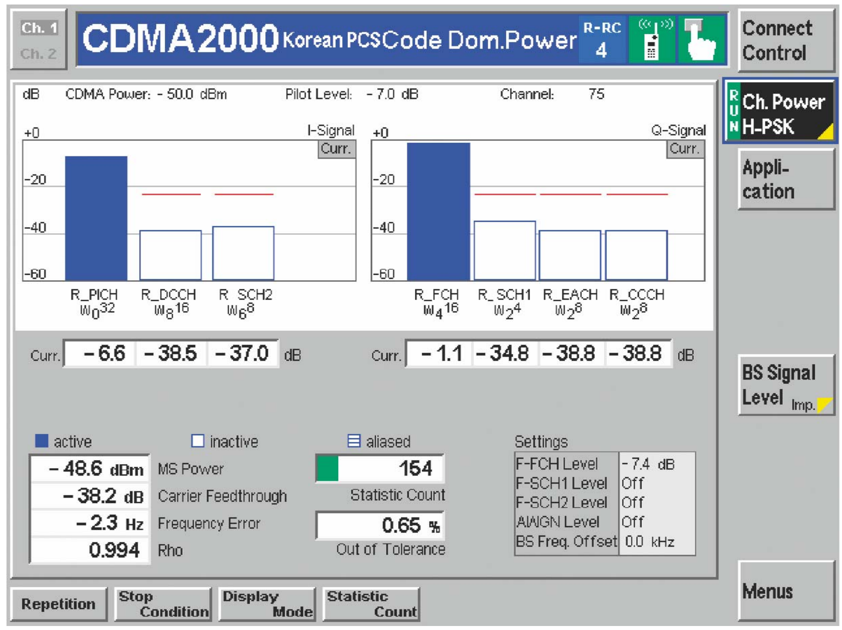
- Voice loopback and comprehensive testing of mobiles
- Powerful signalling capabilities
- Built-in AWGN generator for simulating noise generated by other CDMA calls
- Base station simulation
- Mobile or base station originated call connect/disconnect
- Short measurement time ensuring high throughput
- Combined measurements (RX/TX in parallel)
- Benchmark-breaking IEC/IEEE bus speed (see GSM highlights)
- No specialized network knowledge required
- Various handoffs supported (e.g. CDMA to analog AMPS)
- Dual-band/dual-mode testing
- Support of GPSOne test application

Universal Radio Communication Tester R&S CMU200

cdma2000-1X measurements

The similarities with cdmaOne (same physical conditions and downward compatibility) make the cdma2000-1X T&M concept very similar to that of cdmaOne. There are, however, major differences in the protocols. The R&S CMU200 supports connections in all radio configurations defined for cdma2000-1X, i.e. TIA/EIA-95 connections as well as the usual cdma2000-1X high-speed connections.

Code domain power is a new and highly important measurement for mobile phones in cdma2000. Since several code channels are now transmitted simultaneously in the reverse link, it is necessary to check whether the power distribution of the different channels complies with the test specification (TIA/EIA-IS-98-D) for cdma2000. The measurement concept in the R&S CMU200 is based on ProbeDSP^{TM} technology, which permits high-speed measurement of the code domain power. The emphasis is on fast measurements and clear and concise representation. Of course, the R&S CMU200 also supports the requirements placed on the gpsOne test application; the R&S CMU200 meets the high demands for frequency and phase accuracy. The cdma2000-1X implementation in the R&S CMU200 is based on the TIA/EIA IS-2000 Rev. 0 standard; the measurements comply with the TIA/EIA IS-98-D standard.



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

Signalling mode

- Power measurements
  - Minimum/maximum output power
  - Gated output power
- Receiver quality measurements
  - Frame error rate (FER)
  - Dynamic range, sensitivity and other user-selectable test environments

- Modulation (both RC1/2 and RC3/4)
  - Error vector magnitude (EVM), magnitude error, phase error, waveform quality, carrier feedthrough, frequency error
- Code domain power
  - Code domain power
  - Peak code domain error power, channel power
- Handoffs
  - Implicit handoffs (RF channel, Walsh code, PN offset, frame offset)
  - Interband handoff
  - Handoff to AMPS
- Sideband suppression

Non-signalling mode

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

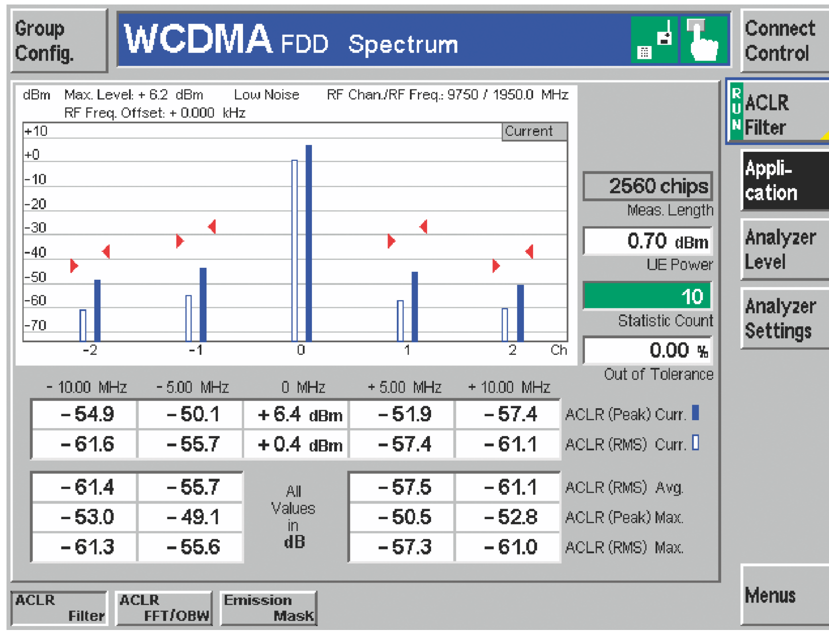
cdma2000 Highlights

- Voice loopback and comprehensive testing of mobiles
- Full support of RC1/RC2 (cdmaOne measurements)
- Support of all band classes specified in IS-2000
- Innovative measurement of code domain power, code domain peak error power, channel power
- Parallel RX/TX measurements ensure high throughput in production environments
- Graphical representation of measurement results best suited for R&D labs
- Readout and display of many mobile specific parameters (ESN, slot cycle index, etc.)
- Extremely fast measurements
- Non-signalling and signalling mode
- Various handoffs supported (e.g. handoff to AMPS, interband handoff)
- Full cdmaOne functionality included

Universal Radio Communication Tester R&S CMU200

WCDMA measurements

The tests are based on the 3GPP/FDD, release 99 WCDMA radio link standards, version June 2001. The R&S CMU200 can easily be upgraded to different functionality steps by means of hardware and software options for non-signalling TX/RX measurements and signalling measurements. All measurements comply with the 3GPP specification TS 34.121. This is especially interesting due to the variety of different filter bandwidths and shapes for ACLR, SEM, MIN power, MAX power, etc that are to be used according to the specification.



ACLR measurements are available using two different measurement methods and displays. In this screenshot, the ACLR is measured using the filter method to obtain results for 5 channels. The scalar display excluding the center channel (0 MHz) may be switched to absolute readout as well.

Non-signalling mode

The non-signalling mode is for generating and analyzing WCDMA (3GPP/FDD) signals. The R&S CMU200 provides WCDMA-specific TX measurements on signals with up to 6 DPDCHs such as

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

RX measurements

A synchronization (but still no call setup) is needed for RX evaluation, synchronized TX measurements and some additional TX measurements, such as

- Inner loop power control with TPC commands: TPC stepping measurement (UE receives TPC commands from R&S CMU200 generator)
- Receiver quality: BER, BLER, (with UE-assisted evaluation, no RF loopback)

The generated channels and functions available are

- P-CPICH/P-SCH/S-SCH/P-CCPCH/DPCCH/DPDCH
- TPC profiles

In conjunction with the Rohde&Schwarz Baseband Fading Simulator ABFS and the planned option R&S CMU-B17, conditions of fading may be simulated and evaluated with the R&S CMU200.

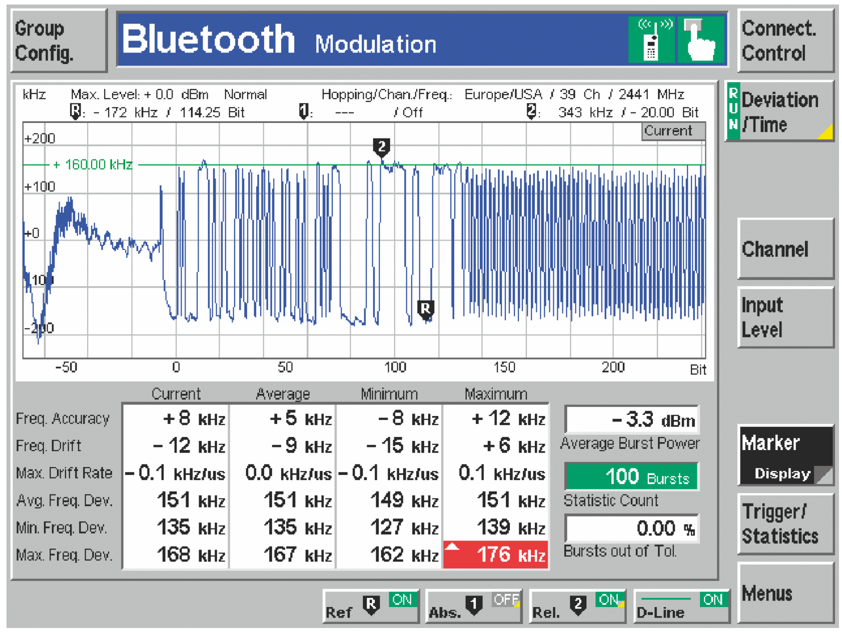
WCDMA highlights

- Shortest measurement time ensuring high throughput
- Combined measurements, many different measurement modes
- Multiband/multimode testing
- Powerful signalling capabilities as part of a clear upgrade path
- Mobile- or base-station originated call connect/disconnect available as a next functionality step
- Simple interactive operation, standardized MMI
- No specialized network knowledge required

Universal Radio Communication Tester R&S CMU200

Bluetooth measurements

The R&S CMU200 is compliant with the *Bluetooth* core specification Ver. 1.0 B and 1.1. The *Bluetooth* Test Mode (Core Spec. Part I:1) is implemented with all commands needed to perform the TX/RX measurements. All measurements can be performed in hopping, reduced hopping or non-hopping mode. The R&S CMU200 supports measurements using DH1, DH3 and DH5 packets.



The graphical display of the modulation results may be spread between 1/1 and 1/16 of a burst for in-depth analysis. The “Max. Freq. Dev.” and “Min Freq. Dev.” results allow the highest and lowest values for 10 bit long fractions of a payload to be evaluated individually

Signalling

The R&S CMU200 acts as the master of a *Bluetooth* piconet, the DUT as a slave. The CMU200 is able to perform the inquiry procedure for the identification of all *Bluetooth* devices within range of the CMU200. All devices found are listed on the display and one of them can be selected for the paging procedure. To increase the speed in production the inquiry procedure can be skipped, if the *Bluetooth* device address of the DUT is already known.

TX measurements

The current measurement values for each parameter are displayed on the R&S CMU200 screen. Additionally average, maximum and minimum values are displayed as a result of a statistical evaluation of a settable number of *Bluetooth* packets (bursts).

- Power measurements
  - Nominal power (measured as the part of the burst starting at the detected 1st bit of the preamble (bit 0) to the last bit of the burst)
  - Leakage power (measured within defined areas before and after the burst)
  - Peak power (shows the highest power level within a burst)
- Timing measurements
  - Packet alignment (distance between ideal master receiver slot and detected bit 0 of the received burst)
- Modulation measurements
  - Frequency accuracy (difference between measured frequency and intended transmitted frequency, measured in the preamble at the beginning of a packet)
  - Frequency drift (difference between the frequency at the start of the packet and the frequency in the payload)
  - Maximum drift rate (maximum drift rate anywhere within the packet payload)
  - Average, maximum and minimum frequency deviation (calculated over the packet payload)

RX measurements

For RX measurements, the built-in signal generator generates a selectable bit sequence, which is looped back in the DUT and demodulated and processed by the R&S CMU200 again. The TX level of the R&S CMU200 can be adjusted for this measurement. The BER application supports defining up to five test programs. Each program can independently set settings such as control parameters, limits, repetition or statistical cycles.

- Sensitivity
  - BER (percentage of bit errors that have occurred within the current statistical cycle)
  - PER (percentage of packet errors that have occurred within the current statistical cycle, where an errored packet is a packet with a header which cannot be corrected)

Universal Radio Communication Tester R&S CMU200

Options overview

The base unit without any options installed, may be used for testing general parameters of 1st, 2nd or 3rd generation mobile phones. The R&S CMU200 base unit is the ideal solution for trimming tasks at module level, i.e. in early production stages of all cellular standards. Constituent parts of the R&S CMU200 base unit are the RF generator (100 kHz to 2.7 GHz) and analyzer which are complemented by a versatile network-independent analyzer/generator menu and a comprehensive spectrum analyzer.

Key advantages for the customer

- Single measurement up to 10 times faster than the previous generation of instruments
- Three times more accurate than the previous generation of instruments with excellent repeatability
- Modular hardware and software concept provides easy extension to further functionality
- Low component count, low power consumption, and effective heat conduction result in unparalleled reliability
- Easy migration to future standards

Instruments, options and ordering information (continued on the next page)

Type/Option	Description	GSM/GPRS/	TDMA	AMPS	cdmaOne	cdma2000	WCDMA	*Bluetooth*	Order number
R&S CMU200	Base unit with following accessories: power cord, operating manual, service manual instrument	✓	✓	✓	✓	✓	✓	✓	1100.0008.02
R&S CMU-B11[1)]	Reference OCXO, aging 2 x 10^{-7}/year. Ensures high absolute accuracy, minimum temperature-dependent drift and especially high long-term stability. Used for measurements with exact frequency stability requirements	☺	☺	☺	☺	☺	☺	☺	1100.5000.02
R&S CMU-B12[1)]	High-stability OCXO, aging 3.5 x 10^{-8}/year. Oven crystal with highest long-term stability. Ensures compliance with tolerances specified by GSM. Used for highly demanding frequency stability requirements to GSM 11.20	☺	☺	☺	☺	☺	☺	☺	1100.5100.02
R&S CMU-B17	I/Q IF interface	☺	☺	–	–	☺	☺	–	1100.6906.02
R&S CMU-B21	Versatile signalling unit. Provides multistandard signalling hardware	✓	✓	✓	–	–	–	✓	1100.5200.02
R&S CMU-B41	Audio generator and analyzer. Includes audio frequency (AF) generator, voltmeter, distortion meter	☺	☺	✓	–	☺	–	–	1100.5300.02
R&S CMU-B52[2)]	Internal versatile multimode speech coder/decoder. This option converts digital speech signals into analog signals and vice versa. The option allows separate uplink and downlink audio application measurements on mobile phones.	☺	☺	–	–	–	–	–	1100.5400.02
R&S CMU-B53[2)13)]	*Bluetooth* extension	–	–	–	–	–	–	✓	1100.5700.02
R&S CMU-B66[13)]	Versatile baseband board	–	–	–	–	–	✓	–	1149.9509.02
R&S CMU-B81	cdmaOne signalling unit	–	–	–	✓	–	–	–	1100.6506.02
R&S CMU-B83	cdma2000 (1x) signalling unit	–	–	–	–	✓	–	–	1150.0301.02
R&S CMU-B99	RF1 level range identical to RF2	☺	☺	☺	☺	☺	☺	☺	1150.1250.02
R&S CMU-U53[2)6)]	*Bluetooth* upgrade kit	–	–	–	–	–	–	✓	1100.7302.02
R&S CMU-U61[14)]	Modification kit: floppy disk drive 3½" instead of PCMCIA	☺	☺	☺	☺	☺	☺	☺	1100.5500.02
R&S CMU-U65	3G measurement DSP	–	–	–	–	✓	✓	–	1100.7402.02
R&S CMU-U66[13)]	Upgrade kit Versatile baseband board	–	–	–	–	–	✓	–	1149.9609.02
R&S CMU-U83[13)]	Upgrade kit to R&S CMU-B83 in exchange for R&S CMU-B81	–	–	–	–	✓	–	–	1150.0401.02
R&S CMU-U99[12)]	Modification kit RF1 level range identical to RF2	☺	☺	☺	☺	☺	☺	☺	1150.1350.02
R&S CMU-K20[2)7)]	GSM400 mobile station signalling/non-signalling test	✓	–	–	–	–	–	–	1115.5900.02
R&S CMU-K21[2)7)]	GSM900, R-GSM and E-GSM mobile station signalling/non-signalling test	✓	–	–	–	–	–	–	1115.6007.02

Universal Radio Communication Tester R&S CMU200

Type/Option	Description	GSM/GPRS/	TDMA	AMPS	cdmaOne	cdma2000	WCDMA	*Bluetooth*	Order number
R&S CMU-K22[2)7)]	GSM1800 (DCS) mobile station signalling/non-signalling test	✓	–	–	–	–	–	–	1115.6107.02
R&S CMU-K23[2)7)]	GSM1900 (PCS) mobile station signalling/non-signalling test	✓	–	–	–	–	–	–	1115.6207.02
R&S CMU-K24[2)7)]	GSM850 mobile station signalling/non-signalling test	✓	–	–	–	–	–	–	1115.6307.02
R&S CMU-K27[2)7)]	IS-136/Cellular (800 MHz band) mobile station signalling/non-signalling test	–	✓	–	–	–	–	–	1115.6607.02
R&S CMU-K28[2)7)]	IS-136/PCS (1900 MHz band) mobile station signalling/non- signalling test	–	✓	–	–	–	–	–	1115.6707.02
R&S CMU-K29[3)]	AMPS mobile station signalling/non-signalling test	–	–	✓	–	–	–	–	1115.6807.02
R&S CMU-K42[11)]	GPRS software extension for all GSM software packages	✓	–	–	–	–	–	–	1115.4691.02
R&S CMU-K53[2)5)]	*Bluetooth* test software	–	–	–	–	–	–	✓	1115.5000.02
R&S CMU-K65[8)]	WCDMA (3GPP/FDD, UL) user equipment TX test, non-signalling	–	–	–	–	–	✓	–	1115.4891.02
R&S CMU-K66[8)9)]	WCDMA (3GPP/FDD, DL) generator software	–	–	–	–	–	✓	–	1115.5100.02
R&S CMU-K81[4)7)]	cdmaOne cellular (800 MHz band) mobile station signalling/non-signalling test	–	–	–	✓	–	–	–	1115.5500.02
R&S CMU-K82[4)7)]	cdmaOne PCS (1700/1900 MHz band) mobile station signalling/non-signalling test	–	–	–	✓	–	–	–	1115.5600.02
R&S CMU-K83[10)7)]	cdma2000 (1x) (450 MHz band) mobile station signalling/non-signalling test	–	–	–	–	✓	–	–	1150.3500.02
R&S CMU-K84[10)7)]	cdma2000 (1x) (cellular band) mobile station signalling/non-signalling test	–	–	–	–	✓	–	–	1150.3600.02
R&S CMU-K85[10)7)]	cdma2000 (1x) (PCS band) mobile station signalling/non-signalling test	–	–	–	–	✓	–	–	1150.3700.02
R&S CMU-K86[10)7)]	cdma2000 (1x) (IMT2000 band) mobile station signalling/non-signalling test	–	–	–	–	✓	–	–	1150.3800.02
BW2-C1	Corner cover 1 (2 pieces required)	☺	☺	☺	☺	☺	☺	☺	1096.2593.00
BW2-C2	Corner cover 2 (2 pieces required)	☺	☺	☺	☺	☺	☺	☺	1096.2602.00
R&S CMU-DCV	Documentation of calibration values	☺	☺	☺	☺	☺	☺	☺	0240.2193.08
CRT-Z2	GSM/GPRS test SIM for loopback mode, required for BER and other applications	☺	–	–	–	–	–	–	1039.9005.02
R&S CMU-Z1	30 Mbyte memory card for use with PCMCIA interface	☺	☺	☺	☺	☺	☺	☺	1100.7490.02
R&S CMU-Z6	Enhancement of wideband modulation	–	–	–	–	–	☺	–	1150.0001.02
R&S CMU-Z10	Antenna coupler 900 MHz/1700MHz to 2200MHz	☺	☺	☺	☺	☺	☺	–	1150.0801.02
R&S CMU-Z11	Shielded chamber extension for R&S CMU-Z10	☺	☺	☺	☺	☺	☺	–	1150.1008.02
R&S CMU-Z12	*Bluetooth* antenna	–	–	–	–	–	–	☺	1150.1043.02
PSM-B9	PCMCIA 500 Mbyte hard disk	☺	☺	☺	☺	☺	☺	☺	1064.5700.02
ZZA-411	19" rack adapter	☺	☺	☺	☺	☺	☺	☺	1096.3283.00

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

1) R&S CMU-B11 or R&S CMU-B12 possible. One of two OCXOs should be installed to ensure high
2) Frequency accuracy or external frequency reference may be used, if available.
3) R&S CMU-B21 necessary.
4) R&S CMU-B21 and R&S CMU-B41 necessary, not required, if R&S CMU-B83 is available.
5) R&S CMU-B81 necessary.
6) R&S CMU-B53 necessary.
7) For upgrade only if factory installation is not applicable. Includes R&S CMU-B53 and R&S CMU-K53.
8) Depending on the required frequency band.
9) R&S CMU-U65 necessary.
10) R&S CMU-U66 or R&S CMU-B66 necessary.
11) R&S CMU-B83 or R&S CMU-U83 necessary.
12) At least one of R&S CMU-K20 to -K24 necessary.
13) Factory installation only.
14) For upgrade only if factory installation is not applicable.
15) For new units only. Factory installation only.

Radio Communication Tester R&S CMU200

Specifications in brief

Timebase TCXO

Max. frequency drift	$\pm 1 \times 10^{-6}$ (+5°C to +45°C)
Max. aging	$\pm 1 \times 10^{-6}$/year

Timebase OCXO option R&S CMU-B11

Max. frequency drift	$\pm 1 \times 10^{-7}$ (+5°C to +45°C)
Max. aging	$\pm 2 \times 10^{-7}$/year

Timebase OCXO option R&S CMU-B12

Max. frequency drift (+5°C to +45°C)	$\pm 5 \times 10^{-9}$, referred to +25°C
Max. aging	$\pm 3.5 \times 10^{-8}$/year

Reference frequency inputs/outputs

Synchronization input	BNC, 0.5 V to 2 V rms, 50 Ω
Frequency sinewave	1 MHz to 52 MHz, step 1 kHz
Frequency squarewave (TTL level)	10 kHz to 52 MHz, step 1 kHz
Max. frequency variation	$\pm 5 \times 10^{-6}$
Synchronization output 1	BNC, >1.0 V_{pp}, 50 Ω
Frequency	10 MHz from internal reference or frequency at synchronization input
Synchronization output 2	BNC, >1.4 V_{pp}, 50 Ω
Frequency	net-specific frequencies in the range 100 kHz to 40 MHz

RF generator

Frequency range	100 kHz to 2700 MHz
Frequency resolution	0.1 Hz
Frequency settling time	<400 µs to Δf <1 kHz

Output level range

RF1	100 kHz to 2200 MHz	– 130 dBm to – 27 dBm
	2200 MHz to 2700 MHz	– 130 dBm to – 33 dBm
RF2	100 kHz to 2200 MHz	– 130 dBm to – 10 dBm
	2200 MHz to 2700 MHz	– 130 dBm to – 16 dBm
RF3OUT	100 kHz to 2200 MHz	– 90 dBm to +13 dBm
	2200 MHz to 2700 MHz	– 90 dBm to +5 dBm

Output level uncertainty (+23°C to +35°C)

RF1, RF2	>–106 dBm	>–117 dBm	–117 to –130 dBm
10 MHz to 450 MHz	<0.6 dB	<0.6 dB	
450 MHz to 2200 MHz	<0.6 dB	<0.6 dB [2]	<1.5 dB [1] [2]
2200 MHz to 2700 MHz	<0.6 dB	<0.8 dB [2]	<1.5 dB [1] [2]

RF3OUT	10 MHz to 450 MHz	<0.8 dB P=– 80 dBm to +10 dBm
	450 MHz to 2200 MHz	<0.8 dB P=– 90 dBm to +10 dBm
	2200 MHz to 2700 MHz	<1.0 dB P=– 90 dBm to +5 dBm

Level settling time	<4 µs
Resolution	0.1 dB

VSWR

RF1	10 MHz to 2000 MHz	<1.2
	2000 MHz to 2200 MHz	<1.3
	2200 MHz to 2700 MHz	<1.6
RF2	10 MHz to 2200 MHz	<1.2
	2200 MHz to 2700 MHz	<1.6
RF3OUT	10 MHz to 2200 MHz	<1.5
	2200 MHz to 2700 MHz	<1.7

Attenuation of harmonics (f_0 = 10 MHz to 2200 MHz, up to 7 GHz)

RF1, RF2	>30 dB
RF3OUT	>20 dB

Attenuation of nonharmonics

10 MHz to 2200 MHz	>40 dB at >5 kHz from carrier

Spectral purity

Phase noise (single sideband, f <2.2 GHz)	
Carrier offset	
20 kHz to 250 kHz	<– 100 dBc
≥250 kHz	<– 110 dBc
Residual FM	
30 Hz to 20 kHz	<50 Hz (rms), <200 Hz (peak)
CCITT	<5 Hz (rms)
Residual AM (CCITT)	<0.02% (rms)
IQ modulation	
(frequency offset 0 Hz to ± 135 kHz)	
Carrier suppression	> 40 dB

RF analyzer

VSWR

RF1	10 MHz to 2000 MHz	<1.2
	2000 MHz to 2200 MHz	<1.3
	2200 MHz to 2700 MHz	<1.6
RF2	10 MHz to 2200 MHz	<1.2
	2200 MHz to 2700 MHz	<1.6
RF4IN	10 MHz to 2200 MHz	<1.5
	2200 MHz to 2700 MHz	<1.6

Power meter (wideband)

Frequency range	100 kHz to 2700 MHz
Level range	
RF1 (continuous power [3])	
100 kHz to 2200 MHz	+6 dBm to +47 dBm (50 W)
2200 MHz to 2700 MHz	+10 dBm to +47 dBm (50 W)
max. peak power [4] (PEP)	+53 dBm (200 W)
RF2 (continuous power)	
100 kHz to 2200 MHz	– 8 dBm to +33 dBm (2 W)
2200 MHz to 2700 MHz	– 4 dBm to +33 dBm
max. peak power [4] (PEP)	+39 dBm (8 W)
RF4IN (continuous power and PEP)	
100 kHz to 2200 MHz	– 33 dBm to 0 dBm
2200 MHz to 2700 MHz	– 29 dBm to 0 dBm

Level uncertainty

RF1		10 to 20 dBm	20 to 47 dBm
	10 MHz to 2700 MHz	<1.0 dB [6]	<0.5 dB [5] [6]
RF2		– 4 to +6 dBm	+6 to +33 dBm
	10 MHz to 2700 MHz	<1.0 dB [6]	<0.5 dB [6]
RF4IN		– 29 to –19 dBm	– 19 to 0 dBm
	10 MHz to 2700 MHz	<1.5 dB	<0.8 dB

Power meter (frequency-selective)

Frequency range/resolution	10 MHz to 2700 MHz/0.1 Hz
Resolution bandwidths	10 Hz to 1 MHz in 1/2/3/5 steps
Level range for rated data	
RF1 (continuous power [3])	
10 MHz to 2200 MHz	– 40 dBm to +47 dBm (50 W)
2200 MHz to 2700 MHz	– 34 dBm to +47 dBm (50 W)
max. peak power [4] (PEP)	+53 dBm (200 W)
RF2 (continuous power [3])	
10 MHz to 2200 MHz	– 54 dBm to +33 dBm (2 W)
2200 MHz to 2700 MHz	– 48 dBm to +33 dBm
max. peak power [4] (PEP)	+39 dBm (8 W)
RF4IN (continuous power and PEP)	
10 MHz to 2200 MHz	– 80 dBm to 0 dBm
2200 MHz to 2700 MHz	– 74 dBm to 0 dBm
Level uncertainty (+23°C to +35°C)	
RF1, RF2 10 MHz to 2200 MHz	<0.5 dB
2200 MHz to 2700 MHz	<0.7 dB
RF4IN 10 MHz to 2200 MHz	<0.7 dB
2200 MHz to 2700 MHz	<0.9 dB

Demodulation (data of hardware paths) Spectral purity

Phase noise (single sideband, f <2.2 GHz)		
Carrier offset	20 kHz to 250 kHz	<– 100 dBc
	250 kHz to 400 kHz	<– 110 dBc
	≥400 kHz	<– 118 dBc
Residual FM	30 Hz to 20 kHz	<50 Hz (rms), <200 Hz (peak)
	CCITT	<5 Hz (rms)
Residual AM (CCITT)		<0.02% (rms)

Radio Communication Tester R&S CMU200

Spectrum analyzer

Frequency range	10 MHz to 2.7 GHz
Span	zero span to full span
Frequency resolution	0.1 Hz
Resolution bandwidths	10 Hz to 1 MHz in 1/2/3/5 steps
Sweep time	≥ 100 ms, depending on RBW
Display	560 dots, horizontal
Marker	up to 3, absolute/relative
Display line	1
Display scale	10/20/30/50/80/100 dB

Level range

RF1 continuous power [3]	up to +47 dBm (50 W)
max. peak power [4] (PEP)	up to +53 dBm (200 W)
RF2 continuous power	up to +33 dBm (2 W)
max. peak power [4] (PEP)	up to +39 dBm (8 W)
RF4IN continuous power and PEP)	up to 0 dBm

Level uncertainty

RF1, RF2, RF4IN (+23°C to +35°C)	
10 MHz to 2200 MHz	0.5 dB
2200 MHz to 2700 MHz	0.7 dB

Reference level for full dynamic range

Logarithmic level display

RF1	+10 dBm to +47 dBm
RF2	– 4 dBm to +33 dBm
RF4IN	– 22 dBm to 0 dBm

Displayed average noise level (RBW 1 kHz)

RF1/RF2/RF4IN	
10 MHz to 2200 MHz	<– 100 dBc
2200 MHz to 2700 MHz	<– 95 dBc
Inherent spurious response, low distortion mode, f >20 MHz, except 1816.115 MHz	<– 50 dB

Inherent harmonics

(f_0 = 10 MHz to 2200 MHz, up to 7 GHz)	
RF1, RF2	> 30 dB
RF4IN	> 20 dB

Audio option R&S CMU-B41

Audio generator

Output impedance	<4 Ω
Maximum output current	20 mA

AF sine generator

Frequency range	20 Hz to 20 kHz
Frequency resolution	0.1 Hz
Level range	10 µV to 5 V

Audio analyzer

Input impedance	1 MΩ ‖ 100 pF

AF voltmeter

Frequency range	50 Hz to 20 kHz
Level range	50 µV to 30 V
Level resolution	1 µV at level <1 mV
	0.1% at level ≥1 mV

THD+N meter

Measurement bandwidth	21 kHz
Frequency range	100 Hz to 10 kHz
Level range	10 mV to 30 V
Resolution	0.01% THD+N

GSM specifications

RF generator GSM

Frequency range	GSM850 band	869 MHz to 894 MHz
	GSM900 band	925 MHz to 960 MHz
	GSM1800 band	1805 MHz to 1880 MHz
	GSM1900 band	1930 MHz to 1990 MHz
Frequency settling time		<500 µs to res. phase of 4°
Attenuation of inband spurious emissions		> 50 dB
Modulation		GMSK, BxT = 0.3
Inherent phase error		≤ 1°, rms,≤ 4°, peak

RF analyzer GSM

Frequency range	GSM850 band	824 MHz to 849 MHz
	GSM900 band	880 MHz to 915 MHz
	GSM1800 band	1710 MHz to 1785 MHz
	GSM1900 band	1850 MHz to 1910 MHz
Measurement bandwidth		500 kHz (in measurement menus)

Phase and frequency error measurement GSM

Level range (PEP)	RF1	– 6 dBm to +53 dBm
	RF2	– 20 dBm to +39 dBm
	RF4IN	– 60 dBm to 0 dBm

Burst power measurement GSM

Reference level for full dynamic range	
RF1	+10 dBm to +53 dBm
RF2	– 4 dBm to +39 dBm
RF3IN	– 22 dBm to 0 dBm
Dynamic range	> 72 dB, rms

TDMA specifications

RF generator

Frequency range	
US Cellular	869 MHz to 894 MHz
PCS (US)	1930 MHz to 1990 MHz
Modulation (non-signalling mode)	π/4 DQPSK or unmodulated
Carrier suppression	>40 dB

RF analyzer

Modulation analyzer	
EVM, rms (residual)	<2%
EVM, peak (residual)	<4%
I/Q offset (residual)	<–50 dB (0.3%)
I/Q imbalance (residual)	<–50 dB (0.3%)
Frequency measurement range	–2 kHz to +2 kHz
Frequency measurement error	≤5 Hz + drift of timebase
Reference level for full dynamic range (low noise mode)	
RF1	+4 dBm to +47 dBm
RF2	–10 dBm to +33 dBm
RF4IN	–28 dBm to –6 dBm
Dynamic range	>74 dB (BW=100 kHz, rms)
Relative measurement uncertainty	
Result >–40 dB	<0.1 dB
–60 dB≤ Result ≤–40 dB	<0.5 dB
Adjacent channel power measurement	
Dynamic range	
1st adjacent channel	>45 dB
2nd and 3rd adjacent channel	>55 dB

AMPS specifications

Modulation

FM deviation range	100 Hz to 20 kHz
AF range	100 Hz to 15.999 kHz

FM distortion

(SINAD; dev. 8 kHz, AF 1 kHz, BW 30 Hz to 15 kHz)	≥40 dB
Residual FM (rms, BW 300 Hz to 3 kHz)	≤10 Hz

Radio Communication Tester R&S CMU200

Deviation uncertainty at 1 kHz AF, 8 kHz dev. (measurement bandwidth 30 Hz to 15 kHz)	<2 % of setting + residual FM

RF analyzer

Power meter (frequency-selective)	
Reference level range RF1	0 dBm to +53 dBm
RF2	–14 dBm to +39 dBm
RF4IN	–37 dBm to 0 dBm
FM measurement	
AF range	100 Hz to 18 kHz
Residual FM	
BW 300 Hz to 3 kHz, rms	≤5 Hz
BW 6 Hz to 20 kHz, rms	≤18 Hz
Uncertainty (BW 6 Hz to 20 kHz)	<1% of reading + residual FM
Carrier frequency measurement range	–47 kHz to +47 kHz

cdmaOne specifications

RF generator

CDMA standards	TIA/EIA-95, J-STD-008, ARIB T53
CDMA test standards (Korea, China)	TIA/EIA-98, J-STD-018
Modulation	
QPSK, multiple QPSK	1.2288 Mcps
Carrier suppression	>35 dB
Waveform quality factor (ρ)	>0.966; >0.995 typ.
AWGN generator	1.23 MHz or 1.8 MHz

RF analyzer

Measurement filter	according to standard (1.23 MHz BW)
Level range (O-QPSK signal)	
RF1	–40 dBm to +47 dBm
RF2	–54 dBm to +33 dBm
RF4IN	–80 dBm to –6 dBm
Modulation analyzer	
Frequency measurement range	–3 kHz to +3 kHz

cdma2000 specifications

RF generator

cdma2000 standards	TIA/EIA IS-2000 Rev. 0
cdma2000 test standards	TIA/EIA IS-98-D
Option R&S CMU-K83	
NMT-450 (band class 5)	421.675 MHz to 494.480 MHz
Option R&S CMU-K84	
US/Korean cellular (band class 0)	869.025 MHz to 893.985 MHz
TACS band (band class 2)	917.0125 MHz to 959.9875 MHz
JTACS band (band class 3)	832.0125 MHz to 869.9875 MHz
North American 700 MHz cellular band (band class 7)	746.000 MHz to 764.000 MHz
900 MHz band (band class 9)	925.000 MHz to 958.750 MHz
Secondary 800 MHz band (band class 10)	851.000 MHz to 939.975 MHz
Option R&S CMU-K85	
North American PCS (band class 1)	1930 MHz to 1990 MHz
Korean PCS (band class 4)	1840 MHz to 1870 MHz
1800 MHz band (band class 8)	1805.000 MHz to 1879.950 MHz
Option R&S CMU-K86	
IMT-2000 (band class 6)	2110.000 MHz to 2169.950 MHz
Output level range (modulated signal)	
RF1	–120 dBm to –33 dBm
RF2	–120 dBm to –16 dBm
RF3OUT	–80 dBm to +7 dBm

Modulation

Dual BPSK, multiple QPSK	1.2288 Mcps
Carrier suppression	>35 dB
Waveform quality factor (ρ)	>0.985
Code channel level uncertainty (relative to total CDMA power)	
F-PICH, F-PCH, F-FCH, F-SCH1, F-SCH2	0.1 dB typ.
All other channels	0.25 dB typ.
AWGN generator	
Bandwidth	>1.8 MHz
Output level range (relative to total CDMA output power)	–20 dB to +4 dB
Output level uncertainty	0.2 dB typ. (1.23 MHz bandwidth)
Supported service options	
Loopback service options	SO 2, 9
Speech service options	SO 1, 3, 17, 0x8000

RF analyzer

Option R&S CMU-K83	
NMT-450 (band class 5)	411.675 MHz to 483.480 MHz
Option R&S CMU-K84	
US/Korean cellular (band class 0)	824.025 MHz to 848.985 MHz
TACS band (band class 2)	872.0125 MHz to 914.9875 MHz
JTACS band (band class 3)	887.0125 MHz to 924.9875 MHz
North American 700 MHz cellular band (band class 7)	776.000 MHz to 794.000 MHz
900 MHz band (band class 9)	880.000 MHz to 913.750 MHz
Secondary 800 MHz band (band class 10)	806.000 MHz to 900.975 MHz
Option R&S CMU-K85	
North American PCS (band class 1)	1850 MHz to 1910 MHz
Korean PCS (band class 4)	1750 MHz to 1780 MHz
1800 MHz band (band class 8)	1710.000 MHz to 1784.950 MHz
Option R&S CMU-K86	
IMT-2000 (band class 6)	1920.000 MHz to 1979.950 MHz
Measurement filter	according to standard (1.23 MHz bandwidth)
Level range (HPSK, O-QPSK signal)	
RF1	–40 dBm to +44 dBm
RF2	–54 dBm to +30 dBm
RF4IN	–80 dBm to –9 dBm

Modulation analyzer

RC1, RC2 (O-QPSK)	waveform quality, error vector magnitude, magnitude error, phase error
ρ uncertainty (for ρ 0.9 to 1)	<0.003
Frequency measurement range	–3 kHz to +3 kHz
RC3, RC4 (HPSK)	waveform quality, error vector magnitude, magnitude error, phase error, code domain power, peak code domain error power, channel power
ρ uncertainty (for ρ 0.9 to 1)	<0.003
Frequency measurement range	–3 kHz to +3 kHz

WCDMA specifications

RF generator

Standard	3GPP-FDD
Symbol rate	3.84 MHz
Synchronization output 2	BNC connector REFOUT2
Frequency	30.72 MHz
Channels	P-CPICH, P-SCH, S-SCH, P-CCPCH, DPCH
Channel levels	–30 dB to +15 dB relative to CPICH
Reference measurement channel RMC	12.2 kbps, 64 kbps, 144 kbps, 384 kbps (3GPP TS34.121)
Frequency ranges	869 MHz to 894 MHz 921 MHz to 960 MHz 1805 MHz to 1880 MHz 1930 MHz to 1990 MHz 2110 MHz to 2170 MHz
Output level range [7]	
RF1	–120 dBm to –36 dBm
RF2	–120 dBm to –22 dBm
RF3OUT	–80 dBm to 0 dBm
Error vector magnitude (EVM)	<5% [8]

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RF analyzer (TX measurements)

Frequency ranges	824 MHz to 849 MHz 876 MHz to 915 MHz 1710 MHz to 1785 MHz 1850 MHz to 1910 MHz 1920 MHz to 1980 MHz

Modulation analysis [9)]

Measurement filter	receiver filter according to standard 3.84 MHz, RRC, a = 0.22
Analysis modes	QPSK, WCDMA uplink
Measurement ranges	
Error vector magnitude (EVM)	up to 25 %
Inherent EVM, rms	<2.5 % [10)]
Frequency error	±3 kHz [11)]
Waveform quality	0.9 to 1.0
Inherent I/Q offset	<–55 dB
Inherent I/Q imbalance	<–30 dB
Peak code domain error (PCDE)	<0.5 dB

Spectrum measurements [12)]

ACLR(FFT, filter)	
Measurement filter	receiver filter according to standard 3.84 MHz, RRC, a = 0.22
Resolution bandwidth	20 kHz
Frequency offsets	
First adjacent channel	±5 MHz
Second adjacent channel	±10 MHz
Dynamic range	
First adjacent channel	>54 dB
Second adjacent channel	>62 dB
Occupied bandwidth	
Range	1 MHz to 6 MHz
Uncertainty	<100 kHz

Spectrum emission mask

Measurement filter	
± 2.515 MHz to ± 3.485 MHz	30 kHz Gaussian filter
± 4.0 MHz to ± 12.0 MHz	1 MHz Gaussian filter
Dynamic range	
± 2.515 MHz to ± 3.485 MHz	>72 dB
± 4.0 MHz to ± 7.5 MHz	>59 dB
± 8.5 MHz to ± 12.0 MHz	>67 dB

Code domain power

Measurement filter	receiver filter according to standard 3.84 MHz, RRC, a = 0.22
Level range	
RF1	–8 dBm to +47 dBm
RF2	–22 dBm to +33 dBm
RF4IN	–45 dBm to 0 dBm

Bluetooth specifications

RF generator

Frequency range	
Europe (except Spain and France), USA and Japan	2.4000 GHz to 2.4835 GHz
France	2.4465 GHz to 2.4835 GHz
Spain	2.4450 GHz to 2.475 GHz
Modulation (GFSK)	1 Mbps, B x T = 0.5

RF analyzer

Frequency range	same as RF generator

Power meter (frequency-selective) and power versus time

Reference level for full dynamic range (GFSK signal)	RF1	0 dBm to +41 dBm
	RF2	–14 dBm to +33 dBm
	RF4IN	–32 dBm to 0 dBm

Modulation analyzer (RBW = 3 MHz)

Level range (GFSK signal)	
RF1, RF2, RF4IN	from full-scale setting down to –25 dB
Frequency deviation error	<±4 kHz
Frequency measurement range	–250 kHz to +250 kHz
Timing measurement range	±20 µs

General data

Inputs and outputs (rear panel)	
IF3 RX CH1	Z_{out} = 50 Ω, BNC, max. level –2 dBm, 10.7 MHz
Remote control interfaces	IEC 625-2 (IEEE 488.2) 24-pin Amphenol
Serial interface (COM1, COM2)	RS-232-C (COM), 9-pin sub-D
Printer interface (LPT)	parallel (Centronics compatible), 25-pin sub-D
Keyboard	PS/2
External monitor (VGA)	15-pin sub-D
Rated temperature range	+5 °C to +45 °C
Storage temperature range	–25 °C to +60 °C
Power supply	100 V to 240 V ± 10% (AC), 3.1 A to 1.3 A, 50 Hz to 400 Hz, – 5% to +10% power factor correction
Power consumption	
Base unit	130 W
with typical options	180 W
Dimensions (W x H x D)	465 mm x 193 mm x 517 mm (19“; 4 height units)
Weight base unit	14 kg
Weight with typical options	18 kg

Ordering informations

see table "Instruments options and ordering information"

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1) Valid for RF1 only.

2) Not valid at frequencies of netclock harmonics.

3) 50 W in the temperature range +5 °C to +30 °C, linear degradation down to 25 W at 45 °C.

4) Mean value of power vs time must be equal or less than allowed continuous power.

5) Calibrated for P>33 dBm only in frequency range 800 MHz to 2000 MHz.

6) Temperature range +5° C to +23 °C or +35 °C to +45 °C and f>2200 MHz: additional uncertainty of 0.2 dB.

7) For crest factor ≤13 dB.

8) Global EVM for DL reference measurement channels (according 3GPP TS34.121 C3.1 to C3.4) with DPCH/CPICH = 0 dB.

9) The specified data is valid for “Low Noise Mode“ operation.

10) With R&S CMU-Z6 <1.5% typ.

11) At 12.2 kbps reference measurement channel.

12) The specified data is valid for “High Dynamic Mode“ operation.

Universal Radio Communication Tester R&S CMU300

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

Photo 43641-6

Brief description

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

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

The tester keeps pace with all steps in the evolution of modern digital mobile radio. It supports GSM, GPRS, EDGE and WCDMA (generator for receiver measurements). Implementation of 3GPP FDD transmitter measurements is planned.

Main features

- Wide frequency range from 10 MHz to 2.7 GHz
- Modular future-proof design
- Flexible RF input/output structure
- Spectrum analyzer function
- Measurements on first-, second- and third-generation base stations with a single instrument
- Manual operation or IEC/IEEE bus control
- Bright, high-resolution TFT colour display
- Realtime automatic temperature correction for maximum accuracy
- Low power consumption
- Low heat dissipation
- Optimized cooling concept for higher reliability and less production down times
- Compact box of only 4 height units
- Flexible configuration for compatibility with various test environments

GSM/GPRS/EDGE functionality

In the non-signalling mode, the instrument consists of a GSM/EDGE generator and analyzer which can be operated independently of each other. As soon as an RF signal is applied to the test input, measurement can be started independently of external trigger signals or signalling sequences. This mode is ideal for testing RF boards and modules with little or no signalling activity. In the signalling mode, however, the R&S CMU 300 operates synchronously with the base station, which is a prerequisite for BER measurements and realtime signalling. The signalling mode is suitable for final testing of TRX modules or the complete base station. In most cases, the instrument can be synchronized via the pilot channel (BCCH) of the base station. It is also possible to trigger the R&S CMU300 via the frame clock.

GMSK/EDGE transmitter measurements

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

- Power/power ramp
- Modulation analysis
- Spectrum measurements

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

- Selective choice of timeslot to be measured in frame

Universal Radio Communication Tester R&S CMU300

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

GMSK/EDGE receiver measurements
This is where the strengths of the R&S CMU300 as a compact tester become obvious. The capability to generate and analyze different channels in realtime is the key prerequisite for continuous bit error rate (BER) measurement and for automatic search of the sensitivity limit. The R&S CMU300 supports various measurement paths (PN generator/device under test (DUT)/BER evaluation).

For the majority of channels to be measured, the test path can be routed via various closed loops within the base station or via the A_{bis} interface. The R&S CMU300 itself can be used as an RF loop. Bit error rate measurements can be performed on the following traffic channels:

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

The RACH signalling channel can also be tested. Further information on the test environment of the base station required to perform customer-specific BER tests can be obtained on request.

Another special feature of the R&S CMU300 is its capability of performing tests on hopping base stations.

WCDMA functionality
For receiver tests on WCDMA base stations, the R&S CMU300 can be equipped with an RF generator (3GPP FDD, release 99). The instrument is thus able to generate all reference test channels specified in 3GPP TS 25.141 from 12.2 kbps up to 2048 kbps in realtime. Test data sequences from PN9 to PN16 are supported. The R&S CMU300 is triggered by the transmission time interval (TTI) signals of the base station. Moreover, it is able to feed measured data into the following physical channels:

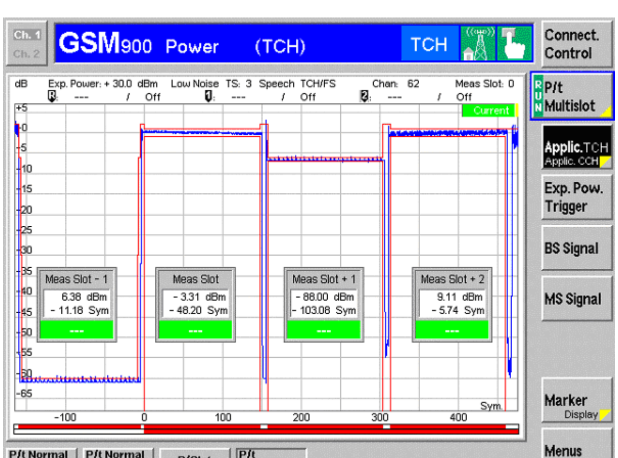
- 15 kbps, 30 kbps, 60 kbps, 120 kbps, 480 kbps, 1 x 960 kbps, 2 x 960 kbps, 3 x 960 kbps, 4 x 960 kbps, 5 x 960 kbps, 6 x 960 kbps

Overview of options

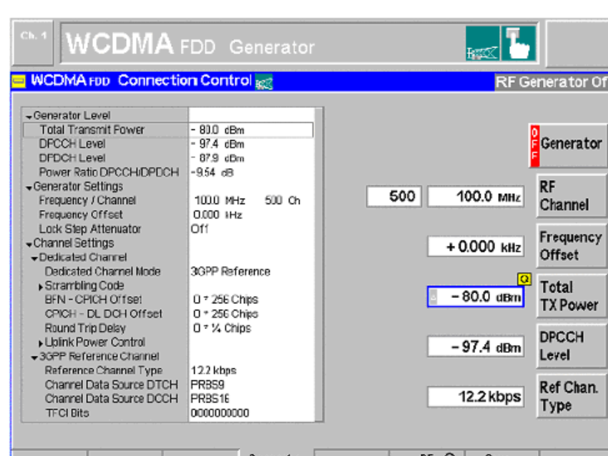
The base unit of the R&S CMU300 provides the functionality of two RF measuring instruments – an RF signal generator and an RF spectrum analyzer.

GSM/EDGE
The base unit is converted into a radiocommunication tester for GSM/GPRS by incorporating the Signalling Unit R&S CMU-B21 and at least one of the five GSM software options R&S CMU-K30 through -K34.

The GSM functions can be enhanced to EDGE by software option R&S CMU-K41. Software option R&S CMU-K39 allows channel setup using the GSM signalling procedures MOC/MTC (mobile originated/terminated call) .



Power versus Multislot measurement menu



Overview of uplink generator settings in Connection Control menu

Universal Radio Communication Tester R&S CMU300

Type/Option	Description	GMSK TX Tests	8PSK TX Tests	BERT GSM	BERT GPRS	BERT EGPRS	WCDMA Generator	Part no
R&S CMU300	Universal Radio Communication Tester for BTS Test: Base unit with following accessories: power cord, operating manual, service manual	✓	✓	✓	✓	✓		1100.0008.03
R&S CMU-B12	Reference Oscillator OCXO, aging 3.5 x 10^{E-8}/year	☺	☺	☺	☺	☺		1100.5100.02
R&S CMU-B15	Additional RF and IF Connectors	☺	☺	☺	☺	☺		1100.6006.02
R&S CMU-B21	Versatile Signalling Unit for R&S CMU	✓	✓	✓	✓	✓		1100.5200.02
R&S CMU-B71	A_{bis} Interface Unit; E1/T1 Protocol; for BER test only;	–	–	☺	–	–		1100.6406.02
R&S CMU-K30	GSM400 BTS Measurement Software	✓ 1)	✓ 1)	✓ 1)	✓ 1)	✓ 1)		1115.4004.02
R&S CMU-K31	GSM900 BTS Measurement Software	✓ 1)	✓ 1)	✓ 1)	✓ 1)	✓ 1)		1115.4104.02
R&S CMU-K32	GSM1800 BTS Measurement Software	✓ 1)	✓ 1)	✓ 1)	✓ 1)	✓ 1)		1115.4204.02
R&S CMU-K33	GSM1900 BTS Measurement Software	✓ 1)	✓ 1)	✓ 1)	✓ 1)	✓ 1)		1115.4304.02
R&S CMU-K34	GSM850 BTS Measurement Software	✓ 1)	✓ 1)	✓ 1)	✓ 1)	✓ 1)		1115.4404.02
R&S CMU-K39	GSM Signalling Procedure MOC/MTC (circuit-switched)	☺	☺	☺	–	–		1115.4791.02
R&S CMU-K41	EDGE/8PSK extension for GSM HW/SW (8PSK TX tests and EGPRS BER tests)	–	✓	–	–	✓		1115.4504.02
R&S CMU-DCV	Documentation of Calibration Values	☺	☺	☺	☺	☺		0240.2193.08
R&S CMU-U61	Modification kit: floppy disk drive instead of PCMCIA	☺	☺	☺	☺	☺		1100.5500.02
R&S CMU-Z1	30 MB Memory Card for use with PCMCIA interface	☺	☺	☺	☺	☺		1100.7490.02
PSM-B9	PCMCIA Type 3, 520 MB hard disk	☺	☺	☺	☺	☺		1064.5700.02
ZZA-411	19" Rack Adapter	☺	☺	☺	☺	☺		1096.3283.00
R&S CMU-B76	Layer 1 Board for WCDMA						✓	1150.0601.02
R&S CMU-K76	WCDMA Generator (3GPP FDD/UL), R&S CMU-B76 necessary						✓	1150.3300.02
R&S CMU-U76	Upgrade kit: Layer 1 - Board for WCDMA (3GPP/FDD/UL) (for upgrade of existing units instead of R&S CMU-B76)						☺	1150.0701.02

✓ mandatory ☺ optional 1) depending on required frequency band – not applicable

The optional A_{bis} Board R&S CMU-B71 is required for BER tests if the bit pattern sent by the R&S CMU300 cannot internally be looped back by the base station.

WCDMA

By adding the hardware option R&S CMU-B76 (WCDMA Layer 1 Board) and the 3GPP FDD software option R&S CMU-K76, the R&S CMU300 is converted into a source for all the required reference test channels up to 2048 kbps. The options GSM/EDGE and WCDMA can be installed independently of one another. If existing instruments are to be retrofitted, the option R&S CMU-U76 must be ordered instead of R&S CMU-B76.

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

Universal Radio Communication Tester R&S CMU300

Specifications in brief

Base unit

Timebase TCXO

Max. frequency drift (+5°C to +45°C)	±1 x 10^{-6}
Max. aging	±1 x 10^{-6}/year

Timebase OCXO – option R&S CMU-B12

Max. frequency drift (+5°C to +45°C)	±5 x 10^{-9}, referred to +25°C
Max. aging	±3.5 x 10^{-8}/year, ±5 x 10^{-10}/day after 30 days of operation

Reference frequency inputs/output

Synchronization input	BNC connector REFIN
Frequency	
Sinewave	1 MHz to 52 MHz, 1 kHz steps
Squarewave, TTL levels	10 kHz to 52 MHz, 1 kHz steps
Max. frequency variation	±5 x 10^{-6}
Input voltage range, impedance	0.5 V to 2 V, rms, 50 Ω
Synchronization output 1	BNC connector REFOUT1
Frequency	10 MHz from internal reference or frequency at synchronization input
Output voltage, impedance	>1.4 V (peak-peak), 50 Ω
Synchronization output 2	BNC connector REFOUT2
Frequency	network-specific (100 kHz to 40 MHz)
Output voltage (f ≤13 MHz), impulse	>1.0 V (peak-peak), 50 Ω

RF generator

Frequency range	100 kHz to 2700 MHz		
Frequency resolution	0.1 Hz		
Frequency uncertainty	same as timebase + resolution		
Frequency settling time	<400 μs to Δf <1 kHz		
Output level range (RF1)			
RF1 100 kHz to 2200 MHz	–130 dBm to –27 dBm		
2200 MHz to 2700 MHz	–130 dBm to –33 dBm		
RF2 100 kHz to 2200 MHz	–130 dBm to –10 dBm		
2200 MHz to 2700 MHz	–130 dBm to –16 dBm		
$RF3_{OUT}$ 100 kHz to 2200 MHz	–90 dBm to +13 dBm		
2200 MHz to 2700 MHz	–90 dBm to +5 dBm		
Output level uncertainty			
RF1, RF2 (+23°C to +35°C)	≥–106 dBm	>–117 dBm	–117 to –130 dBm
10 MHz to 450 MHz	<0.6 dB		
450 MHz to 2200 MHz	<0.6 dB	<0.6 dB 2)	<1.5 dB 1) 2)
2200 MHz to 2700 MHz	<0.8 dB	<0.8 dB 2)	<1.5 dB 1) 2)
RF3OUT (+23°C to +35°C)			
10 MHz to 450 MHz	<0.8 dB P=–80 dBm to +10 dBm		
450 MHz to 2200 MHz	<0.8 dB P=–90 dBm to +10 dBm		
2200 MHz to 2700 MHz	<1.0 dB P=–90 dBm to +5 dBm		
Output level settling time	<4 ms		
Output level resolution	0.1 dB		
Generator RF level repeatability (RF1, RF2, RF3OUT, typical values after 1 h warmup)			
Output ≥–80 dBm	<0.01 dB		
Output <–80 dBm	<0.1 dB		
VSWR (RF1) 10 MHz to 2000 MHz	<1.2		
2000 MHz to 2200 MHz	<1.3		
2200 MHz to 2700 MHz	<1.6		

Spectral purity

Attenuation of harmonics (f_0 = 10 MHz to 2200 MHz, up to 7 GHz)	
RF1, RF2	>30 dB
RF3OUT (P≤ +10 dBm)	>20 dB
Attenuation of nonharmonics	
10 MHz to 2200 MHz	>40 dB at >5 kHz from carrier
Phase noise (single sideband, f < 2.2 GHz)	
Carrier offset	
20 kHz to 250 kHz	<–100 dBc(1 Hz)
≥250 kHz	<–110 dBc(1 Hz)
Residual FM	
30 Hz to 15 kHz	<50 Hz (rms), <200 Hz (peak)
CCITT	<5 Hz (rms)
Residual AM, CCITT	<0.02% (rms)
IQ modulation (data for frequency offset range 0 kHz to ±135 kHz)	
Carrier suppression	>40 dB

RF analyzer

VSWR (RF1)	
10 MHz to 2000 MHz	<1.2
2000 MHz to 2200 MHz	<1.3
2200 MHz to 2700 MHz	<1.6

Power meter (wideband)

Frequency range	100 kHz to 2700 MHz	
Level range		
RF1, continuous power 3)		
100 kHz to 2200 MHz	+6 dBm to +47 dBm (50 W)	
2200 MHz to 2700 MHz	+10 dBm to +47 dBm (50 W)	
Peak envelope power 4) (PEP)	+53 dBm (200 W)	
RF2, continuous power		
100 kHz to 2200 MHz	–8 dBm to +33 dBm (2 W)	
2200 MHz to 2700 MHz	–4 dBm to +33 dBm	
Peak envelope power 4) (PEP)	+39 dBm (8 W)	
RF4IN (continuous power and PEP)		
100 kHz to 2200 MHz	–33 dBm to 0 dBm	
2200 MHz to 2700 MHz	–29 dBm to 0 dBm	
Level uncertainty		
RF1	10 dBm to 20 dBm	20 dBm to 47 dBm
50 MHz to 2700 MHz	<1.0 dB 6)	<0.5 dB 5) 6)
RF2	–4 dBm to +6 dBm	+6 dBm to +33 dBm
50 MHz to 2700 MHz	<1.0 dB 6)	<0.5 dB 6)
RF4IN	–29 dBm to –19 dBm	–19 dBm to 0 dBm
50 MHz to 2700 MHz	<1.5 dB	<0.8 dB
Level resolution	0.1 dB	

Power meter (frequency-selective)

Frequency range; resolution	10 MHz to 2700 MHz; 0.1 Hz
Resolution bandwidth	10 Hz to 1 MHz in 1/2/3/5 sequence
Level range	
RF1, continuous power 3)	
10 MHz to 2200 MHz	–40 dBm to +47 dBm (50 W)
2200 MHz to 2700 MHz	–34 dBm to +47 dBm (50 W)
Peak envelope power 4) (PEP)	+53 dBm (200 W)
RF2, continuous power	
10 MHz to 2200 MHz	–54 dBm to +33 dBm (2 W)
2200 MHz to 2700 MHz	–48 dBm to +33 dBm
Peak envelope power 4) (PEP)	+39 dBm (8 W)
RF4IN (continuous power and PEP)	
10 MHz to 2200 MHz	–80 dBm to 0 dBm
2200 MHz to 2700 MHz	–74 dBm to 0 dBm
Level uncertainty	
RF1, RF2 (+23°C to +35°C)	
50 MHz to 2200 MHz	<0.5 dB
2200 MHz to 2700 MHz	<0.7 dB
RF4IN (+23°C to +35°C)	
50 MHz to 2200 MHz	<0.7 dB
2200 MHz to 2700 MHz	<0.9 dB
RF level measurement repeatability (RF1, RF2, RF4IN, typical values after 1 h warmup)	
Input ≥–40 dBm	<0.01 dB
Input <–40 dBm	<0.03 dB
Level resolution	0.1 dB

Base Station Tester R&S CMU300

Demodulation (data of hardware paths)

Spectral purity	
Phase noise (single sideband, f <2.2 GHz)	
Carrier offset	
20 kHz to 250 kHz	<–100 dBc (1 Hz)
250 kHz to 400 kHz	<–110 dBc (1 Hz)
≥400 kHz	<–118 dBc (1 Hz)
Residual FM	
30 Hz to 15 kHz	<50 Hz (rms), <200 Hz (peak)
CCITT	<5 Hz (rms)
Residual AM, CCITT	<0.02% (rms)

Spectrum analyzer

Frequency range	10 MHz to 2.7 GHz
Span	zero span to full span
Frequency resolution	0.1 Hz
Resolution bandwidths (RBW)	10 Hz to 1 MHz in 1/2/3/5 sequence
Sweep time	≥100 ms, depending on RBW
Display	560 dots, horizontal
Marker	up to 3, absolute/relative
Display line; scale	1; 10/20/30/50/80/100 dB
Level range	
RF1, continuous power[3]	up to +47 dBm (50 W)
RF1, peak envelope power[4] (PEP)	up to +53 dBm (200 W)
RF2, continuous power	up to +33 dBm (2 W)
RF2, peak envelope power[4] (PEP)	up to +39 dBm (8 W)
RF4IN (continuous power and PEP)	up to 0 dBm
Level uncertainty	
RF1, RF2 (+23 °C to +35 °C)	
50 MHz to 2200 MHz	<0.5 dB
2200 MHz to 2700 MHz	<0.7 dB
RF4IN (+23 °C to +35 °C)	
50 MHz to 2200 MHz	<0.7 dB
2200 MHz to 2700 MHz	<0.9 dB
Reference level for full dynamic range (low-noise mode)	
Logarithmic level display	
RF1	+10 dBm to +47 dBm
RF2	–4 dBm to +33 dBm
RF4IN	–22 dBm to 0 dBm
Displayed average noise level (RBW 1 kHz, low-noise mode)	
RF1/RF2/RF4IN	
10 MHz to 2200 MHz	<–100 dBc
2200 MHz to 2700 MHz	<–95 dBc
Inherent spurious response, low-distortion mode, 20 MHz to 2200 MHz, except 1816.115 MHz	<–50 dB
Harmonics (f_0 = 50 MHz to 2200 MHz, up to 7 GHz)	
RF1, RF2	<–30 dB
RF4IN	<–20 dB

GSM specifications – base station test

RF generator

Modulation	GMSK, BxT = 0.3, 8PSK [7]
Frequency range	
GSM 400 band	450 MHz to 458 MHz/478 MHz to 486 MHz
GSM 850 band	824 MHz to 849 MHz
GSM 900 band	876 MHz to 915 MHz
GSM 1800 band	1710 MHz to 1785 MHz
GSM 1900 band	1850 MHz to 1910 MHz
Attenuation of inband spurious emissions	>50 dB
Inherent phase error (GMSK)	<1°, rms; <4°, peak
Inherent EVM (8PSK)	<2%, rms
Frequency settling time	<500 µs to residual phase error of 4°
Output level range (GMSK)	
RF1	–130 dBm to –27 dBm
RF2	–130 dBm to –10 dBm
RF3OUT	–90 dBm to +13 dBm
Output level range (8PSK)	
RF1	–130 dBm to –31 dBm
RF2	–130 dBm to –14 dBm
RF3OUT	–90 dBm to +9 dBm
Output level resolution	0.1 dB
Level uncertainty, RF1, RF2,	
P >–117 dBm (+23 °C to +35 °C)	<0.5 dB
RF3OUT (+23 °C to +35 °C)	
P >–90 dBm to +10 dBm (GMSK)	
P >–90 dBm to +6 dBm (8PSK)	<0.7 dB

RF analyzer

Frequency range	
GSM 400 band	460 MHz to 468 MHz/488 MHz to 496 MHz
GSM 850 band	869 MHz to 894 MHz
GSM 900 band	921 MHz to 960 MHz
GSM 1800 band	1805 MHz to 1880 MHz
GSM 1900 band	1930 MHz to 1990 MHz
Measurement bandwidth in measurement menus	500 kHz

Power meter

Level range	
RF1, continuous power[3]	–40 dBm to +47 dBm (50 W)
Peak envelope power[4] (PEP)	+53 dBm (200 W)
RF2, continuous power	–54 dBm to +33 dBm (2 W)
Peak envelope power[4] (PEP)	+39 dBm (8 W)
RF4IN (continuous power and PEP)	–80 dBm to 0 dBm
Level uncertainty	
RF1, RF2, RF4IN (+23 °C to +35 °C)	<0.5 dB
Level resolution	0.1 dB (0.01 dB via remote control)

Modulation analysis

Level range (PEP)	
RF1	–6 dBm to +53 dBm
RF2	–20 dBm to +39 dBm
RF4IN	–60 dBm to 0 dBm
Inherent phase error (GMSK)	<0.6°, rms; <2°, peak
Inherent EVM (8PSK)	<1.0%, rms
Frequency measurement uncertainty	≤10 Hz + drift of timebase

Burst power measurement

Reference level for full dynamic range (GMSK, low-noise mode)	
RF1	+10 dBm to +53 dBm
RF2	–4 dBm to +39 dBm
RF4IN	–22 dBm to 0 dBm
Dynamic range (GMSK)	>72 dB (BW= 500 kHz, rms)
Reference level for full dynamic range (8PSK, low-noise mode)	
RF1	+6 dBm to +49 dBm
RF2	–8 dBm to +35 dBm
RF4IN	–26 dBm to –4 dBm
Dynamic range	>69 dB (BW= 500 kHz, rms)
Relative measurement uncertainty	
Result >–40 dB	<0.1 dB
–60 dB ≤ result ≤–40 dB	<0.5 dB
Resolution	0.1 dB in active part of burst

Spectrum due to modulation[8]

Level range for full dynamic range	
RF1	+10 dBm to +47 dBm
RF2	–4 dBm to +33 dBm
RF4IN	–22 dBm to 0 dBm

Universal Radio Communication Tester R&S CMU300

Test method	relative measurement, averaging
Filter bandwidth	30 kHz resolution filter (5-pole)
Measurement at an offset of	100, 200, 250, 400, 600, 800, 1000, 1200, 1400, 1600, 1800 kHz
Dynamic range (noise correction mode)	
with offset ≥ 1200 kHz	>80 dB
Spectrum due to switching[8]	
Level range for full dynamic range	
RF1	+10 dBm to +47 dBm
RF2	–4 dBm to +33 dBm
RF4IN	–22 dBm to 0 dBm
Test method	relative measurement, max. hold over several measurements
Filter bandwidth	30 kHz resolution filter (5-pole)
Measurement at an offset of	400, 600, 1200, 1800 kHz
Dynamic range (noise correction mode)	
with offset ≥ 1200 kHz	>80 dB

WCDMA specifications - base station test

Standard	3GPP-FDD
Symbol rate	3.84 MHz
Synchronization output 2	BNC connector REFOUT2
Frequency	30.72 MHz

RF generator		
Physical channels	15 kbps, 30 kbps, 60 kbps, 120 kbps, 480 kbps, 1 x 960 kbps, 2 x 960 kbps, 3 x 960 kbps, 4 x 960 kbps, 5 x 960 kbps, 6 x 960 kbps	
Gain ßc/ßd	1.0, 14/15, 13/15, 12/15, 11/15, 10/15, 9/15, 8/15, 7/15, 6/15, 5/15, 4/15, 3/15, 2/15, 1/15, switch off	
3GPP reference measurement channel	12.2 kbps, 64 kbps, 144 kbps, 384 kbps, 2048 kbps	
Frequency range	1850 MHz to 1910 MHz 1920 MHz to 1980 MHz	
Frequency resolution	0.1 Hz	
Output level range		
RF1	–130 dBm to –40 dBm	
RF2	–130 dBm to –23 dBm	
RF3OUT	–90 dBm to 0 dBm	
Output level uncertainty		
	+20°C to +35°C	+5°C to +45°C
RF1, RF2 ³) –125 dBm	<0.6 dB	<0.9 dB
RF3OUT ³) –80 dBm	<0.8 dB	<1.0 dB
Signal quality		
Error vector magnitude (EVM)	<8%	

General data

Operating temperature range	+5 °C to +45 °C
Storage temperature range	–25 °C to +60 °C
Display	21 cm TFT colour display (8.4")
Resolution	640 x 480 pixels (VGA resolution
Power supply	100 V to 240 V ± 10% (AC), 3.1 A to 1.3 A, 50 Hz to 400 Hz –5% to +10% power factor correction, EN61000-3-2
Power consumption	
Base unit	130 W
With typical options	180 W
Dimensions (W x H x D)	465 mm x 193 mm x 517 mm, (19"; 4 HU)
Weight	
Base unit	14 kg
With typical options	18 kg

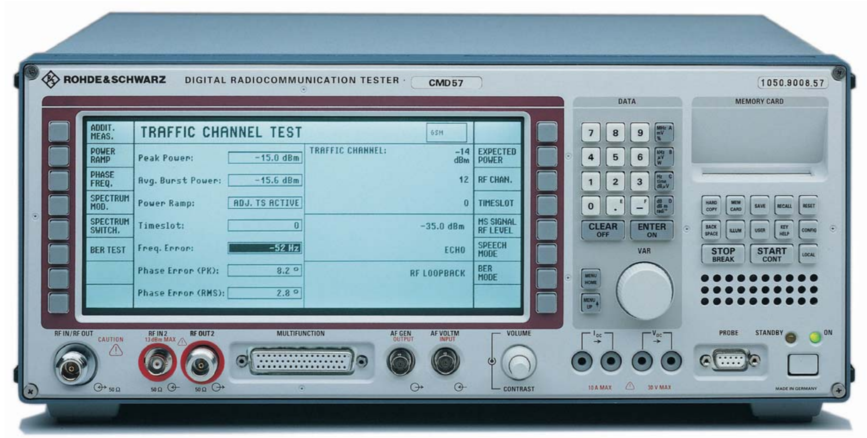
Ordering information

Radio Communication Tester	R&S CMU300	1100.0008.03
Accessories supplied	power cord, operating manual, service manual	
Options		
Reference OCXO	R&S CMU-B12	1100.5100.02
Additional RF and IF Connectors	R&S CMU-B15	1100.6006.02
Versatile Signalling Unit, supports multistandard signalling hardware	R&S CMU-B21	1100.5200.02
A_{bis} Interface, E1/T1 Protocol, for BER test only	R&S CMU-B71	1100.6406.02
Layer 1 Board for WCDMA	R&S CMU-B76 [9]	1150.06061.02
Software		
GSM400 BTS Measurement Software	R&S CMU-K30 [10]	1115.4004.02
GSM900 and E-GSM BTS Measurement Software	R&S CMU-K31 [10]	1115.4104.02
GSM1800 (DCS) BTS Measurement Software	R&S CMU-K32 [10]	1115.4204.02
GSM1900 (PCS) BTS Measurement Software	R&S CMU-K33 [10]	1115.4304.02
GSM850 BTS Measurement Software	R&S CMU-K34 [10]	1115.4791.02
8PSK Extension for all R&S CMU-K3X Packages	R&S CMU-K41 [10]	1115.4604.02
WCDMA Generator (3GPP FDD/UL)	R&S CMU-K76 [11]	1150.3300.02
Modification kits		
Layer 1 Board for WCDMA (3GPP FDD/UL) for retrofitting R&S CMU300 testers	R&S CMU-U76	1150.0701.02
3 ½" floppy disk drive instead of PCMCIA	R&S CMU-U61	1100.5500.02
Extras		
Documentation of Calibration Values	R&S CMU-DCV	0240.2193.08
30 MB Memory Card for use with PCMCIA interface	R&S CMU-Z1	1100.7490.02
520 MB Hard Disk PCMCIA Type 3	R&S PSM-B9	1064.5700.02
19" Rack Adapter	R&S ZAA-411	1096.3283.00

1) Valid for RF1 only.
2) Not valid at frequencies of net-clock harmonics.
3) 50 W (+5 °C to +30 °C), linear degradation down to 25 W at 45 °C.
4) Mean value of power versus time must be equal or less than allowed continuous power.
5) Calibrated for P>33 dBm only in frequency range 800 MHz to 2000 MHz.
6) Temperature range +5°C to +23°C or 35°C to 45°C and f>2200 MHz: add 0.2 dB.
7) With option R&S CMU-K41.
8) Specifications apply to all cases in which interfering carriers (up to the same level as the measured carrier) are more than 50 GSM channels spaced apart.
9) Factory-fitted only.
10) R&S CMU-B21 required.
11) R&S CMU-B76 required.

Digital Radiocommunication Tester R&S CMD57

For production, installation and service of GSM900/1800/1900 base stations



R&S CMD57 (photo 42367)

Brief description

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

- GSM900
- GSM1800
- GSM1900 optionally
- E-GSM
- UIC – European train radiotelephony

The main applications are:

- Module testing in production
- Final testing with A_{bis} control
- Installation with A_{bis} control
- Service with test mobile functionality

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

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

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

The key features at a glance

Characteristic/function	Benefit/application
Transmitter measurements	
Dynamic range >72 dB	Checking the power ramps and output spectrum of the BTS transmitter for compliance with the dynamic range specified by GSM
Measurement of power ramps	Checking the switching characteristics of the BTS transmitter
Phase and frequency error	Testing the modulation characteristics of the BTS transmitter including statistical function
Extremely fast measurement of spectrum due to modulation or switching	Detecting interference to the BTS transmitter at adjacent frequencies, due to modulation or switching
Receiver measurements	
Measurement of bit error rate (BER) via A_{bis}/IEEE bus/ RS-232-C interface, BTS loopback or R&S CMD loopback	Testing the BTS receiver characteristics by adaptation to specific implementation in the BTS
Measurement of adjacent timeslot rejection with up to 50 dB higher level	Measuring the automatic gain control (AGC) of the BTS with high level difference between used and adjacent timeslot; simulation of different BTS receive levels
Level error <1dB at –104 dBm	Reproducible and conclusive measurements even at low output levels especially at the sensitivity limits of the receiver

Digital Radiocommunication Tester R&S CMD57

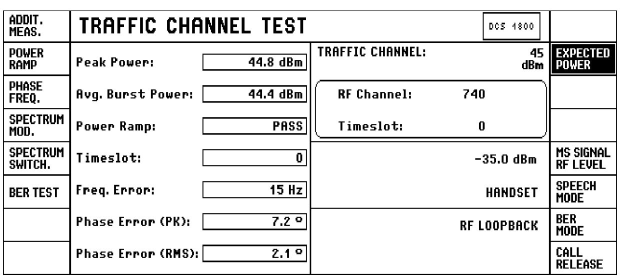
Characteristic/function	Benefit/application
Other measurements	
Echo test	Subjective test of speech quality with call established
Module test	Complete transmitter measurements even without signalling or time synchronization
Multifunction RF generator	Ideal for alignment of receiver modules
DC current and voltage measurement	Optimized for pulsed signals; replaces external measuring instruments
AF measurement facilities and 60-MHz frequency counter (optional)	Replaces external frequency counter; ideal for measuring reference frequencies
RF monitor with bandwidths of 30 kHz, 100 kHz	Replaces external spectrum analyzer
Simulation of fading effects	On request
Flexible use	
Various BTS synchronization facilities as to time and frequency	Easy integration of measuring instrument into operational environment and problem-free adaptation to the specific synchronization signals of a BTS
Remote control via RS-232-C and IEC/IEEE bus	SCPI-compatible for easy generation of user-specific control programs
Low cost of ownership	
Software update via interface	No need to open the instrument; simple download of the latest software version via the RS-232-C interface
3 years of warranty	The optional warranty allows the instruments to be utilized at calculable costs

Overview of options and extras

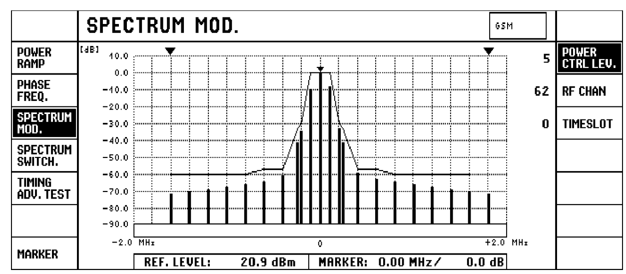
Designation	Brief description, recommendation	Option	Order No.
I/Q Modulator Output	For BER measurement on BTS receivers under conditions of fading (application note 1MA04_0E available on request). Generator/fading simulator SMIQ can be connected. Not useable with R&S CMD-B8 **and** R&S CMD-B2 together, but with R&S CMD-B8 **or** R&S CMD-B2 (only R&S CMD59)	**R&S CMD-B17**	1099.3003.02
GSM1900 Base Station Test	For testing GSM1900 base stations	**R&S CMD-B19**	1059.6201.02
OCXO Reference Oscillator	For highly demanding requirements on frequency stability. Oven crystal with highest long-term stability. Aging $3.5 \cdot 10^{-8}$	**R&S CMD-B2**	1059.8604.02
Reference Frequency Inputs/Outputs	For synchronizing DUT and measuring instrument with internal or external frequencies	**R&S CMD-B3**	1051.6202.02
AF Measurement Unit with Frequency Counter	This option includes an AF generator, a voltmeter, a distortion meter and a frequency counter for measurements on the audio interface or on modules. R&S CMD-B41 permits measurements up to 60 MHz as are required for LO alignment	**R&S CMD-B41**	1051.6902.02
Realtime Speech Coder/ Decoder	This option converts digital speech signals into analog signals (and vice versa) (in conjunction with R&S CMD-K1x, R&S CMD-K30 or R&S CMD-B8)	**R&S CMD-B52**	1115.8800.02
Adapter for R&S CMD-B6x Options	Required for operating the options R&S CMD-B61 and R&S CMD-B62	**R&S CMD-B6**	1051.7409.02
IEC/IEEE bus Interface	Alternative to standard RS-232-C interface for remote control of R&S CMD	**R&S CMD-B61**	1051.7609.02
Memory Card Interface	Memory cards are a versatile medium for storing instrument settings	**R&S CMD-B62**	1051.8205.02

Digital Radiocommunication Tester R&S CMD57

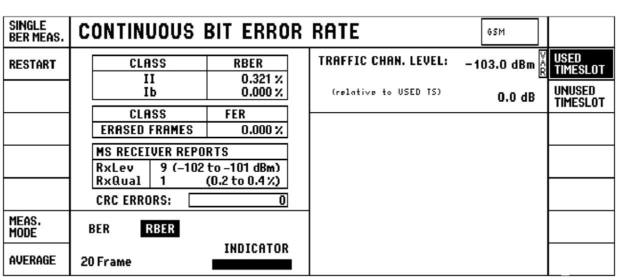
Designation	Brief description, recommendation	Option	Order No.
A_{bis} Interface	For sensitivity measurements; required for A_{bis} control. A_{bis} card for BER measurements at this interface	**R&S CMD-B71**	1115.8500.02
Modification Kit High-Level 2nd RF Output (9 dBm or 11 dBm)	For off-air measurements. The standard output level range of the second output is approx. –35 dBm to –120 dBm; the level range +9 dBm/+11 dBm to –60 dBm is offered alternatively (not usable with R&S CMD-U13)	**R&S CMD-U3**	1059.6501.02
Handset	Together with R&S CMD-B8 + R&S CMD-B5 allows to talk using R&S CMD in the same way as a mobile	**R&S CMD-Z50**	1059.4250.02
Transit Case	Robust case for transport R&S CMD with Rucksack R&S CMD-Z40	**R&S ZZK-014**	1013.9595.00



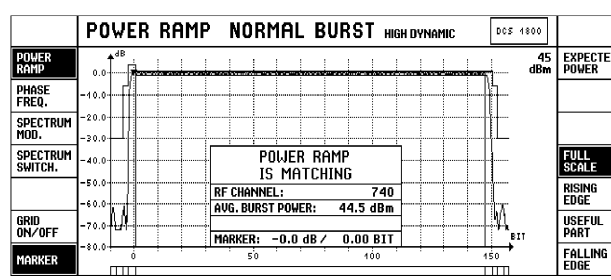
After synchronization to the base station and setting up of a traffic channel, all relevant RF parameters are immediately measured and displayed; this menu also allows a quick change of channel, power and timeslot as well as setting of R&S CMD transmission parameters



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



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



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

Digital Radiocommunication Tester R&S CMD 57

Specifications in brief

Timebase TCXO	standard
Nominal frequency	10 MHz
Frequency drift (0 to 35 °C)	$\leq 1.5 \times 10^{-6}$
Aging	$\leq 0.5 \times 10^{-6}$/year (at 35 °C)
Timebase OCXO	Option R&S CMD-B2
Nominal frequency	10 MHz
Frequency drift (0 to 50 °C) (referred to 25°C)	$\leq 5 \times 10^{-9}$
Aging after 30 days of operation and under constant operat. conditions	$\leq 3.5 \times 10^{-8}$/year; $\leq 5 \times 10^{-10}$/day
Warm-up time (at 25 °C)	approx. 10 min
RF generator	
Frequency range	GSM 900: 890.2 MHz to 914.8 MHz E-GSM 900: 880.2 MHz to 890.0 MHz GSM 1800: 1710.2 MHz to 1784.8 MHz GSM 1900[1)]: 1850.2 MHz to 1909.8 MHz
Frequency accuracy	same as timebase
Resolution	GSM channel spacing 200 kHz
Settling time	<3 ms for phase error <2°
Output level (RF IN/OUT)/(OUTPUT 2)	–35(–37[1)]) to –120 dBm
Modulation	GMSK, B x T = 0.3
Phase error	<4° rms, <10° peak
Peak power meter (RF IN/OUT)	
Frequency range	800 MHz to 1000 MHz 1700 MHz to 1900 MHz
Measurement range	0 dBm to 47 dBm
Maximum RF power	47 dBm pulsed, 45 dBm CW 47 dBm CW at room temperature
VSWR	≤1.3
Phase and frequency error measurement	
Frequency range	GSM 900: 935.2 MHz to 959.8 MHz E-GSM 900: 925.2 MHz to 935.0 MHz GSM 1800: 1805.2 MHz to 1879.8 MHz GSM 1900[1)]: 1930.2 MHz to 1989.8 MHz
Level range	
RF IN/OUT	0 dBm to 47 dBm
RF IN 2	–57 dBm (–51 dBm[1)]) to 0 dBm
Burst power measurement	
Frequency range	GSM 900: 935.2 MHz to 959.8 MHz E-GSM 900: 925.2 MHz to 935.0 MHz GSM 1800: 1805.2 MHz to 1879.8 MHz GSM 1900[1)]: 1930.2 MHz to 1989.8 MHz
Reference level for full dynamic range	
RF IN/OUT	GSM 900: 10 to 47 dBm GSM 1800/1900: 0 to 47 dBm
RF IN 2	–37 dBm (–31 dBm[1)]) to 0 dBm
High-dynamic burst analysis	
Relative error of individual test samples	≤1.5 dB to 72 dB below peak power
Dynamic range	>72 dB
Measurement limit RF IN/OUT	GSM 900: <–36 dBm GSM 1800: <–48 dBm GSM 1900: <–42 dBm
Measurement limit RF IN 2	GSM: <–83 dBm GSM 1800: <–85 dBm GSM 1900: <–79 dBm

GSM-specific measurements	
Spectrum due to modulation	
Test method	relative measurement, averaging
Resolution filter bandwidth	30 kHz
Measurement at an offset of	100/200/250/400/600/800/1000/1200/1400/1600 and 1800 kHz
Dynamic range	better than specified by GSM
for offset >400 kHz	max. 80 dB
Error	<±1.5 dB
Spectrum due to switching	
Test method	relative measurement, Max Hold over several measurements
Resolution filter bandwidth	30 kHz
Measurement at an offset of	400/600/1200 and 1800 kHz
Dynamic range	better than specified by GSM
for offset >400 kHz	max. 80 dB, with SW correction max. 76 dB, without SW correction
Error	≤1.5 dB (dynamic range <50 dBc) ≤2.5 dB (dynamic range 50 dBc to 80 dBc)
Multi-Reference Frequency Inputs	Outputs Option R&S CMD-B3
Synchronization input	
Frequency (selectable)	GSM bit clock (270.8 kHz), 2 /4/16 times GSM bit clock, 1 to 13 MHz in 1 MHz steps, 2.048/16.384/26/39/52 MHz
Impedance	approx. 100 W
Level	0 dBm to TTL
Synchronization output 1:	
Frequency	10 MHz with internal reference or frequency at synchronization input with external reference
Level	TTL, R_{out} = 50 Ω
Synchronization output 2	
Frequency (selectable)	GSM bit clock, 2/4/16 times GSM bit clock, 1/2/4 or 13 MHz
Level	TTL, R_{out} = 50 Ω
A_{bis} Interface	Option R&S CMD-B7
Receive channel (traffic/speech)	75 Ω/high-impedance, unbalanced; 120 Ω/high-impedance, balanced; 16 kbit/s, timeslot selectable
Interfaces	RS-232-C (9-pin), Centronics (25-pin)
DC voltmeter	0 to ±30 V
DC ammeter	current averaging with GSM-adapted time constant, current peak measurement (maximum and minimum)
Measurement range	0 to ±10 A
Common-mode rejection	±30 V
Resistance	50 mΩ
AF Measurement Unit	Option R&S CMD-B41
AF generator	
Frequency range	50 Hz to 10 kHz
Level range	10 µV to 5 V
Output impedance	<5 Ω
AF voltmeter	
Frequency range	50 Hz to 10 kHz
Measurement range	0.1 mV to 30 V
Input impedance	1 MΩ
Distortion meter	
Frequency range	300 Hz to 3 kHz
Input level range	100 mV to 30 V

Digital Radiocommunication Tester R&S CMD 57

AF counter

Frequency range	20 Hz to 10 kHz
Input level range	10 mV to 30 V
Resolution	≤1 Hz

IF counter

Frequency range	10 kHz to 60 MHz
Input level range	100 mV rms to TTL
Resolution	1 Hz

Multicarrier mode (Option R&S CMD-B8)

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

Typical filter characteristics in multicarrier mode

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

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

Phase and frequency error measurement

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

Measurement of peak power/burst power

Level error	≤1.5 dB

GSM-specific spectrum measurements

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

Typical effects of an interferer on power and modulation measurement results

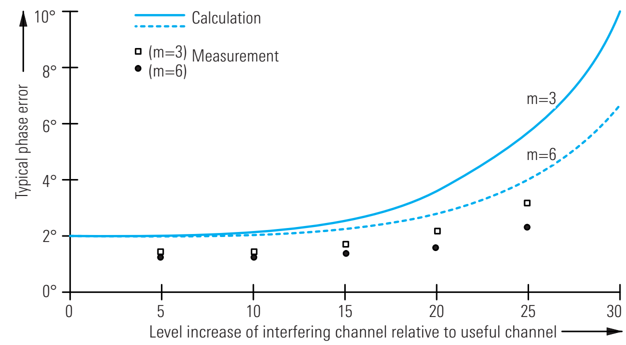
(see diagrams on the right). The characteristics of an interferer close to the carrier have the following effect on the measurement error:

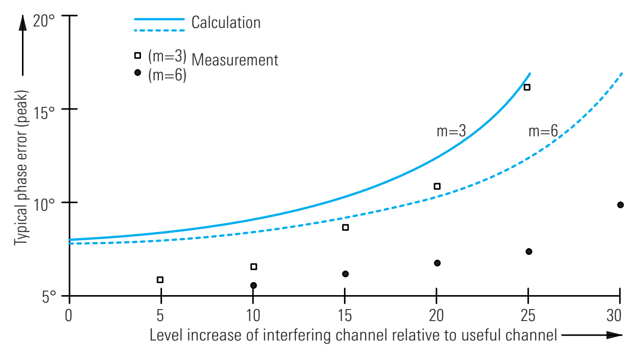
– Power: the lower the power of the interferer, the smaller the measurement error.
– Frequency offset: the larger the frequency offset of the interferer, the smaller the measurement error. In the diagrams on the right an interferer with an offset of m=3 or m=6 GSM channels has been assumed.
– Spectral purity: the narrower the modulation spectrum of the interferer, the smaller the measurement error. In the diagrams on the right the modulation spectrum to GSM 05.05 with linear interpolation (in the dB/Hz coordinates) has been used (worst case spectrum).
– Number of carriers: the fewer the carriers, the smaller the measurement error. In the example, 1 interferer has been assumed.

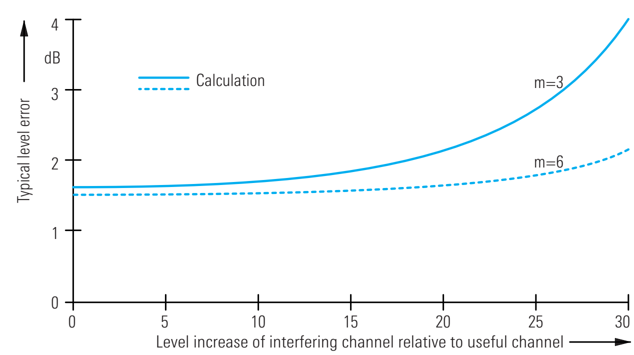
The curves shown in the diagrams have been **calculated** assuming the worst case spectrum as interferer, the warranted R&S CMD-B8 specifications for phase and power measurement and a typical IF filter characteristic.
The **measured values** are based on a real GSM spectrum, typical R&S CMD-B8 specifications and typical filter characteristic.

General data

Rated temperature range	0 to +45 °C to DIN IEC 68-2-1/2
Storage temperature range	–40 to +60 °C







Phase and level error as a function of adjacent-channel power and adjacent-channel frequency offset

Power supply	100 to 120 V AC ±10% 200 to 240 V AC ±10% 50 to 400 Hz ±5%
Power consumption (without options)	approx. 85 W
Dimensions (W x H x D)	435 mm x 192 mm x 363 mm
Weight (without options)	approx. 14 kg

Ordering information

Digital Radiocommunication Tester	R&S CMD 57	1050.9008.57
Accessories supplied	power cable, operating manual, fuses	
Options	see overview of options on page 30	

1) In GSM 1900 mode with option R&S CMD-B19 fitted.

Universal Protocol Tester R&S CRTU-G

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

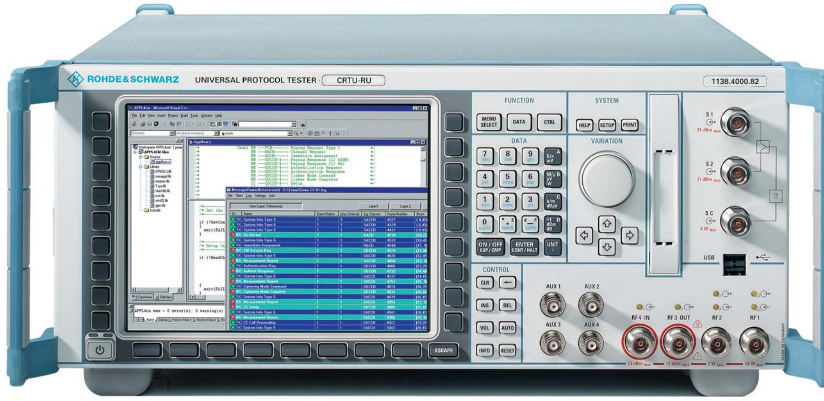


Photo 43667-2

Brief description

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

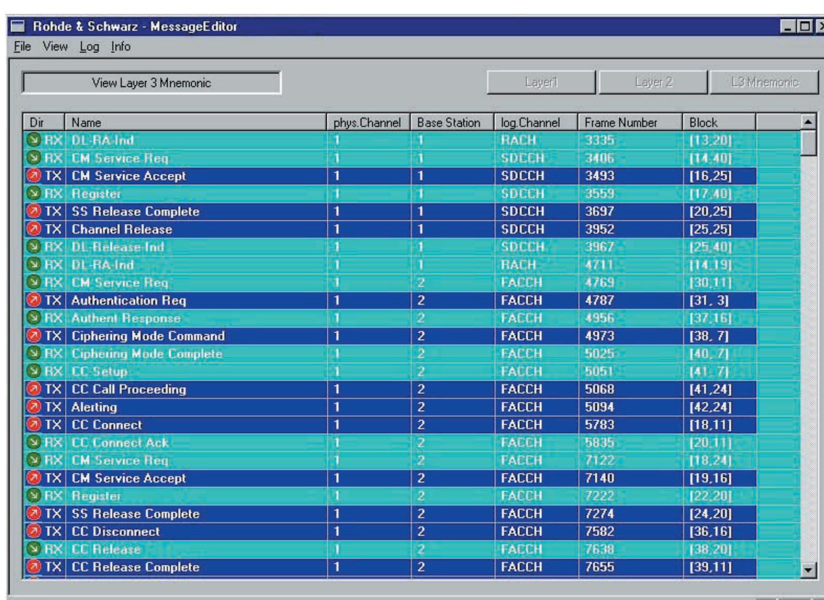
Conformance testing of GSM mobiles
The conformance test of GSM mobiles is based on the test cases defined by 3GPP in specification 51.010. A large number of these test cases have been validated for Rohde & Schwarz by independent test houses and are available for the R&S CRTU-G. Easy-to-use tools, automated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

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

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

Controlling further measuring instruments – multimode tests
The R&S CRTU-G can assume controller functions in test systems comprising several measuring instruments. Control of further instruments via IEEE, COM or Ethernet can be incorporated in test programs. In combination with the CMU 200, handover scenarios to different standards such as IS-136 or CDMA are possible.

Multicell/multichannel systems
Up to four R&S CRTU-G testers can be interconnected for tests requiring more than two channels. Multichannel sys-



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

Universal Protocol Tester R&S CRTU-G

tems capable of handling even complex test scenarios are thus easily configured. All channels are fully synchronized. RF signal routing and transmitter power control are already integrated in the testers so that no extra hardware is required. All testers are controlled via a single test application (see R&S CRTU-S for more details).

Tests under fading conditions using Baseband Fading Simulator ABFS

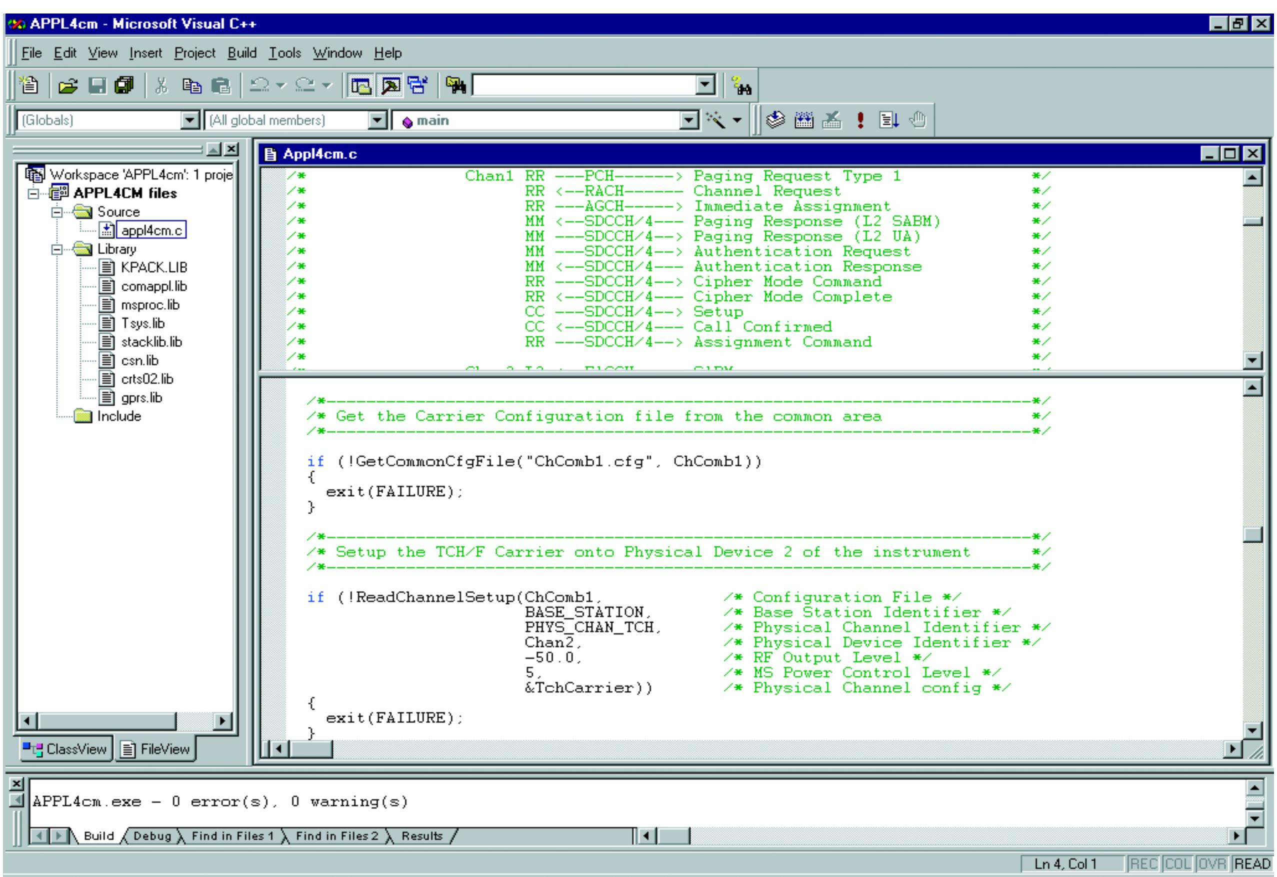
Using the optional IQ/IF interface card, a baseband fading simulator (e.g. the ABFS from Rohde & Schwarz) can be inserted into the signal path to perform fading tests on the DUT. Use of the R&S CRTU-G frontend ensures high level accuracy.

Main features

- Simulation of a GSM cell with two independent channels
- Up to four GSM timeslots per RF channel for GPRS
- Enhancement to multicell systems
- EDGE and software-controlled modulators/demodulators
- Predefined ETSI test cases available
- Platform for validated 3GPP 51.010 test cases
- Programming interface for user-defined tests
- Detailed analysis of messages at various protocol layers
- Customized solution can be further enhanced
- Individual software configuration
- High broadband RF accuracy
- Fit for the future
  - Upgradable to new standards
- Compact single-box, single-supplier solution with Windows 2000 operating system
- Standard PC interfaces and software installation
- Easy and fast calibration
- Upgradable to WCDMA

Tools

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



Program examples and the 3GPP test cases supplied in source code can be modified for customized tests. Programs are generated in Visual C++ with debugging tools

Universal Protocol Tester R&S CRTU-G

Windows PC, using optionally the tools described below.

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

GSM Phase 2+ Operational Software R&S CR02P2P

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

The tester comes with

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

That software options can be added

- GPRS including EDGE (incremental redundancy, link adaptation)
- AMR
- Circuit-switched single-slot data transfer NTDS (RLP)
- GSM 850
- LCS (EOTD)

Upgrade service

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

Specifications in brief

Inband GSM specifications

RF generator

Modulation	GMSK, B x T = 0.3; 8PSK
Frequency range	
GSM 400 band	460 MHz to 468 MHz 488 MHz to 496 MHz
GSM850 band	869 MHz to 894 MHz
GSM900 band	921 MHz to 960 MHz
GSM1800 band	1805 MHz to 1880 MHz
GSM1900 band	1930 MHz to 1990 MHz
Attenuation of inband spurious emissions	>50 dB
Inherent phase error (GMSK)	<1°, rms, <4°, peak
Inherent EVM (8PSK)	<2%, rms
Frequency settling time	<500 µs to res. phase of 4°
Output level range (GMSK)	
RF1	–130 dBm to –33 dBm
RF2	–130 dBm to –16 dBm
RF3OUT	–90 dBm to + 5 dBm
Output level range (8PSK)	
RF1	–130 dBm to –37 dBm
RF2	–130 dBm to –20 dBm
RF3OUT	–90 dBm to +1 dBm
Output level uncertainty inband	
RF1, RF2 at >–117 dBm	<0.7 dB (+23°C to +35°C)
RF3OUT	
–90 dBm to +5 dBm (GMSK)	
–90 dBm to +1 dBm (8PSK)	<0.9 dB (+23°C to +35°C)

RF receiver

Frequency range	
GSM 400 band	450 MHz to 458 MHz 478 MHz to 486 MHz
GSM850 band	824 MHz to 849 MHz
GSM900 band	876 MHz to 915 MHz
GSM1800 band	1710 MHz to 1785 MHz
GSM1900 band	1850 MHz to 1910 MHz
Inherent phase error (GMSK)	<0.6°, rms; <2°, peak
Inherent EVM (8PSK)	<1.0 %, rms
Reference level for full dynamic range	
GMSK	
RF1	+10 dBm to +53 dBm[1)]
RF2	–4 dBm to +39 dBm[2)]
RF4IN	–22 dBm to 0 dBm
8PSK	
RF1	+6 dBm to +49 dBm[1)]
RF2	–8 dBm to +35 dBm[2)]
RF4IN	–26 dBm to –4 dBm

Base unit specifications

Timebase OCXO

Max. frequency drift (+5°C to +45°C)	±5 x 10^{-9} referred to +25°C
Max. aging	±3.5 x 10^{-8}/year

1) Max. continuous input power 50 W, temperature range +5°C to +30°C, linear degradation down to 25 W at +45°C.

2) Max. continuous input power 2 W.

Universal Protocol Tester R&S CRTU-G

Reference frequency inputs/outputs

Synchronization input	
Sinewave	1 MHz to 52 MHz, step 1 kHz
Squarewave (TTL level)	10 kHz to 52 MHz, step 1 kHz
Input voltage range	0.5 V to 2 V, rms
Synchronization output 1	10 MHz from internal reference or frequency at synchronization input
Output voltage	>1.4 V, peak-peak
Synchronization output 2	net-specific frequencies in range 100 kHz to 40 MHz
Output voltage (f ≤13 MHz)	>1.0 V, peak-peak

RF generator

Frequency range	100 kHz to 2700 MHz		
Frequency resolution	0.1 Hz		
Frequency settling time	<400 µs to Δf <1kHz		
Output level uncertainty			
RF1, RF2 (+23°C to +35°C)	>–106 dBm	>–117 dBm	–117 to –130 dBm
10 MHz to 450 MHz	<0.8 dB		
450 MHz to 2200 MHz	<0.8 dB	<0.8 dB	<1.7 dB
2200 MHz to 2700 MHz	<1.0 dB	<1.0 dB	<1.7 dB
RF3OUT (+23°C to +35°C)			
10 MHz to 450 MHz	<1.0 dB (–80 dBm to +10 dBm)		
450 MHz to 2200 MHz	<1.0 dB (–90 dBm to +10 dBm)		
2200 MHz to 2700 MHz	<1.2 dB (–90 dBm to +5 dBm)		
Output level settling time	<4 µs		
Output level resolution	0.1 dB		
RF level repeatability (RF1, RF2, RF3OUT, typical values after 1 h warmup)			
Output ≥–80 dBm	<0.01 dB		
Output <–80 dBm	<0.1 dB		
VSWR			
RF1 (10 MHz to 2000 MHz)	<1.2		
RF2 (10 MHz to 2200 MHz)	<1.2		
RF3OUT (10 MHz to 2200 MHz)	<1.5		
Attenuation of harmonics (f_0 = 10 MHz to 2200 MHz, up to 7 GHz)			
RF1, RF2	>30 dB		
RF3OUT (P ≤+10 dBm)	>20 dB		
Attenuation of nonharmonics			
10 MHz to 2200 MHz	>40 dB at >5 kHz from carrier		
Phase noise (single sideband, f <2.2 GHz), carrier offset			
20 kHz to 250 kHz	<–100 dBc (1 Hz)		
≥250 kHz	<–110 dBc (1 Hz)		
Residual FM			
30 Hz to 15 kHz	<50 Hz (rms), <200 Hz (peak)		
CCITT	<5 Hz (rms)		
Residual AM, CCITT	<0.02% (rms)		
IQ modulation, data for frequency offset range 0 Hz to ±135 kHz			
Carrier suppression	>40 dB		

RF receiver

VSWR	
RF1 (10 MHz to 2000 MHz)	<1.2
RF2 (10 MHz to 2200 MHz)	<1.2
RF4IN (10 MHz to 2200 MHz)	<1.5
Phase noise (single sideband, f <2.2 GHz), carrier offset	
20 kHz to 250 kHz	<–100 dBc (1 Hz)
250 kHz to 400 kHz	<–110 dBc (1 Hz)
≥400 kHz	<–118 dBc (1 Hz)
Residual FM	
30 Hz to 15 kHz	<50 Hz (rms), <200 Hz (peak)
CCITT	<5 Hz (rms)
Residual AM, CCITT	<0.02% (rms)

Power splitter

Insertion loss, SC/S1, SC/S2	
400 MHz to 2200 MHz	<7 dB
VSWR	
SC (400 MHz to 2200 MHz)	<1.3
S1, S2 (2200 MHz to 2700 MHz)	<1.6
Isolation, S1/S2	
400 MHz to 2200 MHz	>17 dB
Max. continuous power	
SC	4 W
S1/S2	21 dBm

Audio

Full range input level	0.079 V (rms)
Input impedance	100 kΩ
Full range output level	0.79 V (rms)
Output impedance	<2 Ω

Inputs and outputs (rear panel)

IEC/IEEE–bus remote control interface	24-pin Amphenol (IEC625-2 (IEEE 488.2))
Serial interface COM1, COM2	RS-232-C (COM), 9-pin sub-D connector
Printer interface LPT	parallel (Centronics-compatible)
Mouse/Keyboard connector	PS/2
Connector for ext. monitor (VGA)	15-pin sub-D connector
USB	double connector
Ethernet	RJ45

Trigger/clock signals

Input (BNC): Trig In A, Trig In B	TTL, 1 kΩ
Output (BNC): Trig Out A, Trig Out B, SLOT CLK, BIT CLK	TTL, 50 Ω

General data

Rated temperature range	+5°C to +45°C
Storage temperature range	–25°C to +60°C
Display	21 cm TFT colour display (8.4")
Resolution	640 x 480 pixels (VGA resolution)
Pixel failure rate	$<2 \times 10^{-5}$
Power supply	100 V to 240 V ±10% (AC), 50 Hz to 400 Hz –5% to +10%
Power consumption	max. 500 W, base unit 200 W typ.
Dimensions (W x H x D); weight	465 mm x 193 mm x 517 mm (19"; 4 height units); 20 kg

Ordering information

Universal Protocol Tester	R&S CRTU-G	1140.0009.02

Equipment supplied

Radio Unit	R&S CRTU-RU
Link Handler (2 pieces)	R&S CRTU-B5
MAC/Speech Board	R&S CRTU-B6
Test SIM Phase 2+	R&S CRT-Z2
Operational Software	R&S CR02P2P

Accessories supplied

VGA monitor, keyboard, mouse, USB/SCSI host adapter, CD-ROM drive, hardlock

Option

2-channel IQ/IF Interface Card	R&S CRTU-B7	1139.0009.02

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

Protocol Tester R&S CRTU-S

Cost-effective multibox and data application testing

New

Photo 43913-2

Brief description

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

Conformance testing of GSM mobiles

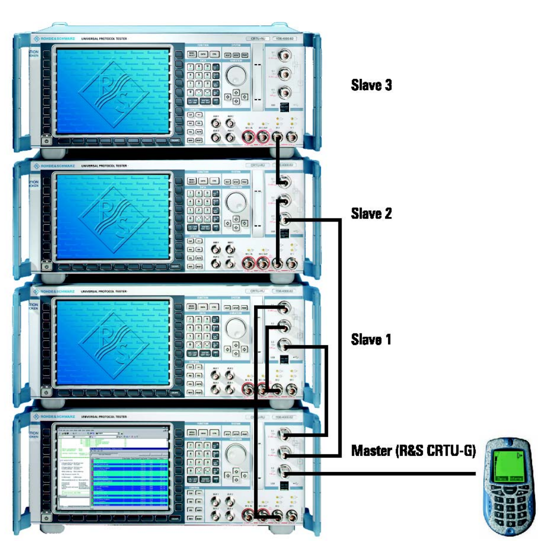
The conformance test of GSM mobiles is based on the test cases defined by 3GPP in specification 51.010. Using an R&S CRTU-G/R&S CRTU-S multichannel solution, the test cases can be expanded to handover, cell selection and cell reselection as well as to other multichannel tests. A large number of these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

Main features

- Enhancement for multichannel tests on R&S CRTU-G
- Platform for data application testing
- Simulation of a GSM cell with two independent channels
- Detailed analysis of messages at various protocol layers
- Fit for future mobile radio standards
- Upgradable to R&S CRTU-G
- Cost-effective solution for multichannel tests
- Platform for reproducible data tests
- User-friendly network simulation for cost-saving application tests
- GSM 850, 900,1800, 1900
- GPRS, EGPRS
- FTP server
- Message viewer for analysis of layer 1, 2, 3
- Layer 1 EDGE tool supporting all EDGE coding schemes
- Compact single supplier solution with Windows 2000 operating system
- Upgradable to R&S CRTU-G and generation of user-specific test cases possible

Multibox scenarios

In conjunction with the R&S CRTU-G, the R&S CRTU-S is a cost-effective test solution for up to eight RF channels. The R&S CRTU-G simulates a GSM base station and records all messages sent to and received from a mobile station. This allows detailed analysis of the protocol stack in the mobile station even under complex multichannel conditions. The R&S CRTU-S is entirely controlled by the R&S CRTU-G and needs no additional control. One R&S CRTU-G unit can control up to three R&S CRTU-S units. The testers



Protocol Tester R&S CRTU-S

are interconnected via the integrated and calibrated RF combiners and TCP/IP cables. There is no need to use external RF components. The messages of the protocol stack can be modified by the user. It is possible, for example, to simulate network errors and analyze a mobile station's response. To test partially implemented protocol stacks in the mobile, the R&S CRTU-G allows sections of the stack to be bypassed.

Data application testing

The R&S CRTU-S is a cost-effective platform for application testing. Through the use of an additional software module specially developed by Analytek Ltd. (a long term partner of Rohde & Schwarz for GSM protocol testing) for the R&S CRTU-G/S units, the R&S CRTU-S becomes a network simulator that is able to provide services such as I-Mode, WAP, MMS, SMS and Internet access requested by mobile phone. Neither mobile radio nor programming knowledge are thus required to test applications and their performance in the mobile phone. The reproducible conditions under which the mobile phone can be tested are the only crucial factor. This application eliminates the need for dialling into a real network and thus the associated costs.

Specifications in brief

Inband GSM specifications

RF generator	
Modulation	GMSK, B x T = 0.3, 8PSK
Frequency range	
GSM400 band	460 to 468 MHz/488 MHz to 496 MHz
GSM850 band	869 MHz to 894 MHz
GSM900 band	921 MHz to 960 MHz
GSM1800 band	1805 MHz to 1880 MHz
GSM1900 band	1930 MHz to 1990 MHz
Attenuation of inband spurious emissions	>50 dB
Inherent phase error (GMSK)	<1°, rms, <4°, peak
Inherent EVM (8PSK)	<2%, rms
Frequency settling time	<500 µs to res. phase of 4°
Output level range (GMSK)	
RF1	–130 dBm to –33 dBm
RF2	–130 dBm to –16 dBm
RF3OUT	–90 dBm to + 5 dBm
Output level range (8PSK)	
RF1	–130 dBm to –37 dBm
RF2	–130 dBm to –20 dBm
RF3OUT	–90 dBm to +1 dBm
Output level uncertainty inband (+23°C to +35°C)	
RF1, RF2 at >–117 dBm	<0.7 dB
RF3OUT	
–90 dBm to +5 dBm (GMSK)	<0.9 dB
–90 dBm to +1 dBm (8PSK)	<0.9 dB

RF receiver	
Frequency range	
GSM400 band	450 to 458 MHz/478 MHz to 486 MHz
GSM850 band	824 MHz to 849 MHz
GSM900 band	876 MHz to 915 MHz
GSM1800 band	1710 MHz to 1785 MHz
GSM1900 band	1850 MHz to 1910 MHz
Inherent phase error (GMSK)	<0.6°, rms, <2°, peak
Inherent EVM (8PSK)	<1.0 %, rms
Reference level for full dynamic range GMSK	
RF1	+10 dBm to +53 dBm [1]
RF2	–4 dBm to +39 dBm [2]
RF4IN	–22 dBm to 0 dBm
8PSK	
RF1	+6 dBm to +49 dBm [1]
RF2	–8 dBm to +35 dBm [2]
RF4IN	–26 dBm to –4 dBm

Base unit specifications

Timebase OCXO	
Max. frequency drift (+5°C to +45°C)	±5 x 10^{-9} referred to +25°C
with instrument orientation	±3 x 10^{-9}
Max. aging	±3.5 x 10^{-8}/year

Reference frequency inputs/outputs	
Synchronization input	BNC connector REFIN, 50 Ω
Sinewave	1 MHz to 52 MHz, step 1 kHz
Squarewave (TTL level)	10 kHz to 52 MHz, step 1 kHz
Max. frequency variation	±5 x 10^{-6}
Input voltage range	0.5 V to 2 V, rms, 50 Ω
Synchronization output 1	BNC connector REFOUT1
Frequency	10 MHz from internal reference or frequency at synchronization input
Output voltage	>1.4 V, peak-peak
Synchronization output 2	BNC connector REFOUT2, 50 Ω
Frequency	net-specific frequencies in range 100 kHz to 40 MHz
Output voltage (f ≤13 MHz)	>1.0 V, peak-peak

RF generator			
Frequency range	100 kHz to 2700 MHz		
Frequency resolution	0.1 Hz		
Frequency uncertainty	same as timebase + resolution		
Frequency settling time	<400 µs to Δf <1kHz		
Output level uncertainty (+23°C to +35°C)			
RF1, RF2	>–106	>–117 dBm	–117 to –130 dBm
10 MHz to 450 MHz	<0.8 dB		
450 MHz to 2200 MHz	<0.8 dB	<0.8 dB	<1.7 dB
2200 MHz to 2700 MHz	<1.0 dB	<1.0 dB	<1.7 dB

1) Max. continuous input power 50 W, in temperature range +5°C to +30°C, linear degradation down to 25 W at +45°C.

2) Max. continuous input power 2 W.

Protocol Tester R&S CRTU-S

RF3OUT	
10 MHz to 450 MHz	<1.0 dB (–80 dBm to +10 dBm)
450 MHz to 2200 MHz	<1.0 dB (–90 dBm to +10 dBm)
2200 MHz to 2700 MHz	<1.2 dB (–90 dBm to +5 dBm)
Output level settling time	<4 µs
Output level resolution	0.1 dB
Generator RF level repeatability (RF1, RF2, RF3OUT, typical values after 1 h warmup)	
Output ≥–80 dBm	<0.01 dB
Output <–80 dBm	<0.1 dB
VSWR	
RF1 (10 MHz to 2000 MHz)	<1.2
RF2 (10 MHz to 2200 MHz)	<1.2
RF3OUT (10 MHz to 2200 MHz)	<1.5
Attenuation of harmonics (f_0 = 10 MHz to 2200 MHz, up to 7 GHz)	
RF1, RF2	>30 dB
RF3OUT (P ≤+10 dBm)	>20 dB
Attenuation of nonharmonics, 10 to 2200 MHz, >5 kHz from carrier	>40 dB
Phase noise (single sideband, f <2.2 GHz)	
Carrier offset	
20 kHz to 250 kHz	<–100 dBc (1 Hz)
≥250 kHz	<–110 dBc (1 Hz)
Residual FM	
30 Hz to 15 kHz	<50 Hz (rms), <200 Hz (peak)
CCITT	<5 Hz (rms)
Residual AM, CCITT	<0.02% (rms)
IQ modulation, data for frequency offset range 0 kHz to ±135 kHz	
Carrier suppression	>40 dB

RF receiver

VSWR	
RF1 (10 MHz to 2000 MHz)	<1.2
RF2 (10 MHz to 2200 MHz)	<1.2
RF3OUT (10 MHz to 2200 MHz)	<1.5
Phase noise (single sideband, f <2.2 GHz)	
Carrier offset 20 kHz to 250 kHz	<–100 dBc (1Hz)
Carrier offset 250 kHz to 400 kHz	<–110 dBc (1Hz)
Carrier offset ≥400 kHz	<–118 dBc (Hz)
Residual FM	
30 Hz to 15 kHz	<50 Hz (rms), <200 Hz (peak)
CCITT	<5 Hz (rms)
Residual AM, CCITT	<0.02% (rms)

Power splitter (400 MHz to 2200 MHz)

Insertion loss, SC/S1, SC/S2	<7 dB
VSWR	
SC	<1.3
S1,S2	<1.5
Isolation, S1/S2	>17 dB
Max. continuous power	
SC	4 W
S1/S2	21 dBm

Audio

Input connector AUX1	BNC, 100 kΩ
Full range input level	0.079 V (rms)
Output connector AUX2	BNC, <2 Ω
Full range output level	0.79 V (rms)

Inputs and outputs (rear panel)

Remote control interface	IEC 625-2 (IEEE 488.2)
Serial interface COM1, COM2	RS-232-C (COM), 9-pin sub-D connector
Printer interface LPT	parallel (Centronics-compatible)
Mouse/Keyboard connector	PS/2
Connector for ext. monitor (VGA)	15-pin sub-D connector
USB	double connector
Ethernet	RJ45

Trigger/clock signals

Input: Trig In A, Trig In B	BNC connectors, 1 kΩ, TTL
Output: Trig Out A, Trig Out B, SLOT CLK, BIT CLK	BNC connectors, 50 Ω, TTL

General Data

Display	21 cm TFT colour display (8.4")
Resolution	640 x 480 pixels (VGA resolution)
Pixel failure rate	$<2 \times 10^{-5}$
Rated temperature range	+5°C to +45°C
Storage temperature range	–25°C to +60°C
Power supply	100 V to 240 V ±10% (AC), 500 VA, 50 Hz to 400 Hz –5% to +10% power factor correction, 200 W
Dimensions (W x H x D); weight	465 mm x 193 mm x 517 mm (19"; 4 height units); 20 kg

Ordering Information

Test equipment for Protocol verification of GSM Mobiles	R&S CRTU-S	1140.0009.82

Equipment supplied

Radio Unit	R&S CRTU-RU
Link handler (2 pieces)	R&S CRTU-B5
MAC/speech board	R&S CRTU-B6
Test SIM phase 2+	R&S CRT-Z2
Operational software	R&S CR02P2P

VGA monitor, keyboard, mouse, USB/SCSI host adapter, CD-ROM drive, hardlock

Option

2-channel IQ/IF interface card for R&S CRTU-S	R&S CRTU-B7	1139.0009.02

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

Protocol Tester R&S CRTU-W

Protocol test solution for 3G user equipment (UE)

New

Photo 43914-2

Brief description

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

Powerful tools enable the user to define and execute TTCN test cases according to 3GPP test specification TS 34.123, and to visualize the test results. In addition, customer-specific test scenarios can be implemented in TTCN or C++.

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

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

Main features

- 2 RF channels/simulation of 2 WCDMA (FDD) cells
- Platform for 3GPP signalling test cases acc. to TS 34.123
- Detailed analysis of all protocol layers at U_u interface
- TTCN toolbox support
- C/C++ API for test script development
- Upgradable to GSM/GPRS
- Upgrading of existing R&S CRTU-G to WCDMA possible
- Intersystem handover testing

R&S CRTU-VT (see page 45)

For starting into 3GPP protocol testing, Rohde & Schwarz has enhanced its R&S CRTU product family. The 3GPP WCDMA Virtual Tester R&S CRTU-VT tests the protocol behaviour of UE above the physical layer using the same powerful tools like the R&S CRTU-W.

Test cases that have been verified/validated for the R&S CRTU-W can be implemented with the R&S CRTU-VT via a TCP/IP link. A clearly defined interface allows fast linkup of the R&S CRTU-VT.

R&S CRTU-W Tools

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

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

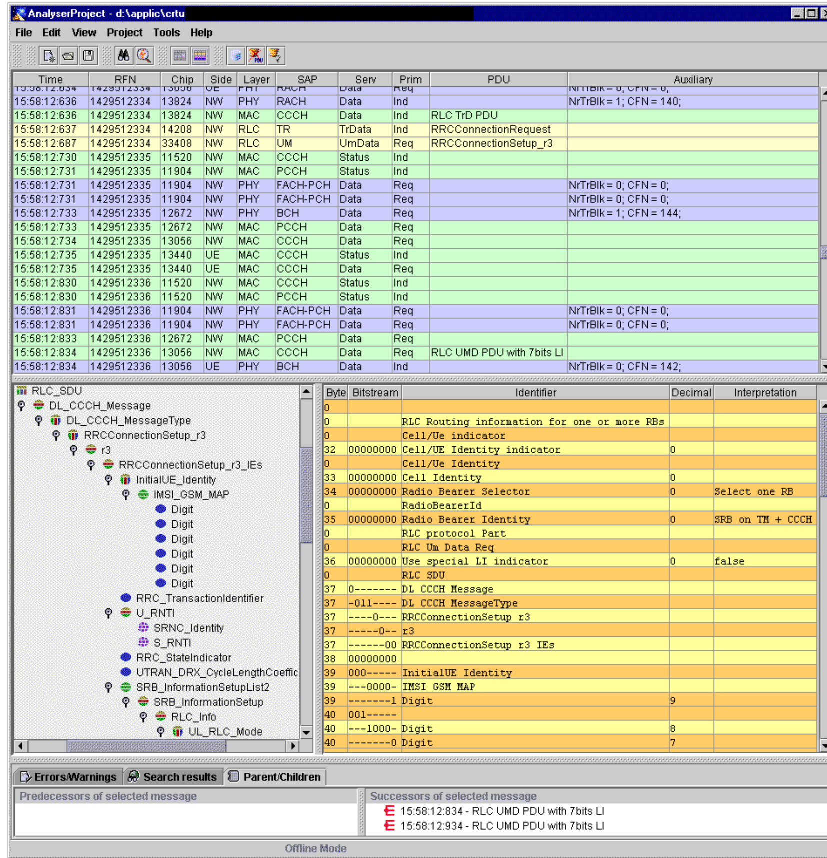
Project Explorer

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

In addition to handling test cases, the Project Explorer can be used to configure the hardware or reference implementations.

The Project Explorer also controls the complete run of the test session.

Protocol Tester R&S CRTU-W



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

Message Analyzer

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

Another powerful feature of the Message Analyzer is the message sequence chart.

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

Test Case Analyzer

The Test Case Analyzer allows analysis of the automatically generated test case result file. This file contains all information about the messages sent or received by the test case, as well as all information about timer and configuration. The TTCN Editor can be started with a hyperlink during the analysis. The corresponding TTCN source code is displayed within the TTCN Editor. Full and in-depth analysis of the test case result file is possible.

TTCN Editor

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

Technical details

RF

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

DL physical channels

- Up to 16 physical channels in parallel per cell
- CPICH
- P-/S-SCH
- P-CCPCH
- S-CCPCH
- PICH
- AICH
- n * DPCH + OCNS with m channels
- Power level can be set for each physical channel separately

Protocol Tester R&S CRTU-W

UL physical channels
- PRACH
- DPCCH
- 6 * DPDCH

Physical layer – transport channels
- DL transport channels
  - BCH, PCH, FACH
  - Up to 8 DCH with 384 kbit/s (single code and multicode) Service multiplexing
- UL transport channels
  - RACH
  - Up to 8 DCH with 384 kbit/s (single code, service multiplexing)

Reference implementations of
- MAC
- RLC
- RRC

Specifications in brief

Standard

Standard	3GPP-FDD, 3.84 Mcps

RF Generator

Modulation	According to standard 3.84 MHz, RRC, α = 0.22
Frequency range	2110 MHz to 2170 MHz
Channel spacing	5 MHz
Channel raster	200 kHz
Output level range (rms value, 10 MHz to 2200 MHz, max. value depends on channel configuration)	
RF1	–120 dBm to –27 dBm
RF2	–120 dBm to –10 dBm
RF3OUT	–80 dBm to +13 dBm
Output level rang (PEP value, 10 MHz to 2200 MHz, max. value depends on channel configuration)	
RF1	–120 dBm to –19 dBm
RF2	–120 dBm to –2 dBm
RF3OUT	–80 dBm to +13 dBm
Output level uncertainty	See specifications of Radio Unit
Output level resolution	0.1 dB

RF Receiver

Demodulation	Receiver filter according to standard 3.84 MHz, RRC, α = 0.22
Frequency range	1920 MHz to 1980 MHz
Channel spacing	5 MHz
Channel raster	200 kHz
PEP and rms values for WCDMA-modulated signals, rms value of WCDMA signal must not exceed the continuous power value	
RF1, continuous power[1)]	0 dBm to +47 dBm
RF1, peak envelope power (PEP)	0 dBm to +53 dBm
RF2, continuous power	–14 dBm to +33 dBm
RF2, peak envelope power (PEP)	–14 dBm to +39 dBm
RF4IN, continuous power	–37 dBm to 0 dBm
RF4IN, peak envelope power (PEP)	–37 dBm to 0 dBm
Dynamic of demodulator	Reference level (PEP) down to –30 dB

Specifications of Radio Unit R&S CRTU-RU

(In some cases the R&S CRTU-W uses only partial functionality)

Timebase OCXO

Max. frequency drift (+5 °C to +45 °C)	$\pm 5 \times 10^{-9}$, referred to +25 °C
Max. aging	$\pm 3.5 \times 10^{-8}$ /year
Warm-up time at +25 °C	Approx. 10 min

Reference Frequency Inputs/Outputs

Synchronization input	BNC connector REFIN, 50 Ω
Sinewave signal	1 MHz to 52 MHz, step 1 kHz
Squarewave signal (TTL level)	10 kHz to 52 MHz, step 1 kHz
Input voltage range (sinewave)	0.5 V to 2 V (rms)
Synchronization output 1	BNC connector REFOUT1, 50 Ω
Frequency (internal reference mode)	10 MHz from internal reference
Frequency (external reference mode)	Frequency of synchronization input
Output voltage	>1.4 V (peak-peak)
Synchronization output 2	BNC connector REFOUT2, 50 Ω
Frequency (WCDMA mode)	30.72 MHz
Synchronization output 3	BNC connector REFOUT3, 50 Ω
Frequency (WCDMA mode)	15.36 MHz

RF generator

Frequency range	100 kHz to 2700 MHz		
Frequency resolution	0.1 Hz		
Frequency settling time	<400 μs to Δf <1kHz		
Output level uncertainty			
RF1, RF2 (+23°C to +35°C)	>–106 dBm	>–117 dBm	–117 to –130 dBm
10 MHz to 450 MHz	<0.8 dB		
450 MHz to 2200 MHz	<0.8 dB	<0.8 dB	<1.7 dB
2200 MHz to 2700 MHz	<1.0 dB	<1.0 dB	<1.7 dB
RF3OUT (+23°C to +35°C)			
10 MHz to 450 MHz	<1.0 dB (–80 dBm to +10 dBm)		
450 MHz to 2200 MHz	<1.0 dB (–90 dBm to +10 dBm)		
2200 MHz to 2700 MHz	<1.2 dB (–90 dBm to +5 dBm)		
Output level settling time	<4 μs		
Output level resolution	0.1 dB		
RF level repeatability (RF1, RF2, RF3OUT, typical values after 1 h warmup)			
Output ≥–80 dBm	<0.01 dB		
Output <–80 dBm	<0.1 dB		

Protocol Tester R&S CRTU-W

VSWR	
RF1 (10 MHz to 2000 MHz)	<1.2
RF2 (10 MHz to 2200 MHz)	<1.2
RF3OUT (10 MHz to 2200 MHz)	<1.5
Attenuation of harmonics (f_0 = 10 MHz to 2200 MHz, up to 7 GHz)	
RF1, RF2	>30 dB
RF3OUT (P ≤+10 dBm)	>20 dB
Attenuation of nonharmonics	
10 MHz to 2200 MHz	>40 dB at >5 kHz from carrier
Phase noise (single sideband, f <2.2 GHz), carrier offset	
20 kHz to 250 kHz	<–100 dBc (1 Hz)
≥250 kHz	<–110 dBc (1 Hz)
Residual FM	
30 Hz to 15 kHz	<50 Hz (rms), <200 Hz (peak)
CCITT	<5 Hz (rms)
Residual AM, CCITT	<0.02% (rms)
IQ modulation, data for frequency offset range 0 Hz to ±135 kHz	
Carrier suppression	>40 dB

RF receiver

VSWR	
RF1 (10 MHz to 2000 MHz)	<1.2
RF2 (10 MHz to 2200 MHz)	<1.2
RF4IN (10 MHz to 2200 MHz)	<1.5
Phase noise (single sideband, f <2.2 GHz), carrier offset	
20 kHz to 250 kHz	<–100 dBc (1 Hz)
250 kHz to 400 kHz	<–110 dBc (1 Hz)
≥400 kHz	<–118 dBc (1 Hz)
Residual FM	
30 Hz to 15 kHz	<50 Hz (rms), <200 Hz (peak)
CCITT	<5 Hz (rms)
Residual AM, CCITT	<0.02% (rms)

Power splitter

Insertion loss, SC/S1, SC/S2	
400 MHz to 2200 MHz	<7 dB
VSWR	
SC (400 MHz to 2200 MHz)	<1.3
S1, S2 (2200 MHz to 2700 MHz)	<1.6
Isolation, S1/S2	
400 MHz to 2200 MHz	>17 dB
Max. continuous power	
SC	4 W
S1/S2	21 dBm

General specifications

R&S CRTU-RU

Operating temperature range	+5 °C to +45 °C
Storage temperature range	–25 °C to +60 °C
Interfaces (for connection to R&S CRTU-PU)	
Control A	68-pin SCSII
Control B	68-pin SCSII
IF (RX and TX, CH1 and CH2)	BNC
Clock	BNC
Remote control	IEC/IEEE bus, 24-pin Amphenol
Power supply	100 V to 240 V ±10% (AC), 500 VA 50 Hz to 400 Hz –5% to +10%
Power consumption	Approx. 160 W
Dimensions (W x H x D)	465 mm x 193 mm x 517 mm 19", 4 height units
Weight	Approx. 18 kg

R&S CRTU-PU

Interfaces	
USB	Double connector, rear and front panel
Ethernet 1 and Ethernet 2	RJ45
Ethernet HUB	RJ45
External monitor (VGA)	15-pin Sub-D
External monitor (DVI)	24-pin + 4-pin
Serial interface COM1	RS-232-C, 9-pin Sub-D
Printer interface LPT	Parallel (Centronics-compatible), 25-pin
Interfaces (for connection to R&S CRTU-RU)	
Control A	68-pin SCSII
Control B	68-pin SCSII
IF (RX and TX, CH1 and CH2)	BNC
Clock	BNC
Remote control	IEC/IEEE bus, 24-pin Amphenol
Power supply	100 V to 120 V ±10% (AC) or 220 V to 240 V ±10% (AC), 600 VA, 50 Hz to 60 Hz –5% to +10%
Power consumption	Approx. 180 W
Dimensions (W x H x D)	465 mm x 238 mm x 617 mm, 19", 5 height units
Weight	Approx. 21 kg

Ordering information

Protocol Tester	R&S CRTU-W	1140.0509.02
Included in package		
Radio Unit (incl. R&S CRTU-B7)	R&S CRTU-RU	
Protocol Unit	R&S CRTU-PU	
Monitor		
USB keyboard, USB mouse, hardlock		
Operational software	R&S CRTUW001	
Extras		
Antenna Coupler for Handheld Telephones	R&S CMU-Z10	1150.0801.02
Shielded Chamber for 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

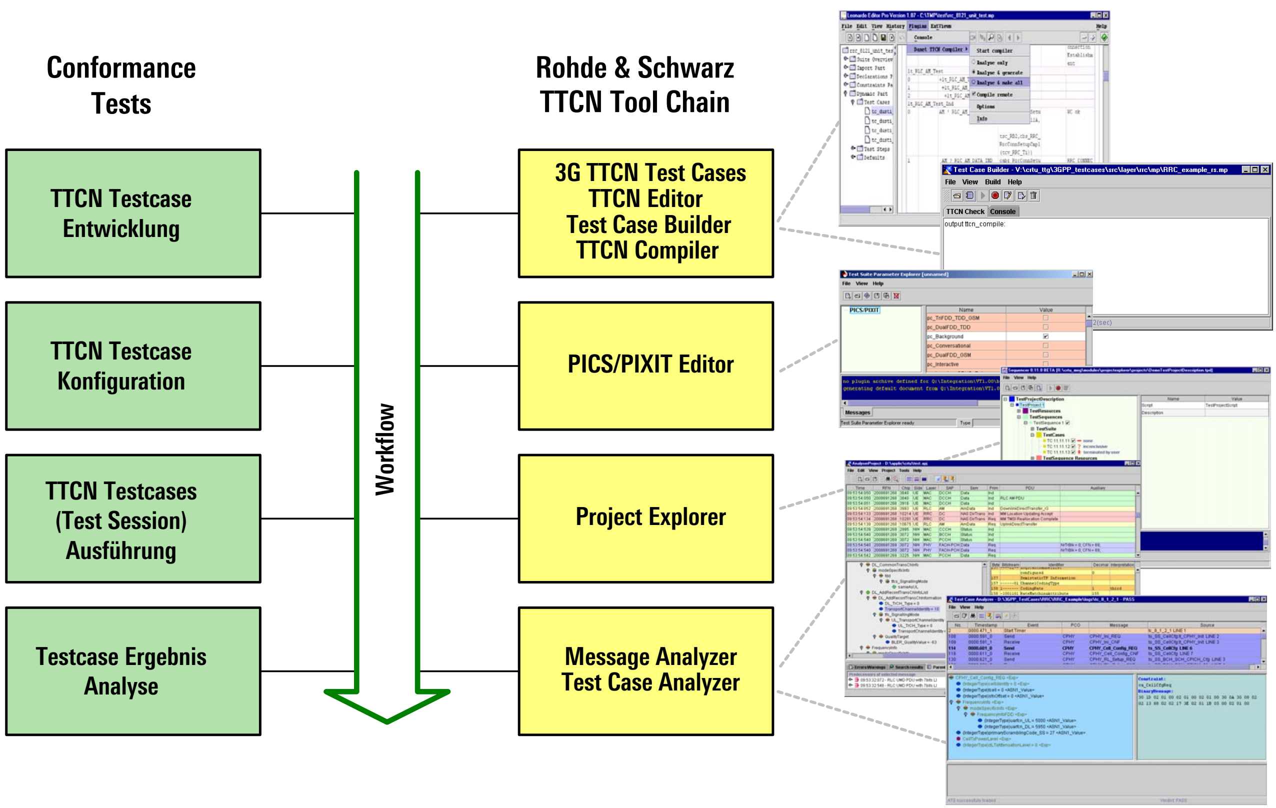
1) 50 W in temperature range +5 °C to +30 °C, linear degradation down to 25 W at +45 °C.

2) Not valid at frequencies of netclock harmonics.

3) Valid for RF1 only.

3G Virtual Protocol Test System R&S CRTU-VT

New



Protocol tests on the PC, overview of R&S CRTU-VT software tools

Brief description

The 3G Virtual Protocol Test System R&S CRTU-VT combines a complete TTCN (testing and test control notation) software development environment, verified 3GPP signalling test cases and powerful analysis tools for testing 3G UE protocol stacks. It ideally complements the 3G Protocol Tester R&S CRTU-W and permits early and comprehensive testing of signalling procedures in 3G networks, regression testing of UE protocol stack implementations and the high-level application tests of new 3G services.

Main features

The 3G Virtual Protocol Test System R&S CRTU-VT contains everything required for an early conformance test of 3G UE protocol stacks even before integration into the physical layer.

Software tools

- Integrated TTCN development environment with graphics editor, test case builder and compiler for creating new 3GPP TTCN test cases or for modifying test cases that are supplied
- Standard reference implementation of UTRAN protocol stack in line with the 3G specifications including the simulation of layer 1
- Powerful software tools for configuration and execution of signalling test cases and for detailed analysis of test results with the aid of generated log files
- Signalling conformance test cases in TTCN according to 34.123-3
- Identical software tools for virtual tester and Protocol Tester R&S CRTU-W, upgrade to R&S CRTU-W

3GPP test cases

- Verified 3GPP TTCN signalling conformance test cases for testing MAC, RLC, RRC and NAS to 34.123-3
- Automatic generation of 3GPP executable test cases
- GCF test case packages 1 - 4 are supported

3G Virtual Protocol Test System R&S CRTU-VT

- Scheduling of individual test case packages in line with GCF prioritization
- Re-use of 3GPP TTCN test cases with R&S CRTU-W

Applications

- Virtual testing of:
  - 3G UE protocol stack implementations
  - Regression tests
  - Application tests

Characteristics

The software of the virtual tester is identical with that of Protocol Tester R&S CRTU-W. An upgrade from R&S CRTU-VT to R&S CRTU-W can also be supplied. R&S CRTU-VT is a pure software product on a CD-ROM which can be run under Windows 2000 on any modern PC. The R&S CRTU-VT tools and test cases are licensed and hardlock-protected.

System architecture

Different test cases are available for the different protocol procedures such as connection setup, paging or call setup. The appropriate TTCN test case and the UTRA protocol stack simulate the 3G network. The responses of the UE protocol stack to be tested are recorded by R&S CRTU-VT, compared to the protocol behaviour defined by the 3G specifications and checked for conformance.

Hardware and software requirements

Hardware	**Minimum requirements**
CPU	Pentium III, 800 MHz class
Memory	256 Mbyte RAM, 512 Mbyte additional export memory (swap space)
Min. hard disk memory	1 Gbyte
CD ROM drive	>16 x
Graphics card	1024 x 768 XGA resolution
Interfaces	
Entry	keyboard, mouse
Network adapter	standard 10 Mbit or 100 Mbit network adapter
I/O ports	Centronics parallel or USB connector for hardlock dongle
Software	**Minimum requirements**
Network	TCP/IP network driver installed
Operating system	Windows 2000

Ordering information

Virtual test environment for WCDMA FDD protocol tests on mobile terminal equipment	R&S CRTU-VT	1139.7190.02

Equipment supplied

Operating software

Virtual Testing WCDMA FDD Operational Software for UE test UTRAN protocol stack reference implementation MAC, RLC, layer 1 shortcut; layer 1 shortcut at transport channel level; upper tester, PHY and CPHY interface API (TCP/IP); Rohde&Schwarz project explorer; Rohde&Schwarz message analyzer, C/C++ compiler, Microsoft Visual C/C++ version 6.0	R&S CRTU WO01VT	1139.6007.02

TTCN and analysis tools

TTCN Editor/Analyzer, TTCN Editor Leonardo Pro from Da Vinci Systems, Rohde&Schwarz PICS/PIXIT editor, Rohde&Schwarz TTCN analyzer	R&S CRTU WT03	1139.5530.02
TTCN Compiler from Danet GmbH supports all 3GPP TTCN ATS to 34.123-3	R&S CRTU WT04	1139.5600.02

Test case packages

Virtual Testing TTCN Libraries for support of 3GPP 34.123 test cases, 35 verified 3GPP TTCN test cases to 34.123-3, RRC, RLC, CC, MM test suite, mainly GCF priority 1	R&S CRTU WC01VT	1139.6207.02
Virtual Testing TTCN Libraries for support of 3GPP 34.123 test cases	R&S CRTU WC02VT	1139.6307.02
Virtual Testing TTCN Libraries for support of 3GPP 34.123 test cases	R&S CRTU WC03VT	1139.6407.02

Note: The R&S CRTU-WC01/02/03 packages cover > 80% of GCF package 1. More test case packages for GCF packages 2 to 4 are planned.

Options

Upgrade to R&S CRTU-W

Hardware Upgrade for R&S CRTU virtual testing solution	R&S CRTU U02	1140.1405.02

Support

Support Contract for operating software	R&S CRTU-WS01	1139.6707.02
Support Contract for TTCN tools and premium test case support	R&S CRTU-WS02	1139.6807.02

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

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

R&S CTS65 (photo 43115-1)

Brief description

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

- **R&S CTS55** for mobile phones to GSM900/1800/1900
- **R&S CTS60** for DECT phones (portable part and fixed part)
- **R&S CTS65** for GSM and DECT

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

From the beginning of 2003 the R&S R&S CTS will also support GPRS-compatible mobile phones. The R&S R&S CTS-K4 signalling option will make it possible to perform a GPRS attach/detach as well as block error rate (BLER) measurements in a timeslot.

Main features

- User-friendly menu-guided control via softkeys
- Logical user prompting without interleaved submenus
- Brilliant TFT colour display: an own dimension in this class of instruments
- operating menus in seven different languages
- Compact and robust design, low weight
- Eye-strain-free working
- Dynamic range for measuring the power ramp: GSM >55 dB, DECT >60 dB
- Built-in reference oscillator TCXO or OCXO (option R&S CTS-B1)
- Combined RF input/output for GSM and DECT
- DECT off-air measurements via additional input/output
- Remote control via RS-232-C (option R&S CTS-K6)

GSM measurement functions

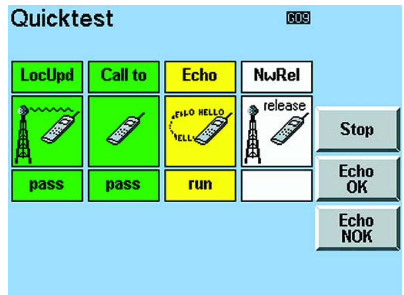
R&S CTS55 simulates a GSM base station for testing mobile phones. The following measurements and tests can performed by automatic test routines or manually.

- Synchronization of mobile phone with base station (which is simulated by R&S CTS)
- Location update
- Call setup (incoming/outgoing)
- Call cleardown (incoming/outgoing)
- Dualband handover
- Control and measurement of transmitter power
- Handover (channel change)
- Sensitivity
  - Bit error rate BER and RBER
  - RxLev and RxQual
- Phase and frequency error
- Power ramp versus time
- Timing error
- Echo test (voice test, includes also testing of loudspeaker and microphone)
- Function test of mobile's keypad through display of dialled number
- Display of
  - IMSI (international mobile subscriber identity)
  - IMEI (international mobile equipment identity)
- AM suppression (with option R&S CTS-K7)
- GPRS
  - Attach/detach
  - BLER measurement

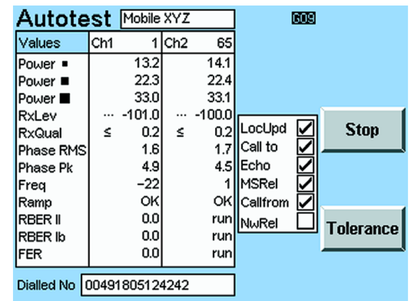
Digital Radio Testers R&S CTS55/60/65 for mobile phones

DECT measurement, test and adjustment capabilities

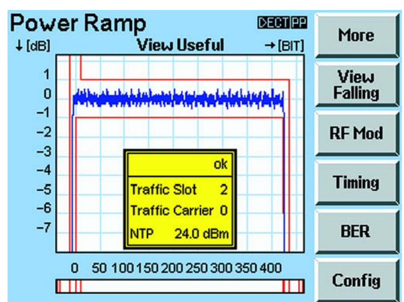
- Synchronization of DUT with the R&S CTS
- Call setup
- Call release
- Echo test
- Detection and display of RFPI (FP)
- Normal transmit power (NTP)
- Power ramp versus time
- Modulation characteristics versus time
- Frequency offset
- Maximum modulation deviation
- Frequency drift
- Timing (jitter,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



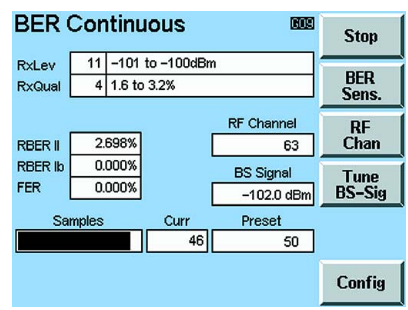
The quick test provides an extremely fast Go/NoGo information covering all essential parts of the mobile phone. A speech test (echo test) is carried out immediately after the call setup (GSM)



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



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



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

Specifications in brief

Built-in reference oscillator	standard
Frequency drift in temperature range +5 °C to 40 °C	≤1 x 10^{-6}
Aging	≤0.5 x 10^{-6}/year at 35 °C

GSM

GSM signal generator

Frequency range	
GSM900 band	935 MHz to 960 MHz
GSM1800 band	1805 MHz to 1880 MHz
GSM1900 band	1930 MHz to 1990 MHz
Resolution	GSM channel spacing 200 kHz
Output level	
RF IN/OUT with 0 dB ext. attenuation	–50 dBm to –110 dBm
RF OUT2 GSM with 0 dB ext. attenuation	–15 dBm to –75 dBm
Level error	
RF IN/OUT	≤1.5 dB
RF OUT2 GSM	≤2.0 dB
Modulation	GMSK, BxT = 0.3

Narrowband Spectrum Monitor Option R&S CTS-B7

Span	300 kHz
Resolution bandwidth	4/10/20/50/100 kHz
Dynamic range	(P >5 dBm)
Δf = 0 kHz to 30 kHz	35 dBc typ.
Δf = 30 kHz to 150 kHz	50 dBc typ.
Markers	3 markers and delta-marker

GSM peak power meter

Frequency range	
GSM900 band	890 MHz to 915 MHz
GSM1800 band	1710 MHz to 1785 MHz
GSM1900 band	1850 MHz to 1910 MHz
Measurement range	
with 0 dB ext. attenuation	–20 dBm to +39 dBm (peak values up to 41 dBm)
with 15 dB ext. attenuation	0 dBm to +39 dBm (peak values up 41 dBm)

GSM measurement of phase and frequency error

Frequency range	
GSM900 band	890 MHz to 915 MHz
GSM1800 band	1710 MHz to 1785 MHz
GSM1900 band	1850 MHz to 1910 MHz
Level range	–15 dBm to 39 dBm (peak values up to 41 dBm)

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

GSM measurement of burst power

Frequency range	
GSM900 band	890 MHz to 915 MHz
GSM1800 band	1710 MHz to 1785 MHz
GSM1900 band	1850 MHz to 1910 MHz
Reference level for full dynamic range with 0 dB ext. attenuation	0 dBm to +39 dBm (peak values up to 41 dBm)
Dynamic range (P >5 dBm)	≥55 dB
Resolution	0.1 dB

DECT

DECT signal generator

Frequency range	1876.608 MHz to 1935.360 MHz and half channels
Frequency drift	same as reference oscillator
Output level	
RF IN/OUT	–100 dBm to –40 dBm
RF OUT2 DECT	–40 dBm to 0 dBm (–20 dBm to 0 dBm if RF IN2 DECT is active), useable up to 5 dBm
Level error	
RF IN/OUT	≤1.5 dB
RF OUT2 DECT	≤2.0 dB
Modulation	GFSK (BxT = 0.5)
DECT analyzer	
Frequency range	same as signal generator
Measurement range	with 0 dB external attenuation
RF IN/OUT	30 dBm to –30 dBm
RF IN2 DECT	–35 dBm to –55 dBm
FM demodulator	
Frequency range	0 kHz to 450 kHz
Resolution	1 kHz
DC offset	<3 kHz
Residual FM	
RF IN/OUT	<15 kHz, peak, 95% confidence (30 dBm to 5 dBm) <5 kHz, peak, 95% confidence (30 dBm to 15 dBm)
RF IN2 DECT	<15 kHz, peak, 95% confidence (–35 dBm to –55 dBm) <5 kHz, peak, 95% confidence (–35 dBm to –40 dBm)
Level meter	
Range	
RF IN/OUT	30 dBm to –30 dBm
RF IN2 DECT	–35 dBm to –55 dBm
Dynamic range	≥60 dB (for P = 24 dBm)
Resolution	0.5 dB
Accuracy	
RF IN/OUT	<1 dB + resolution (30 dBm to 5 dBm) <2 dB + resolution (<5 dBm)
RF IN2 DECT	<2 dB + resolution (–35 dBm to –51 dBm) <2.5 dB + resolution (<–51 dBm)

Audio Interface

Output	unbalanced
Range	558 mV, 300 Hz to 3 kHz
Output impedance	<10 Ω (R_L >2 kΩ)
S/N + THD	30 dB at max. level
Passband ripple	0.5 dB
Input	unbalanced
Range	80 mV, 300 Hz to 3 kHz
Input impedance	22 kΩ
S/N + THD	35 dB at max. level
Passband ripple	0.5 dB

DECT applications	averaging 10 bursts
Modulation section 1, 2, 4	
Error	approx. 11 kHz with min. (202 kHz) permissible deviation approx. 13 kHz with max. (403 kHz) permissible deviation
Frequency drift	approx. 1 kHz/ms (over 200 bursts)
Transmit power	
Measurement accuracy	
RF IN/OUT	<1 dB + resolution (30 dBm to 5 dBm) <2 dB + resolution (<5 dBm)
RF IN2 DECT	<2 dB + resolution (–35 dBm to –51 dBm) <2.5 dB + resolution (<–51 dBm)

General data

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

Ordering information

Digital Radio Tester		
GSM	R&S CTS 55	1094.0006.55
DECT	R&S CTS 60	1094.0006.60
GSM and DECT	R&S CTS 65	1094.0006.65
Options		
OCXO Reference Oscillator Aging 0.2 x 10^{-6}/year	R&S CTS-B1	1079.0809.02
GPRS Signalling (from 2003 on)	R&S CTS-K4	1079.1905.02
GSM Remote Control (with Application Software for Windows)	R&S CTS-K6	1079.2001.01
GSM Module Test	R&S CTS-K7	1079.2501.02
GAP Signalling	R&S CTS-K62	1079.2601.01
Extras		
Universal shielded Chamber	R&S CTS-Z12	1079.1470.02
Antenna Coupler	R&S CMU-Z10	1150.0801.02
RF Shielding Cover for R&S CMU-Z10	R&S CMU-Z11	1150.1008.02
DECT-Antenna with N connector		1086.3116.00
GSM Test SIM	R&S CRT-Z2	1039.9005.02
Compakt keyboard		
German	R&S PSP-Z1	1091.4000.02
US	R&S PSP-Z2	1091.4100.02
Production Calibration	R&S DCV-1	0240.8733.08
Service Manual		1094.3405.24

DECT Tester R&S CMD60

Speedy and cost-effective measurements on DECT communications devices

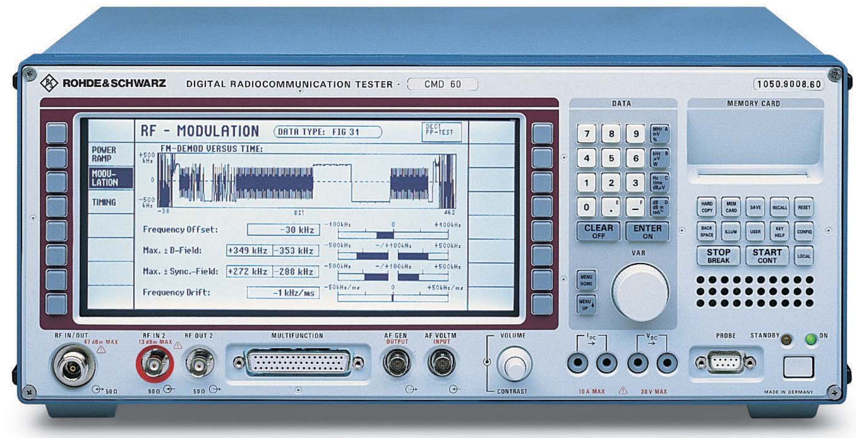


Photo 42198

Brief description

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

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

Benefits at a glance

Production

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

Development

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

Servicing

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

Main features

- For production, service and development
- RF measurements to CTR06
- Comprehensive audio tests
- Extremely fast measurements for high production throughput
- Ergonomic user interface for service applications
- Selfcontained, lightweight, compact tester

DECT Tester R&S CMD 60

Menu structure

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

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

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

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

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

Interface description

R&S CMD 60 transmitter part

In a very busy DECT environment most DECT frequencies may be in use for communication and therefore influence the measurement in production and development. Besides the channels 0 to 9 the R&S CMD 60 enables the use of an extended frequency range for testing. Channels –3, –2, –1 and 10, 11, 12 are outside the normal DECT specification and therefore free for testing.

The DECT standard requires two levels: –83 and –73 dBm. The R&S CMD 60 provides an extra level range of up to 30 dB to overcome external coupler and cable attenuation.

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

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

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

R&S CMD 60 receiver part

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

Should the standard DECT output level of 24 dBm be attenuated due to couplers and cable attenuation, the R&S CMD 60 provides more than 30 dB measurement range.

There are two independent receive paths: For DECT signalling and BER a signalling path is incorporated in the R&S CMD 60. For TX tests the R&S CMD 60 provides a measurement path. The FM and envelope detector are both taken to external connectors and post-processed for power ramp and modulation measurements. The FM and envelope detector output permits monitoring of the DUT transmit signal.

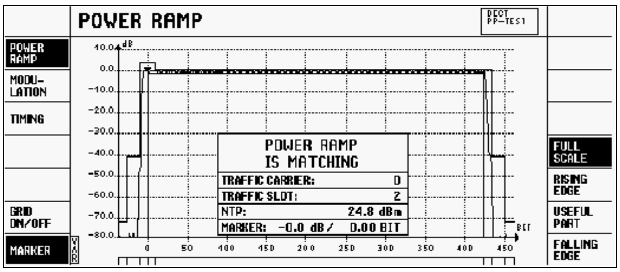
RF input/output

The R&S CMD 60 transmitter and receiver are connected to a bidirectional N connector (RF in/out). All mentioned specifications are valid for this connector. Moreover, there is a high-level output for the R&S CMD transmitter (level range like N connector + approx. 40 dB) as well as a high-sensitivity input for the R&S CMD receiver on the front panel.

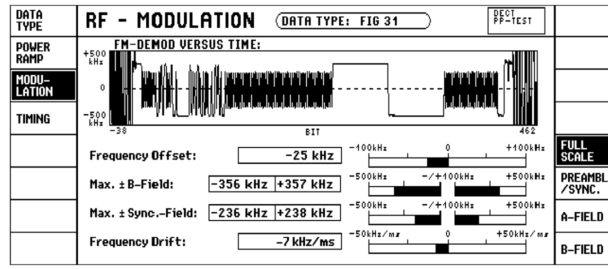
Demodulator interface

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

DECT Tester R&S CMD60



Power ramp measurement



RF modulation measurement

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

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

Overview of options

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

DECT Tester R&S CMD 60

Specifications in brief

Time and frequency reference	
TCXO	standard
Nominal frequency	10 MHz
Temperature effect (0 to 35°C)	$<1.5 \times 10^{-6}$
Aging	$<0.5 \times 10^{-6}$/year
OCXO	option R&S CMD-B1
Nominal frequency	10 MHz
Temperature effect (0 to 50°C	1×10^{-7}
Aging	$<5 \times 10^{-9}$/day or $<2 \times 10^{-7}$/year
DECT signal generator	specifications valid for N connector
Frequency	10 DECT channels 0 to 9
Additional DECT channels	–3 to –1, 10 to 12 and half channels
Level range	–100 dBm to –40 dBm
Burst switch-off	>30 dB
Modulation	GFSK (B x T = 0.5)
DECT analyzer	specifications valid for N connector
Frequency	same as signal generator
Level (setting for external attenuation and expected power shall be matching; –10 to +30 to dBm)	–65 dBm to +30 dBm (for level meter) –30 dBm to +30 dBm (for broadband FM demodulator and signalling), values shifted by about –40 dB for input 2
FM demodulator	for TX postprocessing and analog output
Range	0 to 450 kHz deviation
Resolution	1 kHz
Level meter (transient response)	for TX postprocessing and analog output
Range	–65 dBm to 30 to dBm
Dynamic	70 dB
Analog DECT ADPCM interface	
Output	balanced
Range	1 V, 300 Hz to 3 kHz
S/N + THD	50 dB at full-range level
Input	balanced
Range	50 mV, 300 Hz to 3 kHz
S/N + THD	50 dB at full-range level
DC measurements	
DC voltmeter	0 to ±30 V
DC ammeter	0 to ±10 A

Option R&S CMD-B4 with R&S CMD-B41

AF meter	
Frequency range	50 Hz to 10 kHz
Input voltage	0.1 mV to 30 V
Load impedance	1 MΩ
AF distortion meter	
Frequency range	300 Hz to 3 kHz
Input voltage	100 mV to 30 V
Load impedance	1 MΩ
AF counter	
Frequency range	20 Hz to 10 kHz
Input voltage	10 mV to 30 V
Resolution	1 Hz
Load impedance	1 MΩ
60 MHz counter	
Frequency range	10 kHz to 60 MHz
Input signal	min.: 100 mV; max.: TTL signal
Resolution	1 Hz
Load impedance	1 MΩ || 100 pF
AF generator	
Frequency range	50 Hz to 10 kHz
Resolution	0.1 Hz
Accuracy	0.05 Hz
Output voltage	10 µV to 5 V
Max. current	20 mA
Source impedance	<5 Ω

General data

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

Ordering information

Digital Radiocommunication Tester	R&S CMD 60	1050.9008.60
Options	see overview of options	

DECT Signalling Test Unit R&S PTW15

Support in installation and maintenance of DECT networks

Photo 42907-2

Brief description

The powerful DECT Protocol Tester TS1220 from Rohde&Schwarz is seconded by the extremely favourably priced DECT Signalling Test Unit R&S PTW15. This unit can be used wherever the full functionality of TS1220 is not required: in installation and maintenance of DECT WLL and PABX systems, in DECT audio tests according to CTR10 and in the field of DECT software development.

In the installation of DECT WLL net-works or test networks, R&S PTW15 produces data about the occupancy of the DECT frequency band including relevant statistics to support antenna positioning and assessment of various parameters of the DECT equipment (e.g. dynamic channel selection algorithm). Since most tests are carried out on site directly in the network, the unit was designed for mobile use through its compact size and optional battery powering. For DECT audio tests to CTR10, R&S PTW15 can be used as a DECT signalling unit that supports call setup to portable and fixed DECT radio terminations both in normal operation (generic access profile GAP according to EN 300 444) and in test standby mode by providing voice data at an analog and a digital interface. The required DECT reference implementations can also be used for DECT software development.

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

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

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

Main features

Main applications

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

Main functions

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

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

Brief specifications

Basic instrument

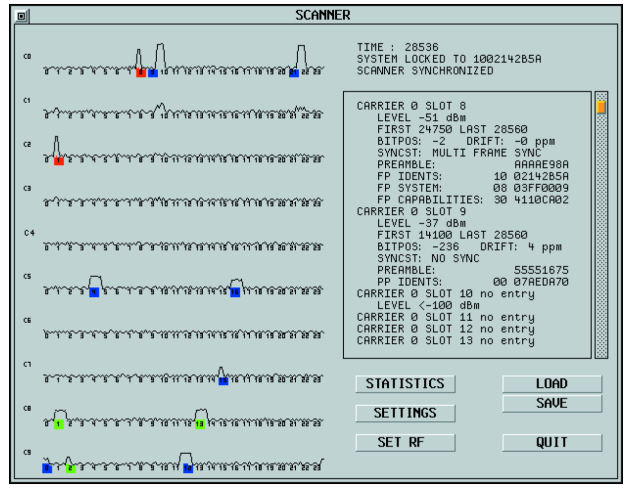
CPU	AMD K5 (586), 133 MHz
RAM	32 MB
Display	8,4" TFT colour display
Surface	non-reflecting
Graphics built-in display	VGA standard: 640 x 480 pixels
Graphics for external monitors	max. 1024 x 768 pixels
Hard disk	>500 MB
Floppy disk drive	1.44 MB, 3½"
Interfaces	4 x 16 bits, dimensions (L x H): 2 x ISA 330 mm x 140 mm 2 x ISA 312 mm x 140 mm
Serial	2 x RS-232-C
Parallel	1 x LPT (Centronix) for printer
Keyboard	DIN and PS/2 for keyboard incl. trackball
Operating system	LynxOS
User interface	MGR
Rated temperature range	+15 °C to +35 °C
Operating temperature range	0 °C to + 40 °C
Power supply	100 V to 120 V ±10%, 50 Hz to 400 Hz ±5%, 1 A (max. 120 W) and 220 V to 240 V ±10%, 50 Hz to 60 Hz ±5%, 0.5 A (max. 120 W)
DC	10 V to 32 V
Dimensions (W x H x D)	412 mm x 198 mm x 380 mm
Weight	8 kg

RF Parameters

Operating frequency Europe	1881.792 MHz to 1897.344 MHz
Optional (exclusive options)	
China	1902.528 MHz to 1918.080 MHz
South America	1911.168 MHz to 1926.720 MHz
Latin America	1912.896 MHz to 1928.448 MHz
Carrier spacing	1.728 MHz
Carrier multiplex	TDMA
Duplexing	TDD
Bit rate	1152 kbps
Modulation method	GFSK (B x T = 0.5)
TX specifications	
Normal transmitter power:	21 dBm ± 2 dBm
Nominal peak deviation (modulation)	288 kHz (acc. to CTR 06)
carrier frequency	DECT carrier frequency ± 30 kHz (acc. to CTR 06)
Synthesizer	transmitter burst acc. to CTR06 (slow synthesizer => 'blind slots'); hardware signalling (R&S PTW15 DECT Sig. Board)
RX Specifications	
Sensitivity	–73 dBm for BER <0.00001 (acc. to CTR 06)
RSSI	–33 dBm to –93 dBm
Maximum level (without damage)	25 dBm
Maximum level (for measurements)	0 dBm

Channel occupancy measurement

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



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

Database
Continuous recording of data packages
Classification: locked, coordinated, uncoordinated, not classified

Permanent scan, simultaneous for fixed (FT) and portable radio termination (PT)

Contents of database record: time of recordings, number of recordings, preamble, level, bit position, drift, identities, system parameters, etc

Assignment of database records to the graphical RSSI indication under consideration of system identities, coordinated and uncoordinated fixed radio terminations

Statistics
Channel occupancy statistics
Graphical indication (coloured)
Statistics referring to EN 300 175 Common Interface 'Channel selection algorithm'

GPS data
NMEA 0183 Interface Standard can be connected to the serial interface; GPS data will be displayed and included in the database file

Ordering information

DECT Signalling Test Unit		
Light	R&S PTW15L	1074.6009.04
China	R&S PTW15CN	1074.6009.03
South and Latin America[1]	R&S PTW15LA	1074.6009.05
Options		
Comfort package (ext. keyboard + adapter)	R&S PTW-B1	1074.6509.02
Battery module for mobile operation	R&S PSP-B3	1091.3740.02
Frequency range China (replaces module Europe)	R&S PTW-B3	1115.2501.02
Frequency range South and Latin America (replaces module Europe)	R&S PTW-B4	1115.2701.02

[1] Frequency channel difference between adjustable in the software.

Protocol Tester R&S PTW60 for *Bluetooth* Solutions

Platform for signalling tests in *Bluetooth* environments

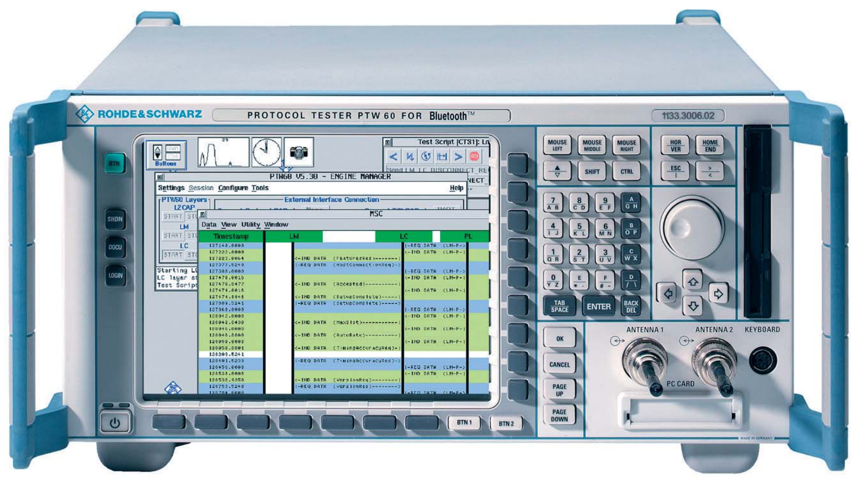


Fig 1 (photo 43882-1)

Brief description

The Rohde & Schwarz *Bluetooth* Protocol Tester R&S PTW60 offers professional and comprehensive protocol test and analysis functions. It is ideal for use in the development and qualification testing of *Bluetooth* products. Equipped with programming interfaces, the R&S PTW60 is even suitable for developing new protocols.

Rohde & Schwarz, unlike most of its competitors, has adopted the strategy of developing protocol layers and the technology-dependent hardware completely on its own. This allows the simulation of protocol errors at all layers, which enables an IUT's error tolerance and robustness to be determined for example.

Main features

Applications

- Integral component in the development of protocol layers, profiles and applications
- Transparent integration of *Bluetooth* components
- Approved reference for protocol and profile conformance tests

Main functions

- Reference implementation of baseband, LM, L2CAP in master and slave mode
- Simulation of a *Bluetooth* pico-network
- Automatic generation of executable test cases from official test vectors issued in TTCN by *Bluetooth* Special Interest Group (SIG)
- Support of official conformance tests for baseband, LM, L2CAP, GAP, SDP and SPP
- Powerful test script package for easy analysis of implementation under test (IUT)
- Comprehensive choice of problem-oriented analysis tools (PCOs, MSCs, TTCN traces)
- Flexible internal and external programming interfaces for adaptation to special measurement tasks

Hardware

- Industrial computer with *Bluetooth* RTSU (realtime signalling unit)
- External interfaces for networking (Ethernet) of PTW60 and connection of *Bluetooth* TCI (test controller interface) via UART, RS-232-C and USB

Software

R&S PTW60 *Bluetooth* protocol stack
Fig. 2 illustrates the *Bluetooth* layer structure and the logic data flow. The baseband, LM (link manager) and L2CAP (logical link control and adaptation protocol) layers can be separately configured, started and stopped.

The realtime LynxOS operating system (realtime UNIX derivative) allows online protocol analysis. The IUT can be evaluated from the data output at the service access points (SAPs).

The analysis and graphic display tools of the R&S PTW60 can be tailored to user requirements – from detail analysis to overview displays.

Stimulus tools

Platform concept with open programming interface
The protocol testers from Rohde&Schwarz are of modular design, i.e. the protocol layers are interlinked via defined interfaces. The use of a uniform function and command format allows

Protocol Tester R&S PTW60 for *Bluetooth* Solutions

access to the individual protocol layers using the C and C++ programming languages.

TTCN toolbox and *Bluetooth* simulation libraries

Compiler process

The Protocol Tester R&S PTW60 for *Bluetooth* Solutions automatically converts the TTCN (tree and tabular combined notation) test cases developed by the *Bluetooth* SIG to executable code. Fig. 4 illustrates this procedure. The *Bluetooth* SIG test vectors are copied to the R&S PTW60 in TTCN.mp format and initially translated by the TTCN compiler into ANSI-C code. An automatic syntax check is performed on the TTCN code.

***Bluetooth* simulation libraries**

For the R&S PTW60, Rohde&Schwarz offers the following simulation libraries for the automatic generation of *Bluetooth* SIG test vectors:

- Baseband (BB)
- Link manager (LM)
- Logical link control and adaptation protocol (L2CAP)
- Generic access profile (GAP)
- Service discovery protocol (SDP)
- Serial port profile (SPP)

Test suite parameter editor

Before running the test cases of a *Bluetooth* SIG test vector, the properties and parameters for the implementation under test must be entered in the form of PICS/PIXIT information (protocol implementation conformance statements/protocol implementation extra information for testing). Based on this information, test cases are selected, alternatives activated and deactivated in the individual test cases and implementation-specific parameters are set. This information can easily be adapted by means of the R&S PTW60's test suite parameter editor, a tool that enables the user to manage any number of PICS/PIXIT files for different IUTs and eliminates the need to re-enter the very complex *Bluetooth* settings every time the IUT is changed. For the bit strings frequently used in test vectors, which may be several hundred bits in length, the test suite parameter editor of the R&S PTW60 enables hexadecimal or octal entry with automatic conversion to the PICS/PIXIT format required for the specific test vector.

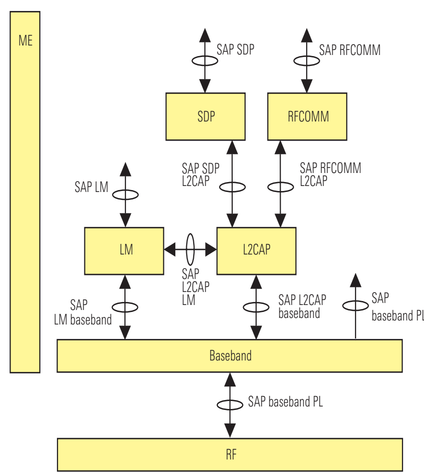


Fig 2: R&S PTW60 protocol data flow

Test case manager

The executable test cases are available in the test case manager (Fig. 5) of the R&S PTW60, a tool for setting up and performing any sequence and repetition of test cases.

All outputs from the running test cases are processed by the test case manager in realtime and made available to the user.

The run logs generated by the test case are strictly oriented to the executed lines of the TTCN test case; this allows simple correlation with the easily readable, tabular TTCN code (TTCN.gr).

The test case selection expression provides the user with an easy means of selecting the test cases of a *Bluetooth* SIG test vector that are appropriate for a particular IUT (implementation under test).

External TTCN editor

Leonardo Synergy Solution™ by Da Vinci Communications Ltd

This R&S PTW60 plug-in provides a practice-oriented, integrated solution for developing, editing and debugging

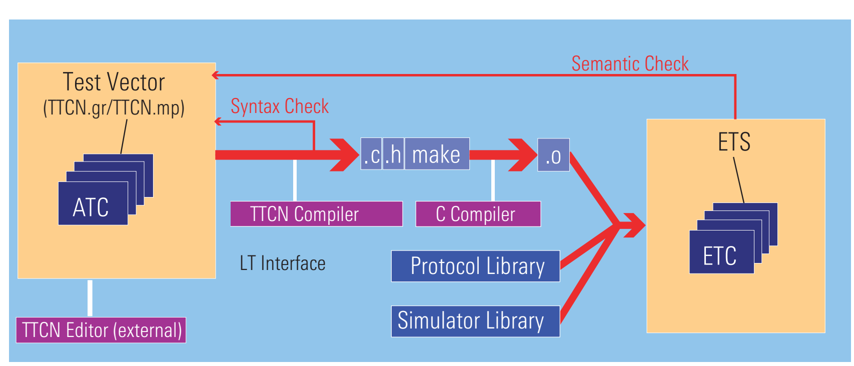


Fig 3: From abstract to executable TTCN test suite

Protocol Tester R&S PTW60 for *Bluetooth* Solutions

Bluetooth SIG test vectors on the R&S PTW60. Key features:

- Remote control of TTCN compiler on R&S PTW60
- Return of error messages for debugging
- Remote management of build directory structure
- Management of different users and test vector versions
- Online help for plug-in

Analysis tools

The R&S PTW60 offers a wide range of analysis tools, including PCOs (points of control and observation), MSCs (message sequence charts) and TTCN traces.

TTCN traces

Detailed TTCN trace files (Fig.7) provide information on the IUT's response when subjected to the *Bluetooth* SIG test cases.

Message sequence chart (MSC) and point of control and observation (PCO)

PCOs and MSCs can display and interpret both received and transmitted data (Fig 6).

A PCO represents data referred to a single service access point (SAP), whereas a MSC displays protocol data units (PDUs) across all protocol layers in a chronological order.

All available PCOs base on the SAPs according to the test specification defined by Rohde&Schwarz.

The analysis tools also provide the following functions:

- Filters for primitives, data packets, ID packets and PDUs
- PDU decoders and ASP (abstract service primitive) checkers
- Single message decoders

Specifications in brief

RF data	
TX frequency range	2.402 GHz to 2.480 GHz
TX power range, impedance	–20 dBm to +18 dBm +/– 3 dB, 50 Ω
RX frequency range	2.402 GHz to 2.480 GHz
RX input power range, impedance	–70 dBm to –20 dBm, 50 Ω
Modulation	GFSK with BxT = 0.5
Carrier spacing, bit rate	1 MHz, 1 Mbps
Processor architecture	
CPU	AMD-K6, 233 MHz
Hard disk	13 GB IDE
RAM	128 MB
Display	8.4" TFT colour LC (640 x 480 dots)
Others	3.5" floppy disk, 3 PCI slots, 3 ISA slots
Operating system	LynxOS v3.0.1
Graphical user interface	MGR v2.20b
Interfaces	
Split RF connectors for RX and TX path	N connectors at front panel
External reference inputs/outputs	BNC connectors at rear panel
Printer port	Centronics
COM 1	RS-232-C
COM 2	RS-232-C (600 to 19200 baud) or TTL (5 V), selectable by means of microswitch
USB	dual-port connector
External monitor	VGA connector
General data	
Rated temperature range	+15 °C to +35 °C
Operating temperature range	+5 °C to +40 °C
Power supply input range, current	100 V to 240 V AC, 1.3 A to 3.1 A
Power supply frequency range	50 Hz to 400 Hz
Dimensions (W x H x D), weight	412 mm x 197 mm x 417 mm, 10 kg

Ordering information

Protocol Tester Basic System	R&S PTW60	1133.3006.02
Libraries for Compilation and Execution of Test Case Packages		
Baseband	R&S PTW60BB	1133.3741.02
Generic Access Profile	R&S PTW60GA	1133.4148.02
Link Manager	R&S PTW60LM	1133.3841.02
Logical Link Control and Adaptation Protocol	R&S PTW60L2	1133.3793.02
Service Discovery Application Profile	R&S PTW60SD	1133.4048.02
Serial Port Profile	R&S PTW60SP	1133.4090.02
Packages: Basic System and libraries		
BB, LM, L2CAP	R&S PTW60P1	1133.3893.02
GAP, SPP, SDAP	R&S PTW60P2	1133.3941.02
BB, LM, L2CAP, GAP, SPP, SDAP	R&S PTW60P3	1133.3993.02
Extras		
Encryption key length 128 bit (export licence required!)	R&S PTW60EK	1133.4190.02
US keyboard with trackball	R&S PSP-Z2	1091.4100.02
Software Service Contracts		
Software Service for Base System, 1 year	R&S PTW-SSB-1	1155.9507.11
Software Service for corresponding Simulation libraries BB, LM, L2CAP, GAP, SPP or SDP	R&S PTW-SSxx	1155.9507.xx
R&S PTW60 Training		
Operating training		0844.2987.xx
Programming training		0844.2987.xx

Bluetooth Tester R4870

RF tests according to *Bluetooth* SIG standards and connection tests with Blue Unit Test Cases carried out by one instrument

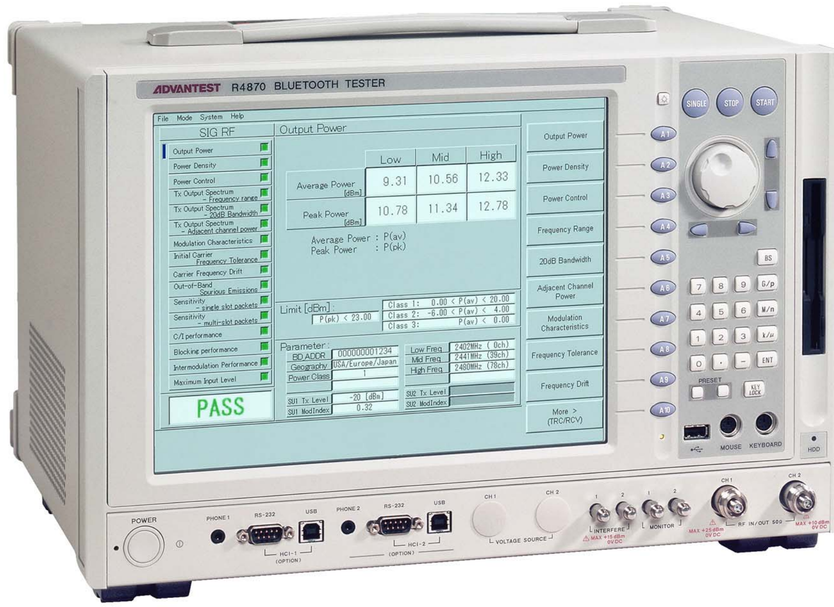


Photo 43880

Brief description

Bluetooth, the specifications for the technology related to short-range communications between electronic devices, has been received considerable attention in every field. The achievement of seamless communications between different types of electronic devices requires identification of the related RF characteristics and communication protocols.

The R4870 *Bluetooth* Tester from Advantest is designed exclusively for *Bluetooth*. Its compact body incorporates every function required for evaluating the performance of *Bluetooth* modules.

The design of a *Bluetooth* module requires verification of interoperability such as RF characteristics. The R4870 provides RF and communication test functions.

Test cases conforming to SIG Ver. 1.1

	SIG Standard No.		Test case	R4870	R4870*)
Transmitter tests	5.1.3	TRM/CA/01/C	Output Power	❍	❍
	5.1.4	TRM/CA/01/C	Power Density	–	❍
	5.1.5	TRM/CA/01/C	Power Control	–	❍
	5.1.6	TRM/CA/01/C	TX Output Spectrum (frequency range)	–	❍
	5.1.7	TRM/CA/01/C	TX Output Spectrum (20 dB bandwidth)	–	❍
	5.1.8	TRM/CA/01/C	TX Output Spectrum (adjacent-channel power)	–	❍
	5.1.9	TRM/CA/01/C	Modulation Characteristics	❍	❍
	5.1.10	TRM/CA/01/C	Initial Carrier Frequency Tolerance	❍	❍
	5.1.11	TRM/CA/01/C	Carrier Frequency Drift	❍	❍
	5.1.12	TRM/CA/01/C	Out-of-Band Spurious Emissions	–	❍
Receiver tests	5.1.13	RVC/CA/01/C	Sensitivity (single-slot packets)	❍	❍
	5.1.14	RVC/CA/01/C	Sensitivity (multi-slot packets)	❍	❍
	5.1.15	RVC/CA/01/C	C/I Performance	–	❍
	5.1.16	RVC/CA/01/C	Blocking Performance	–	❍
	5.1.17	RVC/CA/01/C	Intermodulation Performance	–	❍
	5.1.18	RVC/CA/01/C	Maximum Input Level	❍	❍
			Signalling	❍	❍

*) R4870 system with full features

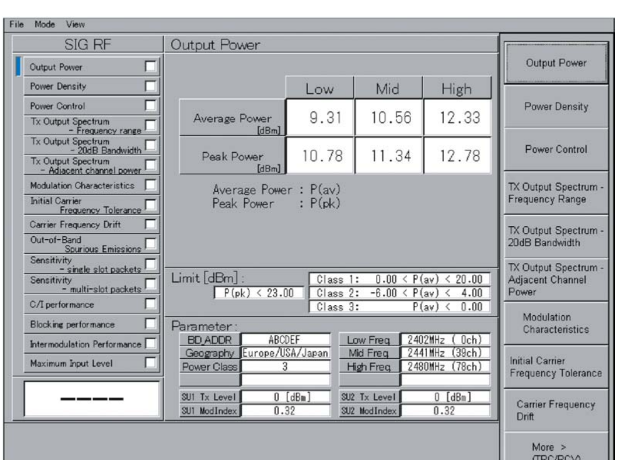
Bluetooth Tester R4870

The RF test can evaluate power, frequency, modulation index, and receiver sensitivity that conform to *Bluetooth* SIG standards by control through a wireless interface. In addition, the R4870 implements the Blue Unit Test Cases, which are included in the *Bluetooth* SIG standards, so that the communication test can evaluate interoperability by executing the connection test with the R4870.

The *Bluetooth* qualification test consists of complicated series of test items and requires a considerable amount of labor for pre-qualification. To reduce this effort, the R4870 provides an option for connecting external devices (system expansion) so that pre-qualification tests of *Bluetooth* modules can easily be performed.

Main features

- All major *Bluetooth* SIG test cases with loopback testing
- Dirty transmitter signal is supported for measuring receiver sensitivity
- BER test
- Embedded test protocol for Blue Unit Test Cases
- Control commands of the spectrum analyzer and signal generator for interference are incorporated to facilitate complete system configuration
- 12-inch TFT LCD included
- User-friendly touch panel for control
- Compact, light-weight design



Embedded HCI command enabling loopback test

Embedded HCI command

The *Bluetooth* module must be set to test mode before a loopback test can be executed. The R4870 houses an HCI interface, and can set the module to the test mode wait state. Then, the test mode can be activated by an RF signal to automatically start the loopback test. If a *Bluetooth* module does not contain an HCI interface and is in the test mode already, the test will be executed by turning off the HCI control of the R4870.

Test execution

The R4870 provides its own independent automatic test environment. It executes the specified test cases sequentially, displays the test data along with an indication of PASS or FAIL which appear with different colours, and delivers an overall evaluation. In addition, it can select an individual test to be repeated. The test data can be stored in the built-in hard disk memory. The data can be retrieved at any time or exported to a personal computer.

Easy modification of test cases

The test channel for each test case can be specified individually. The criteria for determining the PASS or FAIL result of the tests can also be adapted to individual requirements. An optimum test environment can thus quickly be set up by modifying the system according to the tests that vary with changing requirements.

RF test (transmit and receive characteristics) supporting Test Specification Rev. 0.91

Tests provided independently by the R4870

- Transmitter characteristics
  - Peak power, average power
  - Modulation characteristics
  - Carrier frequency
  - Frequency drift, frequency drift rate
- Receiver characteristics
  - Sensitivity (single-slot packets)
  - Sensitivity (multi-slot packets)
  - Maximum input level

Bluetooth Tester R4870

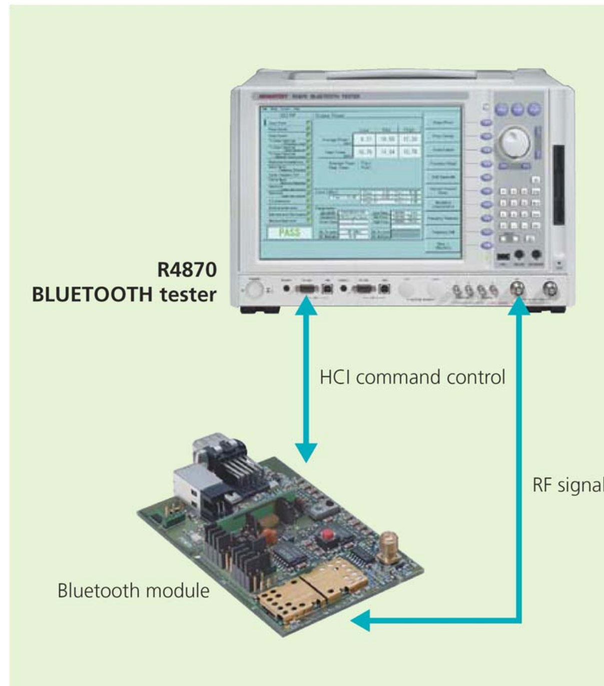
Connection test based on Blue Unit Test Cases to Bluetooth SIG standard

Communication test

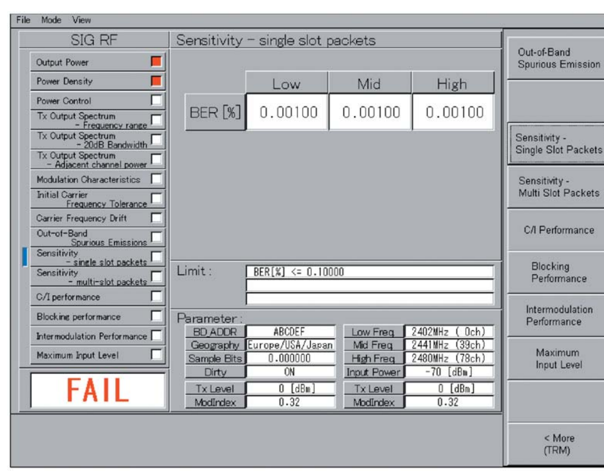
RF, BB and LM operation compatibility testing is specified in the Blue Unit Test Cases to maintain a minimum level of interoperability of *Bluetooth* modules. The R4870 supports 12 test cases, which are listed below. Therefore, an interoperability evaluation that is equivalent to the connection test with the current Blue Unit is available. The built-in test cases are executed sequentially, and either PASS or FAIL is indicated in different colours as the result for each test. An individual test case can be executed separately.

Configuring the system for pre-qualification testing

Evaluation testing at the *Bluetooth* Qualification Test Facility (BQTF) is complicated and time-consuming. In addition, failing the test leads to unnecessary excessive expenses and/or loss of business opportunities. A test system configuration consisting of the R4870 as the core and spectrum analyzer, signal generators and power meter connected via IEC/IEEE bus supports all RF tests according to the *Bluetooth* SIG standards.



A dirty transmitter signal is supported for the receiver sensitivity test. The test setting can be switched to a test with a normal signal.



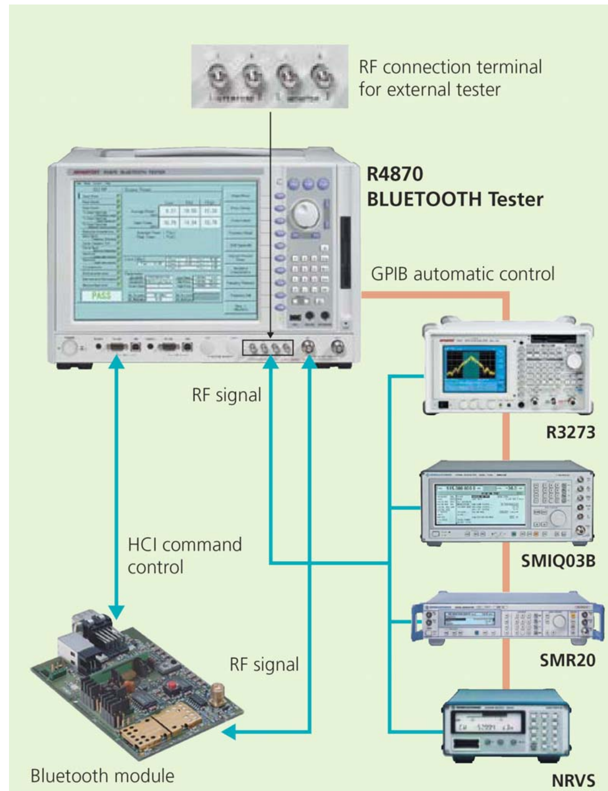
Example of receiver sensitivity test

Bluetooth Tester R4870

Then the user does not have to create a system control software for the test since the whole system can be controlled from the R4870. The RF signal will be transmitted via the R4870. The loss of signal level on the RF path can be compensated by adjusting the initial settings of the R4870. The test can be started immediately without measuring and entering corrective data.

Externally connected devices

- R3273: Spectrum Analyzer (to 26.5 GHz)
  - OPT.01: Digital Modulation Analysis Option
  - OPT.66: *Bluetooth* Modulation Analysis Option (required)
- SMIQ03B: Digital Modulation Signal Generator (to 3 GHz)
  - SMIQ-B11: Data Generator
  - SMIQ-B12: 16 MB Memory Extension
  - SMIQ-B20: Digital Modulation Coder
- SMR20: CW Signal Generator (to 20 GHz)
- NRVS: Power Meter (for system calibration)
  - NRV-Z52: Power Sensor (required)



Externally connected devices

Specifications in brief

Transmitter specifications

Frequency	
Range	2402 MHz to 2480 MHz
Resolution	1 kHz
Accuracy	100 Hz + reference OSC
Modulation index	
Range	0.25 to 0.40 (specified 0.28 to 0.34)
Resolution	0.01
Filter	
BT	0.5 ±0.01
20 dB bandwidth	1.0 MHz
Bit rate	1 Mbps
Accuracy	±1 ppm
Adjustable range	±40 ppm
Level	
Range	–13 dBm to –93 dBm
Resolution	1 dB
Accuracy	±1 dB
TX spectrum	
Adjacent channel	–40 dBm (2 MHz, output level –10 dBm) –50 dBm (3 MHz, output level –10 dBm)
Initial carrier frequency tolerance	±5 kHz
Carrier frequency drift	in accordance with tables 6 and 7 of *Bluetooth* SIG RF Test Specification Revision 0.91
Power ramp	in accordance with Annex 6 of RF test specification Revision 0.91

Receiver specifications

Frequency measurement (Frequency error + deviation) Analysis range +20 to –40 dBm	
FM deviation	+300 to –300 kHz
Resolution	1 kHz
Accuracy	1 kHz
Power measurement	
Range	–5 dBm to +25 dBm
Accuracy	±1.2 dB
BER	loopback test available
Reference OSC	
Frequency	10 MHz
Aging rate	0.1 ppm/year

General data

Power supply	
Voltage	100 V to 120 V, 220 to 240 V
Weight	approx. 15 kg

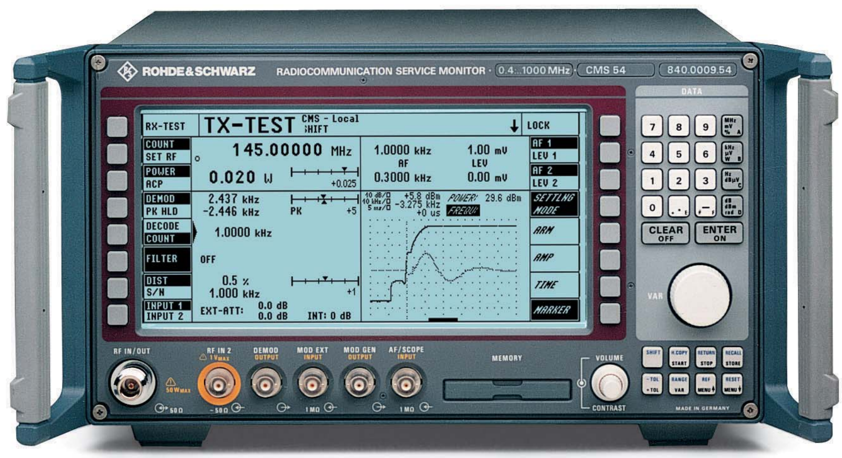
Ordering information

***Bluetooth* Tester**	R4870

Radiocommunication Service Monitors R&S CMS50/54

0.4 MHz to 1000 MHz

Radio testers for service, production and development



R&S CMS54 (photo 41410)

Brief description

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

Main features

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

Overview of models

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

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

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

- Radio measurements same as R&S CMS50

Basic model additionally with:

- Full-span tracking generator from 0.4 MHz to 1000 MHz
- Adjacent-channel power meter with standard ETSI filters
- Duplex modulation meter
- Automatic harmonic measurement
- Cable fault test

Operation

- All functions are clearly displayed; 16 softkeys allow direct access to individual parameters
- The large, backlit LCD screen provides clear and simultaneous readout of all test results, entries and functions
- Hardcopy of screen display, entry of tolerance and reference values are made at a keystroke
- Settings can be varied in selectable steps using the spinwheel
- Programs, instrument settings and test results can be stored on memory cards
- Additional inputs and outputs allow independent and versatile use of signal sources and test facilities

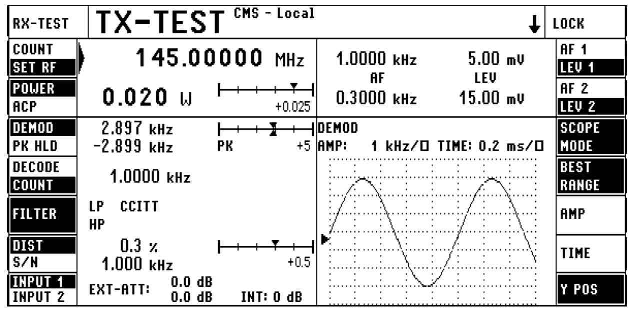
Automatic tests

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

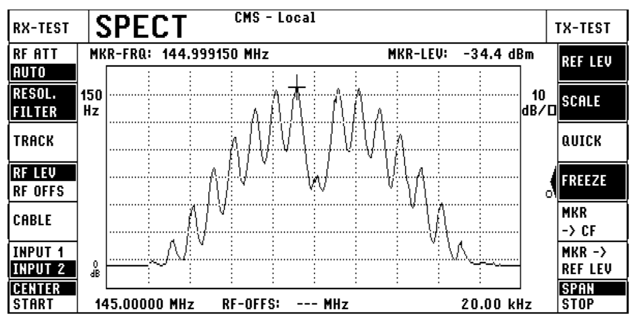
Radiocommunication Service Monitors R&S CMS 50/54

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

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



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



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

Signal sources

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

Signalling

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

Measuring facilities

- ◆ RF frequency counter, RF frequency-offset counter
- ◆ Power meter
- ◆ Selective RF power meter
- ◆ RF spectrum monitor with wide dynamic range and filters which also allow modulation analysis (AM, FM, SSB)
- ◆ Tracking generator
- ◆ Adjacent-channel power meter with standard ETSI filters
- ◆ Modulation meter for AM, FM and φM; weighting: +PK, –PK, PK HOLD, ±PK/2, RMS, RMS √2
- ◆ Duplex modulation meter for duplex spacings of any size
- ◆ AF voltmeter with peak and true RMS weighting
- ◆ SINAD meter with variable test frequency
- ◆ S/N/Distortion meter with variable test frequency
- ◆ AF frequency counter with period and gate-time counting
- ◆ Selective-call decoder for all standards (also user-programmable)
- ◆ DTMF decoder
- ◆ Oscilloscope
- ◆ DC ammeter/voltmeter
- ◆ Transient recorder for analysis of power and frequency transients
- ◆ Cable fault test

Filters

- ◆ CCITT or C-message filters for weighting to relevant standards
- ◆ Continuously tunable bandpass filter with high skirt selectivity for selective modulation and AF measurement
- ◆ Continuously tunable notch filter for signal suppression
- ◆ Highpass and lowpass filters for band limiting and measurement of subaudio tones

Other facilities

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

Radiocommunication Service Monitors R&S CMS50/54

Extensions for basic model	Option	R&S CMS50	R&S CMS54	Order No.	Specifications	
OCXO Reference Oscillator For long-term stability	R&S CMS-B1	❍	❍	0840.9406.02	See timebase Aging	 2×10^{-7}/year
OCXO Reference Oscillator For extremely high long-term stability	R&S CMS-B2	❍	❍	1001.6809.02	Specs same as R&S CMS-B1, except for aging	$\leq 1 \times 10^{-7}$/year
Duplex Modulation Meter For operation of RF frequency counter and modulation meter independent of RF generator (two-port measurements, also on frequency-converting modules)	R&S CMS-B59	❍	–	1032.0990.02	Specs same as basic model, except residual FM	$\leq$10 Hz
Duplex Modulation Meter Same as R&S CMS-B59, plus adjacent-channel power meter for measurements on duplex radio, cellular mobile phones and frequency-converting modules	R&S CMS-B9	–	●	0840.9506.02	Specs same as basic model, adjacent-channel power meter with ETSI filters Channel spacings Dynamic range	 10/12.5/20/25 kHz and user-selectable up to 1 MHz $\geq$70 dB (chan. spacing 25 kHz)
10 MHz Reference Frequency Input/Output External synchronization for measuring systems	R&S CMS-B22	❍	❍	1001.6750.02	Output Input	TTL signal, $Z_{out} \approx 50\ \Omega$, f = 10 MHz level > 1.5 V (V_{pp}), $Z_{in} \approx 50\ \Omega$, f = 10 MHz ±500 Hz
100 W RF Power Meter Measurement of high RF input power	R&S CMS-B32	❍	❍	1001.7905.02	Maximum input power: 100 W for 3 min, then 10 min power off; continuous power: 80 W; max. output level and measurement sensitivity at input 1 reduced by 3 dB; additional error: $\leq$0.15 dB (P>40 mW, AM = 0%)	
13 dBm Output	R&S CMS-B34	❍	❍	1032.1350.02	Additional power output for off-air measurements	
IEC/IEEE bus Interface	R&S CMS-B54	❍	●	1032.0748.02	Use of R&S CMS50 in automatic test systems	

Signalling units for models with Duplex Modulation Meter R&S CMS-B9 or R&S CMS-B59

	Option	R&S CMS50	R&S CMS54	Order No.	Specifications
Signalling Unit for Cellular Radio NMT 450/900, E-AMPS, E-TACS, J-TACS, TACS Issue 4 (opt.), R 2000	R&S CMS-B53 1)	❍	❍	1032.0890.02	Simulation of base station for testing cellular mobile phones, e.g. call setup, call cleardown, channel and power change
Signalling for POCSAG, ZVEI/ VDEW digital for R&S CMS-B53	R&S CMS-B26	❍	❍	1031.9993.10	

● fitted as standard
❍ option
– not possible

Radiocommunication Service Monitors R&S CMS 50/54

Optional control interfaces [3]						
Order No.	**R&S CMS-B5 0841.0502.10**	**CMS-B55 1032.0790.02**	**CMS-B20 0841.1209.02**	**CMS-B39 1032.0090.02**	**Specifications**	
DTMF Decoder	●	●	●	●	Decoding of DTMF dual tones and VDEW direct dialling	
CCITT Filter	●	●	●	●		
Centronics Interface	●	●	●	●		
Relays	8	–	–	4	With max. 1 W switching power, V_{max}=30 V, I_{max}=0.1 A	
TTL Input/Output	12	–	–	8	Outputs: 25 mA	
DC Ammeter/ Voltmeter, floating	–	–	●	–	Voltage measurement Range Resolution Error Current measurement Range Resolution Error	 0 to ±30 V 0.1 mV to 100 mV ±1% + resolution 0 to ±10 A 1 mA to 100 mA ≤4% ± 3 mA
600 Ω AF Transformers	–	–	–	●	Output impedance of AF generator Frequency range Output voltage Max. output current Input impedance of AF voltmeter Frequency range	switchable to 600 Ω ±10% 100 Hz to 6 kHz 10 µV to 2.5 V 4 mA switchable to 600 Ω ± 10% 100 Hz to 6 kHz
VSWR Measurements	CMS-Z37 [2]	–	–	CMS-Z37 [2]	Connection of Insertion Units NAS-Z1, -Z3, -Z5, -Z6 (GSM 900), -Z7 (GSM 1800) with direct reading of VSWR as well as forward and reflected power	

1) R&S CMS-B59 also required.

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

3) Choice of one option.

● fitted as standard
– not possible

Radiocommunication Service Monitors R&S CMS50/54

Specifications in brief (all R&S CMS models)

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

Timebase

Standard

Temperature effect 0 to 35°C	≤1 x 10^{-6}
Aging	≤2 x 10^{-6}/year

Options R&S CMS-B1 and R&S CMS-B2

Temperature effect 0 to 50°C	≤1 x 10^{-7}
Aging	≤2 x 10^{-7}/year (R&S CMS-B2: ≤1 x 10^{-7})

Receiver measurements

Signal generator

Frequency range	0.4 MHz to 1000 MHz **(usable from 100 kHz)**
Frequency resolution	50 Hz **(10 Hz)**
Level	
FM, φM, CW	–134 dBm to 0 dBm
AM	–134 dBm to –3 dBm
Level resolution	0.1 dB
Accuracy	±2 dB
Harmonics	≤–20 dBc **(≤–25 dBc)**
Nonharmonics	≤–50 dBc
Phase noise	≤–110 dBc (20 kHz from carrier, referred to 1 Hz test bandwidth)

Modulation

Frequency range	2 MHz to 500 MHz **(0.4 MHz to 1000 MHz)**
AM depth	0 to 99%
Mod. frequency range	DC to 20 kHz
FM deviation	0 to 100 kHz (50 Hz to 50 kHz)
Resolution	1 Hz
Mod. frequency range	20 Hz to 20 kHz
Mod. distortion	≤1%
φM deviation (internal)/resolution	0 to 10 rad/1 mrad
Mod. frequency range	100 Hz to 6 kHz
Mod. distortion	≤1%

AF voltmeter

Frequency range	50 Hz to 20 kHz
Measurement range/resolution	0.1 mV to 30 V/100 µV
Input impedance	approx. 1 MΩ

Transmitter measurements

RF power meter

Frequency range	1.5 MHz to 1000 MHz (2 MHz to 1000 MHz)
Measurement range	5 mW to 50 W (100 W optional)
Accuracy (P >20 mW, AM=0%)	0.4 dB + resolution
Selective level measurement	in frequency range 1 MHz to 1000 MHz
Level range	–60 to +47 dBm w/o weighting filter, –80 dBm to +47 dBm with 2 kHz resonance filter

RF frequency counter

Frequency range	0.5 MHz to 1000 MHz (usable from 100 kHz, IF narrow)
Input level range (CW, FM)	
Input 1	0 to +47 dBm
Input 2	–40 dBm to +7 dBm

Frequency deviation meter

Operating modes	+PK, –PK, ±PK/2, PK HOLD, RMS, RMS√2
Measurement range	0 Hz to 50 kHz **(0 Hz to 100 kHz)**
AF frequency range	20 Hz to 15 kHz **(20 Hz to 20 kHz)** (DC-coupled at demodulator output)
Resolution	1 Hz

Phase deviation meter

Operating modes	+PK, –PK, ±PK/2, RMS, RMS√2
Measurement range/resolution	0.001 rad to 5 rad/0.001 rad
AF frequency range	300 Hz to 6 kHz

AM depth meter

Operating modes	+PK, –PK, ±PK/2, RMS, RMS√2
Measurement range/resolution	0.01% to 99%/0.01%
AF frequency range	50 Hz to 10 kHz **(50 Hz to 20 kHz)**
RF spectrum monitor	1 MHz to 1000 MHz
Display dynamic range	>60 dB
Span	0 (zero span) to 50 MHz
Filter (3 dB bandwidth)	150 Hz, 6/16/50/300 kHz, 1/3 MHz (coupled to span)

RF spectrum monitor (R&S CMS50)

Frequency range	1 to 1000 MHz, usable from 100 kHz
Span	0 (zero span) to 50 MHz
Reference level	+47 dBm to –47 dBm (input 1)
Display dynamic range	>60 dB (for reference level >–7 dBm at input 1)
Resolution filter (3 dB bandwidth)	150 Hz, 6/16/50/300 kHz/1/3 MHz (coupled to span)
Resolution	0.4 dB

RF spectrum monitor (R&S CMS54)

Frequency range	1 to 1000 MHz, usable from 100 kHz
Span	0 (zero span) to 50 MHz; full span for frequency range 10 to 1000 MHz
Reference level	+47 dBm to –47 dBm (input 1)
Sensitivity	<–110 dBm (for resolution filter 6 kHz and reference level ≤–37 dBm at input 2, f ≥10 MHz)
Inherent spurious response	<–50 dBc (for reference level >10 dBm and f >50 MHz)
Display dynamic range	>65 dB (for reference level >–7 dBm at input 1)
Scaling	2/5/10 dB/div
Display range	≤80 dB
Resolution filter (3 dB bandwidth)	150 Hz (for modulation analysis), 6/16/50/300 kHz/1/3 MHz (for full span), coupled to span
Error	<3 dB + resolution
Resolution	0.4 dB

Transient recorder (R&S CMS54)

Measurement of power and frequency as a function of time with graphical display and selectable zoom

Time scale	50 µs/div to 1 s/div, maximum recording time 40 s
Frequency transients	
RF frequency range	1 MHz to 1000 MHz
Measurement range (FM dev.)	0 to ±100 kHz
Scaling	0.5 kHz to 50 kHz/div
Triggering	internal, automatic (frequency changes >8 kHz)

Radiocommunication Service Monitors R&S CMS50/54

Power transients

RF frequency range	1 MHz to 1000 MHz
Display dynamic range	60 dB (for 47 dBm at input 1)
Scaling	2/5/10/20 dB/div
Triggering	internal, automatic (power 10%)

Harmonic measurements (R&S CMS54)

Display of 1st to 4th harmonic	
Max. harmonic frequency	1000 MHz
Dynamic range	>60 dB >90 dB in frequency range 26.965 to 27.405 MHz (CB radio)

Tracking generator (with R&S CMS-B59/-B9)

Frequency range	400 kHz to 1000 MHz
Reference level	–67 dBm to –27 dBm
Display dynamic range	50 dB
Span	0 to 50 MHz (full span for R&S CMS54)
Output level	–128 dBm to 0 dBm
Frequency offset	0 to –999 MHz (depending on span and center frequency)

Transmitter measurements at 2nd RF input

Measurement of RF frequency, modulation (AM, FM, φM), modulation frequency and RF spectrum (level) of small RF signals, e.g. in off-air or module measurements, for input levels from approximately

RF frequency counter	30 µV (selective frequency counter with presetting)
Modulation meter	5 µV (IF narrow) 1 µV (IF narrow, selective meas.)
Selective level measurement	–75 dBm to –35 dBm without weighting filter, –100 dBm to –35 dBm with 2 kHz resonance filter

Transmitter measurements at 2nd RF input (R&S CMS54)

Additional, internally switchable 0/24 dB attenuator pad, for high-level measurements at input 2

Transmitter and receiver measurements

Modulation generator I and II

Frequency range	0.1 Hz
Output voltage range	10 µV to 5 V
Output impedance	≤4 Ω

Distortion meter

Frequency	100 Hz to 5 kHz (100 Hz to 3 kHz)
Measurement range	0.1% to 50%
SINAD meter	
Frequency	100 Hz to 5 kHz (1 kHz ±10Hz)
Measurement range	1 dB to 46 dB

AF frequency counter

Operating modes	demodulation, AF, beat (frequency offset)
Frequency range	20 Hz to 500 kHz (20 Hz to 20 kHz) (superimposed RF)
Resolution	1 Hz/0.1 Hz

Oscilloscope

Bandwidth	
DC	DC to 20 kHz
AC	10 Hz to 20 kHz
Horizontal deflection	20 to 0.1 ms/div
Vertical deflection	scaled in kHz (FM), rad (φM), % (AM), mV/V (AF)
Input voltage range	0 to 40 V (V_P)
Input impedance	approx. 1 MΩ

AF filters

Highpass	f_{cutoff}=300 Hz
Lowpass	f_{cutoff}=3.4 Hz
Bandpass	
broadband	highpass + lowpass
narrowband	100 Hz to 3 kHz **(50 Hz to 5 kHz)**
Notch filter	100 Hz to 3 kHz **(100 Hz to 5 kHz)**
CCITT filter	see option R&S CMS-B5 or R&S CMS-B20

Selective-call coder/decoder

Tone sequences	ZVEI1/ZVEI2/CCIR/EIA/EEA/EURO/NATEL/CCITT/VDEW/DTMF/VDEW direct dialling/user-defined sequences (DTMF decoding see Control Interfaces R&S CMS-B5 and R&S CMS-B55); CDCSS decoder and ATIS see option R&S CMS-B27
Audio monitor (loudspeaker)	demodulated signal, AF signal, beat (frequency offset)

General data

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

Ordering information

Radiocommunication Service Monitor	R&S CMS50	0840.0009.50
	R&S CMS54	0840.0009.54
Extras		
Documentation of Calibration Values	R&S CMS-DCV	0240.2193.08
Memory Card 32 kByte	R&S CMS-Z1	0841.1609.02
Memory Card 128 kByte	R&S CMS-Z2	0841.1509.02
Battery Connector for external DC Supply	R&S CMS-Z7	0841.1350.02
Adapter for VSWR Sensors NAS-Z1/-Z3/-Z5/-Z6 and -Z7	R&S CMS-Z37	1065.4907.02
Carrier-bag	R&S CMS-Z40	1065.5603.02

Antenna Coupler, RF Shielding Cover, *Bluetooth* Antenna R&S CMU-Z10/-Z11/-Z12

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

Photo 43915-3

Brief description

Anyone engaged in mobile phone testing is only too familiar with problems such as getting hold of a suitable RF adapter or keeping RFI away which would otherwise falsify the measurement results.

The R&S CMU-Z10/-Z11/-Z12 from Rohde&Schwarz is the solution to these problems for all mobile phones – whether GSM, US Cellular or WCDMA.

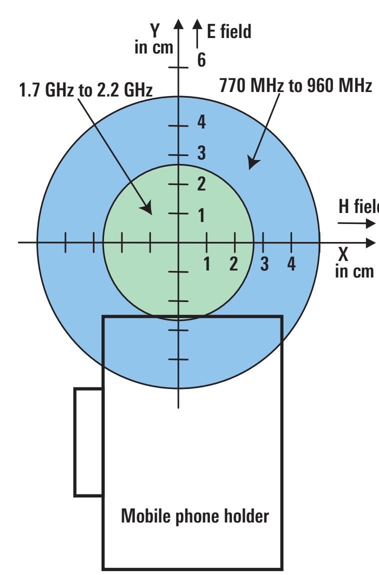
The broadband Antenna Coupler R&S CMU-Z10 is the basis, which in conjunction with the RF Shielding Cover R&S CMU-Z11 can be upgraded to a fully enclosed RF shielded chamber.

Antenna Coupler R&S CMU-Z10

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

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

Position
The blue circle shows the active coupling zone for frequencies from 770 MHz to 960 MHz, the green circle that for frequencies from 1.7 GHz to 2.2 GHz (see illustration). Depending on the radiation center of the phone, the optimum position is different for



Antenna Coupler, RF Shielding Cover, *Bluetooth* Antenna R&S CMU-Z10/-Z11/-Z1

every model. Since the coupling zone is an area, the phone can be shifted somewhat out of the optimum position without dramatic increase in coupling attenuation (see diagram top right). These zones are marked on the coupler by the antenna elements which are visible through the transparent base plate. To facilitate handling of the DUT, a holder is mounted on the base plate for fixing the mobile phones directly above the optimum coupling zone. For applications in which this holder is disturbing, a second absolutely flat base plate is supplied, which can be used instead of the base plate mounted as standard. This base plate can accommodate DUTs of up to 280 mm x 50 mm x 200 mm in size.

Radiated interference

Interference from other transmitters falsifies the measurement results. Interfering transmitters may be neighbouring base stations as well as other mobile phones and test sets in the same service shop or repair line. Distinctly differing results of bit error rate measurements (BER) in different channels are a clear sign of interference. Therefore, it is recommended to use the coupler in combination with the Shielding Cover R&S CMU-Z11.

Shielding Cover R&S CMU-Z11

To reduce effects like standing waves, the ceiling of the shielding cover is lined with absorbing foam material to attenuate the magnetic field which has its maximum at the metal surface. In addition, the electric field component is attenuated by a pyramid-shaped absorber. With the shielding cover, the coupler is upgraded to a high-grade RF shielded chamber which prevents unwanted interference radiated by base stations or other neighbouring test and service sets from affecting the measurement results of the DUT. This is particularly important for BER measurements. The effective closing mechanism can conveniently be managed with only one hand and ensures a very high shielding effectiveness of >50 dB by producing a defined contact pressure.

Specifications

R&S CMU-Z10

VSWR without R&S CMU-Z11, without DUT, with cable supplied	
0.77 GHz to 0.87 GHz	<5,0
0.87 GHz to 0.96 GHz	<3.5
1.7 GHz to 2.0 GHz	<3.5
2.0 GHz to 2.2 GHz	<3.5
Coupling factor	
770 MHz to 960 MHz	5 dB to 8 dB[1)]
1.7 GHz to 2.2 GHz	10 dB to 15 dB70
Connectors	
RF IN/OUT	N female/N female
RF THROUGH	N female/N female
DATA THROUGH	15-pin HDD female filter adapter/ 15-pin HDD male filter adapter

R&S CMU-Z11

Shielding effectiveness (in conjunction with R&S CMU-Z11)	
Antenna coupler	>50 dB
Bluetooth Antenna R&S CMU-Z12	>30 dB

R&S CMU-Z12

VSWR	
2.4 GHz to 2.5 GHz	<2.5
Connector	N female

The *Bluetooth* antenna can be integrated into the R&S CMU-Z10 or used separately.

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

General data

Operating temperature range	–10°C to +60°C
Dimensions (W x H x D)	
R&S CMU-Z10	230 mm x 100 mm x 320 mm
R&S CMU-Z10 with R&S CMU-Z11	250 mm x 180 mm x 430 mm
Usable test space	
(2nd plate without holder)	280 mm x 50 mm x 200 mm
R&S CMU-Z12	56 mm x 56 mm x 50 mm
Weight	
R&S CMU-Z10	2.7 kg
R&S CMU-Z10 with R&S CMU-Z11	4.8 kg
R&S CMU-Z12	0.1 kg

Ordering information

Antenna Coupler	R&S CMU-Z10	1150.0801.02
RF Shielding Cover for R&S CMU-Z10	R&S CMU-Z11	1150.1008.02
Bluetooth Antenna	R&S CMU-Z12	1150.1043.02
Spare RF sealing cord for R&S CMU-Z11		1158.9514.00

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

Equipment supplied

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

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

Brief description

Anyone engaged in mobile phone testing is only too familiar with problems such as getting hold of a suitable RF adapter or keeping RFI away which would otherwise falsify the measurement results.

Shielded Chamber R&S CTS-Z12 ensures constant and defined conditions which without protective measures against external radio fields – e.g. caused by neighbouring base stations – are usually not given.

With its excellent RF characteristics in all frequency bands of cellular mobile radio, R&S CTS-Z12 is an ideal accessory not only for the Digital Radio Tester R&S CTS, but for all digital and analog radio testers from Rohde & Schwarz.

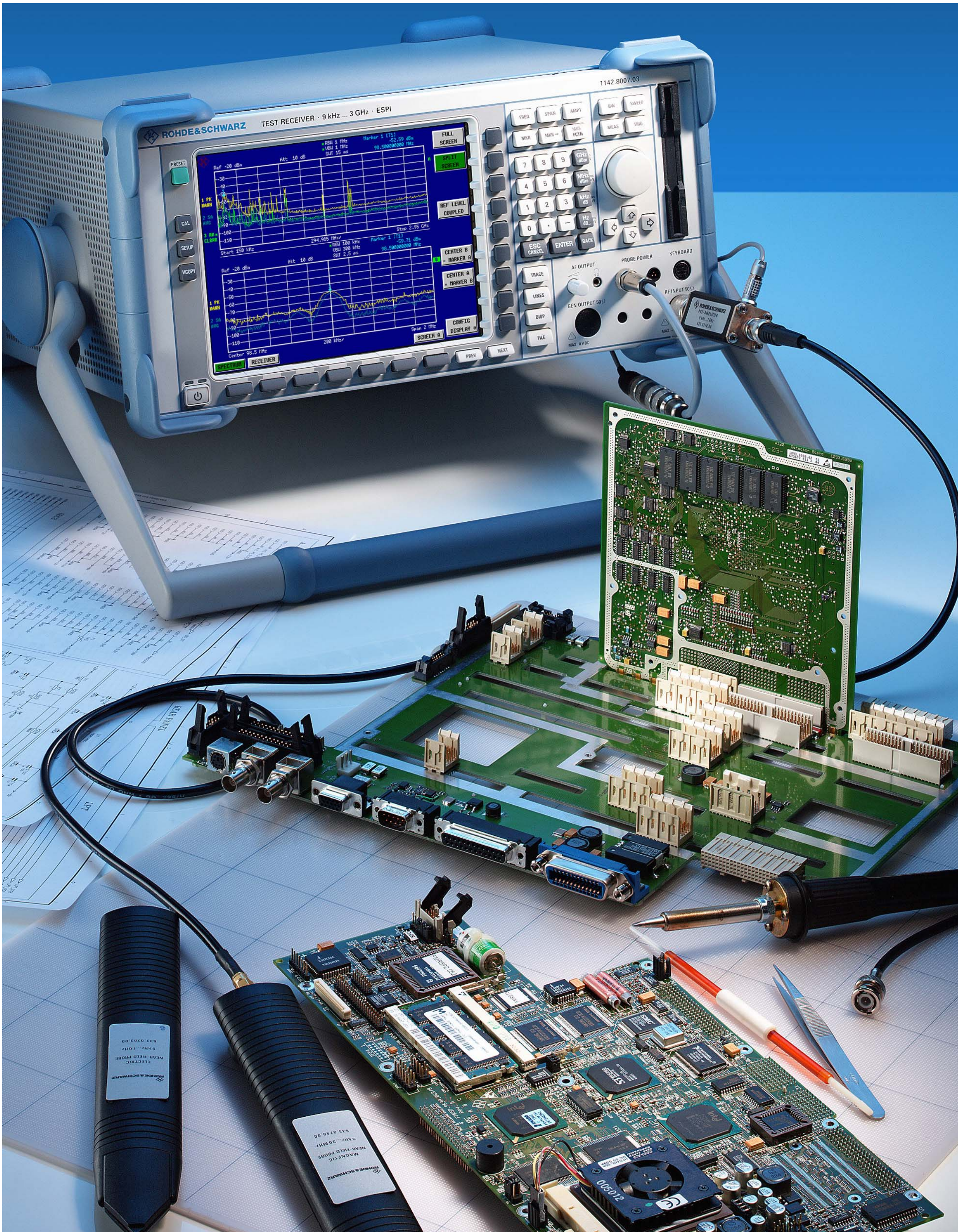
Shielded Chamber R&S CTS-Z12 provides sufficient space for accommodating all customary analog and digital mobile phones. The phone to be tested is connected to the coupler via a mobile holder with a spring clamp. The radio-specific attenuation factors can be determined through calibration.

Specifications

Frequency range	up to 2 GHz
Shielding	≥35 dB
Material	aluminium interior lined with foam mats
Connectors	opening for SMA connector of coupler, 25-pin connector feedthrough
Dimensions (W x H x D)	319 mm x 202 mm x 200 mm
Weight	2.7 kg

Ordering information

Shielded Chamber for Mobile Radios	R&S CTS-Z12	1079.1470.02



The R&S ESPI, which is suitable for all commercial EMI standards to CISPR, EN, ETS, FCC, ANSI C63.4, VCCI and VDE, has been specially designed for pre-compliance measurements in development. The near-field probe sets can be used to determine electromagnetic emissions of any type. Their main applications is in the diagnosis of emissions from printed circuit boards, cables and leakage spots in shielded enclosures (photo 43665-9)

Contents of Chapter 2

Introduction

EMC = EMI + EMS

Electromagnetic compatibility (EMC) is the capability of an electrical device or system to operate in its electromagnetic environment without disturbing or being disturbed by it. EMC is an important criterion of product quality.

To ensure EMC of a product in the most economical way, appropriate measures should be taken as early as in the design phase.

According to the definition, EMC is subdivided into electromagnetic interference (EMI) and electromagnetic immunity or susceptibility (EMS). Legislation prescribes compliance with maximum values for EMI and minimum values for EMS. The relevant limit values, the measurement methods and instruments to be employed are specified in the relevant standards.

Conformity mark

To show their conformity to the EMC requirements prescribed by law, all electrical devices have to be marked accordingly.

European CE conformity mark

Since beginning of 1996 uniform marking is prescribed for the European Economic Area (EEA). From that date on electrical and electronic equipment not bearing the CE conformity mark may not be marketed any more in the whole European economic area.

EMI measurements

For measuring the electromagnetic interference, the interference sink, which in the commercial sector is always the listener or viewer, is replaced by the measuring instrument. As a result, all test receivers for commercial EMI measurements should have man-like response built-in: they must have a quasi-peak-weighting display to show the human perception of interference as a measured value.

In the military sector the interference sink is assumed to be a technical device which responds to the maximum interference level. Therefore, the peak interference is measured.

Interference is emitted by the equipment under test in completely undefined ways. Therefore, the EMC standards contain regulations for connecting the test receiver to the equipment under test, for the environment of the EUT and its operation.

EMS measurements

For measuring the electromagnetic susceptibility, the different interference sources occurring in practice are replaced by appropriate generators, the interfering signals of which are applied to the EUT via suitable coupling/decoupling networks.

For monitoring the proper functioning of the EUT, suitable monitoring equipment can be provided, which so far has not been defined in the relevant EMC standards. In many cases, highly shielded video cameras with a monitor are used for this purpose.

EMC measurement software

Correct EMC measurements are only possible upon strict compliance with a number of regulations and standards for the measuring instruments used and for the measurement methods adopted.

EMI test equipment from Rohde & Schwarz complies with the relevant regulations for measuring instruments. Compliance with the prescribed measurement methods, however, is the user's own problem. Support is rendered in the form of special measurement programs allowing time-saving and correct measurements.

These measurement programs are available as software packages (R&S ES-K1, R&S EMC32-E and R&S ESxS-K1 for EMI measurements and R&S EMC32-S for EMS measurements). They relieve the user of routine settings and offer every convenience from automatic consideration of frequency-dependent transducer factors of the coupling/decoupling networks, automatic selection of the applicable limit lines, display of the results in graphical or tabular form through to the generation of test reports. Similar convenience is provided by the automatic EMI test routines implemented in the Test Receivers of the R&S ESHS, R&S ESVS, R&S ESCS, R&S ESIB and R&S ESPI series. They allow fully automatic time-saving measurements without an external controller, so that extremely compact test scan be implemented.

Introduction

EMC measuring instruments

Rohde & Schwarz not only offers suitable test receivers covering a frequency range from 20 Hz to 40 GHz for EMI measurements, but also the necessary accessories. In the range from 9 kHz to 2.75 GHz, different types of test receivers of the R&S ESCS30 and R&S ESPI families are available. The frequency range of the R&S ESIB receivers starts at 20 Hz and extends to 7 GHz, 26.5 GHz or 40 GHz. There is the right instrument for every application and measurement problem, from the precertification test receiver R&S ESPI for development-accompanying diagnostic measurements through to the high-end ESIP.

Line impedance stabilization networks (LISN) are required as coupling/decoupling networks (CDN) for RFI measurements on power lines in the frequency range from 9 kHz to 30 MHz. These are available for a current drain of up to 16 A for two-phase feeding and up to 200 A for three-phase feeding of the EUTs. Symmetrical LISNs are available for RFI voltage measurements on data lines which are becoming ever more important.

Radiated interference is measured above 30 MHz, with calibrated antennas being required. The Rohde & Schwarz range of products comprises various high-precision antennas, as well as absorbing clamps, which are required for RFI power measurements e.g. on household appliances.

For EMS measurements, the Rohde & Schwarz range of products includes control generators whose modulation and level control characteristics are tailored to the specific requirements of these measurements. Suitable antennas and power meters are also available.

EMC test systems

Planning and implementation of practice-oriented EMC test systems requires a great deal of specialized knowledge and experience. This is what Rohde & Schwarz specialists have. All their expertise goes into turnkey EMC test systems which provide the fastest way of yielding correct EMC measurements. These systems are always tailored to the specific needs of the customer to provide the optimum solution to the tasks on hand. We can offer everything from small systems through to complete equipment of test houses with shielded anechoic chamber and the complete infrastructure required. Naturally, the main emphasis is on fully automatic measurements with comprehensive documentation of the test results and, if desired, statistical evaluation. One of the important factors of automatic EMC test systems is calibration and continuous monitoring of the measurement accuracy to make sure that all test results will pass another compliance test.

EMC seminars

Successful work in the field of EMC requires an accurate knowledge of all the relevant regulations, laws, standards and techniques required. It is not easy to be familiar with all of them and – in view of the frequent modifications – to remain up to date. Support is given in the form of seminars, in which experts both from Rohde & Schwarz and from outside will impart the necessary knowledge to the participants. These seminars are held at the training center in Munich, but are also offered at various Rohde & Schwarz branch offices; or also directly at the customer's if there is such a demand.

EMC legislation and standards

For the European Economic Area (EEA) EMC is regulated in the "Council Directive of 3 May 1989 on the approximation of the laws of Member States relating to electromagnetic compatibility (89/336/EEC)", which was published in the Official Journal of the EU on 23 May 1989.

In the meantime this directive has been transformed into national laws in all EEA member states, e.g. in Germany into the "Law on Electromagnetic Compatibility" (EMVG) of 9 November 1992.

The directive prescribes "protection goals" for all equipment containing electric or electronic components. These protection goals apply to EMI as well as to EMS. The directive does not contain any EMC limits, but refers to the appropriate standards. It is assumed that compliance with these standards entails compliance with the protection goals.

In order to be recognized by the directive and the EMVG, the numbers ("sources") of EMC standards must be published in the Official Journal of the European Communities or the Official Journal of Posts and Telecommunications.

Introduction

EMC standards

The number of standards published in the Official Journals is steadily increasing. The different types of standards include "generic standards", which are to be applied in all cases which are not covered by specific product or product family standards. The product (family) standards are divided into standards limiting low-frequency and high-frequency emission (radio disturbance suppression) and standards defining the requirements of immunity to electromagnetic emission. Besides, there is a series of specific product standards defining EMC requirements.

Individual EMC standards (extract of Official Journal 4/2002):

Generic standards – emission
- EN 50081-1
  Residential, commercial and light industry environment
- EN 50081-2
  Industrial environment

Generic standards – immunity
- EN 50082-1
  Residential, commercial and light industry environment
- EN 61000-6-2
  Industrial environment

Product family standards and product standards for low-frequency emission
- EN 61000-3-2
  EMC Part 2: Limits for harmonics up to 16 A
- EN 61000-3-3
  EMC Part 3: Limits for voltage fluctuations and flicker

Product family standards for high-frequency emission
- EN 55011
  ISM equipment
- EN 55013
  Sound and TV broadcast receivers
- EN 55014-1
  Electrical devices and systems (household appliances and electric tools)
- EN 55015
  Radio disturbance suppression of electrical devices and systems (lighting equipment)
- EN 55022
  Radio disturbance suppression of information technology equipment
- EN 55103-1
  Audio and video equipment

Product standards for immunity
- EN 55014-2
  Household appliances, tools and similar apparatus
- EN 61547
  Lighting equipment; EMC immunity requirements
- EN 55020
  Sound and TV broadcast receivers
- EN 55024
  Informatics equipment
- EN 55103-2
  Audio and video equipment

Special standard for signal transmission in low voltage installations
- EN 50065-1
  Signalling on low-voltage electrical installations.
  Part 1: General requirements, frequency bands and electromagnetic disturbances

Product standards containing EMC requirements:
- EN 50083-2
  Cable distribution systems for TV and sound signals
- EN 50090-2-2
  Electrical system technique for home and buildings
- EN 50091-2
  Uninterruptible power systems (UPS);
- EN 50130-4
  Alarm systems
- EN 50148
  Electronic taximeters
- EN 50199
  Light arch welding equipment
- EN 50227
  Nearing sensors
- EN 50263
  Measuring relays
- EN 50270
  Gas sensors
- EN 60204-31
  Sewing machines
- EN 60439-1
  Low voltage switchgear and control gear assemblies
- EN 60521, EN 60687, EN 61036, EN 61268
  Several AC watt-hour meters
- EN 60601-1-2
  Medical electrical apparatus, General safety requirements – EMC requirements and tests
- EN 60669-2-x
  Electronic switches for household and similar
- EN 60730-x-x
  Automatic electric controls for household and similar use
- EN 60870-2-1
  Telecontrol equipment and systems

Introduction

- EN 60 945
  Maritime navigational equipment
- EN 60 947-x-x
  Low-voltage switchgear and control gear
- EN 61008-1, EN 61009-1
  Residual current circuit breakers
- EN 61 037
  Electronic ripple control receivers for tariff and load control
- EN 61 038
  Time switches for tariff and load control
- EN 61 131-2
  Programmable controllers
- EN 61326
  Electrical equipment for measurement and test, control and laboratory use
- EN 61543
  Residual current protective devices
- EN 61 800-3
  Adjustable speed electrical power drive systems
- EN 12015, EN 12016
  Elevators and escalators, emission, immunity
- EN ISO 14982
  Agricultural and forestry machines
- EN 300386
  Telecommunications network equipment

EMC standards for radio and telecommunication equipment
These include the ENI standards EN30x xxx and EN30x xxx, e.g. EN300 086 Land Mobile Radio. So far, 52 of these standards have been published in the Official Journal.EMC test methods.

As already described above, since January 1996 all electrical products offered on the EEA market must be identified with the CE mark, the prerequisite for this conformity mark being compliance with the relevant EMC standards.

The EMC directive prescribes different test methods, depending on whether the equipment tested is "normal" equipment; it is also of importance whether complete standards, i.e. relating to both EMI and EMS, exist for that equipment.

In the simplest possible case, i.e. if a complete standard is available, the manufacturer or importer in the EEA is authorized to carry out the required tests himself and to label the product with the CE mark without supervision. Incomplete standards, however, require the involvement of a competent body.

All in all, the EMC directive gives the manufacturer or importer more possibilities than previously to pursue independently the certification of the electromagnetic compatibility of his products, which is then recognized on the entire European market.

Field-strength measurements

Wide measurement ranges (30 nV to 7 V) in conjunction with high selectivity and large dynamic range permit the Rohde & Schwarz test receivers to be used as high-accuracy selective voltmeters in labs and test departments. With built-in tracking generators, the test receivers can also perform twoport measurements. Antennas make them suitable for field-strength measurements.

Radiocommunication services (regulation authorities, broadcasting corporations, military, traffic and security authorities as well as civil providers) use field-strength meters for radio control and propagation measurements in the planning stage and for coverage measurements during operation of communication networks.

Field-strength measurements – in particular propagation and coverage measurements – are usually made in mobile mode (vehicle or helicopter). Portability and battery operation are important criteria in the choice of the test receiver.

Hardware from Rohde & Schwarz

Rohde & Schwarz offers the complete range of measuring equipment from a single source: from automatic test receivers through to turnkey systems with power amplifiers and remote-controlled antennas. The Rohde & Schwarz products feature future-oriented design and advanced circuit technology; they comply with the highest international standards both electrically and mechanically.

Software from Rohde & Schwarz

For years Rohde & Schwarz has been creating programs which are extremely user-friendly and can be used without any in-depth programming knowledge. Using modern software development tools and in close cooperation with the customers, program packages are tailored to the specific needs.

Equipment required for EMI measurements to specific standards

Group of equipment			Industrial, scientific and medical equipment	Vehicles with combustion engines, remote/built-in RFI suppression	Sound and TV broadcast receivers	Electrical devices, household appliances	Fluorescent lamps and luminaires	Information technology equipment (ITE)	Military equipment and systems	Generic emission standards	Mains signalling equipment	Cable distribution systems TV/sound	Uninterruptible power systems (UPS)	Professional audio/video equipm.	Electric railways	Medical electrical apparatus	Maritime navigation equipment
Standards		International Europe + Germany Japan USA	CISPR11; EN55011 VDE 0875 Part 11 EACL Sect. 2 FCC Part 18, Subpart C	CISPR12/CISPR25 ECE 10, DIR95/54/EG VDE 0879 Part 1, Part 2, 3; JASO D001-82	CISPR13; EN55013 VDE 0872 Part 13 EACL Sect. 3 & 8	CISPR 1-1; EN 55014-1 VDE 0825 Part 14 EACL Sect. 5; FCC Part 15, Subpart B;	CISPR15; EN55015 VDE 0875 Part 2/ Part 15 EACL Sect. 6 & 7	CISPR22; EN55022 VDE 0878 Part 22 EACL Sect. 4; FCC Part 15, Subpart B; Subpart B	VG95370, 95373 – MIL-STD-461 (CE/RE) DEF-STAN 59-41 (UK)	EN 50 081-1(2	EN 50 065-1	EN 50083-2	EN 50 091-2	prEN55103-1	prEN50121	EN 60601-1-2	EN 60945
Frequency range	Test Receivers	Accessories and extras															
from 20 Hz	ESIB	Current Probe EZ-17							●								
		H-Field Coil HZ-10							●					●			
from 9 kHz		Current Probe EZ-17	❍	❍	❍	❍	❍	●	●		❍	❍					
		H-Field Coil HZ-10							● 4)					●			
		Tripod HFU-Z	●						● 5)						●		●
		Loop Antenna HFH2-Z2	●						● 5)						●		●
		Tripod HZ-1							●								
		Rod Antenna HFH2-Z6							●								
	ESCS30	V-Network ESH2-Z5	●		●	●	●	●	● 6)	●	● 10)	●	●	●	●	●	●
		V-Network ESH3-Z5	●		●	●	●	●	● 6)	●	● 10)	●	●	●	●	●	●
	ESPI 1)	V-Network ENV 4200	●		●	●	●	●	● 6)	●	● 10)	●	●	●	●	●	●
		V-Network ESH3-Z6		●					●								
	ESIB	Coupling Network ENY22						●	● 5)								
		Coupling Network ENY41						●									
		Probe ESH2-Z2	●		●	●	●	●		●	●	●	●	●	●	●	●
		Probe ESH2-Z3	●		●	●	●	●		●	●	●	●	●	●	●	●
		Ant. Imp. Converter EZ-12		●													
		Probe Set EZ-11	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
		Probe Set EZ-14	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
		Triple-Loop Ant. HM 020	❍				●										❍
		RF Cable HZ-3/HZ-4	❍		❍	❍	❍	❍	❍								
from 30 MHz		Current Probe EZ-17	❍	❍	❍		❍	❍	●	●	❍		❍				
		Current Probe ESV-Z1	❍	❍	❍		❍	❍	●	❍	❍						
		Absorb. Clamp MDS-21/22	●	●	❍	●		❍		●	●	●		●			
		Probe Set HZ-11	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
	ESCS30	Probe Set HZ-14	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
		Tripod, Mast HFU-Z	●	●	●		●	●		●	●		●	●	●	●	●
	ESPI 1)	Broadband Dipole HUF-Z1	●	●	●		●	●		●	●		●	●	●	●	●
		Log Periodic Ant. HL023A1	●	●			●	●		●	●		●	●	●	●	●
	ESIB	Biconical Antenna HK116	●	●	●		●	●	●	●	●		●	●	●	●	●
		Log Periodic Ant. HL223	●	●	●		●	●	● 7)	●	●		●	●	●	●	●
		Con. Log Spir. Ant. HUF-Z4							● 8)								
		Tripod HZ-1							●								
		RF Cable HFU2-Z4/-Z5	●	●	●		●	●		●	●		●	●	●	●	●
		Shielded TEM-Line S-LINE						❍		❍	❍		❍	❍		❍	❍
from 1 GHz	ESPI ESCS30 ESIB	Antennas HL025, AC008	●		●			● 2)				●					
		on request							●								
from 2 GHz	ESI	Antennas HL025, AC008	●		●			● 3)				●					
		on request							●								
from 5 GHz	ESIB26	Antennas HL025, AC008	●					●				●					
	ESIB40	on request							● *								
from 10 GHz	ESIB26	Antennas HL025, AC008	●					●				●					
	ESIB40	on request							● **								
from 18 GHz	ESIB40	Accessories							● ***			●					
to 40 GHz		on request															

1)) ESPC has limited compliance with CISPR 16-1   2) FCC: clock frequency <200 MHz.   3) FCC: clock frequency <500 MHz.   4) VG up to 200 kHz   5) VG   6) VG, MIL.

Equipment required for EMI measurements to specific standards

Legend
- ● necessary accessory
- ❍ recommended extra
- * 10 GHz = upper freq. limit to GAM-EG 13
- ** 18 GHz = upper freq. limit to CISPR 11, VG standards and DEF-STAN 59-41
- *** 40 GHz = upper frequency limit to ANSI C63.2, C63.4 and MIL-STD-461

Further European standards see page 76

Low-voltage switchgear and control gear EN 60 947-1	Telecom Systems of large dimensions EN 300 127	Short range devices (SRD) 9 kHz to 25 GHz EN 300 220, 220, 330, 440 ETS300 440, 683, EN301489-1	PMR equipment DECT equipment EN301489-5 EN301489-6	Generic EMC standard for radio equipment EN300339 EN301489-2	ERMES paging receivers ETS300340	GSM 900 MHz GSM 1800 MHz EN301489-7	Fixed radio links EN300385 EN301489-4	Equipment of tele-communication networks ETS300386-1 EN 300 386-2	Wireless microphones and similar equipment EN301489-9	Second generation cordless telephones (CT2) EN301489-10	VHF FM broadcasting transmitters EN301489-11	VSAT, SNG and TES equipment EN301489-12	CB radio and ancillary equipment EN301489-13	On-site and wide-area paging equipment EN 300 741 EN301489-2	Commercially available amateur radio equipment EN301489-15	Analog cellular radio comm. equipment EN301489-16	2.6 GHz wideband trans-mission and HIPERLAN EN301489-17	TETRA and ancillary equipment EN301489-18	VHF maritime mobile radio telephone EN 301843-2	1.5 GHz maritime MES with LBRDC for GMDSS EN 300 829	1.5 GHz receive-only MES for data comm. EN301489-19	1.5/2/2.5 GHz MES for satellite GSM EN 300 831 EN301489-20	<1 GHz MES with LBRDC using LEOs EN 300 832 EN301489-0	Equipment
																								Current probe 5 Hz to 2 MHz/20 Hz to 100 MHz
																								Shielded, calibrated field coil 5 Hz to 10 MHz
		●																						Current probe 20 Hz to 100 MHz
																								Shielded, calibrated field coil 5 Hz to 10 MHz
		●																	●	●				Tripod for Loop Antenna HFH2-Z2
		●																	●	●				Active loop antenna 9 kHz to 30 MHz
																								Tripod for Rod Antenna HFH2-Z6
																								Active rod antenna 9 kHz to 30 MHz
●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	V-network up to 25 A (70 A), 4-line LISN
●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	V-network up to 10 A (16 A), 2-line LISN
●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	V-network up to 200 A, 4-line LISN
			●	●		●	●		●		●	●		●	●	●								V-network up to 150 A (500 A), single-phase LISN
								❍																2-wire Coupling Network
								❍																4-wire Coupling Network)
●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Active probe for RFI voltage measurement
●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Passive probe for RFI voltage measurement
																								Antenna impedance converter 9 kHz to 30 MHz
❍		❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	Near-field probe set 100 kHz to 2 GHz
❍		❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	Near-field probe set 9 kHz to 1 GHz
		❍																	❍	❍				Triple-loop antenna 9 kHz to 30 MHz
																								Low-loss coaxial cables 3 m/10 m
																								Current probe 20 Hz to 100 MHz
																								Current probe 20 to 300 MHz (cal. up to 600 MHz)
																								Absorbing clamp 30 to 1000 MHz
❍		❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	Near-field probe set 100 kHz to 2 GHz
❍		❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	Near-field probe set 9 kHz to 1 GHz
																								Absorbing Clamp Slideway HCA f. autom. meas.
●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Broadband dipoles 20 to 80 MHz
●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Log-periodic antenna 80 to 1300 MHz
●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Biconical antenna 30 to 300 MHz
●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Log-periodic antenna 200 to 1300 MHz
																								Conical log spiral antenna 200 to 1000 MHz
																								Tripod for HK116, HL223 and HUF-Z4
●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	RF connecting cable 12 m/7 m, common-mode suppr.
		❍	❍	❍	❍	❍			❍	❍			❍	❍	❍	❍								Shielded TEM-Line, 0.15 to 1000 MHz (2 models)
		●													●									Log-periodic antenna/directional ant. 1 to 18 GHz
																								e.g. double-ridged waveguide horn antennas
		●													●									Log-periodic antenna/directional ant. 1 to 18 GHz
																								e.g. double-ridged waveguide horn ant.
		●													●									Log-periodic antenna/directional ant. 1 to 18 GHz
																								e.g. double-ridged waveguide horn antennas
		●													●									Log-periodic antenna/directional ant.1 to 18 GHz
																								e.g. double-ridged waveguide horn ant.
		●													●									Double-ridged waveguide horn antenna

7) VG, DEF-STAN. 8) MIL-STD-461 C. 9) Requirements regarding spurious, adjacent-channel power emissions etc are covered by other EN standards but may be tested using the above equipment.

10) see EZ-25 11) important for CISPR 25

Test Receiver R&S ESPI 3/7

R&S ESPI 3: 9 kHz to 3 GHz

R&S ESPI 7: 9 kHz to 7 GHz

The precompliance standard

New

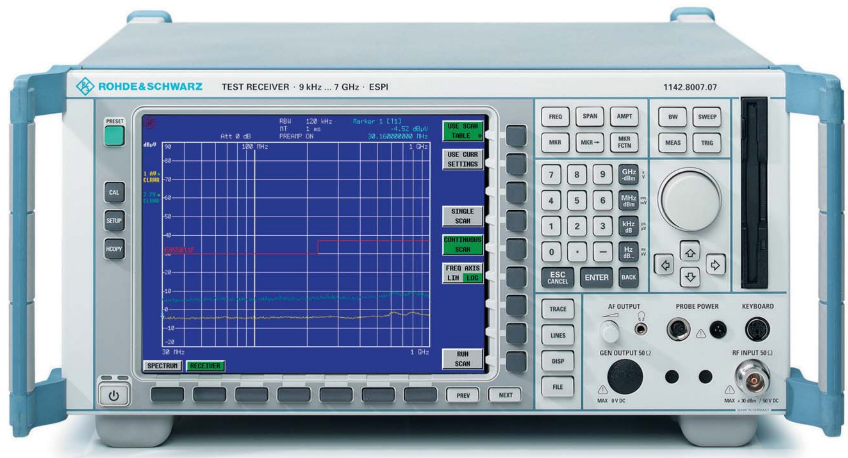


Photo 43665-3

Brief description

The **R&S ESPI 3** and **R&S ESPI 7**, which are suitable for all commercial EMI standards to CISPR, EN, ETS, FCC, ANSI C63.4, VCCI and VDE, have been specially designed for precompliance measurements in development. The aim is to perform EMC diagnostic measurements on the devices under test as quickly as possible and as accurately as necessary and to document the results.

The final compliance test will then be purely a formality. The advantages of test receiver accuracy and selectivity combined with the measurement speed of a spectrum analyzer define the crucial performance features for a new class of test receivers.

These two models make it possible to take products through the critical stages of development and the EMC test plan and still be on schedule for approval and market launch.

Main features

Excellent test receiver features

- Peak, Quasi-Peak, RMS and AV (max. 3 detectors simultaneously)
- EMI measurement bandwidths 200 Hz, 9 kHz, 120 kHz, 1 MHz
- Correct pulse weighting to CISPR 16-1 from PRF of **10 Hz**
- For all commercial EMI standards such as CISPR, EN, ETS, FCC, ANSI C63.4, VCCI and VDE

Extremely high measurement speed

- Fast detection of critical frequencies through overview measurements:
  - Measurement time 100 µs to 100 s in receiver mode,
  - up to 16000 s in analyzer mode
- Fast measurements in the time domain: minimum sweep time 1 µs

Spectrum analyzer

- Resolution bandwidths from 10 Hz to 10 MHz (in 1/3/10 sequence)
- RMS detector for measurements on digitally modulated signals
- Test routines for TOI, ACPR, OBW, amplitude statistics
- Gated sweep for measurements on TDMA signals

Outstanding performance features

- Total measurement uncertainty
  - Spectrum analyzer mode: 0.5 dB (without preselection)
  - Receiver mode: <1.5 dB
- Displayed average noise level (DANL): **–155 dBm** (1 Hz), f <1 GHz
- Phase noise of –145 dBc (1 Hz) typ. at an offset of 10 MHz provides optimum conditions for ACPR measurements on WCDMA systems
- NF = 21.5 dB (12 dB with preamplifier option R&S ESPI-B2)
- User-programmable scan tables
- Display of results and comparison with standard-conformal limit lines
- Correction values for cable loss, coupling networks and antennas included as transducer factor
- Data reduction and modification of a frequency list for weighted final measurement
- Bargraph display for different types of detectors
- Overload indication
- Built-in AF demodulation
- EMI bandwidths to CISPR
- Brilliant 21 cm TFT colour display
- Split-screen display with independent settings and up to 3 traces per screen
- Interfaces: GPIB, Centronics, RS-232-C, LAN (option)

Test Receiver R&S ESPI3, R&S ESPI7

Characteristics

The precompliance measuring instruments from Rohde&Schwarz provide the functions that are required for in-house test sequences:

- Manual measurement of EMI spectra thanks to the receiver-oriented operating concept
- Semi-automatic measurements with predefined scan and sweep tables allowing interactive interruption
- Individual evaluation of critical frequencies using markers and additional detectors assigned to the markers which are simultaneously displayed
- Fully automatic interference measurements in conjunction with external EMI software packages from Rohde& Schwarz, including, for instance, determination of the worst case by automatic switchover of the phase and protective ground settings via the USER port for remote-controlled line impedance stabilization networks

Accuracy and reproducibility are also key parameters for all applications of the R&S ESPI test receiver family.

The combination of test receiver and spectrum analyzer provides an optimum concept for precompliance measurements in development environments.

EMI measurements to standard
Fitted with the optional preselector/ preamplifier (R&S ESPI-B2), all R&S ESPI models feature an excellent dynamic range compared with other precompliance solutions and are, therefore, able to perform precise interference measurements with pulse repetition frequencies (PRF) from **10 Hz** to CISPR 16-1. Measurements to commercial EMI standards such as CISPR, EN 550xx, ETS, FCC, ANSI C63.4, VCCI or VDE can be carried out directly by comparing the EMI spectrum with the associated limit lines and switching on the appropriate detectors (PK, QP, AV, RMS).

Options

Preamplifier and preselection filters up to 3 GHz
The preselector/preamplifier option (R&S ESPI-B2) is available as a protection against overloading by pulsed, high-power signals and for ensuring the validity of signal evaluation in the linear operating range of the measuring instrument. In the spectrum analyzer mode and in the test receiver mode, both modes offer the choice of switching the preamplifier on or off. In the receiver mode, the preselection filter setting is fixed, whereas in the analyzer mode it can be selected.

Tracking generator 9 kHz to 3 GHz
The optional Internal Tracking Generator FSP-B9 up to 3 GHz and External Generator Control FSP-B10 enhance the two R&S ESPI test receiver models to give scalar network analyzer functionality. A frequency offset of ±150 MHz can be set for measurements on frequency-converting modules. The tracking generator can be broadband-modulated by an external I/Q baseband signal.

LAN interface
With the aid of the optional LAN Interface FSP-B16, the R&S ESPI models can be connected to common networks such as 100Base-T so that functions like file logging on network drives or documentation of measurement results via network printer are available. The R&S ESPI can also be remote-controlled via the LAN interface. Control is via a softpanel that behaves exactly as if it were part of a real instrument.

Trigger for coverage measurements
The Firmware Option R&S ESPI-K50 enhances the application range of the Test Receivers R&S ESPI3 and R&S ESPI7 by adding field-strength profile measurements controlled by a displacement sensor. For these measurements, the option provides additional channel filters with bandwidths from 5.6 MHz to 8 MHz for DVB-T signals.

The option allows continuous level measurements to be performed with sufficiently high measurement rate and the results to be transferred to an evaluation unit. The measured levels are usually processed by the controller that remotely controls the Test Receiver R&S ESPI via IEC/IEEE bus or LAN interface.

When a displacement sensor/GPS system is used, the external trigger input of the R&S ESPI can be used to start single measurements. The level values can thus be accurately assigned to the measurement site.

The coverage measurement function of the R&S ESPI is only available in the receiver mode plus remote control. There is a choice of two different measurement modes:

- All measurements are performed at a discrete frequency (>100,000 measurements/s including transfer via IEC/ IEEE bus or LAN)
- A channel list is cyclically processed, i.e. a new frequency is set for each measurement (max. 10,000 channels)

Test Receiver R&S ESPI3, R&S ESPI7

Specifications in brief

Specifications apply under the following conditions:
15 minutes warmup time at ambient temperature, specified environmental conditions met, calibration cycle adhered to and total calibration performed. Data designated "nominal" apply to design parameters and are not tested. Data designated "σ = xx dB" indicate the standard deviation
.

Frequency	**R&S ESPI3**	**R&S ESPI7**
Frequency range	9 kHz to 3 GHz	9 kHz to 7 GHz
Frequency resolution	0.01 Hz	
Internal reference frequency (nominal)		
Aging per year[1]		
nominal	1×10^{-6}	
with option FSP-B4 (OCXO	1×10^{-7}	
External reference frequency	10 MHz	
Frequency display (receiver mode)		
Display	numerical display	
Resolution	0.1 Hz	
Frequency display (analyzer mode)		
Display	with marker or frequency counter	
Resolution	span/500	
Frequency counter		
Resolution	0.1 Hz to 10 kHz (selectable)	
Display range for frequency axis	0 Hz, 10 Hz to 3 GHz	0 Hz, 10 Hz to 7 GHz
Resolution/accuracy of display range	0.1%	
Spectral purity (dBc (1 Hz))		
SSB phase noise, f = 500 MHz		
Carrier offset 100 Hz	<–84, –90 typ.	
1 kHz	<–100, –108 typ.	
10 kHz	<–106, –113 typ.	
100 kHz[1]	<–110, –113 typ.	
1 MHz[2]	<–120, –125 typ.	
10 MHz	–145 typ.	
Residual FM, f = 500 MHz, RBW 1 kHz, sweep time 100 ms	3 Hz typ.	
Frequency scan (receiver mode)		
Scan	scan with max. 10 subranges with different settings	
Measurement time per frequency	100 µs to 100 s, selectable	
Sweep (analyzer mode)		
Span 0 Hz (zero span)	1 µs to 16000 s	
Resolution	125 ns	
Span ≥10 Hz	2.5 ms to 16000 s	
Max. deviation	1%	

1) After 30 days of operation.

2) Valid for span >100 kHz.

Typical values for SSB phase noise (referred to 1 Hz bandwidth)

Carrier offset	f_{in} = 3 GHz	f_{in} = 7 GHz
100 Hz	–74 dBc	–67 dBc
1 kHz	–100 dBc	–94 dBc
10 kHz	–108 dBc	–104 dBc
100 kHz	–108 dBc	–106 dBc
1 MHz	–118 dBc	–118 dBc

	R&S ESPI 3	**R&S ESPI 7**
IF bandwidths (receiver mode)		
Resolution bandwidths (analyzer mode)		
Bandwidths (–3 dB)	10 Hz to 10 MHz; in 1, 3, 10 sequence	
Bandwidth error		
≤100 kHz	<3%	
300 kHz to 3 MHz	<10%	
10 MHz	+10%, –30%	
Shape factor $BW_{60\ dB} : BW_{3\ dB}$		
≤100 kHz	<5:1 (Gaussian filter)	
300 kHz to 3 MHz	<15:1 (4-circuit synchronously tuned filters)	
10 MHz	<7:1	
EMI bandwidths (CISPR)	200 Hz, 9 kHz, 120 kHz (–6 dB) 1 MHz (pulse bandwidth)	
Bandwidth error		
≤120 kHz	<3%	
1 MHz	10%, nominal	
Shape factor $BW_{60\ dB} : BW_{3\ dB}$		
≤100 kHz	<5:1 (Gaussian filter)	
300 kHz to 3 MHz	<15:1 (4-circuit synchronously tuned filters)	
10 MHz (only analyzer mode)	<7	
Video bandwidths (only analyzer mode)	1 Hz to 10 MHz; in 1, 3, 10 sequence	
FFT filter		
Bandwidths (–3 dB)	1 Hz to 30 kHz (–3 dB); in 1, 3, 10 sequence	
Bandwidth error, nominal	5%	
Shape factor $BW_{60\ dB} : BW_{3\ dB}$, nominal	2.5	
Level		
Display range	displayed average noise level to 137 dBµV	
Maximum input level		
DC voltage	50 V	
RF attenuation 0 dB		
CW RF power	127 dBµV (= 0.3 W)	
Pulse spectral density	97 dB(µV/MHz)	
RF attenuation ≥10 dB		
CW RF power	137 dBµV (= 1 W)	
Max. pulse voltage	150 V	
Max. pulse energy (10 µs)	1 mWs	
1 dB compression of input mixer (0 dB RF attenuation, f >200 MHz, without preselector)	0 dBm nominal	
Intermodulation		
3rd-order intermodulation (TOI)		
Intermodulation-free dynamic range, level 2 x –30 dBm, Δf >5 x RBW or 10 kHz, whichever the greater value		
20 MHz to 200 MHz	>70 dBc, TOI >5 dBm	
200 MHz to 3 GHz	>74 dBc, TOI >7 dBm (10 dBm typ.)	
3 GHz to 7 GHz	–	>80 dBc, TOI >10 dBm (15 dBm typ.)
with option R&S ESPI-B2, preselector switched on, preamplifier switched off		
20 MHz to 200 MHz	>65 dBc, TOI >0 dBm	
200 MHz to 3 GHz	>69 dBc, TOI >2 dBm (5 dBm typ.)	
with option R&S ESPI-B2, preselector switched on, preamplifier switched on		
20 MHz to 200 MHz	>45 dBc, TOI >–20 dBm	
200 MHz to 3 GHz	>49 dBc, TOI >–18 dBm (–15 dBm typ.)	

Test Receiver R&S ESPI3, R&S ESPI7

	R&S ESPI 3	R&S ESPI 7
Second harmonic intercept point (SHI)		
<100 MHz	25 dBm typ.	
100 MHz to 3 GHz	35 dBm typ.	
3 GHz to 7 GHz	–	45 dBm typ.
with option R&S ESPI-B2, preselector switched on, preamplifier switched off		
4 MHz to 100 MHz	>40 dBm	
100 MHz to 3 GHz	>50 dBm	
with option R&S ESPI-B2, preselector switched on, preamplifier switched on		
4 MHz to 100 MHz	>25 dBm	
100 MHz to 3 GHz	>35 dBm	

Displayed average noise level

0 dB RF attenuation, RBW = 10 Hz, VBW = 1 Hz, 20 averages, trace average, zero span, 50 Ω termination	R&S ESPI 3	R&S ESPI 7
9 kHz	<–95 dBm	
100 kHz	<–100 dBm	
1 MHz	<–120 dBm, –125 dBm typ.	
10 MHz to 1 GHz	<–142 dBm, –145 dBm typ.	<–140 dBm, –145 dBm typ.
1 GHz to 3 GHz	<–140 dBm, –145 dBm typ.	<–138 dBm, –143 dBm typ.
3 GHz to 7 GHz	–	<–138 dBm, –143 dBm typ.
with option R&S ESPI-B2, preselector switched on, preamplifier switched off		
9 kHz	<–95 dBm	
100 kHz	<–100 dBm	
1 MHz	<–120 dBm, –125 dBm typ.	
10 MHz to 1 GHz	<–142 dBm, –145 dBm typ.	<–140 dBm, –145 dBm typ.
1 GHz to 3 GHz	<–140 dBm, –145 dBm typ.	<–138 dBm, –143 dBm typ.
with option R&S ESPI-B2, preselector switched on, preamplifier switched on		
9 kHz	<–105 dBm	
100 kHz	<–110 dBm	
1 MHz	<–130 dBm, –137 dBm typ.	
10 MHz to 1 GHz	<–152 dBm, –155 dBm typ.	<–150 dBm, –153 dBm typ.
1 GHz to 3 GHz	<–150 dBm, –153 dBm typ.	<–148 dBm, –151 dBm typ.

Immunity to interference

Image rejection	>70 dB
Intermediate frequency (f <3 GHz)	>70 dB
Spurious responses (f >1 MHz, without input signal, 0 dB attenuation)	<–103 dBm
Other spurious (with input signal, mixer level <–10 dBm, Δf >100 kHz)	f <7 GHz: <–70 dBc

Level display (receiver mode)

Digital	numerical; 0.01 dB resolution
Analog	bargraph display, separately for each detector
Spectrum	level axis 10 dB to 200 dB in 10 dB steps, frequency axis user-selectable, linear or logarithmic
Units of level display	dBμV, dBm, dBμA, dBpW, dBpT
Detectors	average (AV), RMS, MaxPeak, MinPeak and Quasi-Peak (QP), 3 detectors can be switched on simultaneously
Measurement time	100 μs to 100 s, selectable

Level display (analyzer mode)

Result display	501 x 400 pixels (one diagram), max. 2 diagrams with independent settings
Log level scale	10 dB to 200 dB in 10 dB steps
Linear level scale	10% of reference level per level division (10 divisions)
Traces	max. 3 per diagram

	R&S ESPI 3	R&S ESPI 7
Trace detectors	MaxPeak, MinPeak, AutoPeak, Sample, RMS, Average, Quasi-Peak	
Trace functions	Clear/Write, MaxHold, MinHold, Average	
Setting range of reference level		
Logarithmic level display	–130 dBm to +30 dBm, in 0.1 dB steps	
Linear level display	70.71 nV to 7.07 V; in steps of 1%	
Units of level scale	dBm, dBmV, dBμV, dBμA, dBpW (log level display); mV, μV, mA, μA, pW, nW (linear level display)	

Level measurement accuracy

	R&S ESPI 3	R&S ESPI 7
Level accuracy at 128 MHz (level = –30 dBm, RF attenuation 10 dB, ref. level –20 dBm, RBW 10 kHz)	<0.2 dB (σ = 0.07 dB)	
Additional error with preselector/preamplifier (with option R&S ESPI-B2)	0.1 dB	
Quasi-peak display	in line with CISPR 16-1, ≥10 Hz pulse repetition frequency (with option R&S ESPI-B2)	
Frequency response		
<50 kHz	+0.5/–1.0 dB	
50 kHz to 3 GHz	<0.5 dB (σ = 0.17 dB)	
3 GHz to 7 GHz	–	<2 dB (σ = 0.7 dB)
with option R&S ESPI-B2, preselector switched on		
<50 kHz	+0.8/–1.3 dB	
50 kHz to 3 GHz	<0.8 dB (σ = 0.27 dB)	
Attenuator	<0.2 dB (σ = 0.07 dB)	
Reference level switching	<0.2 dB (σ = 0.07 dB)	
Display nonlinearity log/lin (S/N >16 dB)		
RBW ≤120 kHz, 0 dB to –70 dB	<0.2 dB (σ = 0.07 dB)	
RBW ≤120 kHz, –70 dB to –90 dB	<0.5 dB (σ = 0.17 dB)	
RBW ≥300 kHz, 0 dB to –50 dB	<0.2 dB (σ = 0.07 dB)	
RBW ≥300 kHz, –50 dB to –70 dB	<0.5 dB (σ = 0.17 dB)	
Bandwidth switching uncertainty (ref. to RBW = 10 kHz)		
10 Hz to 100 kHz	<0.1 dB (σ = 0.03 dB)	
300 kHz to 10 MHz	<0.2 dB (σ = 0.07 dB)	
FFT 1 Hz to 3 kHz	<0.2 dB (σ = 0.03 dB)	
Total measurement uncertainty 0 Hz to 3 GHz		
Analyzer without preselection	0.5 dB	
Receiver/analyzer with preselection	<1.5 dB	
Total measurement uncertainty (0 Hz to 3 GHz)		
Spectrum analyzer mode without preselection	0.5 dB	
Receiver mode with preselection	<1.5 dB	

Audio demodulation AM and FM

Audio output	loudspeaker and headphones output

Trigger functions

Trigger source	free run, video, external, IF level
Trigger offset (span ≥10 Hz)	125 ns to 100 s, resolution 125 ns min. or 1% of offset
Trigger offset (span = 0 Hz)	±125 ns to 100 s, resolution 125 ns min., depending on sweep time
Max. deviation of trigger offset	± (125 ns + (0.1% x delay time))
Gated sweep	
Trigger source	external, IF level, video
Gate delay	1 μs to 100 s
Gate length	125 ns to 100 s, resolution 125 ns min. or 1% of gate length
Max. deviation of gate length	± (125 ns + (0.05% x gate length))

Inputs and outputs (front panel)

	R&S ESPI 3	R&S ESPI 7
RF input	N female, 50 Ω	
VSWR, RF attenuation >0 dB, f <3 GHz	1.5:1	
VSWR, RF attenuation >0 dB, f <7 GHz	–	2.0:1
Input attenuator	0 dB to 70 dB in 10 dB steps	
with option FSP-B25	0 dB to 75 dB in 5 dB steps	

Test Receiver R&S ESPI3, R&S ESPI7

	R&S ESPI 3	R&S ESPI 7
Probe power supply	3-pin female: +15 V DC, –12.6 V DC and ground, max. 150 mA 5-pin mini DIN female: ±10 V DC and ground, max. 200 mA	
Keyboard connector	PS/2 female for MF keyboard	
AF output	mini jack, 10 Ω	
Open-circuit voltage	up to 1.5 V; adjustable	
Inputs and outputs (rear panel)		
IF 20.4 MHz	Z_{out} = 50 Ω, BNC female	
Level, RBW ≤30 kHz, FFT	–10 dBm at reference level, mixer level >–60 dBm	
Level, RBW ≥100 kHz	0 dBm at reference level, mixer level >–60 dBm	
Reference frequency		
Output, frequency, level	BNC female, 10 MHz, 0 dBm nominal	
Input, frequency, required level	BNC fem., 10 MHz, 0 dBm from 50 Ω	
Power supply connector for noise source	BNC female, 0 V and 28 V, switchable, max. 100 mA	
External trigger/gate input, voltage	BNC female, >10 kΩ, 1.4 V	
IEEE-bus remote control	IEEE 488.2 (IEC 625)	
Serial interface	RS-232-C, 9-pin SUB-D connector	
Printer interface	parallel interface (Centronics)	
Mouse connector	PS/2 female	
User interface	25-pin SUB-D female	
Connector for external monitor (VGA)	15-pin SUB-D female	

General data

	R&S ESPI 3	R&S ESPI 7
Display	21 cm TFT colour display (8.4")	
Resolution	640 x 480 pixels (VGA resolution)	
Pixel failure rate	$<2 \times 10^{-5}$	
Mass memory	1.44 Mbyte 3½" disk drive, hard disk	
Data storage	>500 instrument settings	
Rated temperature range	+5°C to +40°C	
Storage temperature range	–40°C to +70°C	
AC power supply	100 V AC to 240 V AC, 50 Hz to 400 Hz	
Power consumption	70 VA	120 VA
Dimension (W x H x D)	412 mm x 197 mm x 417 mm	
Weight	10.5 kg	11.3 kg

Ordering information

Test Receiver		
9 kHz to 3 GHz	R&S ESPI 3	1142.8007.03
9 kHz to 7 GHz	R&S ESPI 7	1142.8007.07
Accessories supplied	Power cable, operating manual, service manual	
Options		
Preselector/Preamplifier (factory-fitted)	R&S ESPI-B2	1129.7498.02
Rugged case, carrying handle (factory-fitted)	R&S FSP-B1	1129.7998.02
OCXO Reference Frequency	R&S FSP-B4	1129.6740.02
TV Trigger and Adjustable RF Power Trigger (40 dB) for FSP and R&S ESPI	R&S FSP-B6	1129.8594.02
Internal Tracking Generator 9 kHz to 3 GHz, I/Q modulator	R&S FSP-B9	1129.6991.02
External Generator Control	R&S FSP-B10	1129.7246.02
LAN Interface 100BT	R&S FSP-B16	1129.8042.02
DC Supply 12 V to 28 V	R&S FSP-B30	1155.1158.02
Battery Pack + Carge Unit[1]	R&S FSP-B31	1155.1258.02
Replace Battery Pack	R&S FSP-B32	1155.1506.02
Software		
Firmware Coverage Measurements	R&S ESPIK50	
Noise Measurement Software	R&S FS-K3	1057.3028.02
Extras		
Pulse Limiter 0 Hz to 30 MHz	R&S ESH3-Z2	0357.8810.54
Control Cable V-Network ESH2-Z5 (2 m)	R&S EZ-13	1026.5293.02
Control Cable V-Network ESH3-Z5 (2 m)	R&S EZ-14	1026.5341.02
Headphones	–	0708.9010.00
US Keyboard with trackball	R&S PSP-Z2	1091.4100.02
PS/2 Mouse	R&S FSE-Z2	1084.7043.02
Colour Monitor, 15", 230 V	R&S PMC3	1082.6004.02
IEC/IEEE-Bus Cable, 1 m or 2 m	R&S PCK	0292.2013.x0
19" Rack Adapter (not for FSP-B1)	R&S ZZA478	1096.3248.00
Bag for Instruments	R&S ZZT-473	1109.5048.00
Matching Pad, 75 Ω, L Section	R&S RAM	0358.5414.02
Series Resistor, 25 Ω[2]	R&S RAZ	0358.5714.02
SWR Bridge, 5 MHz to 3000 MHz	R&S ZRB2	0373.9017.52
High-Power Attenuators, 100 W 3/6/10/20/30 dB	R&S RBU100 (XX = 03/06/10/20/30)	1073.8820.XX
High-Power Attenuators, 50 W 3/6/10/20/30 dB	R&S RBU50 (XX = 03/06/10/20/30)	1073.8695.XX

1) Requires R&S ESPI with option FSP-B1.

2) Taken into account in device function RF INPUT 75 Ω.

See also data sheets
Accessories for Test Receivers and Spectrum Analyzers: PD 0756.4320
EMC Test Antennas: PD 0757.5743

EMI Test Receiver R&S ESCS30

9 kHz to 2.75 GHz

Compact EMI test receiver conforming to all standards

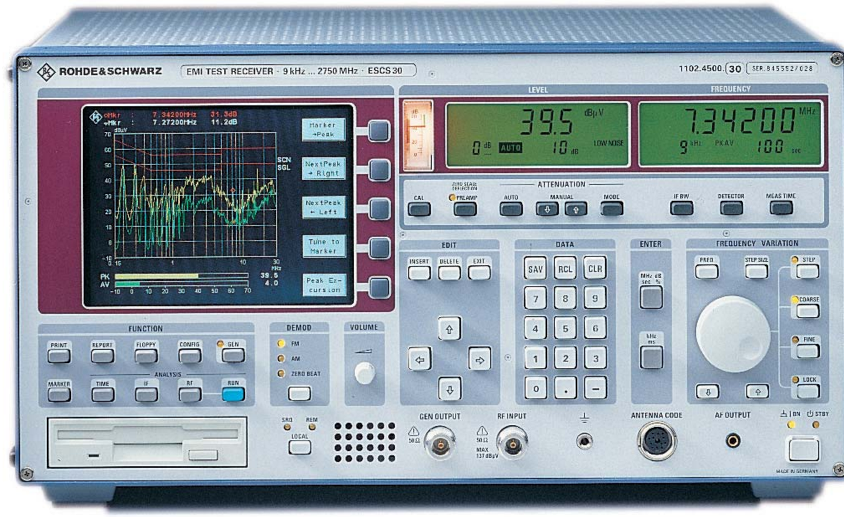


Photo 42987-1

Brief description

EMI Test Receiver R&S ESCS30 is used for measuring electromagnetic emissions in line with all commercial standards and combines three types of instruments in one:

- a portable, manually tunable test receiver with DC input
- an automatic test receiver which as a stand-alone unit performs measurements and reports the results,
- a system-compatible test receiver with IEC/IEEE bus interface and EMI software packages running under Windows™

This specialist for EMI measurements supplies the results fast and highly accurately in line with the standards from CISPR, CENELEC, ETSI, FCC, VCCI and VDE.

Complete tests at a keystroke

Using the SPECTRUM OVERVIEW function and the peak detector, the critical ranges of the spectrum can be determined. With the aid of data reduction routines the final measurement is then made accurately at the critical frequencies using quasi-peak and average detectors. This concept saves valuable measurement time which would otherwise be wasted for ranges with low emission levels.

At a single keystroke the R&S ESCS30 measures as a stand-alone unit

- RFI voltage,
- RFI power,
- RFI field strength

Main features

- Correct weighting to CISPR 16-1 and VDE 0876
- Integrated preselector
- Level measurement range –38 to +137 dBµV
- For all commercial EMI standards such as CISPR, EN, ETS, FCC, ANSI C63.4, VCC, VCCI and VDE
- Automatic overload detection
- User port for control of LISNs
- Ease of use through internal macro functions
- Ext. DC operation

High-grade RF circuit design

- High measurement accuracy
- Fast synthesizer with high frequency resolution
- Wide dynamic range
- CISPR filters with constant group delay
- Parallel detectors for peak, quasi-peak and average indication; all detectors can be switched on simultaneously
- Tracking generator for attenuation and gain measurements; e.g. for checking test cables (9 kHz to 2750 MHz; option R&S ESCS-B5)

Powerful firmware functions

- Macros for automatic and interactive test routines
- Frequency scan over up to 400 user-selectable channels
- Automatic level calibration
- Automatic consideration of frequency-dependent transducer factors
- Nonvolatile storage of all important parameters
- Frequency scan modes
  - Spectrum overview: with fixed attenuation and step size with maximum speed
  - Scan: with automatic attenuation setting and selectable step size
  - Channel: on up to 400 preset frequencies

Optimum result display for every application
- 16.5 cm (6.5") TFT colour LCD for display of interference spectra including limit lines
- Clear digital level indication with 0.1 dB resolution on separate level display
- Quasi-analog display of results in form of bargraphs
- Time domain analysis (oscilloscope mode)
  – Measurement of pulse width and amplitude with a display range from 5 ms to 1 h, zooming up to maximum resolution
  – With a resolution of 100 µs, the time domain analysis satisfies the requirements of CISPR16-1 regarding the accuracy of pulse duration measurements
  – Triggering: internally by level setting using the display line or externally with TTL levels
- IF spectrum analysis with 10 MHz display range for visual check of the spectrum (option R&S ESCS-B4)

Full storage and logging of results
- Built-in 3½" disk drive
- Output of results as lists and diagrams including limit lines and user-definable labelling

Specifications in brief

Frequency range	9 kHz to 2750 MHz
Frequency setting	in 10 Hz, 100 Hz, 100 kHz steps; or user-selectable
Resolution	up to 1000 MHz: 10 Hz from 1000 MHz: 100 Hz
Frequency drift	$<1 \times 10^{-6}$ (after 30 min warm-up) $<5 \times 10^{-7}$ (with option R&S ESCS-B6)
RF input	50 Ω, N female
VSWR, f <1000 MHz	<1.2 with >10 dB RF attenuation
f >1000 MHz	1.5 typ. with >10 dB RF attenuation
RF attenuator	0 to 60 dB, 5 dB steps
Preamplifier	gain 10 dB nominal
Maximum input level (RF attenuation >10 dB)	
DC voltage	7 V
Sinewave AC voltage	137 dBµV (1 W)
Max. pulse voltage (10 µs)	150 V
Max. pulse energy (20 µs)	10 mWs
Preselector 9 kHz to 1000 MHz	2 fixed-tuned filters, 6 tracking filters
1000 to 2750 MHz	2 tracking filters
IF bandwidths	200 Hz/9 kHz/120 kHz/1 MHz

Displayed noise level (average)

Range	Bandwidth	Preamplifier off	on
9 kHz to 30 MHz	200 Hz	<–25 dBµV, –28 dBµV typ.	<–34 dBµV, –38 dBµV
50 MHz to 30 MHz	9 kHz	<–12 dBµV	<–18 dBµV
30 MHz to 1000 MHz	120 kHz	<+1 dBµV, –1 dBµV typ.	<–4 dBµV, –7 dBµV
1000 MHz to 2750 MHz	120 kHz	<+5 dBµV	<0 dBµV

Dynamic range	
Noise figure	5 dB typ. (<30 MHz, preamplifier on) 9 dB typ. (>30 MHz, preamplifier on)
Intercept point d3	10 dB typ. (preamplifier off)
Level display	
Digital	in dBµV, dBµA, dBm, dBµV/m, dBµA/m, dBpW, dBpT
Display	3½-digit LCD, resolution 0.1 dB
Analog	on analog meter in operating range of IF detector with digital display of lower range limit
Bargraph display	horizontal bar; resolution 0.1 dB
Operating range	60 dB
Overdrive indication	for RF and IF signal path
Detectors	AV/PK/QP, (switched on simultaneously)
Measuring times	1 ms to 100 s (1/2/5 steps)
in overview mode	50 µs to 1 s (1/2/5 steps)
Measurement accuracy	
Average indication for S/N >16 dB	
9 kHz to 1000 MHz	<1.0 dB (0.5 dB typ.)
1000 MHz to 2750 MHz	<1.5 dB
Quasi-peak indication	to CISPR 16-1
RF spectrum analysis	
X axis (frequency)	user-selectable, linear or logarithmic
Y axis (level)	10 dB to 200 dB, 10-dB steps
Marker, traces	2 traces, 2 markers with digital display of frequency/time/level
Display modes	Clear/Write, Max Hold, View
Time domain analysis	
Display range (sweep time)	5 ms to 10,000 s
Minimum resolution (X axis)	100 µs
Level display range (Y axis)	10 dB to 200 dB, autoscale function
IF spectrum analysis (option R&S ESCS-B4)	
Display range	10 kHz to 10 MHz, 1/2/5 steps
IF input attenuation	0/20 dB (selectable)
Resolution	1/3/10 kHz
Sweep time	50 ms to 10 s, 1/2/5 steps
Level display range	80 dB
Demodulation modes	AM, FM, A0 (zero beat)
Loudspeaker	built-in; headphones connection
Date, time of day	built-in clock module
General data	
Rated temperature range	0 to +50°C
Storage temperature range	–20°C to +60°C
Power supply	
AC supply	100/120/230/240 V ±10%, 47 Hz to 420 Hz (60 VA), safety class I to VDE 0411 (IEC348)
Battery (external)	11 V to 33 V: 2.5 A/24 V, 4.7 A/12 V
Dimensions (W x H x D)	435 mm x 236 mm x 350 mm
Weight	18.4 kg

Ordering information

EMI Test Receiver	R&S ESCS30	1102.4500.30
Options		
IF Spectrum Analysis	R&S ESCS-B4	1102.6890.02
Tracking Generator 9 kHz to 2750 MHz	R&S ESCS-B5	1102.7097.02
OCXO Reference Oscillator	R&S ESCS-B6	1102.9397.02
RMS Detector	R&S ESCS-B9	1102.7897.02

EMI Test Receiver R&S ESIB

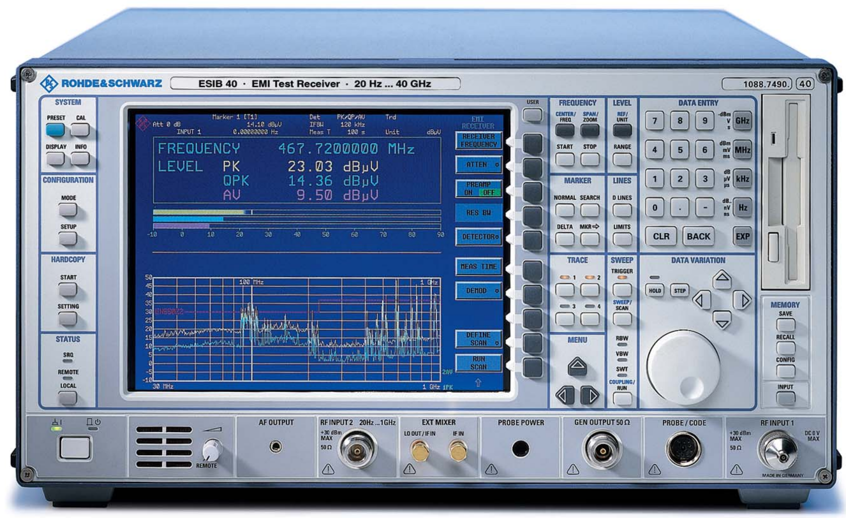
R&S ESIB7: 20 Hz to 7 GHz

R&S ESIB26: 20 Hz to 26.5 GHz

R&S ESIB40: 20 Hz to 40 GHz

EMI measurements up to 40 GHz

conforming to standards



R&S ESIB40 (photo 43176-2)

Brief description

EMI test receivers of the R&S ESIB family combine the versatility and speed of spectrum analyzers with the large dynamic range required for EMI measurements in conformance with standards. The R&S ESIB family comprises three models with different upper frequency limits. The upper frequency limit of the R&S ESIB26 and R&S ESIB40 can be extended up to 110 GHz by means of external mixers (option R&S FSE-B21).

Main features

State-of-the-art technology
- Low inherent noise
- Wide dynamic range
- Preselection + preamplifier
- Automatic overload control
- Pulse-protected 2nd RF input
- Fast overview measurements

Current standards
- Correct weighting of pulses to CISPR 16-1 and VDE 0876
- All commercial and military standards such as CISPR, EN, ETS, FCC, VDE, ANSI, VCCI, MIL-STD, VG, DEF-STAN, and many others

Straightforward operation
- Active colour LCD
- Analog level display for each detector (parallel operation)
- Split-screen display for detailed analysis (i. e. combination of Analyzer and receiver settings)
- Receiver-oriented operating concept allowing manual operation
- EMI software package R&S ES-K1 supplied

System integration
- Fast data processing for use in automatic test systems. The IEC/IEEE bus command set (IEC 625-2) is SCPI-conformal (1994.0)
- Integrated computer function under Windows NT provided as standard
- Use as test system controller by adding a second IEC/IEEE bus card (option R&S FSE-B17)
- Space- and cost-saving implementation of complete test systems without need for an additional controller

Documentation of results
- All printers for which Windows NT drivers are available can be used
- Storage of results also on floppy disk or built-in hard disk in standard formats such as EMF, WMF or BMP

Fit for the future

The R&S ESIB family can be upgraded by a wide variety of options to extend its range of applications and add extra functionality without requiring additional instruments.

Selftest

The built-in selftest supports fault localization down to module level. With individual correction tables being stored on each module, defective modules can be replaced largely without any adjustment or additional instruments. Downtimes and repair costs are reduced to a minimum.

Practice-oriented test routines

During the various development phases of a product, different measurements are performed as required for each stage. The R&S ESIB family offers appropriate features and routines for the different development stages. Early in development, functional measurements play the predominant role. While EMI measurements are important right from the beginning to avoid redesigns, the R&S ESIB at this stage primarily functions as a high-grade spectrum analyzer (see R&S FSE, page 185).

EMI Test Receiver R&S ESIB

As development progresses, EMI measurements become more and more important, for example on modules and their interfaces. Here, too, the R&S ESIB family meets all relevant requirements in terms of performance, functionality and economy of operation:

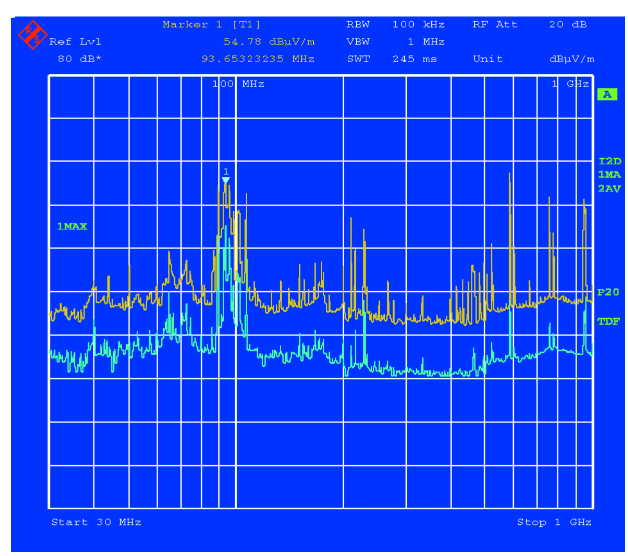
- Fast overview measurements with linear or logarithmic frequency scale in spectrum analyzer mode (sweep mode) or in test receiver mode (scan mode) with tuning in user-defined frequency steps with selectable measuring times per step
- Bandwidths conforming to CISPR16-1 (200 Hz, 9 kHz and 120 kHz), to MIL-STD (10 Hz to 1 MHz) and 10 MHz, and analyzer bandwidths between 1 Hz and 10 MHz, selectable in steps of 1, 2, 3 and 5
- Pulse weighting using quasi-peak, peak and average detectors. The detectors operate in parallel and can be switched in as required
- User-selectable transducer factors for the output of results in the correct unit. Transducer factors for practically any number of transducers can be stored on the internal hard disk. Active transducers are powered and coded via a socket on the R&S ESIB front panel
- User-definable limit lines with linear or logarithmic frequency scale; limit lines are stored on the internal hard disk
- Preselection, preamplifier and 6-dB EMI bandwidths selectable in analyzer mode, too
- Time-domain measurements at up to 50 ns resolution for interference source analysis
- Automatic scan: From 1 measuring curve with max. 250 000 measuring values up to 4 storable traces with max. 80 000 measured values each
- Second, pulse-protected input for the frequency range 20 Hz to 1 GHz. In the case of the R&S ESIB 7, for example, this input can handle pulses with voltages up to 1500 V and powers up to 30 mWs without any damage being caused
- Preselection with 3 fixed-tuned and 6 or 7 (models 26 and 40) tracking filters: in receiver mode (fixed) and analyzer mode (selectable)
- 20 dB preamplifier switch-selectable at switched-on preselection (standard 1 kHz to 7 GHz, expandable to 26 GHz or 40 GHz with option R&S ESIB-B2)
- Level measurement accuracy <±1 dB in frequency range up to 1 GHz

Definition of standard test sequences

To meet the requirements of relevant standards, measurements over various frequency ranges and bandwidths have to be performed, using different step sizes and measurement times or different receiver settings regarding RF attenuation and preamplification. It must also be possible to configure a scan matched to DUT characteristics. For this purpose, the R&S ESIB offers a user-configurable scan table with up to 10 subranges.

Calibration values for transducer factors of absorbing clamps or antennas, for example, are stored in tables and can be switched on as required. The transducer factors can also be combined into transducer sets, for example to display the interference spectrum in the correct unit dBµV/m in measurements with an antenna and a connecting cable.

- EMI emissions are usually measured in two steps. An overview measurement made with the peak detector identifies critical emissions above or close to limit values. In a second measurement with the prescribed detectors (quasi-peak and average to CISPR) and an appropriate measurement time, the critical frequencies are checked for compliance with limit values. The ESIB family supports this procedure by two independent measurement windows on the screen, automatic or interactive investigation of frequencies that have the highest distortion levels as well as application of a partly range maximum method (acceptance analysis).



Overview measurement

EMI Test Receiver R&S ESIB

Specifications in brief

Frequency

	ESIB 7	ESIB 26	ESIB 40
Frequency range			
Input 1	20 Hz to 7 GHz	20 Hz to 26.5 GHz	20 Hz to 40 GHz
Input 2		20 Hz to 1 GHz	
Internal reference frequency (nominal)			
Aging per day[1)]		1 x 10^{-9}	
Total drift (per year)[1)]		2.5 x 10^{-7}	
External reference frequency		10 MHz or n x 1 MHz, n=1 to 16	
Frequency display (receiver mode)		numeric display	
Frequency display (analyzer mode)		with marker	
Accuracy (Sweep time >3xauto sweep time)		± (marker frequency x reference error + 0.5% x span + 10% x resolution bandwidth + ½ (last digit))	
Frequency counter		measures the marker frequency	
Count accuracy (S/N > 25 dB)		±(frequency x ref. error + ½ (last digit))	
Display range for frequency axis	0 Hz, 10 Hz to 7 GHz	0 Hz, 10 Hz to 27 GHz	0 Hz, 10 Hz to 40 GHz
Accuracy		±1%	
Spectral purity			
SSB phase noise, f ≤500 MHz			
Carrier offset 100 Hz		<–81 dBc (1 Hz)	
1 kHz		<–100 dBc (1 Hz)	
10 kHz		<–114 dBc (1 Hz)	
100 kHz[2)]		<–111 dBc (1 Hz)	
1 MHz[2)]		<–129 dBc (1 Hz)	
Frequency scan (receiver mode)		scan with max. 10 subranges with different settings	
Measurement time per frequency		100 µs to 1000 s, selectable	
Sweep (analyzer mode)			
Span 0 Hz (zero span)		1 µs to 16000 s selectable in steps of 5%	
Span ≥10 Hz		5 ms to 1000 s selectable in steps of ≤10%	
Accuracy		±1%	
Picture refresh rate/s (span ≤7 GHz)		>20 updates/s with 1 trace, >15 traces/s with 2 traces at shortest sweep time	
Sampling rate		50 ns (20 MHz A/D converter)	
Number of pixels		500	
Time-domain measurement		with marker and cursor lines	

Preselector (receiver mode)

Filter	Frequency range	Bandwidth (–6 dB)	
1	<150 kHz	230 kHz	fixed
2	150 kHz to 2 MHz	2.6 MHz	fixed
3	2 MHz to 8 MHz	1.9 MHz	tracking
4	8 MHz to 25 MHz	5.6 MHz	tracking
5	25 MHz to 80 MHz	15 MHz	tracking
6	80 MHz to 200 MHz	40 MHz	tracking
7	200 MHz to 500 MHz	85 MHz	tracking
8	500 MHz to 1000 MHz	104 MHz	tracking
9	1 GHz to 7 GHz	highpass filter	fixed
		Bandwidth (–3 dB)	
10	7 GHz to 26.5 GHz (ESIB 26)	35 MHz + f / 1000	YIG filter
	7 GHz to 40 GHz (ESIB 40)	35 MHz + f / 1000	YIG filter

	ESIB 7	ESIB 26	ESIB 40
Preamplifier (1 kHz to 7 GHz)		selectable, between preselector and 1st mixer, gain 20 dB	
IF bandwidths (receiver mode)			
6 dB bandwidths		10/100/200 Hz, 1/9/10/100/120 kHz, 1[3)]/10 MHz	
Bandwidth error			
RBW ≤1 MHz		<10%	
Shape factor BW_{60dB}:$BW_{6\ dB}$			
RBW ≤1 kHz		<5	
RBW >1 kHz		<10	
Resolution bandwidths (analyzer mode)			
3 dB bandwidth		1 Hz to 10 MHz, in steps of 1/2/3/5	
Bandwidth error			
RBW ≤3 MHz		<10%	
RBW = 5 MHz		<15%	
RBW = 10 MHz		+25%, –10%	
Shape factor BW_{60dB}:$BW_{3\ dB}$			
RBW <1 kHz		<6	
RBW = 1 kHz to 2 MHz		<12	
RBW >2 MHz		<7	
Video bandwidths		1 Hz to 10 MHz, in steps of 1/2/3/5	
FFT filter			
3 dB bandwidths		1 Hz to 1 kHz, in steps of 1/2/3/5	
Bandwidth error, nominal		2%	
Shape factor BW_{60dB}:$BW_{3\ dB}$, nom.		25	
Display range for frequency axis		min. 25 x RBW, max. 100000 x RBW or 2 MHz	
Additional level error (reference: RBW = 5 kHz)		<1 dB	
Max. display range		100 dB	
Inherent spurious response		<–100 dBm	

Level

	ESIB 7	ESIB 26	ESIB 40
Display range		displayed noise floor to 137 dBµV	
Max. input level (input 1)			
RF attenuation ≥10 dB			
DC voltage		0 V	
CW RF power		137 dBµV (= 1W)	
Max. pulse volt age (10 µs)	150 V	50 V	
Max. pulse energy (10 µs)	1 mWs	0.5 mWs	
Input 2 (receiver mode)		20 Hz to 1 GHz	
DC voltage (DC/AC coupling)		0 V/50 V	
RF attenuation ≥10 dB			
CW RF power		137 dBµV (= 1 W)	
Max. pulse voltage (10 µs)	1500 V	250 V	
Max. pulse energy (10 µs)	30 mWs	15 mWs	
1 dB compression of input mixer (0 dB RF attenuation)			
Analyzer mode		+10 dBm nominal	
Intermodulation			
3rd-order intercept point (T.O.I.) in dBm			
Analyzer mode, Δf>5 x IF bandwidth or resolution bandwidth, or >10 kHz	≥12, 15 typ. for f >150 MHz		≥12, 15 typ. for f >150 MHz; ≥10 for f>7 GHz
Receiver mode, preamplifier off		≥2, 5 typ. for f >150 MHz	
Receiver mode, preamplifier on		≥ –18, –15 typ. for f >150 MHz	
Intercept point k2, analyzer mode		>25, typ. for f <150 MHz	
		>40, typ. for f >150 MHz	

EMI Test Receiver R&S ESIB

Level display (receiver mode)

Digital	numeric, 0.1 dB resolution
Analog	bargraph display, separate for each detector
Spectrum	level axis 10 dB to 200 dB in 10 dB steps, frequency axis user-selectable, linear or logarithmic
Units of level display	dBµV, dBm, dBµA, dBpW, dBpT, dB(µV/m), dB(µA/m), dBx[4]/MHz
Detectors	average (AV), RMS, peak (PK) and quasi-peak (QP), 4 detectors simultaneously selectable
Measurement time	100 µs to 100 s, selectable

Level display (analyzer mode)

Result display	500 x 400 pixels (per diagram), max. 2 diagrams with independent settings
Logarithmic level display range	10 dB to 200 dB in 10 dB steps
Linear level display range	10% of reference level per division (10 divisions) or logarithmic scaling
Traces	max. 4 per diagram (max. 2 per diagram with display of 2 diagrams); quasi-analog display of all results
Trace detectors	max peak, min peak, auto peak (normal), sample, rms, average
Trace functions	clear/write, max hold, min hold, average

Setting range of reference level

Logarithmic level display	–130 dBm to 30 dBm in 0.1 dB steps
Linear level display	7.0 nV to 7.07 V in 1% steps
Unit of level axis	dBm, dBµV, dBµA, dBpW (logarithmic level display); mV, µA, pW, nW (linear level display)

Displayed noise floor (receiver mode)	**ESIB 7**	**ESIB 26**	**ESIB 40**
Linear average (AV) display (preamplifier off/on)			
20 Hz to 1 kHz, RBW=10 Hz	20 to –10/–	20 to –10/ –	
1 kHz to 9 kHz, RBW=10 Hz	–10 to –16/ –25 to –30	–10 to –16/–25 to –30	
9 kHz to 150 kHz, RBW=200 Hz	0 to –12/ –10 to –24	0 to –12/–10 to –24	
150 kHz to 2 MHz, RBW=9 kHz	5 to –5/ –7 to –17	5 to –5/–7 to –17	
2 MHz to 30 MHz, RBW=9 kHz	<–5/<–17	<–5/<–17	
30 to 200 MHz, RBW=120 kHz	<10/<–6	<13/<–3	
200 to 1000 MHz, RBW=120 kHz	<7/<–6	<10/<–3	
1 GHz to 5 GHz, RBW=1 MHz	<15/<6	<18/<9	
5 GHz to 7 GHz, RBW=1 MHz	<22/<9	<25/<12	
7 GHz to 18 GHz, RBW = 1 MHz	–	<19	<23
18 to 26.5 GHz, RBW = 1 MHz	–	<22	<26
26.5 to 30 GHz, RBW = 1 MHz	–	–	<37
30 to 40 GHz, RBW = 1 MHz	–	–	<41
RMS, typ. increase rel. to AV display		+1 dB	
PK, typ. increase rel. to AV display		+11 dB	
Quasi-peak (preamplifier off/on) Band A	3 to –9/ –7 to –21	3 to –9/–7 to –21	
Band B	9 to 0/ –2 to –12	9 to 0/–2 to –12	
Band C	17/1	20/4	
Band D	14/1	17/4	

Displayed noise floor (analyzer mode)
Displayed average noise level in dBm, typical values in parentheses, 0 dB RF attenuation, RBW = 10 Hz, VBW = 1 Hz, 20 averages, trace average, zero span, 50 Ω termination

		ESIB 7	**ESIB 26**	**ESIB 40**
Frequency	20 Hz	<–74	<–74	
	1 kHz	<–104	<–104	
	10 kHz	<–119	<–119	
	100 kHz	<–129	<–129	
	1 MHz	<–142 (145)	<–142 (145)	
	10 MHz to 6 GHz	<–142 (147)	<–138 (140)	
	6 GHz to 7 GHz	<–139 (141)	<–135 (138)	
	7 GHz to 18 GHz	–	<–138 (140)	<–134 (139)
	18 GHz to 26.5 GHz	–	<–135 (138)	<–131 (136)
	26.5 GHz to 30 GHz	–	–	<–120 (125)
	30 GHz to 40 GHz	–	–	<–116 (122)

Max. dynamic range

1 dB compression point/displayed noise floor (1 Hz bandwidth)	162 dB	160 dB

Max. harmonics suppression, f >50 MHz >90 dB

Max. intermodulation-free range

150 MHz to 7/26.5 GHz (nominal)	115 dB	112 dB
Intermodulation-free range at –40 dBm mixer input level	105 dB	

Immunity to interference

Image frequency	>80 dB, >90 dB typ.	>80 dB
Intermediate frequency	>75 dB	>80 dB
Spurious response (f >1 MHz, without input signal, 0 dB RF attenuation)		
Receiver mode or span <30 MHz	<–3 dBµV	
Span ≥30 MHz	<7 dBµV	
f_{in}=25.175 MHz, 60 MHz, 5.7172 GHz	<7 dBµV	
Other spurious	<–75 dBc	

RF leakage

Voltage display at field strength of 10 V/m and 0 dB RF attenuation ($f \neq f_{in}$, $f \neq f_{IF}$, $f_s \leq 1$ GHz)	<0 dBµV
Additional error in quasi-peak display range (10 V/m) ($f \neq f_{in}$, $f \neq f_{IF}$, $f_s \leq 1$ GHz)	<1 dB

Level measurement accuracy

Level error at 120 MHz (level = –40 dBm, RF attenuation 20 dB, reference level –15 dBm, RBW 5 kHz)	±0.3 dB
Attenuator error	±0.3 dB
IF gain error	±0.2 dB, ±0.1 dB typ.
Linearity error	
Logarithmic level display (RBW ≥1 kHz, analog, S/N >15 dB)	
0 dB to –50 dB	±0.3 dB
–50 dB to –70 dB	±0.5 dB
–70 dB to –95 dB	±1 dB
Linear level display	5% of reference level

EMI Test Receiver R&S ESIB

	ESIB 7	ESIB 26	ESIB 40
Bandwidth switching error			
1 Hz to 30 kHz/100 to 300 kHz	±0.2 dB		
1 MHz to 10 MHz	±0.3 dB		
Frequency response (analyzer mode, 10 dB RF attenuation)			
≤1 GHz	±0.5 dB		
1 GHz to 7 GHz	±1 dB		
7 GHz to 18 GHz	–	±2 dB	
18 GHz to 26.5 GHz	–	±2.5 dB[5]	
26. 5 GHz to 40 GHz	–	–	±3 dB[5]
Total error			
Receiver mode (AV display, display range =0 dB to –50 dB, S/N >15 dB, preamplifier off)			
≤9 kHz	±1.5 dB		
≤150 kHz	±1.2 dB		
≤1 GHz	±1 dB		
1 GHz to 4.5 GHz	±2 dB		
4.5 GHz to 7 GHz	±2.5 dB		
7 GHz to 18 GHz	–	±2.5 dB[5]	
18 GHz to 26.5 GHz	–	±3 dB[5]	
26.5 GHz to 40 GHz	–	–	±3.5 dB[5]
Additional error with preamplifier	<0.5 dB		
Analyzer mode (display range = 0 dB to –50 dB, S/N >15 dB, span/RBW <100)			
<1 GHz	±1 dB		
1 GHz to 4.5 GHz	±1.5 dB		
4.5 GHz to 7 GHz	±2 dB		
7 GHz to 18 GHz	–	±2.5 dB[5]	
18 GHz to 26.5 GHz	–	±3 dB[5]	
26.5 GHz to 40 GHz	–	–	±3.5 dB[5]

General data

	ESIB 7	ESIB 26	ESIB 40
Display	24 cm colour LC display (9.5")		
Resolution	640 x 480 pixels (VGA resolution)		
Pixel error rate	$<2 \times 10^{-5}$		
Mass memory	1.44 Mbyte 3½" disk drive, hard disk		
Rated temperature range	+5 °C to +40 °C		
Limit temperature range	0 °C to +50 °C		
Power supply	200 V to 240 V / 50 Hz to 60 Hz; 100 V to 120 V / 50 Hz to 400 Hz,		
Power consumption	195 VA	230 VA	
Dimensions (W x H x D)	435 mm × 236 mm × 570 mm		
Weight	25.1 kg	26.4 kg	27.0 kg

1) After 30 days of operation.

2) Valid for span >100 kHz.

3) According to CISPR 16 tolerance for impulse bandwidths and MIL-STD (–6 dB).

4) x = μV, μV/m, μA or μA/m.

5) For RF frequencies >7 GHz: error after calling peaking function.
For sweep time <10 ms/GHz: additional error ±1.5 dB.

Ordering information

EMI Test Receiver		
20 Hz to 7 GHz	R&S ESIB 7	1088.7490.07
20 Hz to 26.5 GHz	R&S ESIB 26	1088.7490.26
20 Hz to 40 GHz	R&S ESIB 40	1088.7490.40
Options		
Preamplifier 20 dB, 7 GHz to 26.5 GHz	R&S ESIB-B2	1137.4494.26
Preamplifier 20 dB, 7 GHz to 40 GHz	R&S ESIB-B2	1137.4494.40
Vector Signal Analyzer	R&S FSE-B7	1066.4317.02
Tracking Generator 7 GHz	R&S FSE-B10	1066.4769.02
Tracking Generator 7 GHz with I/Q Modulator	R&S FSE-B11	1066.4917.02
Switchable Attenuator for Tracking Generator	R&S FSE-B12	1066.5065.02
Ethernet Card, RJ-45 connector	R&S FSE-B16	1037.5973.04
Second IEC/IEEE-bus Card	R&S FSE-B17	1066.4017.02
Removable Hard Disk for R&S ESIB [1]	R&S FSE-B18	1088.6993.02
Second Hard Disk for R&S ESIB, Windows NT	R&S FSE-B19	1088.7248.10
External mixer output for R&S ESIB 26/40	R&S FSE-B21	1084.7243.02
Software		
EMC Measurement Software (32 bit)	EMC 32-E	1119.4621.02
EMI Software for EMI Test Receiver (Windows)	R&S ES-K1	1026.6790.02
Script Development Kit	R&S ES-K2	1026.6890.02
Driver for R&S ESIB 7/26/40	R&S ES-K16	1108.0288.02
Driver for Mast (Schäfer) and Turntable (Schäfer)	R&S ES-K30	1026.7196.02
Driver for MDS Absorbing Clamp Slideway (Schäfer)	R&S ES-K31	1026.7921.02
Extras		
Service Kit	R&S FSE-Z1	1066.3862.02
DC Block, 5 MHz to 7000 MHz (type N)	R&S FSE-Z3	4010.3895.00
DC Block, 10 kHz to 18 GHz (type N)	R&S FSE-Z4	1084.7443.02
Microwave Measurement Cable and Adapter Set up to 26 GHz	R&S FS-Z15	1046.2002.02
Headphones	–	0708.9010.00
IEC/IEEE-Bus Cable, 1 m	R&S PCK	0292.2013.10
IEC/IEEE-Bus Cable, 2 m	R&S PCK	0292.2013.20
Control Cable 10 m, R&S ESIB-ESH2-Z5	R&S EZ-5	0816.0625.03
Control Cable 10 m, R&S ESIB-ESH3-Z5	R&S EZ-6	0816.0683.03
Control Cable 3 m, R&S ESIB-ENV 4200	R&S EZ-21	1107.2087.03
Transit Case 19", 5 HU	R&S ZZK-955	1013.9408.00
19" Rack Adapter, 5 HU	R&S ZZA-95	0396.4911.00

EMI accessories
see data sheet PD 0756.4320
(Accessories for Test Receivers and Spectrum Analyzers)

For further extras for spectrum analyzer applications see data sheet PD 0757.1519 (Spectrum Analyzers R&S FSE)

1) Factory-fitted.

Internal Preamplifier R&S ESIB-B2

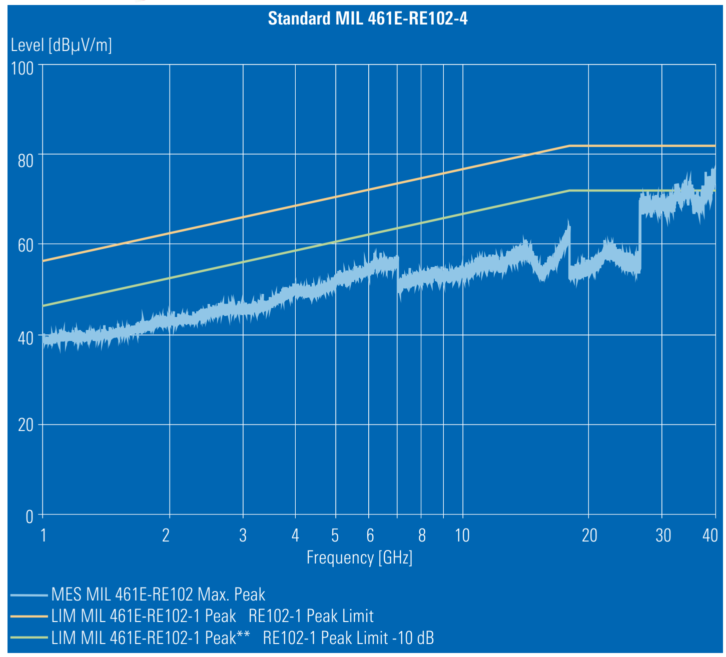
New

Option for the

EMI Test Receivers

R&S ESIB26/40 in the frequency

range 7 GHz to 26.5/40 GHz



Typical displayed average noise level of R&S ESIB 40 with built-in Preamplifier R&S R&S ESIB-B2 (model 40), recorded with peak detector, measurement bandwidth (RBW) of 1 MHz and taking into account cable attenuation and correction factors of three horn antennas up to 18 GHz, 26 GHz and 40 GHz.

Brief description

The internal preamplifier (option R&S ESIB-B2) is used to extend the frequency range of the preamplifier (9 kHz to 7 GHz) integrated as standard in the EMI Test Receivers R&S ESIB26 and R&S ESIB40 in the microwave range up to 26.5 GHz or 40 GHz. The preamplifier is used to improve the input sensitivity of the receivers by approximately 18 dB so that cable losses and antenna correction values can largely be compensated in the GHz range.

Main features

- System noise figure improved by 18 dB typ.
- Nominal gain 20 dB
- Multistage configuration up to 26.5 GHz or 40 GHz
- Connection irrespective of operating mode: analyzer or receiver

Specifications

The specifications below describe the additional data valid as of firmware version 4.01 or higher and are supplementary to the EMI Test Receivers R&S ESIB data sheet (PD 0757.4576). Data designated "nominal" applies to design parameters and is not tested.

Displayed noise floor (receiver mode)
(AV detector, 0 dB RF attenuation, RBW = 1 MHz, 50 Ω termination)

	Model 26	**Model 40**
Preamplifier off		
7 GH to 18 GHz	<22 dBµV	<26 dBµV
18 GHz to 26.5 GHz	<25 dBµV	<29 dBµV
26.5 GHz to 30 GHz	–	<40 dBµV
30 GHz to 40 GHz	–	<44 dBµV
Preamplifier on		
7 GHz to 18 GHz	<4 dBµV	<6 dBµV
18 GHz to 26.5 GHz	<6 dBµV	<9 dBµV
26.5 GHz to 30 GHz	–	<20 dBµV
30 GHz to 40 GHz	–	<26 dBµV

Displayed noise floor (analyzer mode)
(displayed average noise level, 0 dB RF attenuation, RBW = 10 Hz, VBW = 1 Hz, 20 averages, trace average, 50 Ω termination)

Preamplifier off		
7 GHz to 18 GHz	<–135 dBm	<–131 dBm
18 GHz to 26.5 GHz	<–132 dBm	<–128 dBm
26.5 GHz to 30 GHz	–	<–117 dBm
30 GHz to 40 GHz	–	<–113 dBm
Preamplifier on		
7 GHz to 18 GHz	<–153 dBm	<–151 dBm
18 GHz to 26.5 GHz	<–151 dBm	<–148 dBm
26.5 GHz to 30 GHz	–	<–137 dBm
30 GHz to 40 GHz	–	<–131 dBm

Frequency response (10 dB RF attenuation)

7 GHz to 18 GHz	±3 dB[1]	±3 dB[1]
18 GHz to 26.5 GHz	±3.5 dB[1]	±3.5 dB[1]
26.5 GHz to 40 GHz		±4 dB[1]

[1] Error after calling peak function. Additional error of ±1.5 dB for sweep time <10 ms/GHz.

Ordering information

Internal Preamplifier 7 GHz to 26.5 GHz	R&S ESIB-B2	1137.4494.26
Internal Preamplifier 7 GHz to 40 GHz	R&S ESIB-B2	1137.4494.40

Test Receiver R&S ESVN40

9 kHz to 2750 MHz

Useful and interfering signal measurements

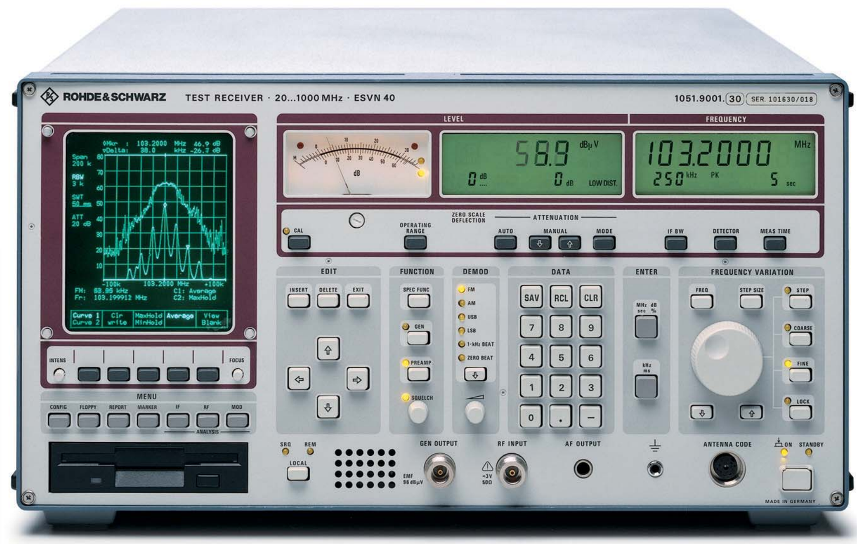


Photo 40630

Brief description

Test Receiver R&S ESVN is used to measure and demodulate both amplitude-modulated (DSB, SSB, pulse) and frequency-modulated signals as well as narrowband and broadband interference. Its high overload capability, wide dynamic range, high measurement rate and versatile analysis functions make the test receiver ideal tool for

- All applications in useful field-strength measurements (e.g. radio surveillance measurements, radio network planning and radiomonitoring),
- RFI measurements in line with all relevant commercial standards

Main features

- 13 fixed-tuned, 5 tracking preselection filters up to 2.75 GHz
- Crystal-stabilized synthesizer as 1st LO
- IF filters for all analog radio services with bandwidths between 1 kHz and 250 kHz; 9 kHz and 120 kHz filters with low delay distortion for quasi-peak and average value measurements to CISPR 16
- Peak, average, rms and quasi-peak detectors
- Demodulators for FM, AM, SSB (LSB and USB), zero beat and 1 kHz beat; loudspeaker, headphones connector; squelch; demodulation using signal processors
- Frequency and frequency-offset measurements with built-in counter
- Demodulators for measuring modulation depth and frequency and phase deviation
- IF analysis with span up to 10 MHz
- Detection of faulty modules by self-test function

Use in radiomonitoring

Thanks to its comprehensive measurement and analysis functions, the test receiver is able to perform all important radiomonitoring and measurement tasks in manual, semi-automatic and fully automatic operation:

- Field-strength measurements to ITU-R Rec. 378-4 with direct display of results
- Frequency and frequency-offset measurements with internal or external precision reference
- Modulation depth, frequency deviation and phase deviation measurements
- Visual spectrum monitoring with RF and IF analysis, the latter with simultaneous aural check of the signal received

Test Receiver R&S ESVN40

Specifications in brief

Frequency range 9 kHz to 2750 MHz, subdivided into

	Range I	Range II	Range III	Range IV
R&S ESVN40	–	20 MHz to 1000 MHz	1000 MHz to 2050 MHz	–
R&S ESVN40 with options R&S ESVN-B1 and R&S ESVN-B2	9 kHz to 30 MHz	30 MHz to 1000 MHz	1000 MHz to 2050 MHz	2050 MHz to 2750 MHz

Interference rejection, nonlinearities

Image-frequency rejection
- 1st IF: 100 dB typ. (1.9 GHz to 2.75 GHz, 90 dB typ.)
- 2nd IF: 100 dB typ.

IF rejection: >90 dB, 100 dB typ.

	preamplifier off	preamplifier on
Intercept point d3	$P_{f1,\,f2}$ = –10 dBm	$P_{f1,\,f2}$ = –20 dBm
Range I, f_{in}>2 MHz (BWI_F<15 kHz, $\|f_1–f_2\|$≥100kHz)	>15, 20 dBm typ.	>0, 5 dBm typ.
Range II ($\|f_1–f_2\|$ ≥10 MHz)		
f_{in}<50 MHz	15 dBm typ.	5 dBm typ.
f_{in}≥50 MHz	>15, 20 dBm typ.	>5, 10 dBm typ.
Ranges III, IV ($\|f_1–f_2\|$ ≥10 MHz)	>13, 18 dBm typ.	>3, 8 dBm typ.
Intercept point k2		
Range I	>40 dBm	>20 dBm
Range II	>35 dBm	>25 dBm
Ranges III, IV	>50 dBm	>40 dBm

Maximum input signals

(RF attenuation >0 dB)

DC voltage	7 V corresp. to 1 W
Sinewave AC voltage	137 dBµV
Max. pulse voltage	
Range I	700 V
Ranges II, III and IV	150 V
Max. pulse energy (10 µs)	
Range I	100 mWs
Ranges II, III and IV	1 mWs

Intermediate frequencies

Range I	74.7/10.7 MHz/100 kHz
Range II	1354.7/74.7/10.7 MHz/100 kHz
Ranges III, IV	394.7/74.7/10.7 MHz/100 kHz

IF bandwidths 1/3/9*)/15/120*)/250 kHz

*) Complying with tolerances to CISPR 16.

For SSB demodulation a 2.4 kHz IF filter is connected into the audio channel.

Customer-specific bandwidths available on request.

Displayed noise floor (average (AV), bandwidth =1 kHz)

	preamplifier off	preamplifier on
Range I (f_{in}>50 kHz)	–27 dBµV typ.	–33 dBµV typ.
Range II	–23 dBµV typ.	–28 dBµV typ.
Ranges III, IV	–22 dBµV typ.	–28 dBµV typ.

RMS value	displayed AV noise +1 dB (typ.)	
Peak value	displayed AV noise +12 dB (typ.)	
Quasi-peak (typ. values)		
Band B (150 kHz to 30 MHz)	–13 dBµV	–19 dBµV
Bands C/D (30 to 1000 MHz)	+2 dBµV	–4 dBµV

Level measurement range

Lower limit (additional error caused by inherent noise <1 dB)

Average value (AV)	4 dB above displayed noise
RMS value	5 dB above displayed noise
Peak value (PK)	15 dB above displayed noise
Quasi-peak (100 Hz pulse freq.)	3 dB above displayed noise
Upper limit	
AV, RMS, PK, QP	137 dBµV (RF attenuation >0 dB)

General data

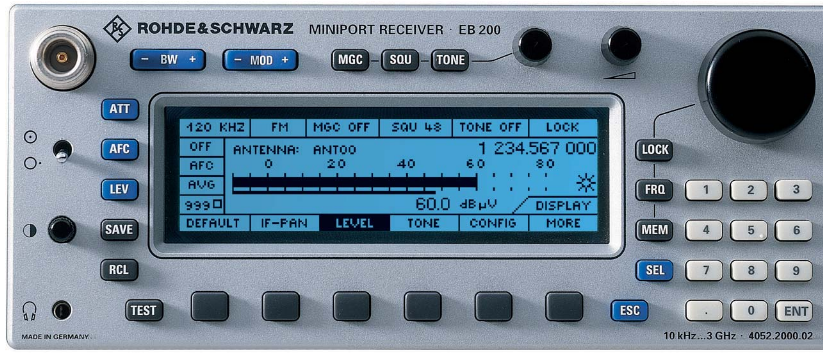
Rated temperature range	–10°C to +55°C (condensation not permissible)
Operation of floppy disk drive	+5°C to +50°C
Storage temperature range	–25°C to +70°C
Power supply	
AC supply	100 V/120 V/240 V ±10%, 230 V +6%/–10%, 47 Hz to 420 Hz, safety class I to VDE 0411
Power consumption	155 VA
Battery (external)	11 V to 33 V (switch-on voltage >12 V) 4.4 A at 24 V/8 A at 12 V
Dimensions (W x H x D)	435 mm x 236 mm x 572 mm
Weight	35 kg incl. R&S ESVN-B1 and -B2; 32 kg without options

Ordering information

Test Receiver	R&S ESVN40	1056.9497.40
Options		
Frequency Extension 9 kHz to 20 MHz for R&S ESVN40	R&S ESVN-B1	1070.4501.02
Frequency Extension 2050 to 2750 MHz for R&S ESVN40	R&S ESVN-B2	1070.4001.02
Balanced 600 Ω Audio Output for R&S ESN and R&S ESVN	R&S ESN-B3	1056.9422.02

Miniport Receiver R&S EB200

Portable monitoring from 10 kHz to 3 GHz with Handheld Directional Antenna R&S HE200



Brief description

Miniport Receiver R&S EB200 is a miniaturized portable professional receiver for the HF-VHF-UHF range. The R&S EB200 is characterized by high input sensitivity and frequency setting accuracy throughout the frequency range from 10 kHz to 3 GHz.

Its small dimensions – ½19", two height units – and low weight as well as a sturdy design make the R&S EB200 ideal for use in places which cannot be reached with a vehicle. Its low power consumption permits battery operation typically of six hours. The R&S EB200 battery pack is easily accessible and can be exchanged quickly. In case of power supply interruption, all the data are stored. Operation can thus be resumed immediately after the power supply is restored.

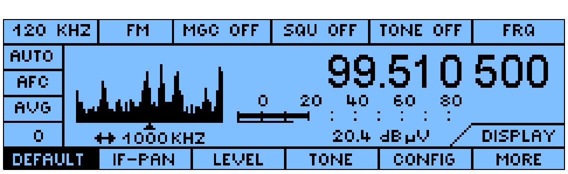
Main features

- Ergonomic design for on-body operation
- Continuous frequency range 10 kHz to 3 GHz
- Digital IF section with 12 bandwidths (150 Hz to 150 kHz)
- Fast, accurate level indication across 120 dB dynamic range
- Search modes
  - Frequency search
  - Memory search
  - Frequency spectrum
- Remote-controllable via LAN (Ethernet 10 Base-T) or RS-232-C

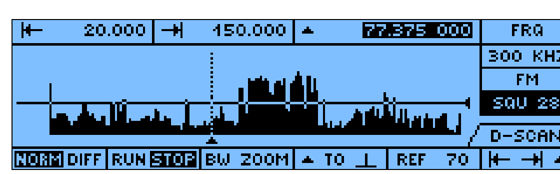
Function

The R&S EB200 is a superhet receiver with a third intermediate frequency of 10.7 MHz. The receiver input is equipped with a highpass/lowpass combination or tracking preselection, as required, to reduce the signal sum load. Intermodulation suppression equals that of many receivers used in stationary applications. The low degree of oscillator reradiation is a result of large-scale filtering. A modern synthesizer concept featuring very low phase noise permits switching times of less than 3 ms. Effective frequency and memory scanning is thus possible.

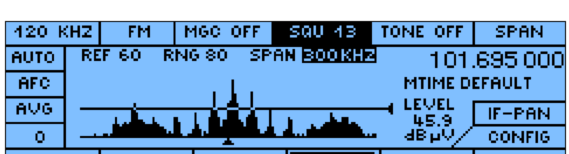
The digital IF section has a wide variety of different filters which are implemented in a minimal space with the aid of DSP. The R&S EB200 has 12 IF bandwidths between 150 Hz and 150 kHz. The following digital demodulators are available: AM, FM, LSB, USB, CW, PULSE and IQ. If the receiver is fitted with the IF panorama option, the number of bandwidths is increased to 17 up to 1 MHz. Bandwidths over 150 kHz are for level and deviation measurement as demodulation is not possible.



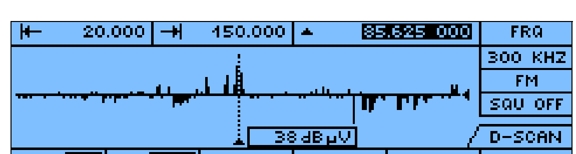
Overview



DIGI Scan listen mode



IF panoramic display



DIGI Scan differential mode

R&S HE200HF: 10 kHz to 20

20 MHz to 200 MHz

200 MHz to 500 MHz

0.5 GHz to 3 GHz

Miniport Receiver R&S EB200

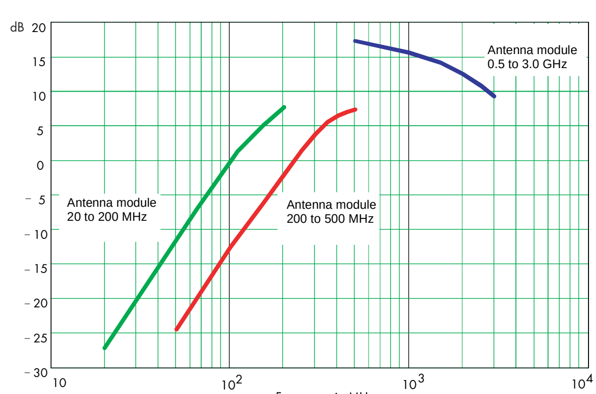
Applications

- Monitoring of given frequencies, e.g. storage of 1 to 1000 frequencies, squelch setting, constant monitoring of one frequency or cyclical scanning of several frequencies
- Searching in a frequency range with freely selectable start and stop frequency and step widths of 0.1 kHz to 10 MHz
- Search with highest speed in the frequency range with free selectable start and stop frequency (option DIGI scan)
- Location of close-range to medium-range targets with the aid of Handheld Directional Antenna R&S HE200
- Detection of undesired emissions including pulsed emissions
- Detection of unlicensed transmitters communicating illegally or interfering with licensed transmission
- Protection against tapping by detecting miniature spy transmitters (bugs)
- Monitoring of one's own radio exercises in a service band
- Monitoring of selected transmissions
- Remote-controlled operation via modem and PC in coverage measurement and monitoring systems

Handheld Directional Antenna

The handy and highly broadband Active Directional Antenna R&S HE200 in conjunction with portable receivers such as R&S EB200 is ideal for locating transmitting and interfering sources. The direction is found by pointing the antenna towards the direction of maximum signal voltage. The overall frequency range from 0.01 MHz to 3000 MHz is covered by 4 exchangeable broadband antenna modules each with a distinct directional pattern

A low-noise broadband amplifier may be added to increase sensitivity in the active mode. The amplifier is bypassed in the passive mode and in this case the antenna may also be used in the vicinity of strong transmitters.



Gain, active mode

Miniport Receiver R&S EB200

Specifications in brief R&S EB200

Frequency range	10 kHz to 3 GHz
Frequency setting via keypad or rollkey	1 kHz, 100 Hz, 10 Hz, 1 Hz or in selectable increments
Frequency accuracy	≤1 x 10^{-6} (–10 to + 55 °C)
Aging	≤0.5 x 10^{-6} /year
Synthesizer setting time	≤3 ms
Oscillator phase noise	≤–100 dBc/Hz at 10 kHz offset
Antenna input	N female, 50 Ω, VSWR ≤3, SMA connector on rear panel for rack mounting
Oscillator reradiation	≤–107 dBm
Input attenuation	manual or automatic
Input selection	
100 kHz to 20 MHz	highpass/lowpass
20 MHz to 1.5 GHz	tracking preselection
1.5 GHz to 3 GHz	highpass/lowpass
Interference rejection, nonlinearities	
Image frequency rejection	≥70 dB, typ. 80 dB
IF rejection	≥70 dB, typ. 80 dB
2nd order intercept point	typ. 40 dBm
3rd order intercept point	typ. 2 dBm
Internal spurious signals	≤–107 dBm
Sensitivity	
Overall noise figure	typ. 12 dB
Demodulation	AM, FM, LSB, LSB, CW, PULSE, IQ
IF bandwidths	12 (150/300/600 Hz/1.5/2.5/6/9/15/30/50/120/150 kHz)
IF bandwidths for level and deviation indication	15 (150 Hz to 1 MHz) only with IF Panoramic Unit R&S EB200SU
Squelch	signal-controlled, can be set from –30 to 110 dBμV
Gain control	AGC, MGC
AFC	digital retuning for frequency-unstable signals
Deviation indication	graphical with tuning label or numerical
Signal level indication	graphical as level line or numerical from –10 to 110 dBμV, acoustic indication by level tone
IF panorama (option SU)	internal module, ranges 25, 50, 100, 200, 500, 1000 kHz, all IF bandwidths additional 25 kHz to 1 MHz
Scan characteristics	
Automatic memory search	1000 definable memory locations to each of which a complete data set can be allocated
Frequency search	START/STOP/STEP definition with receiving data set
RF spectrum DIGI scan (option)	start/stop, up to 1.5 GHz/sec
Inputs/outputs	
Digital IF output	serial data (clock, data, frame) up to 256 ksps
I/Q output (digital)	AF signal, 16 bit
IF 10.7 MHz, wideband	typ. ±5 MHz uncontrolled for external panoramic display
AF output, balanced	600 Ω, 0 dBm
Loudspeaker output	8 Ω, 500 mW
Headphones output	via volume control
Output log. signal level	0 to +4.5 V
BITE	monitoring of test signals by means of loop test
Data interface	LAN (Ethernet 10 Base-T) or RS-232-C

General data

Operating temperature range	–10 to +55 °C
Rated temperature range	0 to +50 °C
Storage temperature range	–40 to +70 °C
Power supply	AC 110/230 V, 50/60 Hz battery pack (typ. 6 h operation) or DC 10 V to 30 V (max. 22 W)
Dimensions (W x H x D)	210 mm x 88 mm x 270 mm, ½ 19" x 2 HU
Weight (without battery pack)	4 kg
Battery pack	1.5 kg

Specifications in brief R&S HE200

Frequency range	0.01 MHz to 3000 MHz
Antenna modules	20 MHz to 3000 MHz, with 3 plug-in antennas
20 MHz to 200 MHz	loaded loop antenna
200 MHz to 500 MHz	loaded loop antenna
500 MHz to 3000 MHz	log-periodic antenna
Option	
0.01 MHz to 20 MHz	loop antenna
Polarization	vertical for all antenna modules, horizontal polarization by turning the longitudinal antenna axis by 90°
Loop antenna 0.01 MHz to 20 MHz	direction finding for horizontally polarized signals not possible because of circular vertical pattern of system
Nominal impedance	50 Ω
SWR	<2.5 typ.
RF output	1 m cable with N connector

General data

Operating temperature range	–10 to +55 °C
Rated temperature range	0 to +50 °C
Power supply	in handle, 4 x 1.5 V mignon cell R6
Dimensions (W x H x D)	470 mm x 360 mm x 180 mm (in transport case)
Weight (without battery)	4.5 kg including transport case

Ordering information

Miniport Receiver	R&S EB200	4052.2000.02
Options		
Internal IF Panoramic Unit	R&S EB200SU	4052.3206.02
RF Spectrum DIGI-Scan	R&S EB200DS	4052.9604.02
LAN (Ethernet 10 Base-T) Interface	R&S EB200R4	4052.9156.02
RS-232-C Interface	R&S ESMBR2	4052.9156.02
Extras		
Carrying Case (telescopic antenna, headset, belt and space for R&S EB200 and battery pack)	R&S EB200SC	4052.9304.02
Battery Pack	R&S EB200BP	4052.4102.02
Handheld Directional Antenna inclusive carrying case	R&S HE200	4050.3509.02
HF Module 10 kHz to 20 MHz	R&S HE200HF	4051.4009.02

EMI Software R&S ES-K1

Automation of EMI measurements with R&S instruments:

Test Receiver Families R&S

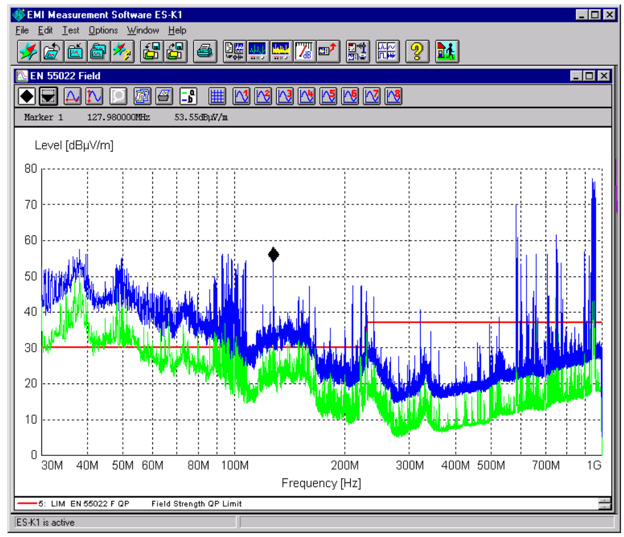
ESCS, ESS, ESHS, ESVS, ECPC

Analyzer families R&S

ESIB7, ESIB26, ESIB40

ESAI, ESBI, ESMI

ESPI3, ESPI7

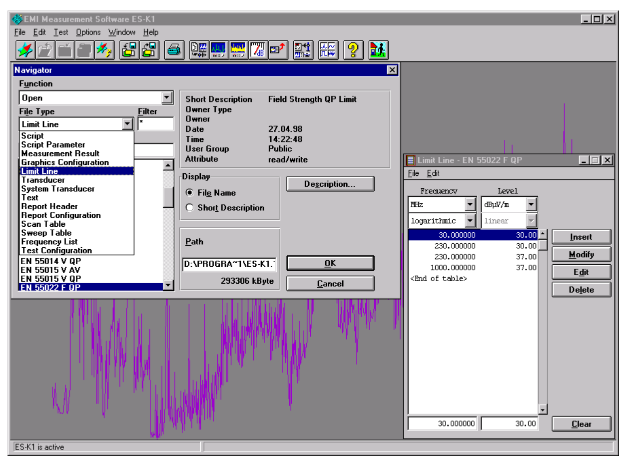


The frequency spectrums for two or more (depending on receiver type) different detectors measuring in parallel are shown simultaneously.

Brief description

EMI Software R&S ES-K1 is a versatile, efficient and user-friendly tool for fully automatic measurement of conducted and radiated emissions to international commercial and military standards such as CISPR, VDE, FCC, EACL, ANSI, EN; MIL, VG, DEF-STAN, GAM-EG13.

Offering various drivers, the software not only supports EMI test receivers and EMI spectrum analyzers from Rohde&Schwarz, but also a large variety of accessories:



The integrated database contains a large number of predefined limit lines, transducer factors and scan or sweep tables that can easily be selected via a navigator and edited.

- Mast and turntable system for measurement of RFI field strength
- Artificial mains networks and absorbing clamp slideways for measurement of conducted emissions
- Matrix for switching over antennas and transducers

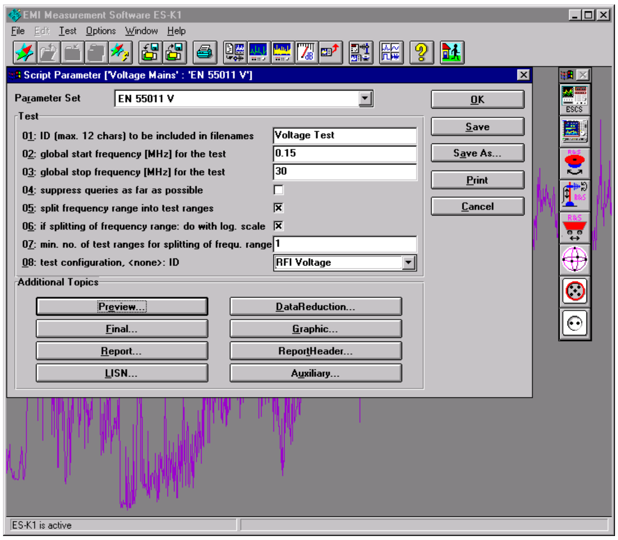
Main features

- User-friendly EMI test software under Windows
- EMI measurements to commercial and military standards
- Adaptation to other standards
- Integrated database
- User-group-specific data allocation
- Fully automatic operation or interactive single measurement
- Automatic compensation of transducers (correction factors) and limit lines
- Large choice of data reduction methods
- Azimuth chart test
- Evaluation of narrowband/broadband interferers
- Test setup calibration
- Convenient and flexible result documentation and report generation
- Universal data storage
- Hardlock key (dongle) for authentication
- Network-compatible

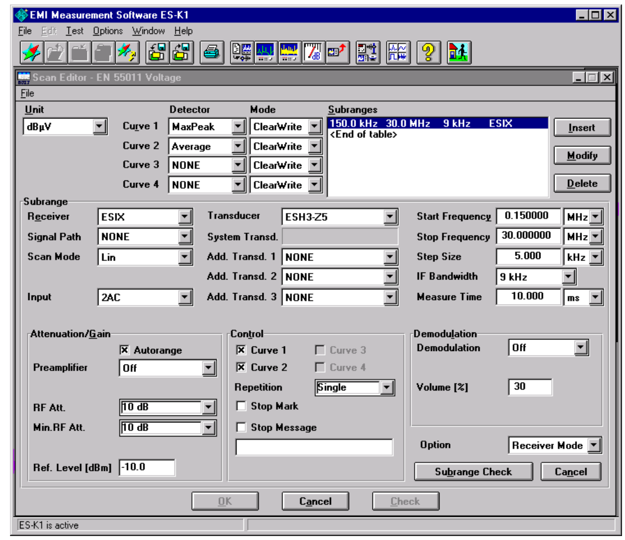
Test runs

Depending on the application and use of the software, control of the test runs is either fully automatic or interactive. By loading automatic test routines defined in the form scripts, measurements can be

EMI Software R&S ES-K1



Standard parameter configuration enables standard-compliant measurement with flexible scripts.



The measurement parameters for frequency subranges can additionally be optimized in standard preset scan tables.

started simply at the press of a button without any time-consuming entries. The scripts control the test run, evaluate the results and generate the necessary test reports. In addition to standard scripts, user-specific scripts can be generated and existing scripts modified (option R&S ES-K2).

A database is integrated in R&S ES-K1 for management of the measured data or of the result files derived with the aid of comprehensive test and evaluation routines. The convenient access to these files with informative short descriptions does away with tiresome file searching.

Versatile and flexible result display is possible in the form of tables or graphs. A maximum of eight test results, limit lines and transducer factors can be displayed simultaneously. A zoom function allows enlargement of any parts of the result display.

Report generation

The script run generates a user-configured report which combines the test results in an informative documentation. Another way of generating the reports is by automatic data exchange between the Windows programs, the DDE function implemented in R&S ES-K1 allowing both graphs and texts to be exported from R&S ES-K1 and copied into the user-generated test report wherever desired. Alternatively the test report can be stored as RTF.

Hardware requirements

IBM compatible PC minimum 486 with Windows 3.1/95/98/NT4.0/2000/ME; minimum 8-MByte RAM; minimum memory capacity on hard disk 8 Mbyte; IEC/IEEE bus interface with Windows driver (DLL), National Instruments IEC/IEEE bus interface.

Ordering information

EMI Software	R&S ES-K1	1026.6790.02

(Windows program with driver for Artificial Mains Networks ESH2-Z5, ESH3-Z5 and Relay Matrixes PSU, RSU and PSN)

Script Development Kit	R&S ES-K2	1026.6890.02

Drivers for Test Receivers and Spectrum Analyzers

ESHS, ESVS, ESVD, ESCS, ESPC	R&S ES-K10	1026.6948.02
ESAI, ESBI, ESMI	R&S ES-K12	1026.7144.02
ESIB7, ESIB26, ESIB40	R&S ES-K16	1108.0288.02
ESPI3, ESPI7	R&S ES-K18	1140.5298.02

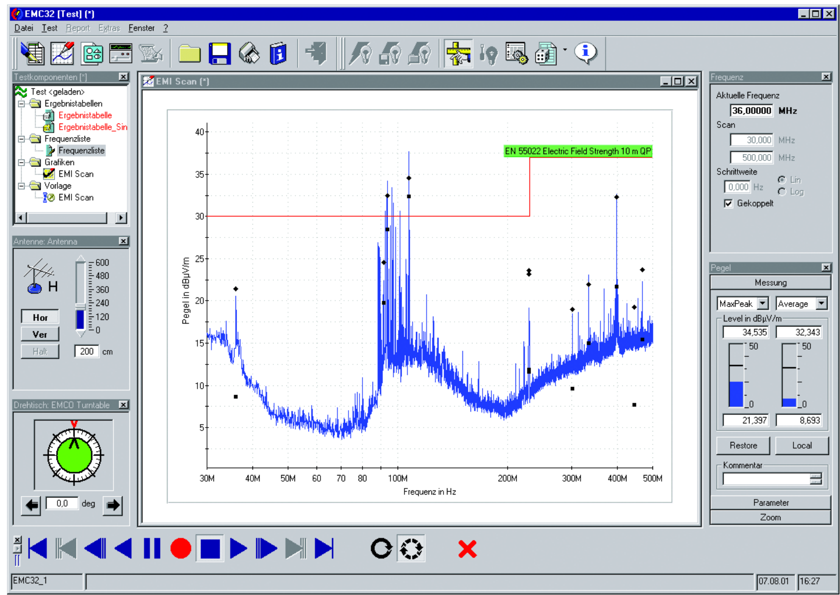
Drivers for accessories

Deisel Controller, Mast, Turntable, HD-MA2xx and HD-DT3xx	R&S ES-K33	1035.1097.02
EMCO Controller, Mast, Turntable, 2090 and SUNOL SC9XV	R&S ES-K40	1140.4591.02
User specific IEC/IEEE Bus Driver	R&S ES-K50	1057.2496.02
Multi-User Licence	R&S ES-K100	1057.0741.02

Further drivers on request.

EMC Measurement Software R&S EMC32

For use in development, for compliance and batch testing



R&S EMC32 display for single EMI measurements; parameters such as current measurement frequency, detectors, bandwidth, measurement time, demodulation or RF attenuation can be varied during the measurement

Brief description

The EMC Measurement Software R&S EMC32 from Rohde&Schwarz runs on 32-bit operating systems from Microsoft and offers a common user interface for electromagnetic interference (EMI) and electromagnetic susceptibility (EMS) measurements. The software is a modern and powerful tool for controlling and monitoring Rohde&Schwarz EMI test receivers and EMC test systems. It guarantees reliable collection, evaluation and documentation of measurement results.

Thanks to its comprehensive and extremely flexible configuration capabilities and its open software structure, R&S EMC32 can be used for all EMI and EMS measurements in line with civil standards.

Main features

Flexible

- Modules for measuring electromagnetic interference (EMI) and electromagnetic susceptibility (EMS)
- Support of measurements to civil standards such as CISPR, IEC, ISO, EN, ETSI, VDE, FCC and ANSI
- Manual and automatic EMI and EMS measurements
- Can be combined with EMC test systems and EMI test receivers/analyzers from Rohde&Schwarz

Efficient

- Graphical user interface for instrument and system configuration
- Menu-guided, intuitive user prompting for all test sequences (virtual instrument)
- Product-oriented test selection
- EUT-specific data management
- Modular calibration concept
  – Minimal recalibration effort required
  – Simplified test system certification
- Assisted installation and configuration
- Online help

Future-oriented

- Modular program structure
- Easily upgradeable
- Data storage in text format
- Reports generated as RTF, HTML or PDF file
- 32-bit software for Windows 98SE, NT4.0, 2000, ME and XP

Applications

An essential feature of the R&S EMC32 software is that it can be optimally adapted to the requirements of the various EMC applications:

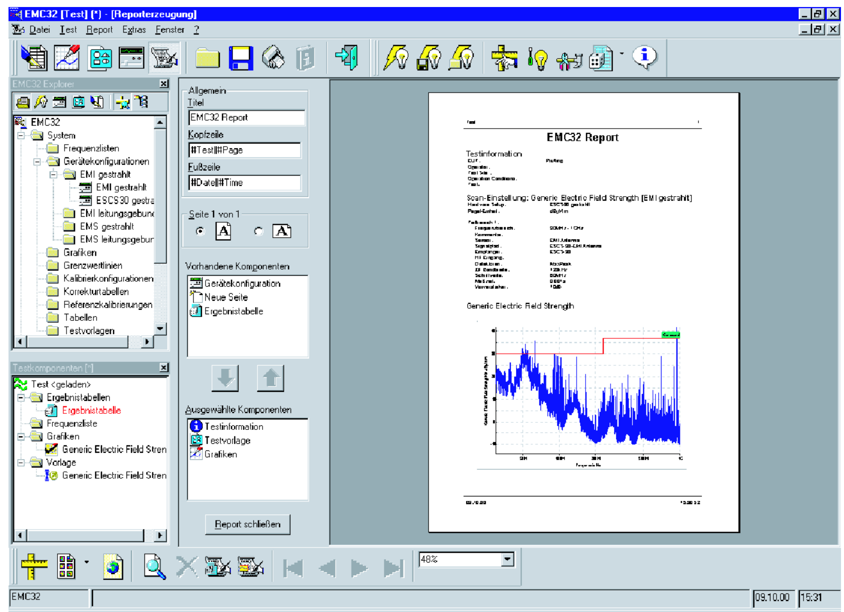
- **Tests during development**
  Switchover between manual and automatic measurements at any time (e.g. manual measurement for fast interference source identification within an automatic measurement sequence)
- **Compliance testing**
  Standard measurements can be performed easily and rapidly with the aid of predefined test routines and an integrated EUT monitoring function (EMS)
- **Batch tests**
  The capability to perform graphical batch measurements is ideal for batch testing

EMC Measurement Software R&S EMC32

The R&S EMC32 software offers EMI and EMS measurements for all civil product groups:

- Industrial, scientific and medical RF instruments (ISM instruments)
- Broadcast receivers and connected units
- Domestic appliances and tools
- Fluorescent lamps and lighting systems
- Information technology equipment (ITE)
- Communications equipment
- Automotive products

The limit values for the applicable international standards are already included in the software. Furthermore, new test criteria can be generated by the user, stored as standard and considered as manufacturer- or product-specific limit values. This makes the software user-configurable for almost any EMC measurement task.



R&S EMC32 with report configuration dialog open; a report consists of several parts, e.g. header, graphs, tables, test template settings, which can be configured and arranged in this dialog

Specifications/system requirements:

Operating system:
Windows 2000 (recommended) or XP or ME or NT 4.0 (with service pack 5.0 or higher) or 98SE

Administration rights

Microsoft Internet Explorer 5.0 or higher
PC with Pentium class processor (at least 200 MHz)
64 Mbyte RAM (Windows NT4.0, 98SE) or 128 Mbyte RAM (Windows 2000)
50 Mbyte free hard disk space

Super VGA monitor, screen resolution at least 1024 x 768 pixels, 65536 colours
USB interface[1] integrated in the motherboard (for i-Key software protection[2])
IEC/IEEE-bus interface card from National Instruments

Available software modules:

R&S EMC32 is available as a complete package for EMI and EMS measurements or as single packages for EMI or EMS measurements.
R&S EMC32-C: for electromagnetic interference and susceptibility test systems (EMI + EMS)
R&S EMC32-E: for electromagnetic interference test systems (EMI)
R&S EMC32-S: for electromagnetic susceptibility test systems (EMS)

The R&S EMC32-E (EMI) software version supports the following Rohde & Schwarz EMI test receivers:
EMI Test Receivers R&S ESIB7, ESIB26, ESIB40
EMI Test Receiver R&S ESCS30
Test Receiver R&S ESPI3, ESPI7
EMI Test Receiver R&S ESAI, ESBI, ESMI
EMI Test Receiver R&S ESxS30

An overview of further currently available device drivers (RF generators, mast and turntable controllers, etc) of R&S EMC32 is provided on the Rohde & Schwarz website at www.emc32.rohde-schwarz.com.

Ordering information

EMC Measurement Software R&S EMC32

for EMI and EMS test systems	R&S EMC32-C	1119.4644.02
for EMI test systems	R&S EMC32-E	1119.4621.02
for EMS test systems	R&S EMC32-S	1119.4638.02

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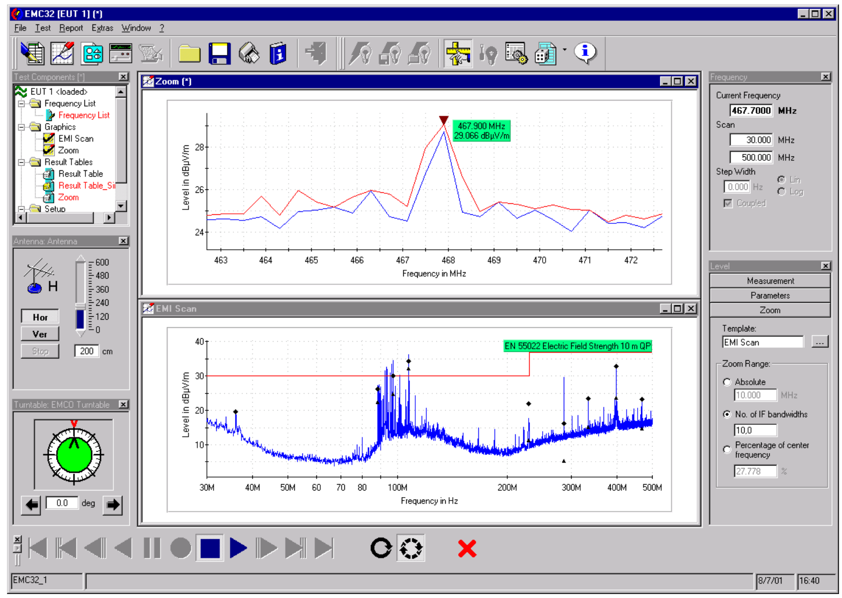
1) Software support for the USB port of NT4.0 is included in R&S EMC32.

2) Software protection: R&S EMC32 is protected by a hardware dongle (i-Key). When used for demonstrations or without control of (hardware) system components, R&S EMC32 can be installed on a computer without further registration and can be operated without an i-Key.

EMI Measurement Software R&S EMC32-L

For EMI measurements during development with the Test Receivers R&S ESPI

New



R&S EMC32-L display for single EMI measurements; parameters such as current measurement frequency, detectors, bandwidth, measurement time, demodulation or RF attenuation can be varied during the measurement; with the aid of an auxiliary zoom function, a small range around the RFI frequency can be scanned; the results of the individual measurement are entered in a separate result table and also represented as a separate trace in the graph

Brief description

The R&S EMC32-L software from Rohde & Schwarz measures conducted and radiated emissions and runs on the 32-bit operating systems from Microsoft. It is based on the EMI Measurement Software R&S EMC32-E and mainly supports EMI measurements during development in line with all civil standards. It ensures reliable logging, evaluation and documentation of measured data.

In contrast to R&S EMC32-E, which comprises additional functions and also performs automatic tests, R&S EMC32-L is intended exclusively for controlling the ESPI precompliance test receivers from Rohde & Schwarz.

Main features

Flexible

- Measurement of conducted and radiated emissions
- Support of measurements to civil standards such as CISPR, IEC, ISO, EN, ETSI, VDE, FCC and ANSI
- Manual and automatic EMI measurements

Efficient

- Graphical user interface for instrument configuration
- Menu-guided, intuitive user prompting for all test sequences (virtual instrument)
- Product-oriented test selection
- EUT-specific data management
- Assisted installation and configuration
- Online help

Future-oriented

- Modular program structure
- Data storage in text format
- Reports generated as RTF, HTML, or PDF file
- 32-bit software for Windows 2000, NT4.0, XP, ME or 98SE

Applications

An essential feature of the R&S EMC32-L software is that it can be optimally adapted to the requirements of the various EMC applications:

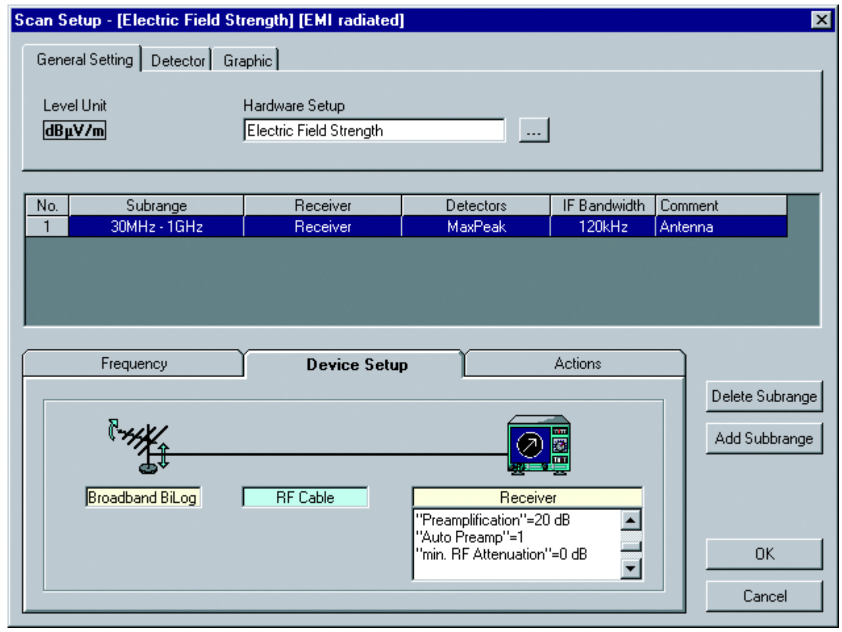
- **Tests during development**
  Switchover between manual and automatic measurements at any time (e.g. manual measurement for fast interference source identification within an automatic measurement sequence)
- **Batch tests**
  The capability to perform graphical batch measurements is ideal for batch testing

EMI Measurement Software R&S EMC32-L

The R&S EMC32-L software offers EMI measurements for all civil product groups:

- Industrial, scientific and medical RF instruments (ISM instruments)
- Broadcast receivers and connected units
- Household electrical appliances and tools
- Fluorescent lamps and lighting systems
- Information technology equipment (ITE)
- Communications equipment
- Automotive products

The limit values for the applicable international standards are already included in the software. Furthermore, new test criteria can be generated by the user, stored as standard and considered as manufacturer- or product-specific limit values.



EMI scan editor of R&S EMC32-L where parameters can be set for measuring the susceptibility to radiated interference; the settings of the instruments used are modified in a separate editor

Specifications/system requirements

Operating system:
Windows 2000 (recommended), ME, XP or NT 4.0 (with service pack 5.0 or higher) or 98 Second Edition

Administration rights

Microsoft Internet Explorer 5.0 or higher
PC with Pentium processor (at least 200 MHz)
64 Mbyte RAM (Windows NT4.0, 98SE) or 128 Mbyte RAM (Windows 2000)
50 Mbyte free hard disk space
Super VGA monitor, screen resolution at least 1024 x 768 pixels, 65536 colours
IEC/IEEE-bus interface card from National Instruments

Ordering information

EMI Measurement Software for Test Receivers ESPI	R&S EMC32-L	1106.4286.02

Other R&S EMC32 software modules

R&S EMC32-C: for electromagnetic interference and susceptibility test systems (EMI[1] + EMS)
R&S EMC32-E: for electromagnetic interference test systems (EMI[1])
R&S EMC32-S: for electromagnetic susceptibility test systems (EMS)

Latest news on R&S EMC32 software modules are provided on the Rohde & Schwarz website at www.EMC32.rohde-schwarz.com.

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[1] The R&S EMC32-E (EMI) software version supports the following Rohde & Schwarz EMI test receivers:
EMI Test Receivers R&S ESIB7, ESIB26, ESIB40
EMI Test Receiver R&S ESCS30
EMI Precompliance Test Receivers R&S ESPI3, ESPI7
EMI Test Receivers R&S ESAI, ESBI, ESMI (from mid 2002)
EMI Test Receivers R&S ES(x)S (from mid 2002).

EMI Software R&S ESxS-K1

User-friendly EMI test software under Windows

Can be used for all Test Receivers of R&S ESCS, ESS, ESHS, ESVS, ESPC, ESVN, ESVD, ESVB

Photo 42219

Brief description

EMI Software R&S ESxS-K1 combines the main features of commercial EMI measurement requirements in one complete, easy-to-use application including: setup definition and storage, scan data capture and display with automatic data reduction, peak search with acceptance margin and subrange selection, final measurement with worst case selection, report generation and measured data storage.

R&S ESxS-K1provides for all test receiver and EMI test receiver families (except R&S ESPI, ESIB, ESxI) a low-cost Windows based remote-control display and result storage solution.

Much benefits of Windows are available including: keyboard and mouse operation, report printout on any printer/plotter supported by Windows, and dynamic data exchange (DDE). Online help explains all software functions, so no user manual is required.

Main features

- Full on-screen setup entry and storage to disk, including limit lines and transducer factors
- Colour graphic display of scan data, with automatic data reduction
- Marker function, including Marker to Peak and Tune Receiver to Marker Frequency
- Automatic Peak Search with user-definable acceptance margin and subrange/peak value count
- Peak List Edit function for automatic, semi-automatic or manual measurements
- Find Worst Case function: to find max hold level
- Zoom function: expands frequency axis to display a part of the scan in greater detail
- Report generation compatible with R&S ESxS receiver family using any printer or plotter supported by Windows
- Report data export to other applications (WinWord, Excel)

Hardware requirements

Runs under Windows 3.1/95/98/NT4.0/2000/XP/ME on any IBM-compatible machine with an 80486 processor or higher and minimum 8 MByte RAM; requires an IEC/IEEE bus interface card for receiver control, e.g. PS-B4 (model 04) from Rohde&Schwarz, or PCII/IIA, AT-GBIP from National Instruments.

Ordering information

EMI Software	R&S ESxS-K1	1082.9678.02

Absorbing Clamps R&S MDS-21/-22, Ferrite Clamp R&S EZ-24

RFI power and shielding effectiveness measurements on lines. Reproducible interference field-strength and power measurements

Absorbing Clamps R&S MDS-21 and R&S MDS-22; center: Ferrite Clamp R&S EZ-24

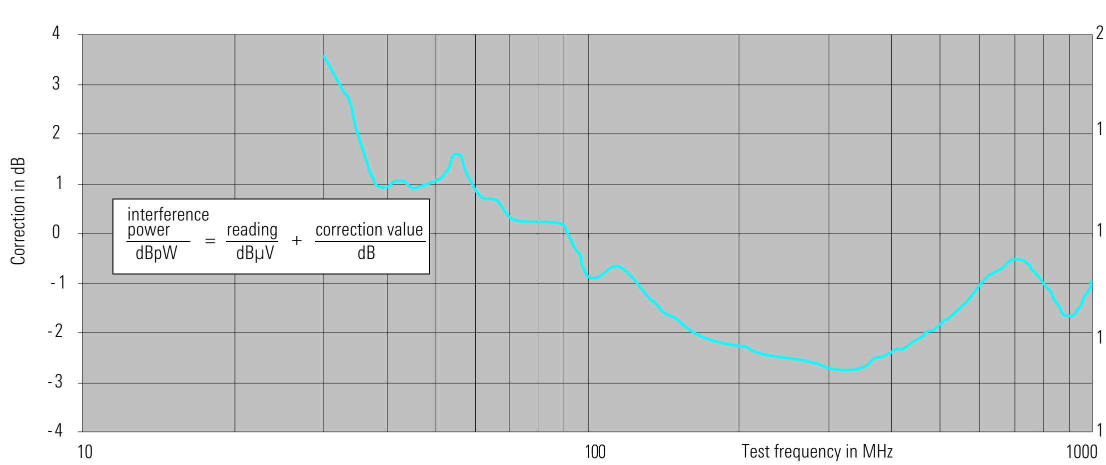
Brief description

The RFI emission of electrical appliances, machinery and systems must be kept within the limits specified by regional and international standards. Absorbing Clamps MDS can be used in conjunction with EMI test receivers to measure RFI power on lines to CISPR 14-1, EN 55014-1, VDE 0875 Part 14 and EN 50083-2, and in conjunction with two-port measurement devices to measure the shielding effectiveness of lines to DIN 47250 Part 6, IEC 96-1, EN 50083-2 and DIN 0855 Part 200. MDS clamps are also used for testing the effectiveness of RFI suppression devices for high-voltage ignition systems in line with VDE 0879 Part 4 and CISPR 12 (4th edition). Draft documents for the measurement of radiated interference provide for the use of ferrite absorbers for line loading to improve the reproducibility of RFI field-strength measurements. Ferrite absorbers are also used to improve RFI power and shielding effectiveness measurements.

Interference measurements in the VHF/UHF range

In the frequency range below 30 MHz, where interference is mainly propagated via lines, this interference is determined as laid down in many regulations by measuring the RFI voltage produced by the EUT across the terminals of a line-impedance stabilization network.

In the VHF/UHF range, where radiated emission predominates, interference is defined in terms of the RFI field strength at a certain distance. Small EUTs emit interference mainly via the connecting cables such as power lines. For the above reasons as well as to avoid complex field-strength measurement, several regulations prescribe the use of an absorbing clamp for measurement of the RFI power.



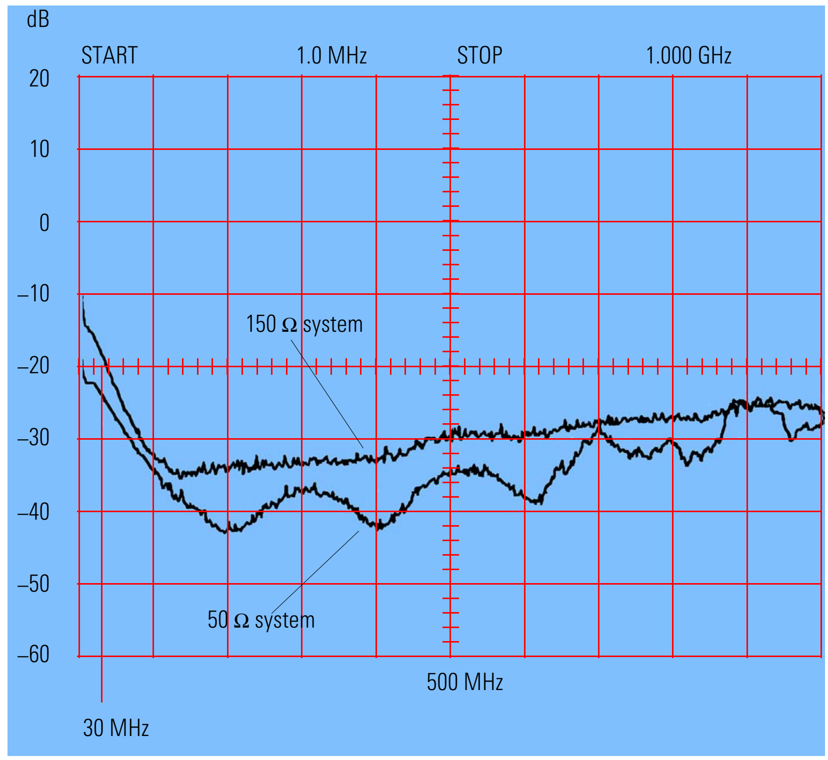
Typical calibration curve of Absorbing Clamp R&S MDS-21

Absorbing Clamps R&S MDS-21/-22, Ferrite Clamp R&S EZ-24

Further applications

In addition to measuring the interference emitted by small appliances and the shielding effectiveness of cables, Absorbing Clamp R&S MDS-21 can also be used for testing the effectiveness of RFI suppression devices for high-voltage ignition systems according to VDE 0879 Part 4/ Draft 9.89 and CISPR 12. High-energy pulses are coupled out and taken to the test receiver whose inputs are protected in a special way.

MDS clamps are also suitable for use as coupling clamps for testing the susceptibility of electronic devices.



Insertion loss characteristic of Ferrite Clamp R&S EZ-24

Specifications

	R&S MDS-21	**R&S MDS-22**
Frequency range	30 MHz to 1000 MHz	300 MHz to 2500 MHz
Insertion loss to CISPR 16-1, typ. (individual calibration report supplied with clamp)	17 ±4 dB	17 +6/–4 dB
Calibrated for receiver input impedance	50 Ω	50 Ω
Connector	N female 50 Ω	N female 50 Ω
Permissible DC current or peak value of AC current	30 A	50 A
Max. permissible RF input power for susceptibility measurement	5 W	5 W
Max. cable diameter	20 mm	12 mm
Insert sleeves supplied (diameter)	10 mm	3, 6, 9 mm
Rollers	ball bearing, dust-protected	ball bearing, dust-protected
Overall dimensions (W x H x D) in mm	610 x 115 x 80	230 x 70 x 70
Weight	6.3 kg	1.25 kg

	R&S EZ-24
Frequency range	1 MHz to 1000 MHz
Skin current attenuation in range 30 MHz to 1000 MHz in 50 Ω circuit	>15 dB (see typ. insertion loss)
Max. permissible skin current RF power	50 W
Overall dimensions (W x H x D) in mm	626 x 57 x 80
Weight	3.5 kg

Ordering information

Absorbing Clamp	R&S MDS-21	0194.0100.50
	R&S MDS-22	1052.3507.02
Ferrite Clamp	R&S EZ-24	1107.2535.02

Accessories supplied

R&S MDS-21	1 coaxial connecting cable (for connecting R&S MDS-21 to EMI test receiver), 5 m long with 2 x N connector; 6 dB attenuator, 2 x N connector
R&S MDS-22	1 calibration curve without cable insertion loss (insertion loss of connecting cable must be added)

Triple-Loop Antenna R&S HM020

9 kHz to 30 MHz

van Veen/Bergervoet system: more sensitive, faster and cheaper than previous test methods to CISPR Publication 16

New standards: CISPR 15, CISPR 16-1 Amd 1, CISPR 11/12.97

Normal setup (photo 39533-7)

Test setup with reduced height (photo 39533-6)

Brief description

Test method to CISPR16-1 Amd 1 for electric lighting equipment to CISPR 15 and for induction sources to CISPR11

- Fully automatic measurement of the magnetic field strength in the X, Y and Z planes of a centrally placed EUT

Main features

- Automatic control with Software ES-K1 from test receivers or manual remote control from optional Control Unit BG020
- Loop system suitable for mobile use; can be folded in one plane
- Wooden pedestals (100 kg load capacity) for various installation heights available
- Neither EUT nor loop need to be turned during the measurement
- The effect of the shielded room on the test result is considerably reduced
- Ambient interference is strongly suppressed in open-area measurements
- The antenna is factory-calibrated with the Calibration Dipole R&S HM020Z3 placed at the antenna center, which is available to the user for recalibration

Specifications in brief

Frequency range	9 kHz to 30 MHz
Loops	switchable between X, Y and Z planes
Transducer factor of current probe	0 dB, referred to 1 S
RF connector	N female, 50 Ω
Dimensions (W x H x D); weight	
Loops set up, normal mode	2.49 m x 2.57 m x 2.07 m; 45 kg
Loops set up, reduced height	2.49 m x 2.09 m x 2.07 m
Transport crate	2.68 m x 2.32 m x 0.57 m
Basic Pedestal R&S HM020Z1	0.9 m x 1 m x 0.9 m; 40 kg
Adapter Pedestal R&S HM020Z2	0.9 m x max. 0.5 m x 0.9 m; 30 kg

Ordering information

Triple-Loop Antenna	R&S HM020	4023.4508.02
Extras		
Control Unit	R&S BG020	4024.1002.02
Basic Pedestal	R&S HM020Z1	4023.5504.02
Adapter Pedestal	R&S HM020Z2	4023.5604.02
Calibration Dipole	R&S HM020Z3	4023.5704.02
Control Cable	R&S EZ-14 (included)	1026.5341.05

Active Antennas R&S AM524, R&S HM525

Active Antenna System

R&S AM524: 100 Hz to 1 GHz

Active H-Field Test Antenna R&S

HM525: 100 Hz to 30 MHz

R&S AM524 (photo 40442)

R&S HM525 (photo 43082)

Brief description

For measuring unwanted, compromising emissions, antennas are required which allow detection of extremely low-level signals. Active Antennas R&S AM524 and R&S HM525 are able to measure signals with a level 10 dB to 20 dB lower than that of signals that can be measured with conventional EMC test antennas. Therefore they are mainly used in anechoic chambers.

Equipment supplied

R&S AM524 consists of three antennas (R&S HE525, R&S HE526 and R&S HE527) with the appropriate junction units, a basic unit with power supply, transit case and support. R&S HM525 requires the same peripheral devices as R&S AM524.

Specifications in brief

Sensitivity at 1 Hz bandwidth				
Frequency	**R&S HE525**	**R&S HE526**	**R&S HE527**	**R&S HM525**
100 Hz	0 dB(µV/m)			18 dB(µA/m)
1 kHz	–18 dB(µV/m)			–22 dB(µA/m)
10 kHz	–35 dB(µV/m)			–50 dB(µA/m)
100 kHz	–43 dB(µV/m)			–68 dB(µA/m)
1 MHz	–48 dB(µV/m)			–88 dB(µA/m)
10 MHz	–49 dB(µV/m)			–93 dB(µA/m)
30 MHz	–51 dB(µV/m)	–49 dB(µV/m)		–92 dB(µA/m)
100 MHz		–54 dB(µV/m)		
200 MHz		–48 dB(µV/m)	–49 dB(µV/m)	
300 MHz			–54 dB(µV/m)	
400 MHz			–48 dB(µV/m)	
500 MHz			–49 dB(µV/m)	
1000 MHz			–54 dB(µV/m)	

Ordering information

Active Antenna System	R&S AM524	4015.7001.02
consisting of		
Active Rod Antenna	R&S HE525	4015.7101.02
Active Dipole Antenna	R&S HE526	4015.7501.02
Active Dipole Antenna	R&S HE527	4015.8008.02
Junction Unit for R&S HE525	R&S GX525	4015.9256.02
R&S HE526	R&S GX526	4015.9504.02
R&S HE527	R&S GX527	4015.9756.02
Basic Unit with power supply	R&S KK524	4015.9004.02
Transit Case	R&S ZR524K	4015.8508.02
Support for R&S HE526 and HE527	R&S AM524-Z1	4036.0506.02
Active H-Field Test Antenna	R&S HM525	4031.0508.02
Support for H-Field Test Antenna	R&S HM525-Z1	4036.1402.02
Control Unit	R&S GS525	4035.5004.02

Shielded, Calibrated Magnetic Field Pickup Coil R&S HZ-10

5 Hz to 10 MHz

Measurement of magnetic field strengths to relevant standards

R&S HZ-10 with (right) and without (left) spacing plate (photo 40877)

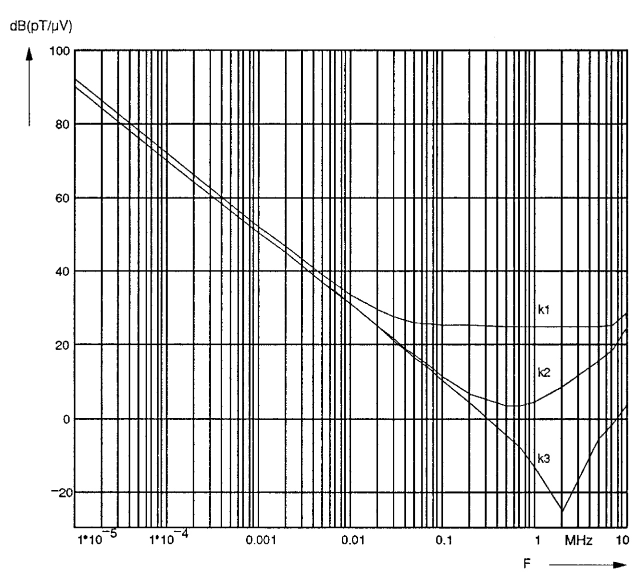
Brief description

The shielded and individually calibrated Magnetic Field Pickup Coil R&S HZ-10 allows magnetic field strengths in the frequency range from 20 Hz to 200 kHz to be measured in line with commercial and military standards MIL-STD-461/462, DEF STAN 59-61, GAM-EG 13, VG 95377 Part 13 and EN55103-1.

These standards give limits for the magnetic flux density in the frequency range from 30 Hz to 50 kHz or 200 kHz and prescribe an electrostatically shielded coil with a defined number of turns for measuring the magnetic flux density. The coil comes with a calibration certificate for the range from 5 Hz to 10 MHz.

Main features

- Built to MIL-STD-461A and 462D
- Individually calibrated
- Shielded twin-wire connection
- Spacing plate 7 cm (MIL-STD-461, DEF-STAN 59-41) and 5 cm (VG standard)
- Isolated coil with shielded twin-wire connection to avoid galvanic surface currents induced in the shielding
- ¼" thread for mounting on a camera tripod



Antenna factors in dB(pT/µV) measured and calculated by calibration: antenna factor k1 with 50 Ω, k2 with 600 Ω and k3 with 1 MΩ; k2 and k3 valid up to 100 kHz (above 100 kHz approximate values only)

Specifications in brief

Frequency range	5 Hz to 10 MHz
Antenna factor	see diagram (calibration certificate supplied with coil)
Coil	
Diameter	133 mm
Number of turns	36
Type of wire	7-41, litz wire
Resistance	10 Ω
Inductance	415 µH
Connector	Twinax female
Dimensions (W x H x D); weight	142 mm x 178 mm x 29 mm; 260 g

Ordering information

Shielded, Calibrated Magnetic Field Pickup Coil	R&S HZ-10	0816.2511.02
Extras		
RF Connecting Cable balanced/unbalanced, 0.2 m, Twinax/BNC connector	R&S EZ-19	1052.2630.02

E and H Near-Field Probe Sets R&S HZ-11, R&S HZ-14

R&S HZ-11 (photo 43417-2)

R&S HZ-14 (photo 43441-2)

R&S HZ-11: 100 kHz to 2 GHz

R&S HZ-14: 9 kHz to 1 GHz

Diagnostic tools for solving EMC problems

Brief description

The near-field probe sets can be used in conjunction with test receivers, spectrum analyzers or oscilloscopes to determine electromagnetic emissions of any type. Their main applications is in the diagnosis of emissions from printed circuit boards, cables and leakage spots in shielded enclosures. The passive probes can be used for a local susceptibility test.

Probe Set R&S HZ-11 is for a qualitative, Probe Set R&S HZ-14 for a quantitative analysis. The probe sets come in a handy transit case.

Equipment supplied, characteristics

Probe Set R&S HZ-11 comprises:
- three passive H-field probes
- two passive E-field probes
- one probe extension and
- one preamplifier with built-in battery and battery charger

The H-field probes are small (diameter of 1 cm, 3 cm and 6 cm) electrically shielded loop antennas with directional pattern; the E-field probes, shaped as rod and spherical probes, are for omnidirectional reception of the interference source.

Probe Set R&S HZ-14 comprises:
- two passive H-field probes (9 kHz to 30 MHz and 30 MHz to 1 GHz)
- one active E-field probe (9 kHz to 1 GHz)
- one 30 dB preamplifier for the H-field probe (can be powered from all Rohde&Schwarz test receivers and spectrum analyzers)
- a test jig for testing the H-field probes and simplified normalization of H-field measurements with the aid of a tracking generator and normalization functions provided in spectrum analyzers

Specifications in brief

R&S HZ-11

Type of probe	Measurement of	E- or H-field rejection	1st resonant frequency
Loop 6 cm	H-field	41 dB	790 MHz
Loop 3 cm	H-field	29 dB	1.5 GHz
Loop 1 cm	H-field	11 dB	2.3 GHz
Sphere 3.6 cm	E-field	30 dB	>1 GHz
Rod 6 mm	E-field	30 dB	>2 GHz

Gain of broadband preamplifier

100 kHz	1 MHz	100 MHz	1 GHz	2 GHz	3 GHz
35 dB	38 dB	39 dB	33 dB	26 dB	14 dB

Noise figure at 500 MHz	3.5 dB typ.
Saturated output level at 100 MHz	12 dBm typ.
1 dB compression point at 100 MHz	8 dBm typ.

R&S HZ-14	9 kHz to 1 GHz
H-field probe, max. input power	≤30 MHz: 0.5 W >30 MHz: 0.25 W
VSWR (f >30 MHz)	<2
E-field probe	
Frequency response	3 dB
Sensitivity	13 mV/V
Connectors	SMA female
Preamplifier	9 kHz to 1 GHz
Gain	30 ±2 dB (1 dB typ.)
Input/output	BNC female/N male
Impedance, VSWR	50 Ω, <2
Powering	10 V ±0.1 V, <100 mA
DC connector	LEMO

Ordering information

E and H Near-Field Probe Set		
with power supply 220 V	R&S HZ-11	0816.2770.04
with power supply 110 V	R&S HZ-11	0816.2770.05
E and H Near-Field Probe Set	R&S HZ-14	1026.7744.02

Precision Halfwave Dipole Sets R&S HZ-12, R&S HZ-13

R&S HZ-13 (photo 40784)

R&S HZ-12 (photo 40786)

R&S HZ-12: 30 MHz to 300 MHz

R&S HZ-13: 300 MHz to 1 GHz

Test standards for antenna calibration and test-site attenuation measurements

Brief description

Antenna calibration

Tunable halfwave dipoles are used for the calibration of VHF-UHF broadband antennas, which have their advantages in practical use but whose characteristics cannot be strictly calculated.

Test-site attenuation measurements

Halfwave dipoles are the only tool for checking reference sites used for antenna calibration to ANSI C63.5. They are also used for checking anechoic chamber test sites.

Characteristics

The dipoles contain balance-to-unbalance transformers and attenuators. The attenuation between the dipole connectors and the 50 Ω connector is about 10 dB. Two closely linked dipoles provide an attenuation of about 20 dB. This value can be very accurately measured with a network analyzer. The sum of the two antenna factors $2k_e$ (it is only the sum that is of significance for the test-site validation) can thus be precisely calculated:

$2\ k_e = 20\ \text{dB} + 2 \times 1.64\ \text{dB}$
$+ 2 \times 20 \log (2\ \pi/\lambda)\ \text{dB}$
1.64 dB = voltage transformation
$2\ \pi/\lambda$ = antenna factor of $\lambda/2$ dipole

Equipment supplied

Each dipole set comes in a transit case to protect the dipole rods. The dipole supports are fitted with flanges suitable for mounting on Rohde & Schwarz antenna masts. The manual supplied with the dipole sets contains the attenuation values of the dipole set and a table for height-dependent correction of the antenna factors above a conductive ground plane.

Specifications in brief

Frequency range	
R&S HZ-12	30 MHz to 300 MHz
R&S HZ-13	300 MHz to 1000 MHz
Power attenuation of dipole pair (closely coupled)	20 dB (calibration curve supplied with set)
Antenna factor	
R&S HZ-12	7.5 dB to 27.6 dB (proportional to f)
R&S HZ-13	27.4 dB to 38 dB (proportional to f)

Ordering information

Precision Halfwave Dipole Set	R&S HZ-12	0816.2870.02
	R&S HZ-13	0816.2940.02

Active Receiving Dipoles R&S HE202, R&S HE302

R&S HE202 (photo 43529)

R&S HE302 (photo 43518)

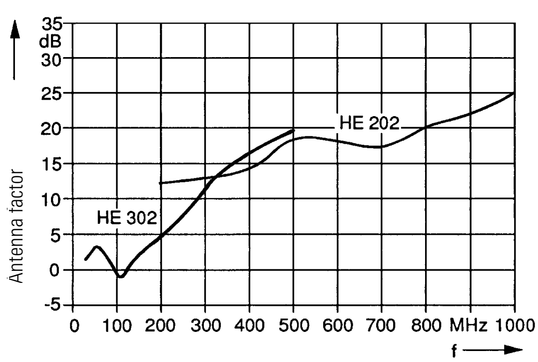
Brief description

Despite their extremely large bandwidth, R&S HE202 and R&S HE302 feature a field-strength sensitivity that is in the entire frequency range comparable to that of antennas with smaller bandwidth and considerably larger dimensions.

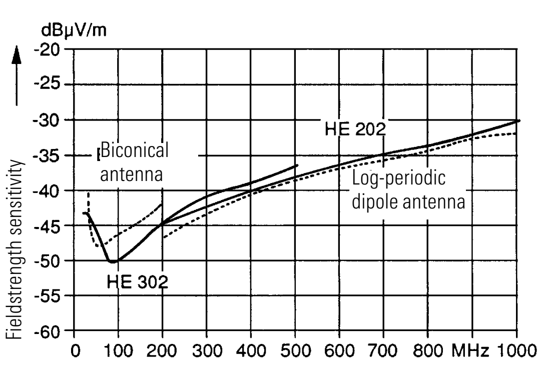
The degree of nonlinear distortion in the test system is important for signal field strength and interference field-strength measurements in shielded rooms. With 1-dB compression, for example, the Active Receiving Dipole R&S HE 302 is in the linear range for field strengths up to 5 V/m at 20 MHz and up to 8 V/m at 500 MHz. At frequencies below 20 MHz the maximum field strength increases by 40 dB per decade thanks to the reactive components in the input circuit.

Main features

- Extremely small size
- High sensitivity
- Wide frequency range
- High immunity to nonlinear distortion, comparable to passive antennas in conjunction with high-grade preamplifier
- High immunity to nearby lightning strikes
- Shock- and vibration-resistant



Antenna factor as a function of frequency



Field-strength sensitivity of R&S HE 202, R&S HE 302 compared to that of passive antennas with a receiver noise figure of 10 dB

Specifications in brief

		R&S HE202	R&S HE302
Frequency range		200 to 1000 MHz	20 to 500 MHz
Polarization		linear	linear
Connector		N female, 50 Ω	N female, 50 Ω
VSWR		<2.5	<2.5
Electronic gain		5 dB to 9 dB	–11 dB to +8 dB
Practical gain		7 dB to 11 dB	–9 dB to +10 dB
Directivity		2 dB average	2 dB average
Antenna factor and field-strength sensitivity		see diagrams	see diagrams
Noise figure		200 MHz: 6 dB 1000 MHz: 7 dB	20 MHz: 28 dB 500 MHz: 9 dB
Intercept point	2nd order	>55 dBm	>60 dBm
	3rd order	>30 dBm	>30 dBm
Power supply (from Power Supply Unit IN115), DC voltage		18 V to 30 V, via RF cable	
		200 mA	170 mA
Dimensions (L x H)		512 mm x 238 mm	1 m x 240 mm
Weight		2.1 kg	2.5 kg

Ordering information

Active Receiving Dipoles	R&S HE202	0630.0310.0x
	R&S HE302	0644.1114.0x

(x = 2: for monitoring; x = 3: calibrated to ANSI C63.5)

Extras		
Mast Adapter	R&S HE202 Z1	0649.7510.02
RF Cable	R&S HE202 Z2	0649.7785.02
Antenna Adapter	R&S AM524Z2	4036.0658.02
Calibration at Delivery	R&S HE202, R&S HE302	0758.3109.23

HF Antennas

Loop Antenna R&S HFH 2-Z2

Broadband active loop antenna for measuring the magnetic field-strength components

Photo 28024

Inductive Probe R&S HFH 2-Z4

Inductive probe for the assessment of the magnetic field-strength components

Photo 28826

Rod Antenna R&S HFH 2-Z6

Broadband active rod antenna for measuring the electrical component of radiated EMI in test setups to MIL-STD-461/462 and similar MIL standards

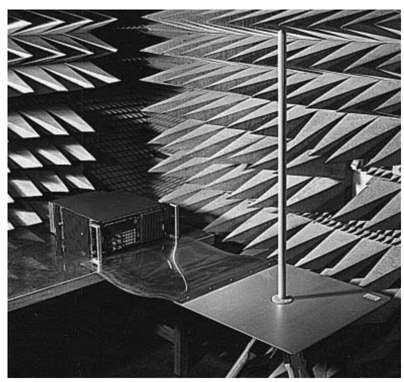


Photo 36487-1

Power Supply R&S HZ-9

Photo 38647

Power supply for feeding the active Antennas R&S HFH 2-Z1/Z2/Z6 if these antennas cannot be powered from the test receiver

Specifications in brief: HZ-9

Output voltages	±10 V ±0.5 %
Min. current load	100 mA
DC connector	12-contact Tuchel female
AC supply	100 V to 240 V, –15/+10%
Dimensions (W x H x D)	125 mm x 70 mm x 188 mm
Weight	1.5 kg

Ordering information R&S HZ-9

Power Supply for Active Antennas R&S HZ-9 0816.1015.02

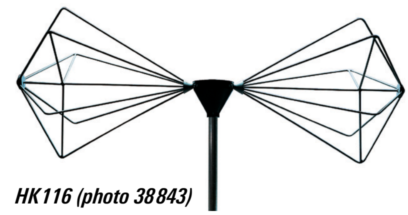
Specifications in brief

	Loop Antenna R&S HFH 2-Z2	**Inductive Probe R&S HFH 2-Z4**	**Rod Antenna R&S HFH 2-Z6**
Frequency range	9 kHz to 30 MHz	100 kHz to 30 MHz	9 kHz to 30 MHz
Antenna factor k, referred to 1/m	20 dB (E field)	80 dB (E field)	10/20 dB, selectable
Accuracy	1 dB	6 dB	1 dB
Measurement range (IF bandw. 200 Hz, AV ind.)			
Lower limit, frequency-dependent	9 kHz to 1 MHz: +40 to +10 dB(μV/m) 1 to 30 MHz: +10 to +5 dB(μV/m)	50 dB(μV/m) (≈0 dB(μA/m))	+15 to –18 dB(μV/m)
Upper limit	140 dB(μV/m)	>190 dB(μV/m) (≈140 dB(μA/m)	140 dB(μV/m) 130 dB(μV/m) (k = 10 dB)
Connectors			
RF	BNC female, 50 Ω	BNC male, 50 Ω	BNC female, 50 Ω
Supply and coding (antenna factor)	12-contact Tuchel female	12-contact Tuchel male	12-contact Tuchel female
Length of connecting cables	10 m	1 m	10 m
Current drain (±10 V)	<40 mA	—	<45 mA
Dimensions	loop dia.: 590 mm	outer dia.: 50 mm height: 20 mm	base: 60 x 60 mm rod height: 1000 mm
Weight	in transit case, without cable: 12 kg	with cable: 0.3 kg	without cable: 5 kg
Order No.	0335.4711.52	0338.3016.52	0837.1866.54

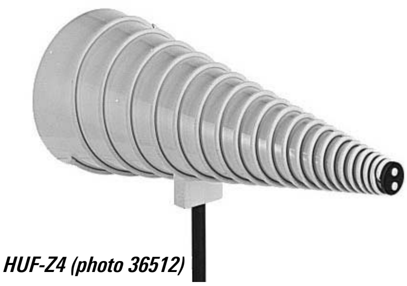
VHF, UHF and SHF Antennas

Biconical Antenna R&S HK116, Log Periodic Antennas R&S HL223, HL023A1, HL025 and HL040, High-gain Log. Per. Antenna R&S HL046

R&S HL025 (photo 33011-2)



HK116 (photo 38843)



HUF-Z4 (photo 36512)

Brief description

These linearly polarized antennas are used for EMI and EMS measurements in line with commercial and military standards. Depending on frequency and type of antenna, maximum field-strength values between 10 V/m and 300 V/m can be achieved. The use of Conical Log Spiral Antenna HUF-Z4 with circular polarization is limited to measurements in line with MIL-STD-461 A to C.

HL046 with option R&S HL046-P (photo 43285)

R&S HL223 (R&S HL023A1 on page 117) (photo 38841)

Specifications in brief

	R&S HK116	**R&S HL223**	**R&S HL023 A1**	**R&S HL040**	**R&S HL025**	**R&S HUF-Z4**
Frequency range	20 MHz to 300 MHz	0.2 GHz to 1.3 GHz	0.08 GHz to 1.3 GHz	0.4 GHz to 3 GHz	1 GHz to 18 GHz	0.2 GHz to 1 GHz
Antenna factor k	21 dB to 8 dB	10 dB to 26 dB	4 dB to 25 dB	17 dB to 33 dB	22 dB to 47 dB	17.5 to 27 dB
Power-handling capacity	70 W	1500 W to 600 W	700 W to 230 W	50 W	5 W	100 W
Max. field strength	10 V/m to 40 V/m	300 V/m	150 V/m to 200 V/m	50 V/m to 100 V/m	40 V/m	10 V/m to 50 V/m
VSWR	2.5 typ.	1.6 typ. (<2)	2 typ. (<2.5)	2 typ. (<2.5)	<2.5	<3
Connector/nominal impedance	N female/50 Ω	N female/50 Ω	N female/50 Ω	N female/50 Ω	SMA female	N female/50 Ω
Weight	3 kg 2 kg		7.7 kg	2.8 kg	0.7 kg	7.7 kg
Order No.	4000.7752.02	4001.5501.02	0577.8017.02	4035.8755.02	0671.5317.02	0837.2210.52

Specifications in brief HL046

Frequency range	80 to 1300 MHz
Polarization	linear
Polarization isolation	20 dB typ.
Front-to-back ratio	>20 dB typ.
VSWR	<2
Max. input power (T_{amb} = +40 °C)	
80 MHz	1000 W + 100% AM
500 MHz	500 W + 100% AM
1000 MHz	300 W + 100% AM
1300 MHz	250 W + 100% AM
Gain	>7 dBi
RF connector	N female, 50 Ω
Dimensions (W × H × L)	
without trolley (in m)	0.85 × 1.57 × 1.75
with trolley (in m)	0.86 × 1.9 (variable up to 2.6 m) × 1.85
Weight without/with trolley	12.5 kg/22.5 kg

Ordering information HL046

High-gain Log. Per. Antenna	R&S HL046	4040.8708.02
Extras		
Pneumatic Control	R&S HL046-P	4053.1694.02
Pedestal, movable	R&S HL046Z1	4061.0106.02

ULTRALOG R&S HL562

30 MHz to 3000 MHz

EMI and EMS measurements

in an extremely wide frequency range

HL562 with option HL562Z1 (photo 43317)

Brief description

The ULTRALOG antenna combines the characteristics of a biconical and a log-periodic antenna. The ULTRALOG antenna is mainly used for measuring emissions in the broad frequency range from 30 MHz to 3 GHz without change of the antenna. Symmetry and matching (VSWR) of the ULTRALOG allow its use in EMS measurements where field strengths of 10 V/m or higher are required.

The log-periodic part of the antenna is V-shaped in order to increase the system sensitivity in particular from 500 MHz to 1 GHz. Unlike with conventional designs, this gain-increasing measure brings about the compact size of the ULTRALOG.

Special features

- Only one antenna required to cover wide frequency range
- Selectable polarization plane
- Suitable for EMS measurements with high field strengths
- Gain increase at high frequencies
- Compact size
- Individual calibration (ANSI C63.5 and DIN 45003)

Specifications

Frequency range	30 MHz to 3000 MHz
Polarization	linear
Polarization isolation	>20 dB (acc. to CISPR16-1)
Nominal impedance	50 Ω
VSWR	<2 typ.
Max. input power (T_{amb} = +40 °C)	
30 MHz	150 W + 100% AM
80 MHz	300 W + 100% AM
250 MHz	500 W + 100% AM
1000 MHz	280 W + 100% AM
3000 MHz	180 W + 100% AM
Gain	8 dBi typ. from 200 MHz
RF connector	N female
Class of application	laboratory
Dimensions (W × H × L)	approx. 0.60 m × 1.65 m × 1.68 m
Weight	approx. 5 kg

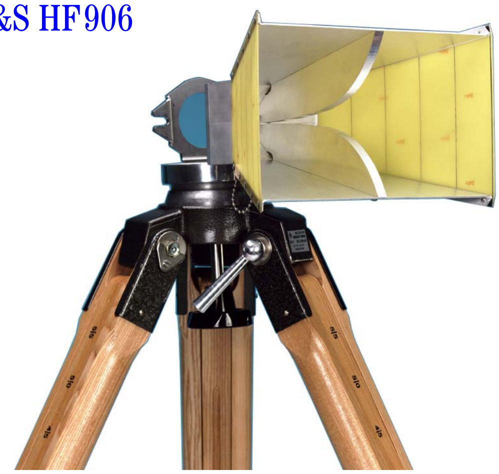
Ordering information

ULTRALOG	R&S HL562	4041.3000.02
Extra		
Tripod, movable	R&S HL562Z1	4041.3900.02

Double-Ridged Waveguide Horn Antenna R&S HF906

1 GHz to 18 GHz

Broadband directional antenna, preferably for use in EMI measurements



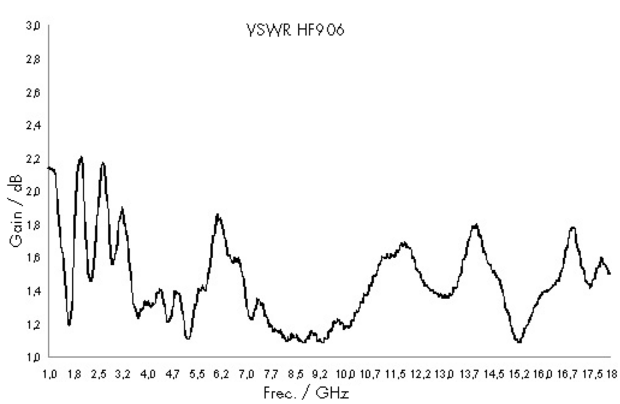
R&S HF906 with optional Wooden Tripod HZ-1 (photo 43268-3)

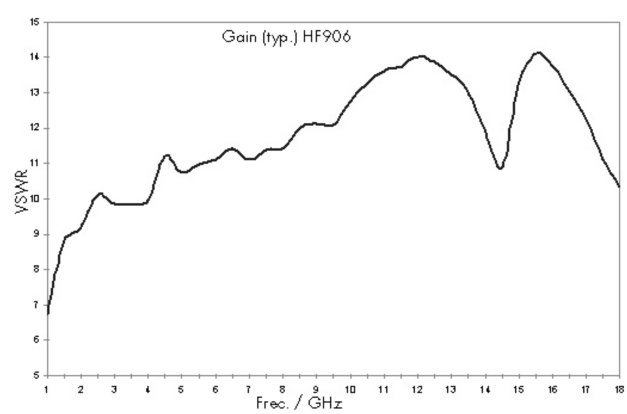
Brief description

The Double-Ridged Waveguide Horn Antenna R&S HF906 with linear polarization is a broadband compact transmitting and receiving antenna for the frequency range from 1 GHz to 18 GHz. The calibrated antenna is ideal for use in EMI measurements. High gain and low VSWR allow the generation of high field-strength levels without any significant return loss as well as the measurement of weak signals. The principle of the exponential double-ridged waveguide makes for the wide frequency range from 1 GHz to 18 GHz of the Antenna R&S HF906 despite its small dimensions. The gain increases with the frequency. The horn antenna requires little space and is easy to handle. The use of an N connector allows easy adaptation to existing units as well as high input power. The antenna is made of aluminium and tinned GRP boards to keep its weight low.

Main features

- Wide frequency range
- High gain
- Input power up to 300 CW/500 W PEP





Specifications

Frequency range	1 to 18 GHz
Polarization	linear
Nominal impedance	50 Ω
VSWR	<1.5 typ.
Max. input power	300 W CW/500 PEP
Gain	7 to 14 dB typ. (see diagram)
Connector	N female
Operating temperature	0 to +50 °C
Dimensions (L × W × H)	290 mm × 250 mm × 160 mm
Weight	1.5 kg

Ordering information

Double-Ridged Waveguide Horn Antenna	R&S HF906	4044.4507.02
Extra		
Wooden Tripod	R&S HZ-1	0837.2310.02

Broadband Dipole R&S HUF-Z1

The antenna complies with CISPR16-1. The antenna factor k is nearly constant in the range 25 MHz to 80 MHz; a factor of 15 dB or 20 dB can be selected.

Specifications in brief

Frequency range	20 MHz to 80 MHz
Connector	N female
Nominal impedance	50 Ω
VSWR	
for k = 15 dB	<2
for k = 20 dB	<1.3
Antenna factor k	
for k = 15 dB	
20 MHz to 25 MHz	22.5 dB to 15 dB
25 MHz to 80 MHz	15 dB
for k = 20 dB	
20 MHz to 25 MHz	27.5 dB to 20 dB
25 MHz to 80 MHz	20 dB
Dipole length	1.77 m
Folded size	0.9 m x 0.13 m dia.
Weight	2.5 kg
Order No.	0358.0512.52

R&S HUF-Z1 (photo 33925-1)

Mast and Tripod R&S HFU-Z

Brief description

The mast consists of three epoxy glass laminate tubes, a swivel arm holder and an antenna carrier. Guy ropes and pegs are supplied with the mast. The receiving antenna can be positioned at a height between 1 m and 5 m. Azimuth and polarization plane can be chosen as desired; the elevation angle can be varied by a maximum of ±30°.

Specifications in brief

Dimensions (folded)	
Mast	length: 1.65 m
Tripod	length: 0.9 m dia.: 0.22 m
Transport weight	
Mast	36 kg (with crate)
Tripod	9 kg

Ordering information

Mast	R&S HFU-Z	0100.1120.02
Tripod	R&S HFU-Z	0100.1114.02

Mast and Tripod R&S HFU-Z with Antenna R&S HL023A1 (photo 29359-1)

Wooden Tripod R&S HZ-1

Brief description

This tripod supports the Antennas R&S HFH2-Z6, R&S HK116, R&S HL223 and R&S HUF-Z4.

- Light-metal universal ball joint tiltable all round up to 25°; lockable in any position
- Antenna holder with captive ¼" screw
- Each two-section tripod leg extensible between 830 mm and 1360 mm

Specifications in brief

Length, collapsed	910 mm
Weight	6.5 kg

Ordering information

Wooden Tripod R&S HZ-1	0837.2310.02

V-Networks R&S ESH2-Z5, R&S ESH3-Z5, R&S ESH3-Z6

Interference measurements on AC-powered loads: models -Z5 for remote-control via Rohde & Schwarz EMI test receivers, insertion loss calibrated to ANSI C63.4

Main features

- AC voltage supply to EUT
- Isolation of test circuit from line interference
- Standardized load impedance
- Defined feed of interference voltage produced by EUT to EMI test receiver

Brief description R&S ESH2-Z5

Four-line V-network (50 µH + 5 Ω) shunted by 50 Ω in line with VDE0876 and CISPR16-1. It uses air-core inductances and contains an artificial hand as well as a PE simulating network that can be bypassed. A built-in fan with its own

R&S ESH2-Z5 (photo 35326)

AC supply provides automatically controlled or permanent cooling, as required.

Brief description R&S ESH3-Z5

Two-line V-network (50 µH + 5 Ω) shunted by 50 Ω in line with VDE0876 and CISPR16-1. It uses air-core inductances and contains an artificial hand as well as a PE simulating network that can be bypassed. The compact design and low weight make the R&S ESH 3-Z5 an ideal choice for frequently varying applications.

R&S ESH3-Z5 (photo 35760)

Brief description R&S ESH3-Z6

R&S ESH3-Z6 is a single-phase V-network (5 µH + 1 Ω) shunted by 50 Ω complying with the requirements of VDE 0876 Part 1 (onboard power supply systems), CISPR Publ. 16 (low-impedance power supplies) as well as MIL-STD-462 Notice 3, MIL-I-6181D, MIL-I-16910C, MIL-E-55301, DEF-STAN 59-41 and DO 160 in the frequency range 100 kHz to 200 MHz.

R&S ESH3-Z6 (photo 35913)

Specifications in brief

	R&S ESH2-Z5	**R&S ESH3-Z5**	**R&S ESH3-Z6**
Frequency range	9 kHz to 30 MHz	9 kHz to 30 MHz	0.1 MHz to 200 MHz
Impedance accuracy	±20%	±20%	±20%
Continuous current	4 x 25 A	2 x 10 A	100 A (150 A to T_{amb} = 35 °C)
Max. short-time current	4 x 50 A (2 min)	2 x 16 A (30 min)	500 A (30 s)
Max. AC supply voltage	250 V rms	250 V rms	250 V rms; 600 V DC
Max. AC supply frequency	63 Hz	63 Hz	440 Hz
AC supply input connector	4 x 32 A (Cekon male) European male for fan	earthing-contact type male with 1.8-m cable	screw terminal M8
AC supply connector for EUT	4 x 32 A (Cekon female) 2 x 16 A (earthing-contact type female)	earthing-contact type female	screw terminal M8, reference ground to metallic ground plate
RF output to test receiver	BNC female	BNC female	N male
Remote-control input from test receiver	50-contact Amphenol female	9-contact Cannon female	–
Input for artificial hand	two 4 mm jacks	4 mm jack	–
Dimensions (H x B x T)	492 mm x 294 mm x 603 mm	219 mm x 147 mm x 350 mm	122 mm x 128 mm x 322 mm
Weight	26 kg	5.5 kg	1.9 kg

Ordering information

V-Network	0338.5219.53	0831.5518.52	0836.5016.52
Extras			
Control cable to test receiver R&S ESxI/ESIx	R&S EZ-5 (0816.0625.02) (10 m)	R&S EZ-4, 0816.0560.02 (3 m) or R&S EZ-6, 0816.0683.02 (10 m)	–
Control cable to test receiver R&S ESCS/ESPI	R&S EZ-13 (1026.5293.02)	R&S EZ-14 (1026.5341.02	

200-A Four-Line V-Network R&S ENV4200

150 kHz to 30 MHz

For RFI voltage measurements at high currents

Photo 42885

Brief description

Four-Line V-Network R&S ENV4200 is used for measuring RFI voltages on AC supply connections of EUTs carrying very high currents.

It uses air-core inductances and contains an artificial hand. R&S ENV4200 satisfies the requirements of CISPR 16-1, VDE 0876 and ANSI C 63.4 for V-networks with an impedance of 50 µH || 50 Ω in the frequency range 150 kHz to 30 MHz.

CISPR 16-1 specifies two types of V-networks for the frequency range 150 kHz to 30 MHz: one with an impedance of 50 µH || 50 Ω and another with an impedance of (50 µH + 5 W) || 50 Ω. V-Network R&S ENV4200 corresponds to type 1.

The maximum attainable current of the V-network is limited by the voltage drop at the standardized inductances (CISPR 16-1 prescribes the voltage drop at 5% of the AC supply voltage) and by unavoidable heat losses.

Main features

- ◆ V-network to CISPR, EN, VDE, ANSI
- ◆ Impedance 50 µH || 50 Ω
- ◆ Artificial hand
- ◆ Continuous current up to 4 x 200 A
- ◆ Air-core design
- ◆ Remote control with TTL levels
- ◆ Calibrated to CISPR/A/201/CDV and ANSI C63.4

Specifications in brief

Frequency range	150 kHz to 30 MHz
Impedance characteristic of V-network	50 µH || 50 Ω
Error limits (to CISPR 16-1)	±20%
Test path (to EUT)	
Max. permissible continuous current	4 x 100 A with fans switched off 4 x 200 A with fans switched on
Operating time derated	at higher currents
DC resistance per path	6.7 mΩ typ.
AC supply frequency range	0 to 63 Hz
Max. permissible AC supply voltage	260 V/450 V
Test path (to test receiver)	
Pulse limiter	to 150 dBµV (built-in)
Voltage attenuation between EUT and test receiver	10 dB (built-in attenuator pad)
Cooling	with 4 built-in fans
Connectors	
EUT connectors	knob for 15 mm terminals
Ground	screw terminal M8
Reference ground	uninsulated busbars
RF connector	BNC female
Remote control	25-pin Cannon female
General data	
Rated temperature range	+5°C to +40°C
Storage temperature range	–30°C to +70°C
Dimensions (W x H x D); weight	450 mm x 315 mm x 670 mm; 43 kg

Ordering information

Four-Line V-Network	R&S ENV4200	1107.2387.02
Extras		
25-wire remote control cable for control by Test Receivers of		
ESxS Series: control cable 3 m	R&S EZ-21	1107.2087.03
control cable 10 m	R&S EZ-21	1107.2087.10
2 required for shielded room		
EBxI Series: control cable 3 m	R&S EZ-22	1107.2235.03
(Combination with R&S EZ-21 required for shielded chamber)		

Coupling Networks R&S ENY

for EMI emission and immunity tests on unshielded symmetrical telecommunication ports

New

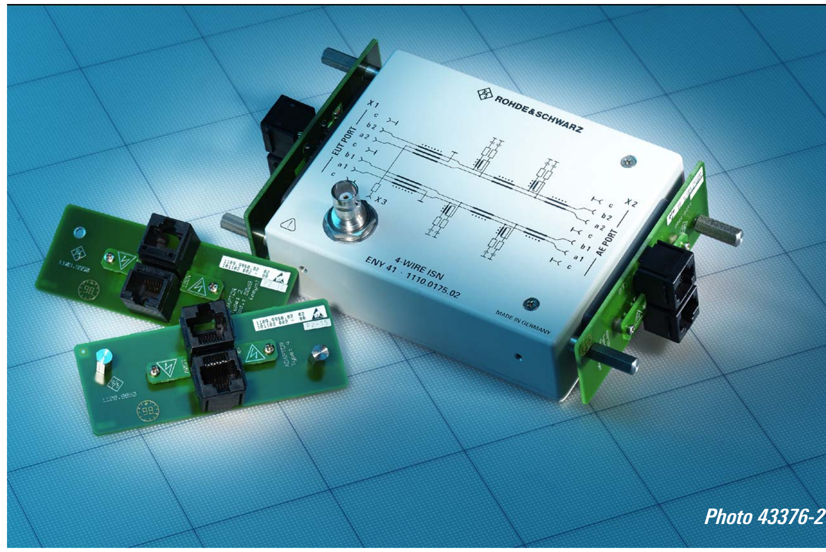


Photo 43376-2

Brief description

Coupling Networks R&S ENY22 and R&S ENY41 have been designed to measure the asymmetrical (common-mode) RFI voltage of unshielded symmetrical telecommunication ports of EUTs in the frequency range 150 kHz to 30 MHz according to CISPR22, 1997/EN55022, 1998. In these product standards, this type of coupling networks is referred to as ISN (impedance stabilization network), whereas in basic standards they are called AAN (asymmetrical artificial network) or Y-network (CISPR16) or CDN (coupling/decoupling network, IEC61000-4-6). In addition to emission measurements, R&S ENY22 and R&S ENY41 also enable immunity testing of the above-mentioned EUTs in the frequency range 150 kHz to 80 MHz according to CISPR24, 1997/EN55024, 1998 and IEC61000-4-6. They meet the requirements of CISPR22/1997.

Main features

- Four-wire and double two-wire networks (ISNs)
- Conducted emission measurements to CISPR22/1997 and EN55022/1998 (150 kHz to 30 MHz)
- Conducted immunity measurements to CISPR24 and EN55024 (150 kHz to 80 MHz)
- Adapter sets to meet LCL requirements (LCL: 50 dB, 60 dB and 80 dB) and various telecommunication standards
- High transfer bandwidth for useful signal (100 MHz)

The table gives an overview of available RJ45 adapter sets. The four types I through IV are available for the four-wire ISN R&S ENY41. For the double two-wire ISN, type V is available. For the latter, pins 3, 4 and 5, 6 are connected in parallel. In addition, there is an adapter set for user-selectable wiring (type VI).

Interface standard	Usual connectors		Pin configuration of RJ45 connector								Type
	RJ45		8	7	6	5	4	3	2	1	
		RJ11		6	5	4	3	2	1		
Deutsche Telekom		X			a	W	E	b			I
Deutsche Telekom V_{PN}, $V_{P0/E}$		X			a			b			V
Siemens	X				E	b	a	W			I
Siemens V_{PN}, $V_{P0/E}$	X					b	a				V
US-Norm	X				W	b	a	E			I
Token Ring	X				RX	TX	TX	RX			I
10Base T	X				RX			RX	TX	TX	II
100Base T	X				RX			RX	TX	TX	II
ATM	X		X	X					X	X	III
FDDI	X		X	X					X	X	III
ISDN basic rate access	X				X	X	X	X			I
ISDN primary rate access 2048 kbit/s	X					X	X		X	X	IV
ISDN primary rate access 1544 kbit/s	X					X	X		X	X	IV

Coupling Networks ENY

Description

R&S ENY22 comprises two separate two-wire networks with two receiver ports in one box, whereas R&S ENY41 includes one four-wire network.

R&S ENY22 and R&S ENY41 terminate the interface of the EUT with 150 Ω (asymmetrical or common-mode impedance) and couple the asymmetrical impedance to the test receiver with a voltage-division factor of approx. 10 dB. The useful symmetrical (differential-mode) signal passes through the network almost unattenuated with a bandwidth of up to 100 MHz (measured for a symmetrical impedance of 100 Ω). At the same time the coupling network decouples the test circuit from interference effects (RFI voltage, impedance) at the AE (auxiliary equipment) port.

ISN Functional Test Set R&S ENYBS incl. 2 baluns R&S ENYB21 and one Set of ISN test boards (photo 43150-1)

Specifications

Frequency range			
Emission measurements	150 kHz to 30 MHz		
Immunity measurements	150 kHz to 80 MHz		
Asymmetrical impedance			
Impedance in range 0.15 MHz to 30 MHz	150 Ω ± 20 Ω		
Phase angle in range 0.15 MHz to 30 MHz	0 ± 20°		
Impedance in range 150 kHz to 80 MHz	150 Ω ±40 Ω		
Voltage-division factor			
in asymm. circuit In range 150 kHz to 30 MHz	10 dB ±1 dB typ. (calibration data supplied[1])		
Transfer bandwidth (3 dB)			
in symm. circuit	>100 MHz (for 100 Ω source and load impedances)		
Differential-mode rejection (LCL)	80 dB adapter	60 dB adapter	50 dB adapter
150 kHz to 1.5 MHz	(80 – 3) dB	(60 ±3) dB	(50 ±3) dB
1.5 MHz to 30 MHz	>(80 to 55) dB –3 dB	(60 to 35) dB ±3 dB	(50 to 25) dB ±3 dB
Decoupling attenuation			
150 kHz to 1.5 MHz	>35 dB to 55 dB (linear increase with log frequency)		
1.5 MHz to 80 MHz	>55 dB		
Maximum values			
Max. permitted RF input voltage	17 V		
Max. permitted DC and low-frequency AC voltage between symm. line and ground	160 V		
Max. DC current (phantom current)	150 mA (current on each individual wire of one pair or on different pairs)		
Connectors			
Output to receiver/ input from signal generator	BNC connectors		
EUT and auxiliary equipment (AE)	adapters with screw terminals and RJ45 connectors		
General data			
Nominal temperature range	+ 5°C to 40°C		
Storage temperature range	–40°C to + 70°C		
Dimensions of basic unit	144 mm x 95 mm x 52 mm		
Dimensions of unit with adapters	168 mm x 96 mm x 52 mm		
Weight of unit with adapters	535 g		
Weight of carrying case with basic adapter set	2170 g		
Weight of option R&S ENY4-B1	330 g		

Order designation

Double Two-Wire ISN to CISPR22	R&S ENY22	1109.9508.02
Four-Wire ISN to CISPR22	R&S ENY41	1110.0175.02
Option for R&S ENY41: 3 additional RJ45 adapter sets	R&S ENY4-B1	1109.9950.02
Accessories supplied	plastic carrying case with foam material, calibration data	
Extra		
ISN Functional Test Set	ENBY	1110.0298.03

[1] The calibration data contain: asymmetrical impedance and phase, voltage-division factor, differential-mode rejection ratio.

Antenna Impedance Converter R&S EZ-12

Photo 43427-3

R&S EZ-12 is a broadband matching unit for test receivers and spectrum analyzers with low-impedance inputs. It is used for high-impedance measurements of interference voltage at the feedpoint of a vehicle-mounted antenna in the long-, medium- and shortwave bands to VDE 0879 Part 2 and CISPR25. For measurements in the VHF-FM range antenna signal can be switched to a separate 50-Ω input.

- ◆ Flat frequency response
- ◆ High sensitivity
- ◆ High overload capability
- ◆ Rugged metal case

The R&S EZ-12 can be directly powered from Rohde & Schwarz test receivers or spectrum analyzers. Should this not be possible, it is recommended to use Power Supply HZ-9 (see page 113).

Specifications in brief

Frequency range	150 kHz to 30 MHz (120 MHz)
RF input	DIN 415845
Input impedance	>100 kΩ, <10 pF (at 1 MHz)
Gain factor for	
direct input to antenna connector	0 ±1 dB
correction factor –10 dB	+11.2 dB
AM output	BNC female, 50 Ω
VSWR	≤1.4
FM output, remote controlled	BNC female, 50 Ω
Noise voltage at output (input terminated with antenna simulator; average detector, BW = 10 kHz)	
f >150 kHz	<–5 dBµV
f >500 kHz	<–7 dBµV
1 dB compression point	>107 dBµV
Power supply	+10 V ±0.1 V
Current drain	<50 mA
Dimensions (W x H x D)	125 mm x 110 mm x 40 mm
Weight	0.6 kg

Ordering information

Antenna Impedance Converter	R&S EZ-12	1026.4800.03

Current Probe R&S EZ-17

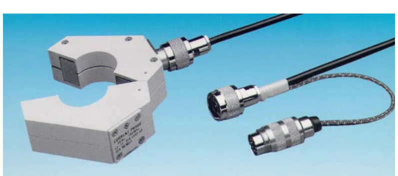


Photo 39784-2

Model 02 with its extremely flat frequency response is optimal for current measurements as well as for measuring shielding effectiveness. Due to its high load capacity, model 03 is recommended for EMS measurements (bulk current injection). Thanks to their high magnetic overload capacity, these two models can be employed on power lines with currents up to 300 A without having an adverse effect on the measurement results.

Current Probes R&S EZ-17 comply with the following standards:

- ◆ CISPR 16-1 and VDE 0876 Part 1 for measurement of RFI currents
- ◆ MIL-STD-461 CE 01 and CE 03
- ◆ VG 95373 Part 20, VG 95377 Part 14
- ◆ DEF-STAN 59-41 DCE 01 and 02
- ◆ RTCA/DO-160 C

Main features

- ◆ High sensitivity and overload capability
- ◆ Wide frequency range
- ◆ High load capacity for DC and AC current (300 A)
- ◆ Small dimensions in spite of large inner diameter (30 mm)
- ◆ Simple clamping thanks to spring-loaded mechanism

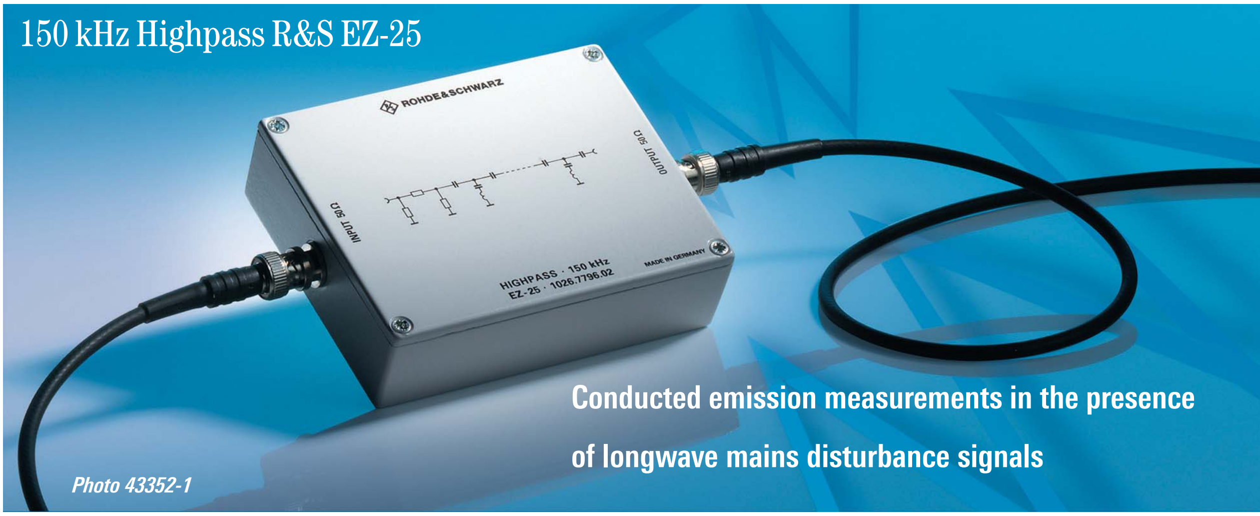
Specifications in brief

	Model 02	**Model 03**
Frequency range	20 Hz to 100 MHz	20 Hz to 100 MHz
Range with constant transducer factor (–3 dB)	1 MHz to 100 MHz	2 MHz to 100 MHz
Transducer factor reduced by 20 dB/decade in range	20 Hz to 1 MHz	20 Hz to 2 MHz
RF connector	N female	N female
Source impedance	≤0.8 Ω	≤1 Ω
Transfer impedance Z_T in range with constant transducer factor	3.16 Ω	7.1 Ω
Transducer factor k in range with flat frequency response	–10 dB	–17 dB
Load capacity (RF current measurement)		
Max. DC current or peak AC current	300 A (f <1 kHz)	300 A (f <1 kHz)
Max. RF current (rms)	2 A (f >1 MHz)	1 A (f >1 MHz)
Load capacity (EMS measurement)		
Max. power at RF connector	–	10 W (f >1 MHz)

Ordering information

Current Probe	R&S EZ-17	0816.2063.02	0816.2063.03

150 kHz Highpass R&S EZ-25



Conducted emission measurements in the presence of longwave mains disturbance signals

Photo 43352-1

Brief description

During signal transmission in low-voltage networks below 150 kHz, very high voltage levels may occur near the upper limit frequency of 148.5 kHz. This has been described in EN 50065-1. The selectivity of the CISPR measuring receiver specified in CISPR 16-1 can cause problems in the conformance of the equipment with the RFI voltage limits at 150 kHz. For this reason a highpass for an amendment of CISPR 16-1 has been defined in CISPR/A/244/FDIS, which can be used in front of the CISPR measuring receiver in order to improve the selectivity and so to achieve the values defined in part 1 of EN 50065, without affecting the passband of the measuring receiver.

Problems with high interfering voltages in the range below 150 kHz can also occur with EUTs, which are not involved with low-voltage signalling. Only very few EMC standards specify limits in the frequency range below 150 kHz. Therefore equipment manufacturers use suppression filters with extremely steep slopes to meet the requirements above 150 kHz. In these cases measuring receivers may be overloaded, entailing measurement errors in the frequency range above 150 kHz. Highpass R&S EZ-25 prevents this and allows exact measurements.

Main features

- Conducted emission measurements to EN 50065 Part 1
- Pass frequency range 150 kHz to 30 MHz
- Very steep slope acc. to CISPR16-1: 1999 (selectivity)
- Suitable for any CISPR measuring receiver
- Relative attenuation >50 dB below 130 kHz
- Built-in 10 dB attenuation pad for exact 50 Ω termination of the LISN
- High pulse energy capability (50 mWs)
- Calibrated response

Specifications

Passband	150 kHz to 30 MHz
Insertion loss in passband	9.5 dB to 11 dB (calibration data supplied)
Stopband	below 130 kHz
Minimum attenuation in stopband	60 dB
Attenuation in the transition region	
146 kHz	<12 dB
145 kHz	>12 dB
140 kHz	>24 dB
130 kHz	>60 dB
Maximum input voltage (continuous)	137 dBμV
Maximum impulse energy (50 μs)	50 mWs
Connectors	BNC female
Nominal temperature range	0 to + 40 °C
Dimensions (L x W x H)	144 mm x 95 mm x 34 mm
Weight	400 g

Ordering information

Highpass 150 kHz	R&S EZ-25	1026.7796.02
Accessories supplied	Short description with calibration data	

VHF Current Probe R&S ESV-Z1

Brief description

Current Probe R&S ESV-Z1is used for selective or broadband measurement of very small as well as of very large RF currents in electric lines. They are shielded against electrostatic effects and comply with CISPR16-1 and VDE0876.

Specifications in brief

Frequency range	20 MHz to 300 MHz
Measurement range (average indication)	–33 to +117 dBμA (IF bandwidth 7.5 kHz)
Transfer admittance $Y_t = I_{in}/V_{out}$	0.1 S
Transducer factor k = 20 log (Y_t/s)	–20 dB
Max. current (superimposed on RF current or peak AC current)	50 A
Max. diameter of conductor	13.5 mm
RF connector	N male, 50 Ω, 1 m
Coding connector (transducer factor)	12-contact Tuchel
Dimensions (dia./height)	55 mm/20 mm
Weight	130 g

Photo 28825

Ordering information

VHF Current Probe R&S ESV-Z1 0353.7019.02

Pulse Limiter R&S ESH3-Z2

Brief description

Pulse Limiter R&S ESH3-Z2, Attenuator R&S ESH2Z11
High RF input levels and high-energy interfering pulses generated on artificial mains networks when the DUT is switched on and off can damage the RF input circuits of test receivers.

Pulse Limiter R&S ESH3-Z2 limits and **Attenuator R&S ESH2Z11** reduces the interference level.

Specifications in brief

	R&S ESH3-Z2	**R&S ESH2Z11**
Frequency range	0 Hz to 30 MHz	0 Hz to 1500 MHz
Insertion loss	10 dB ±0.3 dB	–
f ≤500 MHz	–	20 dB ±0.25 dB
f ≤1000 MHz	–	20 dB ±0.5 dB
f ≤1500 MHz	–	20 dB ±1.5 dB
Frequency response	≤±0.3 dB	–
SWR with 50 Ω termination, input/output	≤1.06/≤1.25	–
Power-handling capacity in continuous mode	1 W	10 W
Pulse power-handling capacity	E=0.1 Ws (6 μs)	P=750 W (3 μs)
RF connectors	N (female/male), 50 Ω	N (female/male), 50 Ω
Dimensions (L x W x H or L x Ø)	94 mm x 25 mm x 25 mm	97 mm x 42 mm
Weight	120 g	150 g

Ordering information

Pulse Limiter	R&S ESH3-Z2	0357.8810.54
Attenuator	R&S ESH2Z11	0349.7518.52

R&S ESH2Z11

R&S ESH3-Z2

Probes R&S ESH2-Z2, R&S ESH2-Z3

R&S ESH2-Z3 (photo 34981)

Active Probe R&S ESH2-Z2
The active probe is used for measuring AC voltages on lines that do not carry AC supply voltage.

Passive Probe R&S ESH2-Z3
The passive probe is suitable for measuring RFI voltages (on AC supply lines) to CISPR16-1 and VDE0876.

Attenuator R&S ESH2-Z31
For checking the interference source impedance to VDE 0877, Part 1 and CISPR16-2

Specifications in brief

	R&S ESH2-Z2	**R&S ESH2-Z3**
Frequency range	9 kHz to 30 MHz	9 kHz to 30 MHz
Measurement range (average indication, IF bandwidth 200 Hz with Rohde&Schwarz Test Receivers)	−20 dBµV to +120 dBµV	+10 dBµV to +150 dBµV
Attenuation/error	10 dB/<1 dB	30 dB/−1 to +5 dB
Input impedance	118 kΩ ±5% ǀǀ 8 pF	1.5 kΩ ±2% ǀǀ 9 pF
Max. input voltage f <63 Hz	100 V	250 V
f <500 Hz	5 V	250 V
9 kHz to 30 MHz	3 V	30 V

Ordering information

Active or Passive Probe R&S ESH2-Zx	0299.7210.52	0299.7810.52
Attenuator R&S ESH2Z31	0827.6513.02	0827.6513.02
BNC Adapter URV-Z	0241.1110.02	0241.1110.02

RF Connecting Cables R&S HFU2-Z4, R&S HFU2-Z5

Low-loss cables for connecting antennas to test receivers. With this type of cable the outer sheath is filled with a special ferrite to reduce sheath currents.

Ordering information

RF Connecting Cable		
12 m	R&S HFU2-Z4	0252.0090.56

Feeder Cables R&S HZ-3, R&S HZ-4

Connecting cables with 12-contact Tuchel male/female connectors for remote feeding of active antennas from the test receiver or from Power Supply R&S HZ-9, page 113. The correction factor for automatic correction of unit and level display on the test receiver is also transmitted.

Ordering information

Feeder Cable		
3 m	R&S HZ-3	0837.3469.02
10 m	R&S HZ-4	0816.0519.02

From top to down: TV Test Receiver R&S EFA, MPEG2 Measurement Decoder and MPEG2 Measurement Generator DVG (photo 43704)

Contents of Chapter 3

DTV-Recorder Generator R&S DVRG

Recording and generation of digital video streams

Photo 43401-1

Brief description

R&S DVRG is a universal processing platform for digital video streams. It allows the record and play of MPEG2 transport streams. This is done either degradation free using the RAM when the transport stream is of limited length or directly using the hard disk. Minimum wear an tear can thus be achieved during continuous operation.

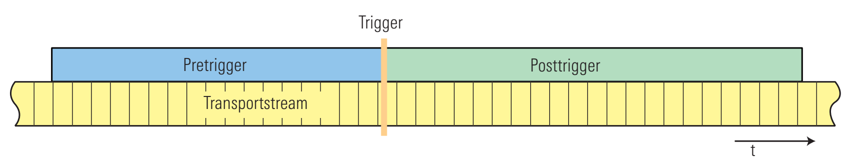
Main features

- Replay of recorded transport streams
- Endless and seamless MPEG2 generation
- Triggered recording for error analysis
- RAM or hard-disk based operation
- Large choice of test signals
- Compliant to ATSC and DVB
- Optional record and replay of uncompressed SDI video streams (to ITU-R BT. 601/656 or SMPTE 259M) at a data rate of 270 Mbit/s
- Embedded Windows NT platform
- HDTV Sequences optional
- Test card M streams optional
- Software options
- Stream Combiner™ for creating user-specific transport streams
- Quality Explorer™ for analyzing video elementary streams
- Easy and self-explanatory operation

Modes

Recording

A transport stream is first recorded in the RAM. If the volume of recorded data exceeds the available RAM capacity or if



The length of the pretrigger and posttrigger parts of a transport stream can be defined for a triggered recording with R&S DVRG

the transport stream is to be achieved, storage is in the form of a file on the hard disk in TRP format. For error analysis, recording can be controlled by means of an external trigger signal. The stored signal includes time sections of different lengths before and after the trigger event.

Replay of TRP files

Recorded transport streams can be replayed as often as required. The replay starts immediately after selecting the file with the data being buffered in the RAM. Any other data rate can be used for test purposes. In this mode, R&S DVRG supports files in TRP /TS format.

Replay of GTS files

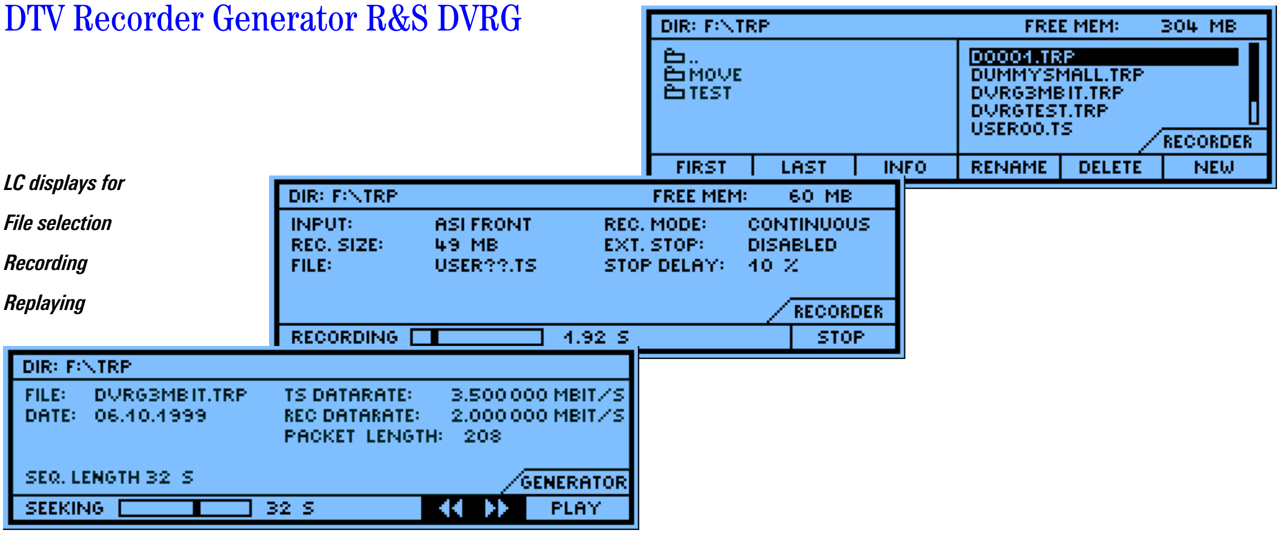
In this mode, transport stream files are replayed in an endless loop. The use of the GTS format provides discontinuity-free signal generation in an endless and seamless loop. During replay a jitter of up to ±10 ms with settable frequency and waveform can be superimposed on the PCR values (i.e. for stress tests of multiplexers and decoders).

Test signals

R&S DVRG produces a large number of predefined MPEG2 transport streams to the ATSC and DVB standards at a keystroke. The transport streams contain several elementary streams and consist of video, audio and other data (e.g. teletext or PRBS). Video streams with different data rates, formats, frame rates and contents are available.

The signal set comprises sequences with moving picture contents and some static test patterns. It includes known test patterns such as colour bar signals, zone plate, CCIR17/18/331, ITS1 to 4 and many others as well as the Rohde&Schwarz CODEC test pattern. Thanks to integrated test signals the analog outputs of a set-top box (or IRD) can be tested within seconds with the aid of a suitable video analyzer, e.g. VSA from Rohde&Schwarz. In

DTV Recorder Generator R&S DVRG



LC displays for
File selection
Recording
Replaying

addition, integrated moving picture elements allow visual checking of the decoder functionality.

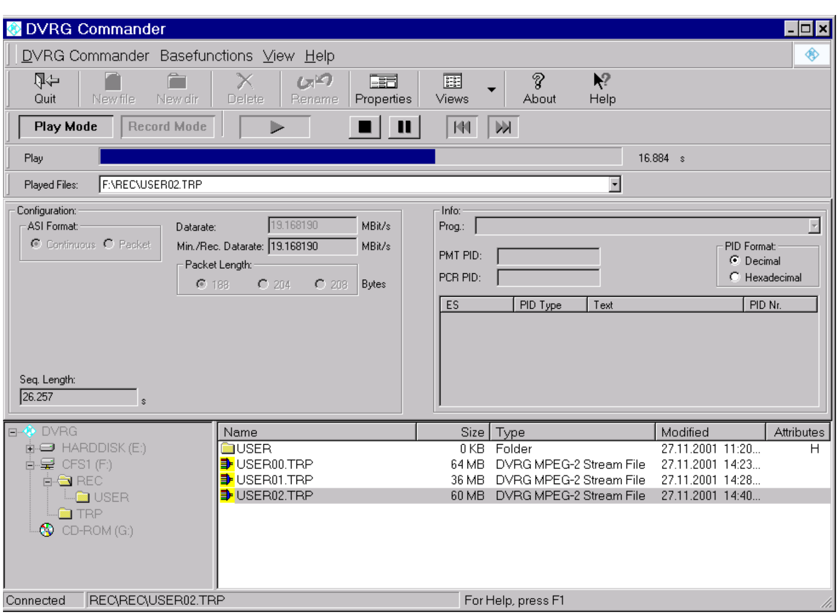
Audio data streams with different rates and frequencies contain the accompanying sound for the video sequences as well as special audio test signals.

Moreover, a large choice of further test signals is available: the option DV-HDTV provides test sequences for high-definition TV. Both DVB and ATSC formats are supported. Due to its versatility, this collection allows testing of diverse devices to practically all worldwide standards. Further test signals are provided by the option DV-TCM. This option enables special tests through transport streams with dynamically varying structure. The transport streams also contain a large number of elementary streams in different formats. The formats are partly changed even within a transport stream to enable easy testing of a large variety of decoder functions.

Applications

Thanks to its versatility, flexibility and wide range of options, R&S DVRG is the MPEG2 platform for a whole variety of applications:

- Development of set-top boxes and all other instruments that process digital TV signals to the MPEG2 standard
- Quality management by replaying standardized transport streams
- Production of digital TV components (e.g. set-top boxes, MPEG2 decoders and multiplexers)
- Substitution signal source for playout center, cable headend and satellite uplink or downlink
- Error analysis by recording a part of the transport stream either before or after an external trigger event



Windows user interface of R&S DVRG for local and remote mode

DTV Recorder Generator R&S DVRG

Specifications

The relevant data sheet is stored on the CD-ROM.
/DATASHEET/DVRG.PDF

Data sheet on CD-ROM

To get back here, please press ⇦ in the Acrobat Reader toolbar.

Ordering information

DTV Recorder Generator	R&S DVRG	2083.1302.02
Accessories supplied	power cable, operating manual	
Hardware options		
Additional hard disk internal, 36 GB	R&S DVRG-B2	2083.1919.02
SDI (ITU-R B.T. 601/656) Record&play	R&S DVRG-B4	2083.1931.02
CD-R R/W drive (DVD read only)	R&S DVRG-B5	2083.1948.02
SMPTE-310 Interface	R&S DVRG-B6	2083.1954.02
Software options		
Stream Combiner™ 1)	R&S DVG-B1	2068.9835.02
Quality Explorer™ 2)	R&S DVQ-B1	2079.7151.02
HDTV Sequences	R&S DV-HDTV	2085.7650.02
TestCard M Sequences	R&S DV-TCM	2085.7708.02
Extras		
Documentation of calibration test values	R&S DRG-DCV	2082.0409.21
19" Adapter (2 HU) for installation with handles (rackmount without handles on request)	R&S ZZA-211	1096.3260.00
Service manual		

1) See data sheet PD 0757.3611.

2) See data sheet PD 0757.5450.

HDTV Sequences
R&S DV-HDTV

Comprehensive collection of high-resolution transport and elementary streams

New

Brief description

The R&S DV-HDTV option from Rohde&Schwarz is a versatile combination of MPEG-2-coded streams for high-definition TV. Its versatility enables the testing of diverse units to almost all worldwide standards. In addition to several video formats for the European and American television, MPEG-coded and AC-3-coded audio data are supplied.

All video streams, with audio streams combined to transport streams, can be loaded to the R&S DVG and R&S DVRG from Rohde&Schwarz, and directly replayed. To combine individual transport streams with the Stream Combiner™ software, all the elementary streams used are stored individually on the CD-ROMs. This allows easy creation of customized MPEG-2-compliant transport streams.

The transport streams supplied are stored in the GTS format, which was developed by Rohde&Schwarz, and which allows endless, continuous and errorfree replay also at the transition between the beginning and the end of a stored sequence. The Stream Combiner™ software can also create transport streams in the GTS format.

Transport Streams PRK1080IGTS and PRK1080I_L.GTS

	PRK1080I.GTS	**PRK1080I_L.GTS**
TS ID:	5002 (0x138A)	5003 (0x138B)
Length:	240 videoframes (9.600 s)	720 videoframes (38.400 s)
Runs on:	☐DVG (20MByte)	☐DVG (20MByte)
	☒DVG (32MByte)	☐DVG (32MByte)
	☒DVRG	☒DVRG
Tables:	☒DVB	
	☐ATSC	
Transmission:	☐Satellite	
(description)	☒Cable	
	☐Terrestrial	

Program:
Program 1: Service_name: PARK MPEG
Program 2: Service_name: PARK AC-3

Video:

Park scene from the transport and elementary stream combination

MPEG-2 MP@HL Single stream shared by both programs (PID 0x0100)

Frames/s	Lines/picture	Pixels/line	Mbit/s	
☒25	☐480	☐704	☒16	☒Seamless at sequence end
☐29.97	☐720	☐1280		☒Scene cuts
☐50	☒1080	☒1920		☒Moving Picture
☐59.94				
☐24				
				☒One PES per videoframe

Audio:

Background noise
Program 1: MPEG-1 Layer 2 Stereo
Program 2: AC-3 (3/2 LFE)

ksample/s	kbit/s	PRK1080I.GTS	PRK1080I_L.GTS
☐32	☐192	☐Seamless at sequence end	☒Seamless at sequence end
☐44.1	☐256	☐Continuous tone	☐Continuous tone
☒48	☒384		

HDTV Sequences R&S DV-HDTV

Main features

- Large choice of transport streams compatible with DVB and ATSC
- All video streams also available as elementary streams for individual combination with Stream Combiner™ software
- Ready for use with DVRG or DVG
- Support of all customary video formats and frame rates
- Different audio formats: MPEG-1 Layer 2 and AC-3
- Endless replay with non-interrupting transition from sequence end to sequence start for video and audio in the event of replay by DVRG

Characteristics

Video and audio formats
The collection of transport and elementary streams comprises a variety of sequences. They are based on several test patterns and real film sequences. All video sequences are available as elementary streams in various resolutions and frame rates. They are complemented by audio signals in different formats, both in MPEG-1 Layer 2 and AC-3. The transport streams are designed to comply with the DVB and ATSC standards according to the formats of the video streams included. Furthermore, the transmission path (terrestrial, cable or satellite), defined by the transport stream, varies.

Frame examples taken from the transport and elementary stream collection

Specifications

Video formats supported

Frequency in Hz	Sampling	Number of lines	Number of columns
24	progressive	1080	1920
25	interlaced	1080	1920
50	progressive	720	1280
29	interlaced	1080	1920
59	progressive	720	1280
59	progressive	480	704

Audio formats supported	MPEG-1 Layer 2 and AC-3
Video contents	Fireworks Public park Shark and other fish in the aquarium HDTV test pattern Colour bars Horizontal ramp Horizontal frequency sweep
Sequence length	up to 32.032 seconds

Ordering information

HDTV Sequences for DVG and DVRG	R&S DV-HDTV	2085.7650.02
Transport Stream Upgrade on CD-ROM with special parallel cable for installation on DVG	R&S DVG-Z1	2069.0419.00
Stream Combiner™	R&S DVG-B1	2068.9835.02
MPEG-2 Measurement Generator	R&S DVG	2068.8600.03
DTV Recorder Generator	R&S DVRG	2083.1302.02

Test Card M Sequences R&S DV-TCM

Special transport stream collection for testing DTV receivers and decoders

New

Example from transport stream collection

Brief description

This option from Rohde&Schwarz enhances the wide choice of already available transport streams by a large number of special streams particularly designed for testing and development of DTV decoders and receivers. The transport streams provided by this option have been derived from the Test Card M libraries of Snell & Wilcox. They have been adapted by Rohde&Schwarz for endless[1], continuous and error-free replay by the R&S DVRG and R&S DVG, and allow simple and effective testing of standard as well as special DTV receiver and decoder functions without the need of any additional measuring equipment.

[1] Realtime calculation of all time-relevant parameters ensures error-free replay even at the transition from the start to the end of the stored sequence. This refers to the transport stream syntax as well as to the elementary streams.

Main features

- Large variety of DVB- and ATSC-specific transport streams
- Immediately ready for replay by MPEG-2 players R&S DVRG and R&S DVG
- Endless replay
- Comprehensive PSI, SI and PSIP data
- SDTV and HDTV test sequences
- MPEG-1 Layer II and AC-3 audio formats
- Testing of DVB- and ATSC-specific functions
- Testing of audio/video synchronism

Supported video and audio formats

All elementary video streams are encoded in 4:2:0 format.

DVB

Frequency[1]	Sampling	Number of columns	Number of lines
25	interlaced	720	576

Audio: MPEG-1 Layer II

ATSC

Frequency[1]	Sampling	Number of columns	Number of lines
29,97	interlaced	1920	1080
59,94	progressive	1280	720
29,97	interlaced	720	480
59,94	progressive	720	480

Audio: AC-3

[1] The repetition frequency refers to frames. In interlaced display mode, the field repetition frequency is twice the specified frame rate.

Ordering information

Test Card M Sequences[1]	R&S DV-TCM	2085.7708.02
Transport Stream Update on CD	R&S DVG-Z1	2069.0419.00
with special parallel cable for installation on R&S DVG		
MPEG-2 Measurement Generator	R&S DVG	2068.8600.03
DTV Recorder Generator	R&S DVRG	2083.1302.02

[1] If you order the option for MPEG players already supplied, please specify Serial No. and Type of the instrument on which the option is to be installed.

MPEG2 Measurement Generator R&S DVG

Large choice of digital TV test signals (525- and 625-line standard), endless MPEG2 sequence loop thanks to realtime updating of all time stamps

Photo 42480-3

Brief description

MPEG2 Measurement Generator R&S DVG is a universal generator for digital TV signals in the form of transport streams in line with the MPEG2 standard. The structure of these streams and the data reduction methods employed were developed and standardized by the Moving Picture Experts Group (MPEG) and the Digital Video Broadcasting (DVB) project.The transport stream contains several programs, each consisting of several substreams carrying video, audio and data signals.

R&S DVG generates in an endless loop a large variety of selectable MPEG2 transport streams with combined video, audio and data sequences as contents and is thus a favourably priced and compact alternative to expensive MPEG2 encoders with multiplexer and external standard generators.

Complementary to R&S DVG, MPEG2 Measurement Decoder DVMD is offered for realtime monitoring, analyzing and decoding of MPEG2 transport streams.

Main features

- Endless MPEG2 sequence loop: all the required time information is continuously updated during playback of the transport stream, and the signal is available without any interruption
- The output data rate can be varied as desired and thus adapted to the specifications of the transmission link or devices under test
- Thanks to the settable PID of the program elements, R&S DVG is ideal for use as a substitution signal source
- A built-in PCR (program clock reference) jitter generator is available for stress testing of decoder PLLs

The optional Stream Combiner™ software can be used to configure any new transport streams from the supplied or customer-specific elementary streams (ES) in addition to stored transport streams.

A PC card interface on the front panel allows the exchange of user-defined transport streams via a small exchangeable hard disk.

Applications

The digital data streams generated by R&S DVG are used as test signals for a variety of equipment employed on digital TV transmission links – from the studio to the domestic receiver. One field of application of R&S DVG therefore is in the development, production, quality management and servicing of equipment processing MPEG2-coded signals.

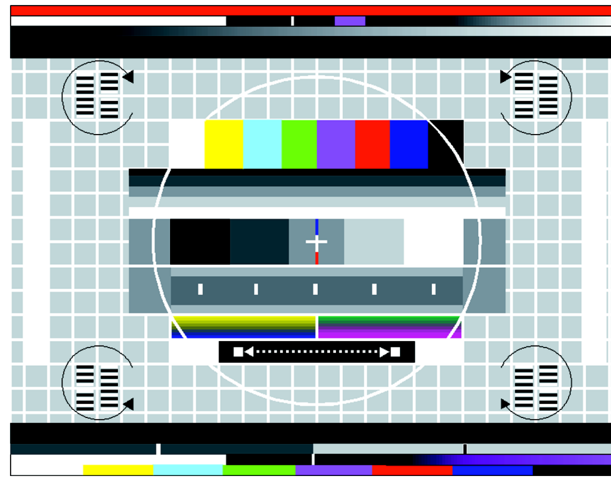
Further applications are in the field of signal distribution and transmission (e.g. cable headends), where the generator can be used as a substitution signal source.

Test signals

R&S DVG offers a variety of predefined MPEG2 transport streams which can be called at a keystroke. Video data streams of different contents and data rates are available. The set of signals stored comprises moving picture sequences as well as stationary test patterns. For fast testing of set-top boxes, i.e. integrated receiver decoders (IRT), R&S DVG provides the Rohde & Schwarz codec test pattern.

MPEG2 Measurement Generator R&S DVG

Thanks to integrated test signals in the upper and lower picture area and using a suitable video analyzer such as VSA, analog interfaces can be tested out within a few seconds. In addition, moving elements at the corners and in the center of the picture allow visual checking of the decoder functions. Audio data streams, which are also available at different data rates, comprise the sound component accompanying the video sequences as well as special audio test signals.



Rohde&Schwarz codec test pattern

Moreover, a large choice of further test signals is available: the option DV-HDTV provides test sequences for high-definition TV. Both DVB and ATSC formats are supported. Due to its versatility, this collection allows testing of diverse devices to practically all worldwide standards. Further test signals are provided by the option DV-TCM. This option enables special tests through transport streams with dynamically varying structure. The transport streams also contain a large number of elementary streams in different formats. The formats are partly changed even within a transport stream to enable easy testing of a large variety of decoder functions.

Specifications

The relevant data sheet is stored on the CD-ROM.
/DATASHEET/DVG.PDF

Data sheet on CD-ROM

To get back here, please press in the Acrobat Reader toolbar.

Ordering information

MPEG2 Measurement Generator	R&S DVG	2068.8600.03
Accessories supplied	power cable, operating manual, null modem cable	
Options		
Stream Combiner^{TM} Software	R&S DVG-B1	2068.9835.02
Calibration Data Documentation	R&S DVG-DCV	2082.0490.14
Transport Stream Update on CD-ROM with special parallel cable	R&S DVG-Z1	2069.0419.00
HDTV Sequences	R&S DV-HDTV	2085.7650.02
TestCard M Sequences	R&S DV-TCM	2085.7708.02
Extras		
19" Adapter (1 HU)	R&S ZZA-91	0396.4870.00
Service Manual		2069.0354.24

Stream Combiner™ R&S DVG-B1

Generating user-specific MPEG2 transport streams with the PC

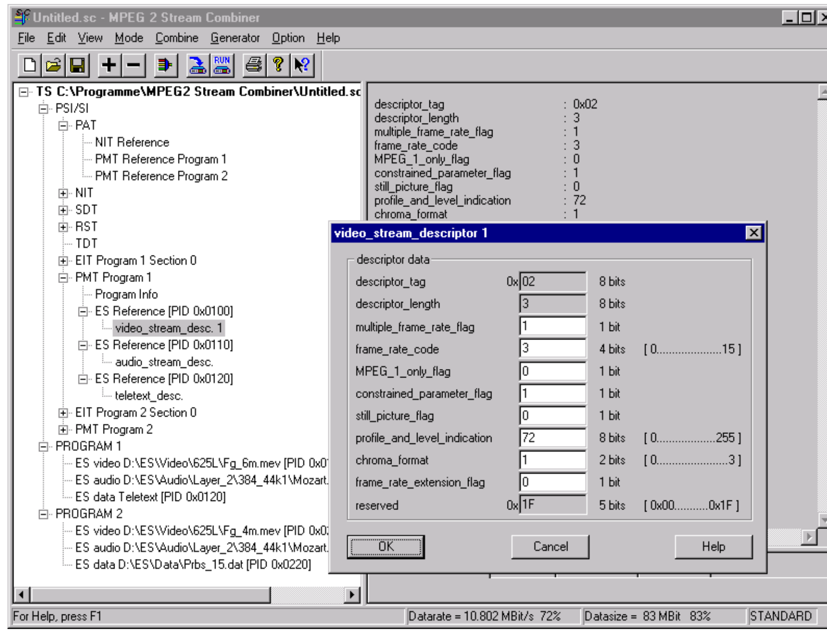


Fig. 1: Display of transport stream structure with information on individual elements

Brief description

Stream Combiner™ Software R&S DVG-B1 in conjunction with MPEG2 Generator R&S DVG allows user-specific transport streams to be generated. The software runs under Windows 9x/NT/2000 on any PC or laptop. The data are loaded into the R&S DVG via a parallel interface or a PC card hard disk. The user-friendly operating concept with integrated help function ensures fast and efficient working right from the start without any special knowledge of MPEG2 or DVB being required.

Main features

- Generation of user-specific transport streams
- Elementary stream library
- Insertion of external elementary stream files
- Editing PSI and SI tables as required
- Setting of defined nonconformal states
- Windows 9x/NT/2000/XP operating system

Defining a user-specific transport stream

A new transport stream can be defined very easily step by step with the Stream Combiner™. In the lefthand part of the program window (Fig. 1), all elements of the transport stream that have already been defined are represented as a tree structure. In the righthand part of the window, detailed information on the individual elements is displayed. The elements can be selected by means of a mouseclick.

Adding programs

In the first step, the user adds the desired number of programs (max. 6) to the transport stream. Stream Combiner™ automatically generates the required PSI tables, e.g. PAT and PMT, and represents these tables in the tree structure. The tables contain predefined default settings which can be changed as required.

Adding elementary streams

In the second step the desired elementary streams such as video, audio or data are added to the programs. Each program may contain up to 6 elementary streams. The software comes with a comprehensive elementary stream library from which the user can configure his specific transport stream. Stream Combiner ™ automatically updates the relevant PSI tables every time a new elementary stream is added.

Adding service information

In the third step, further SI and PSI tables (PAT, PMT, CAT, NIT, BAT, SDT, EIT, RST, TDT, TOT, ST, SIT, DIT) can be added to the transport stream. Each of these tables can be fully edited; the repetition rates can be set independently for each table.

Generating the transport stream data file for the R&S DVG

As a final step, Stream Combiner™ generates a transport stream data file for the MPEG2 Generator R&S DVG. The file can be transferred to the R&S DVG directly via cable. Alternatively, a PC card hard disk can be used. This is expedient if the generated transport stream is to be installed in several generators. R&S DVG generates the new transport stream in the same way as the preconfigured stored signals as an endless MPEG2 sequence with all time stamps being continuously updated.

Stream Combiner™ R&S DVG-B1

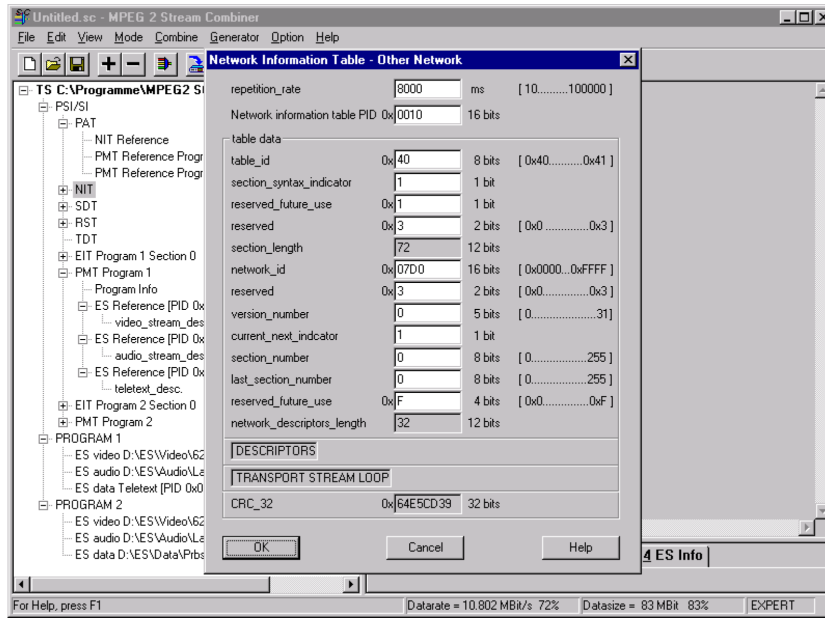


Fig. 2: Editing individual tables using the Network Information Table (NIT) as an example

Inserting external elementary streams (data files)

Besides the elementary streams from the library supplied, Stream Combiner™ allows external elementary streams (binary files to ISO/IEC 13818, MP@ML) to be inserted. Such files are offered by various suppliers on the Internet or on CD-ROMs (MPG, VID, M2V, MP2, AUD, M2A file extensions). Stream Combiner™ first checks whether the external file is suitable for integration, and then processes the file so that it can be inserted into the new transport stream. Thus it is ensured that the R&S DVG plays back the new transport stream as an endless MPEG2 loop.

With option DV-HDTV Rohde & Schwarz also offers special signals for high-resolution TV. All included video sequences are also available for simple integration with the Stream Combiner™ as an elementary stream.

Editing a user-specific transport stream

All transport streams generated with the Stream Combiner™ can subsequently be modified. This is possible for the elementary streams and for all tables of a transport stream. Editing can be performed after the respective file has been opened.

The Stream Combiner™ operates in the same mode as for generating a new transport stream, i.e. the tree structure and the contents of the tables are displayed. Any desired element can be modified, deleted from or added to the transport stream.

Generating defined nonconformal states

Stream Combiner™ offers various possibilities of integrating nonconformal states into a transport stream:

- Insertion of descriptors into tables for which they are not intended
- Insertion of wrong information into tables and descriptors
- Changing the repetition rate of tables
- Removing specific tables
- Introducing an offset between elementary stream clock (PTS, DTS) and PCR
- Switching off PCR, PTS and DTS updating at the end of a video/audio sequence

Specifications

The relevant data sheet is stored on the CD-ROM.
/DATASHEET/DVG-B1.PDF

Data sheet on CD-ROM

To get back here, please press ⬅ in the Acrobat Reader toolbar.

Ordering information

Stream Combiner™	R&S DVG-B1	2068.9835.02

Digital Video Quality Analyzer R&S DVQ

Getting the picture on picture quality

Photo 43318-3

Brief description

With Digital Video Quality Analyzer R&S DVQ the assessment of picture quality according to subjective criteria becomes an objective realtime measurement method. This method is based on the analysis of video data and can thus also be used where no reference video material is available.

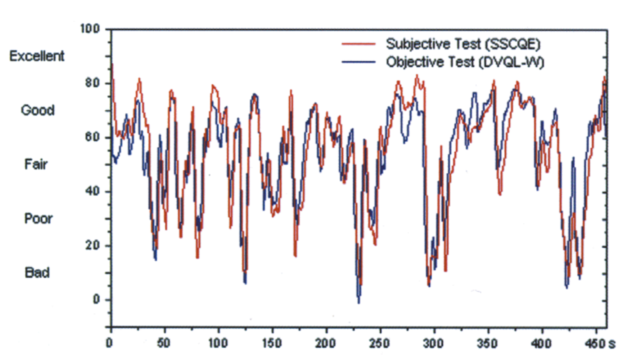
To this end, the optional PC software Quality Explorer™ is available, allowing complete display and analysis of all coding data as well as convenient remote control of R&S DVQ and display of the recorded quality data.

The increasing use of digital, data-compressed TV signals calls for monitoring and assessment of the picture quality. Picture quality assessment is very strongly influenced by the subjective perception of the human eye. R&S DVQ is a tool that ideally satisfies both requirements. It determines the picture quality in relation to digital compression and evaluates the results according to the subjective criteria of visual perception.

Applications
- Quality monitoring in distribution networks
- Program quality assessment
- Development, evaluation and setting of operational hardware
- Testing of set-top boxes

Main features

- Realtime measurement
- No reference signal required
- SSCQE scaling of quality levels
- Monitoring of picture freeze, picture and audio loss
- Recording of quality profile (long-term)
- ITU-R 601 and MPEG2 inputs
- Histogram representation of quality levels
- Internal event and error report and statistics
- Program decoding



Comparison of objective test results (R&S DVQL-W) and subjective quality assessments (SSCQE) for 480 s sample sequence

Characteristics

In addition to the analysis unit, R&S DVQ also has a built-in decoder for audio and video data in the format Mainprofile @ MainLevel and 4:2:2 Profile @ MainLevel. The program being analyzed is decoded and can simultaneously be viewed on a connected video monitor (CCVS or ITU-R 601 formats). The audio signals are available at the connectors both in analog and digital form (AES/EBU).

A MPEG2 transport stream usually contains several programs made up of video and audio data streams. For automatic monitoring of all programs, a scan mode is provided in R&S DVQ allowing all or selected programs to be successively analyzed for picture quality and interference over a selectable period of time.

R&S DVQ has a built-in 32 Mbit memory for transport stream data. Depending on the data rate of the video stream, the memory is sufficient for storing a video data sequence of approx. 5 s to 10 s. The sequence can be read out for in-depth analysis via one of the remote-control interfaces using for instance the Quality Explorer™.

For comparative quality measurements the quality analysis can simultaneously be carried out on two different signals. Quality analysis is carried out completely

Digital Video Quality Analyzer R&S DVQ

independently for each signal and the final result is formed from the differences found. There is no pixel comparison of two video data sources in this mode either.

Altogether 12 relay outputs which can be allocated to one or several (ORed) events are fitted as standard. The switching mode (active when open or closed) can be set separately for each relay. In addition to the data interfaces floating switching contacts are thus available for external signalling of failures and quality degradations.

Operation

R&S DVQ can be controlled manually via the keypad with fast-access keys for the main menus and softkeys for the submenus.

The displayed contents of the clearly arranged LCD is inserted into the decoded picture at the video output. With a recorder connected the quality ratings can be logged together with the associated picture contents.

Specifications

The relevant data sheet is stored on the CD-ROM.
/DATASHEET/DVQ.PDF

Data sheet on CD-ROM

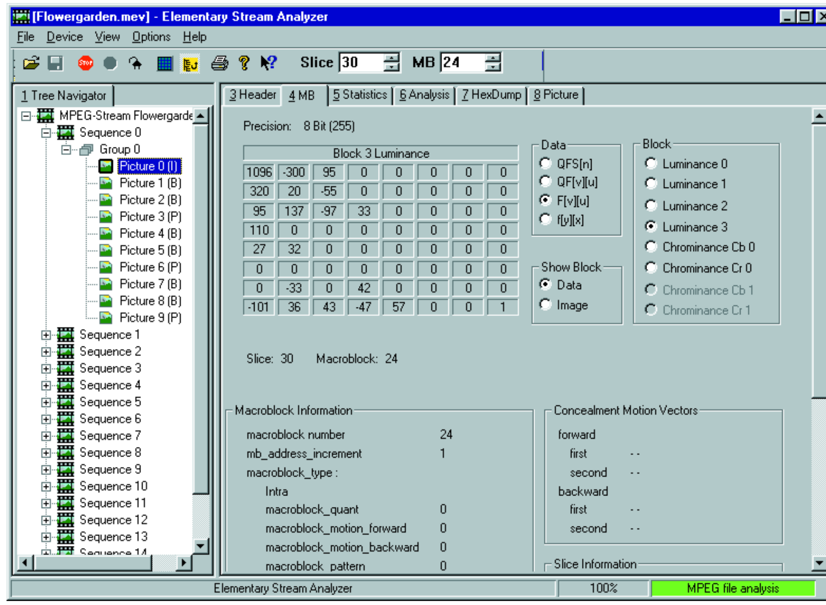
To get back here, please press ⇦ in the Acrobat Reader toolbar.

Ordering information

Digital Video Quality Analyzer	R&S DVQ	2079.6003.02
Accessories supplied	power cable, operating manual, audio adapter (Lemo-Triax to XLR), modem bypass cable	
Options		
Quality Explorer™ Software	R&S DVQ-B1	2079.7151.02
Calibration Data Documentation	R&S DVQ-DCV	2082.0490.20
Extras		
19" Rack Adapter (2 HU)	R&S ZZA-211	1096.3260.00
Service Manual		

Quality Explorer™ R&S DVQ-B1

Comprehensive quality and MPEG2 elementary stream analysis



Clear display of header information with Elementary Stream Analyzer, illustrated by picture header

Brief description

Quality Explorer™ R&S DVQ-B1 from Rohde&Schwarz is a software package that performs comprehensive analysis on MPEG2-coded transport streams. It can be used either on an external PC connected to R&S DVQ or fully independently of R&S DVQ for elementary stream analysis from data media (e.g. hard disk, CD-ROM).

R&S DVQ-B1 comprises two independent tools: The Quality Monitor reads the quality parameters provided by the Digital Video Quality Analyzer R&S DVQ in real time via the remote-control interface. It displays the quality levels graphically as a histogram. Archiving on data storage media is also possible.

The Elementary Stream Analyzer analyzes the content of MPEG2-coded video elementary streams. For this purpose R&S DVQ has a 32 Mbit internal buffer memory for the elementary stream to be analyzed. The elementary stream buffered in R&S DVQ can also be stored as a PC file.

Alternatively, elementary streams available in the form of PC files can be analyzed. Therefore, Quality Explorer™ can be used on other instrument platforms without the R&S DVQ.

Full remote control of R&S DVQ is provided by a library routine (DLL) supplied with the software and the Quality Monitor's user interface.

The software runs under Windows 9x or Windows NT/2000/XP on any PC or laptop connected to the R&S DVQ via an RS-232-C interface or network (10BaseT) interface. The easy-to-operate software, as well as the clear presentation of the analysis results in windows of variable size, ensure speed and success right from the start.

Specifications

Elementary Stream Analyzer

MPEG2 formats	
Profile	MP (main profile 4:2:0) 422P (4:2:2 profile)
Aspect ratios	any, e.g. 4:3, 14:9, 16:9
Picture formats	any SDTV & HDTV

System requirements

PC or laptop with Pentium processor (Pentium II with 266 MHz clock frequency recommended, min. Pentium I with 100 MHz), Windows 9x or Windows NT/2000/XP operating system, min. 16 Mbyte RAM (Windows NT: 32 Mbyte), required memory on hard disk approx. 20 Mbyte, 1 free serial RS-232-C interface (recommended data rate 115 kbit/s) or 1 free 10BaseT-network interface, CD-ROM drive, 1 parallel printer interface

Ordering information

Quality Explorer™	R&S DVQ-B1	2079.7151.02

Equipment supplied
CD-ROM with setup program, serial cable for connecting R&S DVQ to the PC, dongle for the parallel printer output of the PC, manual

Multichannel Digital Video Quality Analyzer R&S DVQM

Always in the picture about picture quality in all channels

New

Photo 43629-2

Brief description

The R&S DVQM is the multichannel version of the successful Digital Video Quality Analyzer R&S DVQ from Rohde&Schwarz. The R&S DVQM can combine the performance of up to twelve R&S DVQs. The resulting large variety of configurations allows the R&S DVQM to be optimally adapted to different requirement profiles.

For configuration of the individual analyzer boards and for readout of the measurement results, the R&S DVQM comes with the R&S DTV NetView PC software running under MS Windows. This software enables remote communication with all instruments via the Ethernet interface where the instruments are not used at the same place or there are major distances between the measuring instruments and the PC. The software can be individually adapted to different instrument configurations and provides a fast overview of the analysis results of all the instruments.

Video quality analysis is optionally available (R&S DVQM-B4) for the individual analyzer boards of the R&S DVQM.

Main features

- Simultaneous monitoring of up to 12 channels
- Optional monitoring of video quality with SSCQE scaling of quality levels
- No reference signal required
- 12 programmable alarm relay contacts per channel
- Selectable alarm thresholds
- SDI interface
- Video outputs: SDI and CCVS
- Compatible with DVB and ATSC
- Ethernet interface (TCP/IP-SNMP)
- MS Windows software for remote control
- Internal event and error report and statistics
- Optional decoding of CA programs

Possible configurations

The basic unit of the R&S DVQM comes with two analyzer boards. The instrument can accommodate another 10 boards. These may be analyzer boards for simultaneous monitoring of 12 channels, or descrambling boards for decoding of pay TV programs. Up to six scrambled programs can be monitored simultaneously (6 descrambling boards and 6 analyzer boards).

The analyzer boards can be inserted into any of the 12 slots, whereas the descrambling boards are subject to the following condition: they must be inserted into the slot immediately following the associated analyzer board. This means that slot 1 may not contain a descrambling board.

Analyzer boards with and without associated descrambling boards may be combined as desired. Altogether, up to 12 unscrambled or 6 scrambled programs can be analyzed simultaneously.

Analyzer board characteristics

Test parameters

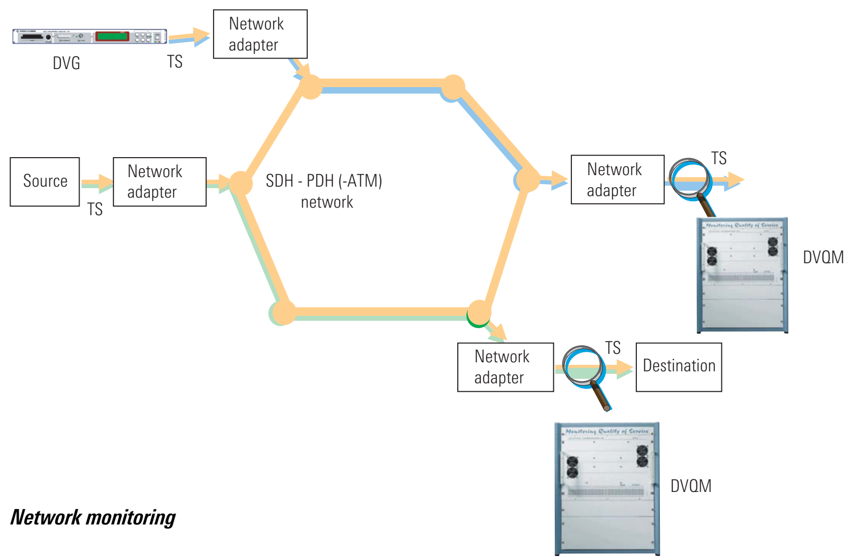
Each analyzer board can be used to monitor all the relevant parameters of the video and audio elementary streams of the selected program. Moreover, they determine whether a valid transport stream is present or whether there are failures. The hysteresis for the detection of transport streams or failures can be set by the user.

The video stream is checked for picture freeze and picture loss. The check is made using the threshold values for spatial and temporal activities as well as the period for which the threshold values have not been adhered to. All threshold values for the determination of picture freeze and picture loss can be set by the user.

The audio stream, if available (audio sync), is checked for its volume separately for the right and left channels. If the volume is below a certain threshold for a defined period, this indicates a sound loss. Minimum volume and maximum period can be set by the user. AC-3-coded

Multichannel Digital Video Quality Analyzer R&S DVQM

audio streams are also monitored in this way. For this purpose, the audio signal is downconverted to a stereo signal according to a method especially specified by Dolby so that this signal can be monitored in the described way. The R&S DVQM-B4 option allows additional continuous monitoring of the picture quality.



Network monitoring

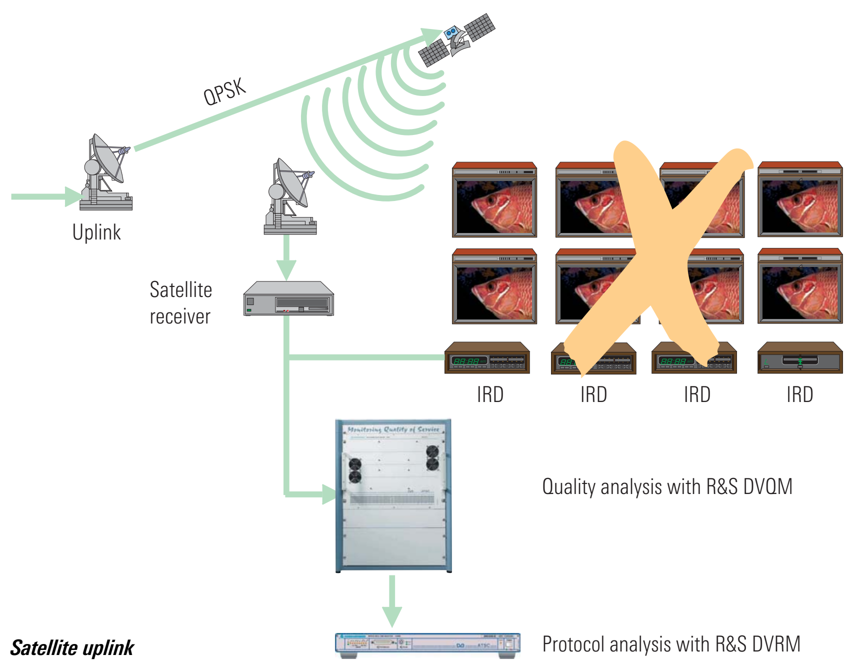
Applications

The unique combination of realtime capability and independence from a reference signal opens up a wide field of applications for the R&S DVQM. Long-term recording and evaluation of the quality parameters allows a quality assessment that is closer to reality than that of short standardized test sequences.

Quality monitoring in distribution networks

The R&S DVQM allows the picture quality to be monitored during program transmission and in realtime. Degradations in quality and failures can be recognized at an early stage so that remedial measures can be taken in time. Since the analysis method employed does not require any reference signals, the R&S DVQM is suitable for use wherever MPEG-2-coded video data is transmitted or received. The R&S DVQM can be used to document the picture quality versus time at the gateway between two different networks. This can, for example, be used as an evidence for the contractual performance of services.

The network compatibility of the R&S DVQM ensures optimum integration into monitoring systems.

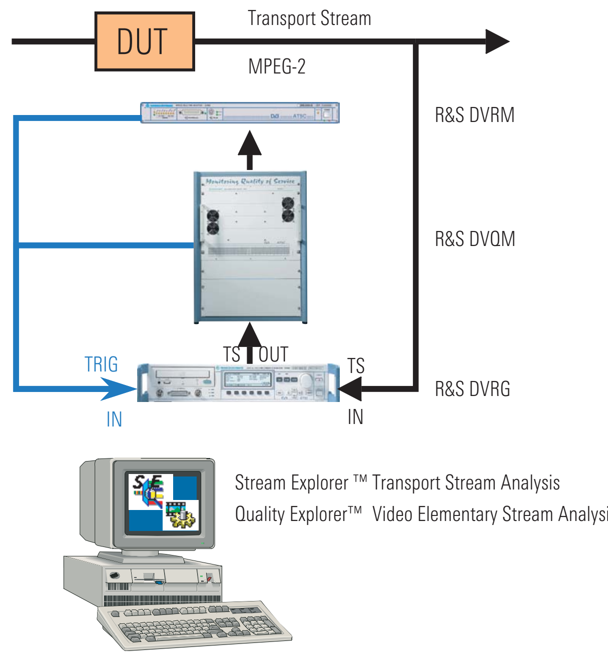


Satellite uplink

The R&S DVQM in conjunction with the DTV Recorder Generator DVRG (see DVRG data sheet PD 0757.5708) and, optionally, the Realtime Monitor DVRM (see DVRM data sheet PD 0757.5566) forms a complete monitoring system with recording capability even for very rare disturbances.

The relay outputs of the R&S DVQM and the DVRM are connected to the trigger input of the DVRG, whose elaborate trigger characteristics make it possible to save a transport stream section of arbitrary length before and after an error event for subsequent detailed analysis.

Multichannel Digital Video Quality Analyzer R&S DVQM



Error analyses using DVRG and realtime analyzers

Program quality assessment
Again, it is a benefit that the measurement method is based on the analysis of video data and does not need reference pictures. Instead of lengthy observations carried out by a test person, unknown program material can automatically be checked for its picture quality (e.g. satellite uplink).

Options

Analyzer Board (R&S DVQM-B2)
An additional Analyzer Board R&S DVQM-B2 can be ordered for monitoring a further channel. It corresponds to the two analyzer boards contained in the basic R&S DVQM model. The video quality analysis for this board is activated – same as for the boards contained in the basic unit – via the R&S DVQM-B4 option.

Video Quality Analysis R&S DVQM-B4
Video quality analysis of the individual R&S DVQM analyzer boards is optionally available. The measurement functions of the analyzer board are enhanced by this option to include determination of the picture quality. The option allows continuous analysis of the video quality of a video elementary stream according to a patented weighting algorithm, which takes into account the masking effects of the eye and thus furnishes measurement results that are adapted to the human perception. If the result is below a defined quality level, an alarm message and a report entry are generated.

Descrambling Options R&S DVQMB1x
As a rule, pay TV programs are transmitted in scrambled form to protect them against unauthorized access. Different CA systems are used, and the programs have to be descrambled accordingly in order to analyze, decode and display the picture and sound contents.

The R&S DVQM comes with options for the most common CA systems. The options include a card reader, the slot for which is provided on the rear of the R&S DVQM. It takes up the smart card that is issued by the program broadcaster and serves as the subscriber's identity card. The smart card is not included in the R&S DVQMB1x options.

Software

The R&S DVQM functions are considerably enhanced by several software packages. The R&S DTV NetView software comes with the R&S DVQM for easy detection and clear display of the errors detected by the R&S DVQM, as well as for easy configuration of all devices connected.

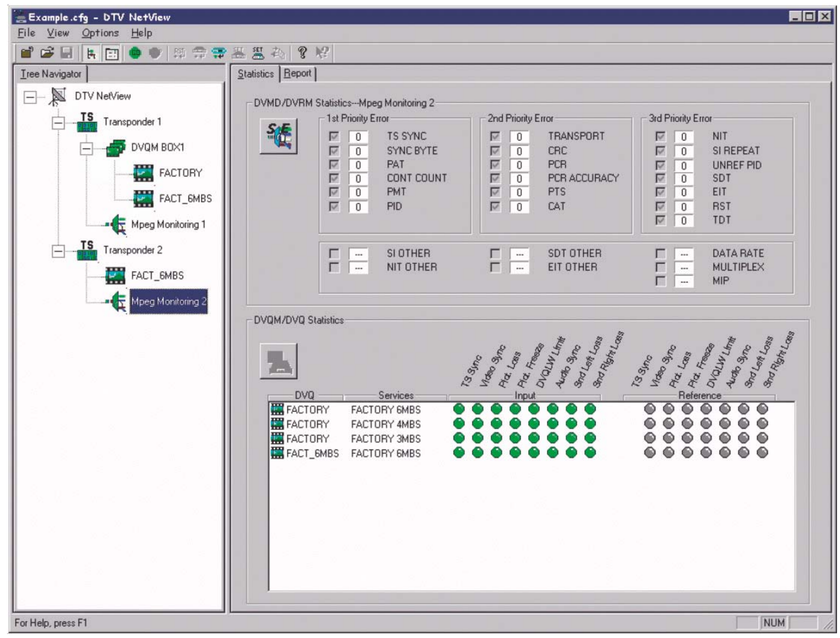
The Quality Monitor, which also comes with the R&S DVQM, allows continuous display and recording of the measurement results of an analyzer board and can conveniently be started from R&S DTV NetView for individual analyzer boards. The Elementary Stream Analyzer allows in-depth analysis of an MPEG-2 video elementary stream monitored by an analyzer board (option R&S DVQ-B1).

R&S DTV NetView
One of the assets of R&S DTV NetView is its high flexibility allowing it to be adapted to quite different monitoring system configurations. The adaptation is made with the aid of a special file reflecting the configuration of the monitoring system. Several R&S DVQMs and R&S DVQs can be integrated. R&S DTV NetView also allows the integration of the DVRM and the DVMD; these are Rohde & Schwarz instruments for moni-

Multichannel Digital Video Quality Analyzer R&S DVQM

toring and analyzing of the transport stream syntax.

After opening the configuration file via R&S DTV NetView, all devices mentioned above are initialized and the structure read is displayed as a tree structure in the program window to provide a good overview of all the devices contained in the system. This tree structure also serves for selecting individual devices in order to start further programs (Quality Monitor or Stream Explorer), to configure these devices, or to display the status information for selected devices only.



R&S DTV NetView

Quality Monitor
This software, which is also ideal for use with a R&S DVQ, allows remote control of each analyzer board (R&S DVQM-B2) in the same way as the R&S DTV NetView software. In addition, it allows easy and continuous reading of the measured values: spatial and temporal activities, data rate and R&S DVQL-W quality levels.

The Quality Monitor can be installed on an external PC with MS Windows9x or NT/2000/XP operating system. The connection to the R&S DVQM is established via an RS-232-C or Ethernet interface. Using a compatible interchange format (CSV), the measured values can be continuously stored in a data memory and graphically displayed. An automatic, user-definable save function allows convenient storage of measurement results over any period of time.

Specifications

The relevant data sheet is stored on the CD-ROM.
/DATASHEET/DVQM.PDF

Data sheet on CD-ROM

To get back here, please press ⇐ in the Acrobat Reader toolbar.

Ordering information

Multichannel Digital Video Quality Analyzer	R&S DVQM	2088.0004.02
Basic unit with two analyzer boards (R&S DVQM-B2) plus R&S DTV NetView remote-control software		

Options

Additional Analyzer Board	R&S DVQM-B2	2088.0027.02
max. 10 optional R&S DVQM-B2 per R&S DVQM		
Video Quality Analysis for R&S DVQM-B2	R&S DVQM-B4	2088.0062.02
Activates digital video quality determination for an Analyzer Board R&S DVQM-B2		

CA systems
One slot required per system (max. 6 per R&S DVQM)

Conax, Nagravision or Viaccess	R&S DVQMB10	2088.0491.02
Irdeto	R&S DVQMB11	2088.0504.02
Mediaguard	R&S DVQMB12	2088.0510.02
NDS-Videoguard BSkyB	R&S DVQMB15	2088.0540.02
BetaCrypt		
BetaDigital	R&S DVQMB16	2088.0556.02
DTAG	R&S DVQMB16	2088.0556.03
ORF	R&S DVQMB16	2088.0556.04
Cryptoworks	R&S DVQMB17	2088.0562.02

Quality Explorer™	R&S DVQ-B1	2079.7151.02
Only one license required for several analyzer boards		

MPEG2 Measurement Decoder R&S DVMD

25 DVB or 18 ATSC realtime measurements at a time, analyzer and decoder in one unit, analysis of data rates, integrated long-term report, on-screen display on video monitor

Photo 42482

Brief description

MPEG2 Measurement Decoder R&S DVMD monitors and analyzes the MPEG2 transport stream. It indicates the contents and provides comprehensive information on the quality of the transport stream.

The combination of decoder and analyzer in one unit with conventional operating concept (no PC system) makes R&S DVMD the waveform monitor of digital television. It is suitable for use wherever MPEG2 signals have to be checked.

Realtime measurements and simultaneous in-depth analysis yield extremely fast results. This makes R&S DVMD an indispensable tool in development, in troubleshooting as well as in quality management and production.

Another important application is in the final inspection of MPEG2 signals before they leave the studio. While R&S DVMD checks the video and audio signals at the output, error information is inserted directly into the decoded program (on-screen display).

Remote control capability allows integration into automatic monitoring networks. R&S DVMD is thus ideal for network operators.

Complementary to Decoder R&S DVMD, MPEG2 Measurement Generator R&S DVG (page 90) is offered for providing continuous MPEG2 transport streams made up of video, audio and data sequences in an endless loop.

Analyzer

The analyzer functions of R&S DVMD comprise a protocol analysis of the measured MPEG2 transport stream in realtime. All measurements are in conformance with the Measurement Guidelines for DVB Systems (ETR 290) of the European DVB project or based on these guidelines (ATSC-Standard). In the DVB mode, the repetition rates of all EIT/SDT/NIT "other" tables are monitored in realtime in addition to ETR 290.

Any error occurring is directly indicated by front-panel LEDs. R&S DVMD also detects sporadic errors. Moreover it provides error statistics showing how often a particular type of error has occurred within a specified time interval. A list (REPORT; see lower figure on righthand page) giving detailed information on the errors occurred including date and time can be obtained. The list contains up to 1000 entries and may be edited to cover exclusively a single type of error.

In addition, the R&S DVMD analyzes the MIP packets (megaframe initialization packets) that are inserted into the transport stream in order to synchronize the transmitters of DVB-T single-frequency networks.If there is an error, the trigger/capture facilities of R&S DVMD can be used to freeze part of the transport stream affected by the error (approx. 2 Mbit) and output it, analyzed down to bit level, via the RS-232-C interface.

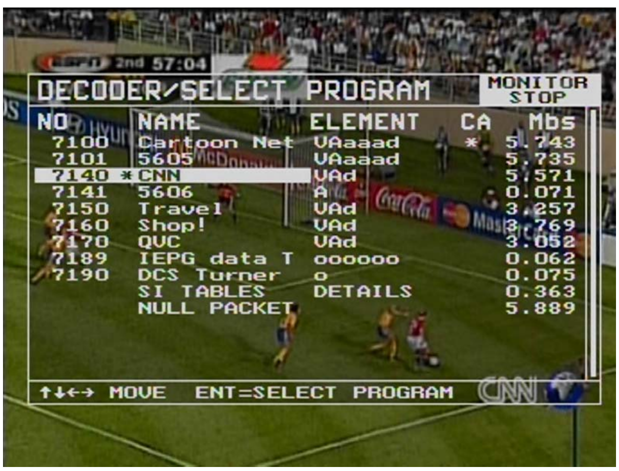
In addition to in-depth analysis, the optional Stream Explorer™ software (see page 105) allows further online measurements with graphic display on the screen (e.g. data rates, PCR jitter, etc).

Decoder

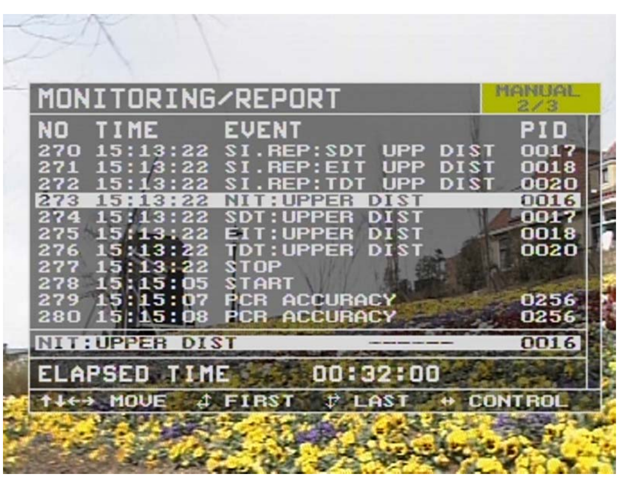
An MPEG2 transport stream usually consists of a number of programs which may contain video, audio and data streams (elementary streams). R&S DVMD decodes a video and an audio stream from the selected program. The decoded video signal is simultaneously output in CCVS, analog Y/C and digital serial ITU-R601 formats. Audio signals are output as analog stereo signals and as digital AES/EBU signals.

MPEG2 Measurement Decoder R&S DVMD

Optional alarm lines and parallel printer interface
In addition to a second parallel printer interface, 12 alarm lines for signalling errors detected in the transport stream are available. Each alarm line can be allocated to one or several (ORed) types of errors. The contacts close to ground and in case of an error they can be chosen to close or open.



List of all elementary streams of a program



Error report with detailed information on causes of errors

Specifications

The relevant data sheet is stored on the CD-ROM.
/DATASHEET/DVMD.PDF

Data sheet on CD-ROM

To get back here, please press ⬅ in the Acrobat Reader toolbar.

Ordering information

MPEG2 Measurement Decoder (DVB)	R&S DVMD	2068.8597.02
Accessories supplied	power cable, operating manual, audio adapter (LEMO Triax to XLR)	
Options		
Stream Explorer™ Software	R&S DVMD-B1	2068.8597.02
Distribution as ATSC standard	R&S DVMD-B2	2068.9341.00
Alarm Lines + Parallel Printer Interface	R&S DVMD-B5	2068.9393.02
Calibration Data Documentation	R&S DVMD-DCV	2082.0490.15
Extras		
19" Adapter (1 HU)	R&S ZZA-91	0396.4870.00
Service Manual		2069.0348.24

MPEG2 Realtime Monitor R&S DVRM

Realtime monitoring and analysis of MPEG2 transport streams

Photo 43410-1

Brief description

R&S DVRM is the optimized solution for the continuous monitoring of MPEG2 transport streams in real time. The measurements performed are necessary to ensure smooth interplay of all components of a DTV transmission network.

Main features

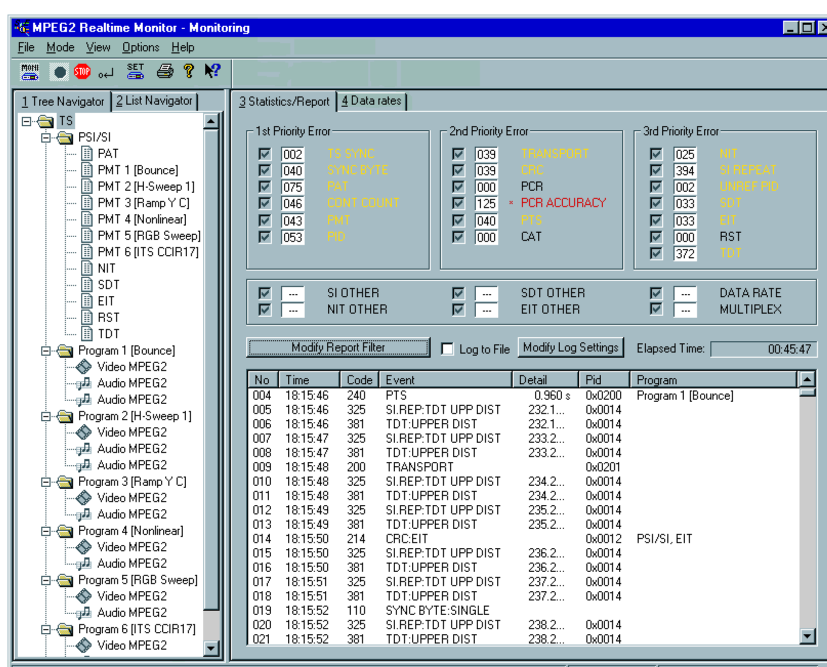
- 26 DVB or19 ATSC realtime measurements at a time
- Integrated long-term report
- Analysis of data rates
- Trigger-on-error function
- Remote control via supplied PC software
- 12 built-in relays for error signalling

Analyzer

The analyzer functions of R&S DVMD comprise a protocol analysis of the measured MPEG2 transport stream in realtime. All measurements are in conformance with the Measurement Guidelines for DVB Systems (ETR 290) of the European DVB project or based on these guidelines (ATSC-Standard). In the DVB mode, the repetition rates of all EIT/SDT/NIT "other" tables are monitored in realtime in addition to ETR 290.

Any error occurring is directly indicated by front-panel LEDs. R&S DVMD also detects sporadic errors. Moreover it provides error statistics showing how often a particular type of error has occurred within a specified time interval. A list (REPORT) giving detailed information on the errors occurred including date and time can be obtained. The list contains up to 1000 entries and may be edited to cover exclusively a single type of error.

In addition, the R&S DVMD analyzes the MIP packets (megaframe initialization packets) that are inserted into the transport stream in order to synchronize the transmitters of DVB-T single-frequency networks.If there is an error, the trigger/



If the supplied PC software running under Windows 9x or NT/2000/XP is used, three information blocks are available simultaneously:

1. Structure of transport stream with all elements shown in the form of a tree or list (left)

2. Current status as well as error seconds of each error measured in realtime (top right)

3. Chronological list of all errors detected (bottom right)

MPEG2 Realtime Monitor R&S DVRM

capture facilities of R&S DVMD can be used to freeze part of the transport stream affected by the error (approx. 2 Mbit) and output it, analyzed down to bit and byte level, via the RS-232-C interface.

In addition to in-depth analysis, the optional Stream Explorer™ software (see page 105) allows further online measurements with graphic display on the screen (e.g. data rates, PCR jitter, etc).

Remote control

In addition to readout and display of complete error information, the MPEG2 Realtime Monitor software allows full remote control of R&S DVRM. Moreover, it offers moving graphical representation of the data rates of all transport stream elements in the form of bargraphs. Apart from continuous storage of the error report on hard disk, the software enables integration of R&S DVRM into networked monitoring systems via the COM/DCOM interface.

ATSC-Standard R&S DVRM-B2

When ordered with option R&S DVRM-B2, the unit comes preconfigured for ATSC. For changeover of R&S DVRM to the respective other standard, a PC Windows software is supplied with R&S DVRM.

Specifications

The relevant data sheet is stored on the CD-ROM. /DATASHEET/R&S DVRM.PDF

Data sheet on CD-ROM

To get back here, please press ⇦ in the Acrobat Reader toolbar.

Ordering information

MPEG2 Realtime Monitor	R&S DVRM	2068.8580.02
Equipment supplied	Power cable, modem bypass cable, operating manual, CD-ROM with PC operating software, update firmware for ATSC and DVB standards, factory-configured for DVB standard	
Options		
Configuration for ATSC standard	R&S DVRM-B2	2068.9606.00
Stream Explorer™ software	R&S DVMD-B1	2068.9406.02
Documentation of calibration values	R&S DRM-DCV	2082.0490.24
Extras		
19" adapter (1 HU)	R&S ZZA-91	0396.4870.00
Service manual		2069.0348.24

Stream Explorer™ R&S DVMD-B1

Enhanced MPEG2 analysis with MPEG2 Measurement Decoder R&S DVMD and Realtime Monitor R&S DVRM

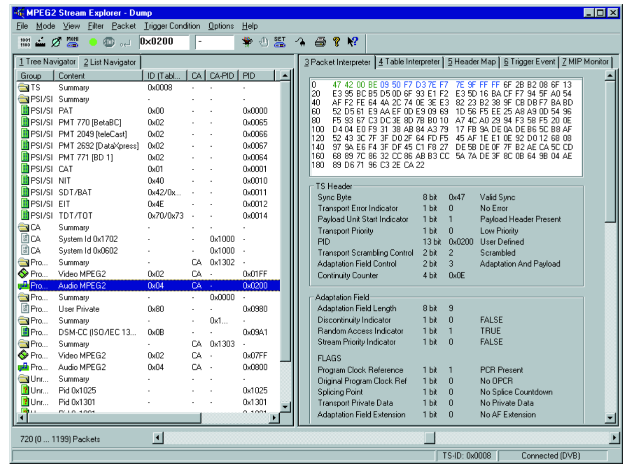


Fig. 1: All transport stream details under control with List Navigator and Packet Interpreter (DVB mode)

Brief description

Stream Explorer™ Software R&S DVMD-B1 enhances the MPEG2 Measurement Decoder R&S DVMD (page 101) from Rohde & Schwarz to form a universal analysis system for MPEG2 transport streams. The software runs under Windows 9x/NT/2000 on any PC or laptop connected to the R&S DVMD via a serial interface. The easy-to-operate software and the clear presentation of test results ensure efficient working right from the start. R&S DVMD can buffer a transport stream of up to 2 Mbit and transfer it on request via the serial interface to the Stream Explorer™. R&S DVMD uses several data or event filters (TRIGGER), which can be activated via the Stream Explorer™. The investigated data quantity of the transport stream can thus be considerably increased if required. Moreover, the software can activate realtime analyses in the R&S DVMD and output the results as moving graphic representations. The realtime measurement functions of R&S DVMD are thus considerably enhanced.

Five operating modes

- **DUMP:** for comprehensive analysis of transport stream contents
- **TRIGGER:** for detailed investigation of errors in transport streams
- **MEASURE:** for graphic display of transport stream parameters in realtime
- **MONITORING:** for remote control
- **OFFLINE:** for storage and subsequent recall of any test scenarios (available for all four operating modes named above)

DUMP

This operating mode allows detailed analysis of the contents of transport streams (TS). The transport stream contents is represented by Stream Explorer™ in hexadecimal format as well as in an interpreted form. This makes it very easy for the user to recognize any irregularities that may occur.

The analyzed transport stream data can be filtered as follows:

- only TS packets with a specific PID
- only TS packets with adaptation field
- only TS packets with start of a PES packet (payload unit start indicator set)

Combinations of the above selection criteria are also possible. Irrespective of the filter settings, Stream Explorer™ additionally determines the complete contents structure of the transport stream.

Display modes

- **NAVIGATOR:** Display of transport stream contents as a tree structure (Fig. 2, left) or in tabular form (Fig. 1, left) with general information about elementary streams such as PID, stream ID, data rate and information about scrambling. This display mode is always available together with a second display mode
- **PACKET INTERPRETER:** (Fig. 1, right) Display of a TS packet in hexadecimal format and at the same time as an interpreted list of all elements contained in the transport stream. A colour code for the various parts of the packet (header, adaptation field, payload, etc) makes for a clear representation. The packets are selected either via the NAVIGATOR or via a software slide switch allowing all buffered packets to be addressed in their original sequence
- **TABLE INTERPRETER:** (Fig. 2, right) Lists all elements of a selected table and interprets the contents. The following tables can be selected:
  - All standards: CAT, PAT, PMT, PT
  - DVB: BAT, DIT, EIT, NIT, RST, SDT, SIT, ST, TDT, TOT
  - ATSC: CVCT, EIT, ETT, MGT, PIT, RRT, STT, TVCT
- **HEADER MAP:** Gives an overview of the distribution of elementary stream packets within the transport stream. The headers of a selected elementary stream are highlighted

Contents Overview | Chapter Overview | Type Index | R&S Addresses

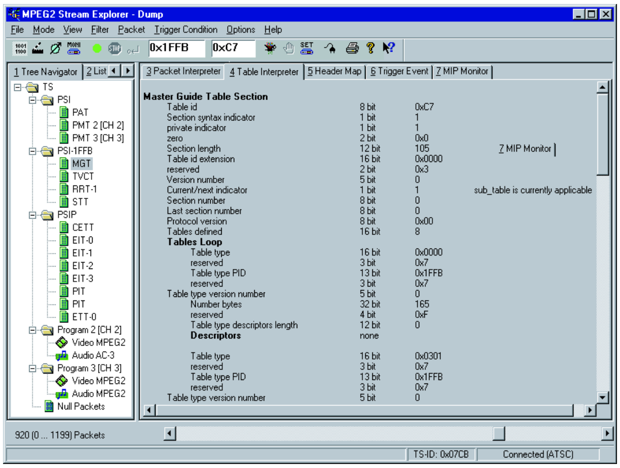


Fig. 2: Clear representation of transport stream structure with Tree Navigator and of Table Interpreter (ATSC mode)

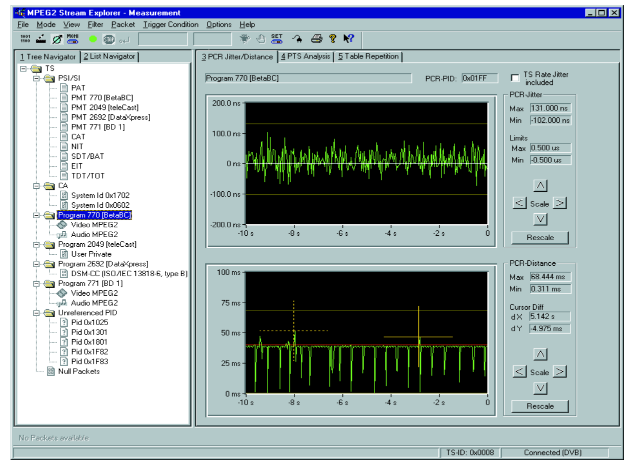


Fig. 3: Realtime measurement of PCR jitter and PCR spacings (DVB mode)

TRIGGER

If an error occurs in the transport stream applied to R&S DVMD, the data in the region of the error are stored in the R&S DVMD and made available to Stream Explorer™ for evaluation. The cause of the error can thus reliably be detected and displayed in detail.

TRIGGER EVENT: This display mode is additionally available for error investigation. It shows the structure elements in which the error occurred. Faulty data are shown in red. The type of error is explained in addition.

MIP MONITOR: Regularly updated display of MIP (megaframe initialization packets) data. These data are indispensable in SFNs (single frequency networks) to enable synchronized operation of the various transmitters.

MEASURE

This operating mode allows realtime analysis of several transport stream parameters and graphic display in the form of bargraphs or traces:

- PCR jitter (Fig. 3): accuracy and overall jitter MGF1, MGF2 and MGF3
- Spacing of PCR values in transport stream (Fig. 3)
- Spacing of elementary-stream-related PTS values
- PTS/PCR difference
- Spacing of PSI, SI and PSIP tables
- Data rates of elementary streams

MONITORING

Full remote control of the R&S DVMD is integrated in this operating mode, including display, filtering and storage of the monitoring report.

Other features

By switching to offline mode, the current contents of the transport stream can be stored in all operating modes for subsequent analysis.

Stream Explorer™ supports the software interface COM/DCOM (**D**istributed **C**omponent **O**bject **M**odule) which allows data and commands to be exchanged between Windows programs. In networked monitoring systems the Stream Explorer™ can be remote-controlled as an OLE automation server by application software packages.

System requirements

PC or laptop with Pentium processor (recommended clock frequency min. 100 MHz), Windows 9x or NT/2000/XP operating system, min. 16 Mbyte RAM (Windows NT/2000/XP: 32 Mbyte), required space on hard disk approx.10 Mbyte, 1 free RS-232-C interface (recommended data rate: 115 kbit/s), 1 parallel printer interface, 3.5'' disk drive

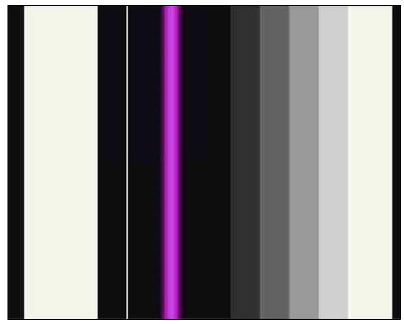
Ordering information

Stream Explorer™	R&S DVMD-B1	2068.9406.02
Equipment supplied	3.5'' floppy disks with setup program; cable for connecting the R&S DVMD to the PC, manual and dongle for connection to the parallel printer output of the PC	

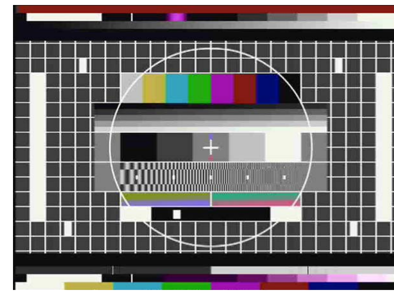
DVD Compendium Professional R&S TestDVD

New

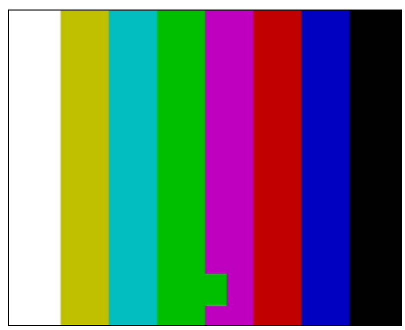
Comprises 5 DVDs with professional test patterns and test data streams for audio, video and EMC applications – particularly designed for use with DVD players and recorders



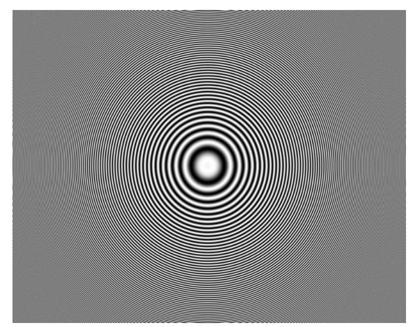
CCIR 17



Codec 43



ITU-R BT.801-1 with moving element



Zone plate

Brief description

In many cases, measurement quality is determined to a considerable extent by the scope and quality of the available test signals. The DVD compendium offers a unique compilation of many different video and audio streams for professional applications.

Main features

- Precompliance measurements on video and audio equipment
- Objective measurement and assessment of video and audio signals, especially those used in DVD systems (DVD video and DVD audio), for example by means of video analyzers (UAF, DVQ, VSA) and audio analyzers (UPL)
- Subjective quality tests of video and audio equipment
- Type approval tests in accordance with international standards, e.g. with EMS Test System R&S TS 9980, to determine electromagnetic susceptibility of sound and TV broadcast receivers as well as satellite and DVB receivers

Characteristics

The compendium consists of three albums for different types of tests:

- Album 1 contains more than 150 test patterns, video and audio sequences on a DVD VIDEO including tests for measuring electromagnetic susceptibility
- Album 2 contains one DVD AUDIO and one DVD VIDEO with stereo and multichannel test sequences
- Album 3 comprises two DVDs with data streams for testing the reliability of systems containing DVD components, including automatic error correction tests and endurance tests of DVD equipment

Particular importance was attached to the digital test sequences meeting relevant quality standards. Offering a choice of suitable picture structures and audio frequencies, the test sequences allow standard-conforming measurements of maximum quality as well as the subjective assessment of audio and video equipment.

DVD Compendium Professional R&S TestDVD

The DVDs also contain special test sequences enabling automatic measurements and evaluation in conjunction with equipment or test systems from Rohde & Schwarz.

For example, the video DVD includes:

- CCIR 17 test pattern for measuring nonlinearities, level and group-delay errors
- Codec 43 test pattern combining a variety of test signals in one pattern for the simultaneous, automatic measurement of significant parameters of a video signal
- Test data stream based on ITU-R BT.801-1 including a moving element for the automatic, objective picture assessment with analog and digital degradations

Numerous live video sequences for visual quality assessment are also provided, including:

- Sequences containing elements with rotating or back-and-forth motion for the assessment of smearing effects on monitors, TFT displays, plasma tubes or projectors as contrasted with conventional TV picture tubes
- Special video test streams such as zone-plate signals that support the visual assessment of artefacts generated in scaling conversion

The video sequences also contain audio signals ranging from 997 Hz reference signals and pink noise up to AC-3 test signals for the simultaneous and complete assessment of audio and video streams.

The test sequences are provided for PAL or NTSC systems as well as for 4:3 and 16:9 aspect ratios.

The audio signals on the audio DVDs allow the exact measurement of multichannel frequency response as well as the precise determination of S/N ratios and distortion. In addition, numerous sequences are available for the control of discrete channels, for example to test downmix functions or loudspeaker parameters set in the decoder.

Descriptions of the data streams can be downloaded from the following Internet address:

www.testdvd.rohde-schwarz.com

The test DVDs are provided by Rohde & Schwarz and Burosch with support from Audiovision and TESTfactory.

DVDs included

DVD1, video *)	Test patterns and data streams for video and EMC applications
DVD2 video *), DVD3 audio	Test sequences for stereo and multichannel systems
DVD4, video *)	Test sequences for laser and error correction measurements
DVD5, video *)	Endurance tests of DVD equipment

*) TV standard PAL or NTSC

General data

5 DVDs	1 x DVD-9, 4 x DVD-5
Regional code	0
TV standard	PAL or NTSC
Aspect ratio	4:3; 16:9 (not for all test sequences)

Ordering information

DVD Compendium Professional R&S TestDVD

PAL	1159.6090.02
NTSC	1159.6090.03

TV Test Receiver Family R&S EFA

Test receivers and demodulators for analog and digital (DVB-C, J.83/B, DVB-T or ATSC/ 8VSB) TV signals

R&S EFA63

Brief description

DTV

R&S EFA's powerful digital signal processing provides fast and thorough analysis of the received digitally modulated TV signal. The MPEG2 transport stream is permanently available for decoding as well as for video and audio reproduction.

Due to its real-time analysis capability, the high number of measured values necessary for the complex calculation and display processes are made available for subsequent mathematical/statistical processing in an extremely short and as yet unequalled time. Because of its high-speed data acquisition, the TV Test Receiver R&S EFA is the ideal choice not only for R&D but also for production environments where short measurement cycles are essential.

Analog TV

The analog R&S EFA models provide high precision demodulated baseband signals (vision and sound) for measurements in various applications (TV transmitters, cable headends, coverage measurements, R&D). At the same time, all relevant RF parameters are monitored at high speed and represented in a logical manner. User-configurable alarm messages permit unattended monitoring of the received signals as well as switchover to alternative links in the event of a failure.

The high-end demodulator version is used for on-site measurements on TV transmitters. This version offers particularly low-distortion demodulation of the broadcast signal. It is perfectly suited for these types of measurements; its low measurement uncertainty permits optimal alignment as well as permanent quality control of transmitters.

Applications

- Production of modulators and transmitters (calibration and test)
- Transmitter installation and adjustment of Single Frequency Networks (SFN in DVB-T)
- Coverage measurements on terrestrial signals
- Monitoring of TV transmitters, transposers and cable head-ends
- Research and development
- Service
- Measurement of noise margin of digital signals
- Monitoring of MPEG2 Transport streams

Main features

Common features

- Simple, user-friendly operation
- Modular design easy retrofitting of options
- Alarm messages for measurement functions, internal storage
- IEC/IEEE-bus and RS-232-C interface
- Error report
- Input of any IF frequency with the aid of the R&S EFA-B3 option: frequency range continuously tunable from 5 MHz to 1000 MHz
- Special function: invert spectrum feature (with option R&S EFA-B3)

Standard test receiver (model 12/40/50/60/70/78/90)

- Selective receiver
- Typical use in the field where adjacent channels need to be filtered
- Excellent price/performance ratio

High-end demodulator (model 33/43/53/63/73/89/93)

- Wideband input (non-selective receiver), tunable
- Typically used for transmitter testing
- Outstanding SNR, excellent intermodulation characteristics
- High-end synthesizer with extremely low phase noise

High-end test receiver (model 33/43/53/63/73/89/93 + option R&S EFA-B3)

- Outstanding SNR and improved intermodulation characteristics
- Rejection of image frequency and IF
- Two additional selective RF inputs (50 Ω and 75 Ω)
- Extended frequency range from 4.5 MHz to 1000 MHz

Test Receiver Family R&S EFA - The family members, specific features

DTV

Model	Description	Features
40	DVB-T Test receiver	selective
43	DVB-T Test demodulator	broadband
50	ATSC/8VSB Test receiver	selective
53	ATSC/8VSB Test demodulator	broadband
60	DVB-C Test receiver	selective
63	DVB-C Test demodulator	broadband
70	ITU-T J.83/B Test receiver (US cable)	selective
73	ITU-T J.83/B Test demodulator (US cable)	broadband

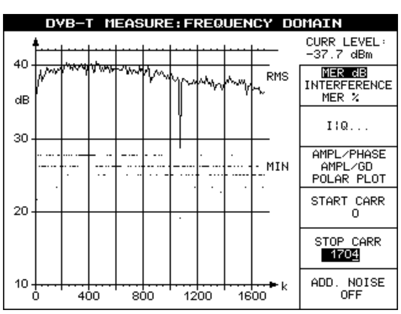
Analog TV

Model	Description	Features
12	Analog TV Test receiver	standard B/G, selective
33	Analog TV Test demodulator	standard B/G, broadband
78	Analog TV Test receiver	standard D/K or I, selective
89	Analog TV Test demodulator	standard D/K or I, broadband
90	Analog TV Test receiver	standard M/N NTSC/ BTSC, selective
93	Analog TV Test demodulator	standard M/N NTSC/ BTSC, broadband

Specific features

DVB-T

DVB-T Test Receiver R&S EFA, fully compatible with the EN 300 744 standard, receives, demodulates, decodes and analyzes OFDM (orthogonal frequency division multiplex) signals.



MER as a function of the frequency is one of the most powerful measurements that the R&S EFA can perform. It displays the MER for every QAM modulated carrier of the OFDM signal. At a glance, the overall quality of the transmitter under test can be measured.

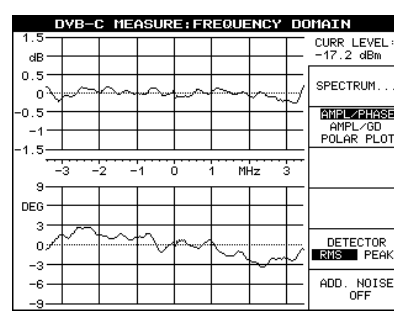
With 'START CARR' and 'STOP CARR', any impaired QAM carrier in the OFDM signal can be quickly located. Co-channel interference can also be measured and displayed when an interference measurement is performed (interference-to-carrier measurement).

All key parameters for demodulating the receive signal can be selected automatically or manually:

- 6, 7 or 8 MHz operating bandwidth
- 2K or 8K OFDM modulation
- QPSK, 16QAM or 64QAM
- Constellation diagram
- 1/2, 2/3, 3/4, 5/6 or 7/8 code rate
- 1/4, 1/8, 1/16 or 1/32 guard interval
- α =1, 2 or 4 hierarchical demodulation
- Reed-Solomon error correction 204/188
- 6 MHz, 7 MHz or 8 MHz SAW filter bandwidth (selectable)
- General measurement functions for
  - RF input level
  - Carrier frequency offset
  - Bit rate offset
  - BER (before Viterbi, before and after Reed-Solomon)
- In-depth measurement capabilities
  - OFDM parameter analysis
  - MER analysis over frequency
  - Q analysis over frequency
  - Frequency domain analysis (channel estimation)
  - Time domain analysis (impulse response and amplitude distribution)
  - History function
- Integrated noise generator for measurement of noise margin
- MPEG2 transport stream output (serial or parallel)

DVB-C

Fully compatible with the DVB-C standard (EN 300 429), the R&S EFA 60/63 models receive, demodulate, decode and analyze all orders of QAM (Quadrature Amplitude Modulated) signals.



The coefficients of the equalizer are used to display the amplitude and phase frequency response (shown here), the group delay (not shown here) and the polar plot representation.

The polar plot representation — which is the complex representation of amplitude and phase — may help to interpret very short echoes that are difficult to visualize on the echo pattern display.

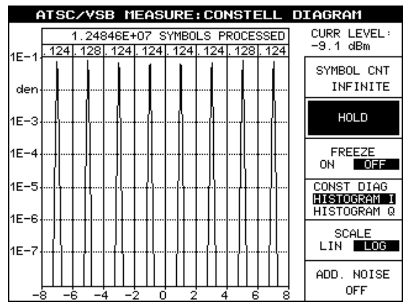
Test Receiver Family R&S EFA - Specific features

All key parameters for demodulating the received signal can be automatically or manually selected:

- 4, 16, 32, 64, 128 or 256QAM modulation
- Variable symbol rate for special modulator tests and lab analysis (1 Msymbol/s to 6.999 Msymbol/s)
- Reed-Solomon error correction 203/187/8
- Optional SAW filter bandwidths: 6 MHz, 7 MHz, 8 MHz and 2 MHz
- General measurement functions for
  - RF input level
  - Carrier frequency offset
  - Bit rate offset
  - BER (before and after Reed-Solomon)
- In-depth measurement capabilities
  - QAM parameter analysis
  - Constellation diagram (including histogram function)
  - Frequency domain analysis (from equalization)
  - Spectrum analysis (including automatic shoulder attenuation measurement)
  - Time domain analysis (Echo pattern and amplitude distribution)
  - History function
- Integrated noise generator for measurement of noise margin
- Special function: invert spectrum feature
- MPEG2 transport stream output (serial or parallel)

ATSC/8VSB

The ATSC/8VSB Test Receiver R&S EFA, fully compatible with the ATSC Doc. A/53 standard, receives, demodulates, decodes and analyzes 8VSB (eight-level vestigial sideband) signals.



Histogram I represents the distribution of the eight-level vestigial sideband modulation (8VSB) on the X axis, and can be expressed in a linear or logarithmic scale.

It allows an estimate of the interferer's origin (interferer, Gaussian noise, etc).

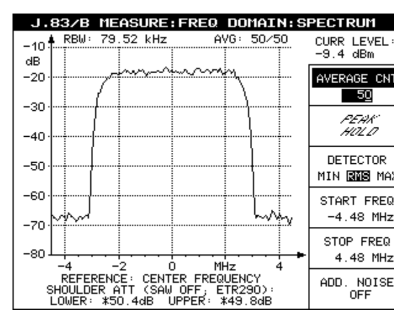
Hint: Check the position of the sync pulse (±5), and check the impact on the distribution.

All key parameters for demodulating the received signal can be automatically or manually selected:

- 8VSB modulation
- Trellis decoder (code rate 2/3)
- Fixed symbol rate for normal use (10.762238 Msymbol/s)
- Variable symbol rate for special modulator tests and lab analysis (2 Msymbol/s to 11 Msymbol/s)
- Reed-Solomon error correction 207/187/10
- Optional SAW filter bandwidths: 6 MHz, 8 MHz and 2 MHz
- General measurement functions for
  - RF input level
  - Carrier frequency offset
  - Bit rate offset
  - BER (before and after Reed-Solomon)
- In-depth measurement capabilities
- 8VSB parameter analysis
- Constellation diagram (including histogram function)
- Frequency domain analysis (from equalization)
- Spectrum analysis (including automatic shoulder attenuation measurement according to FCC rec.)
- Time domain analysis (Ghost pattern and amplitude distribution)
- History function
- Integrated noise generator for measurement of noise margin
- MPEG2 transport stream output (serial or parallel)
- Additional SMPTE310M MPEG2 transport stream output

ITU-T J.83/B (US cable)

Fully compatible with the ITU-T J.83/B standard, the R&S EFA 70/73 models receive, demodulate, decode and analyze 64 QAM or 256 QAM (quadrature amplitude modulated) signals.



Thanks to this integrated feature, a separate spectrum analyzer is not required anymore.

All basic spectrum analyzer functions are provided: start/stop frequency (or center/span) and several detection and averaging modes.

All key parameters for demodulating the received signal can be automatically or manually selected:

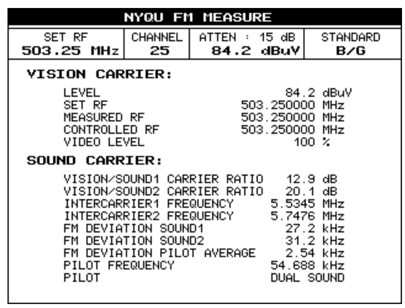
- 64QAM or 256QAM modulation
- Trellis decoder (code rate 14/15 for 64 QAM and 19/20 for 256QAM)
- Fixed symbol rate for normal use (5.056941 Msymbol/s for 64QAM and 5.360537 Msymbol/s for 256QAM)

Test Receiver Family R&S EFA - Specific features

- Variable symbol rate for special modulator tests and lab analysis (1 Msymbol/s to 6999 Msymbol/s)
- Reed-Solomon error correction 128/122/3
- Optional SAW filter bandwidth: 6 MHz, 8 MHz and 2 MHz
- General measurement functions for
  - RF input level
  - Carrier frequency offset
  - Bit rate offset
  - BER (before and after Reed-Solomon)
- In-depth measurement capabilities
  - QAM parameter analysis
  - Constellation diagram (including histogram function)
  - Frequency domain analysis (from equalization)
  - Spectrum analysis (including automatic shoulder attenuation measurement)
  - Time domain analysis (Ghost pattern and amplitude distribution)
  - History function
- Integrated noise generator for measurement of noise margin
- MPEG2 transport stream output (serial or parallel)

Analog TV

Fully compatible with analog standards, the analog R&S EFA models receive and demodulate the analog TV standards B/G, D/K and I.



All parameters for the demodulated standard B/G TV channel are displayed on a single screen and can be checked at a glance:

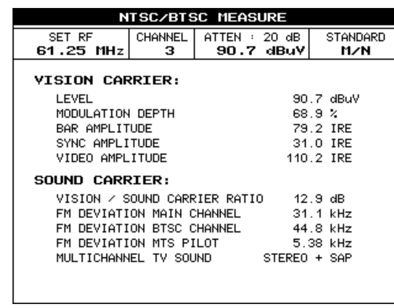
- ***Vision carrier level***
- ***Video modulation depth***
- ***Sound intercarrier measurements***
- ***Vision/sound level ratio***
- ***Sound 1 & 2 FM deviation***
- ***Pilot decoding***

All key parameters for demodulating the received signal can be automatically or manually selected:

- Switchable group delay correction
- Switchable synchronous detector (5 different modes)
- Demodulation using intercarrier method
- Balanced audio outputs
- Measurement functions for
  - vision/sound carrier spacing (level and frequency)
  - FM sound carrier and pilot deviation
  - RPC (Residual Picture Carrier) or video modulation depth

Analog TV standard M/N NTSC/BTSC

Fully compatible with the FCC standard, the R&S EFA 90/93 models receive and demodulate any analog TV signals to standard M/N (NTSC/BTSC and PAL).



All parameters for the demodulated standard M/N TV channel are displayed on a single screen and can be checked at a glance:

- ***Vision carrier level***
- ***Video modulation depth***
- ***Bar/sync/video amplitudes (expressed in IRE)***
- ***Vision/sound level ratio***
- ***Main and BTSC channel FM deviation***
- ***FM deviation of MTS pilot***
- ***Sound mode indication (Mono, Stereo, SAP)***

All key parameters for demodulating the received signal can be automatically or manually selected:

- Switchable group delay correction
- Switchable envelop or synchronous detector (5 different modes)
- Demodulation using intercarrier or split carrier method
- Integrated BTSC/MTS decoder
- Balanced audio outputs
- Measurement functions for
  - vision/sound carrier spacing (level)
  - FM sound carrier and MTS pilot deviation
  - RPC (Residual Picture Carrier) or video modulation depth

Test Receiver Family R&S EFA - Options overview

Option	Description
Hardware	
NICAM demodulator/decoder (R&S EFA-B2)	– Demodulation and decoding of signals to NICAM-728 standard – Measurement parameters: bit error ratio, eye height, clock and data jitter – I and Q signal output
MPEG2 decoder (R&S EFA-B4)	– Real-time analysis to ETR 101290 – Error report – Video and audio output
Video distributor (R&S EFA-B6)	– 2 video outputs on front panel, 2 video outputs on rear panel – 1 additional Q output on front panel
Switchable sound trap (R&S EFA-B7)	– Only available for standard B/G (R&S EFA models 12/33) – Allows video bandwidth measurements up to 6 MHz
OFDM demodulator (R&S EFA-B10)	– Option for analog R&S EFA models – DVB-T demodulation, according to EN 300 744
6 MHz SAW filter (R&S EFA-B11)	– Adjacent-channel rejection – Meets US requirements
7 MHz SAW filter (R&S EFA-B12)	– Designed to DVB-T standards – Adjacent-channel rejection – Meets European and Australian standards
8 MHz SAW filter (R&S EFA-B13 model 02)	– Designed to DVB-T standards – Adjacent-channel rejection – Meets European standards
8 MHz SAW filter (R&S EFA-B13 model 03)	– Adjacent-channel rejection – Meets European and US standards, recommended for spectrum measurement
2 MHz SAW filter (R&S EFA-B14)	– Adjacent-channel rejection – Meet channel return requirements
Digital demodulator platform (R&S EFA-B20)	– Upgrade for analog R&S EFA models – Supporting DVB-C demodulation (with option R&S EFA-K21), ATSC/8VSB demodulation (with option R&S EFA-K22), ITU-T J.83/B demodulation (with option R&S EFA-K23) – Included in basic R&S EFA 50/53/60/63/70/73 models
Software	
DVB-C firmware (R&S EFA-K21)	– Analysis, demodulation and monitoring of DVB-C signals according to EN 300 429 standard – Included in basic R&S EFA 60/63 models
ATSC/8VSB firmware (R&S EFA-K22)	– Analysis, demodulation and monitoring of ATSC/8VSB signals according to ATSC Doc. A/53 – Included in basic R&S EFA 50/53 models – Additional SMPTE310M MPEG2 transport stream output
ITU-T J.83/B firmware (R&S EFA-K23)	– Analysis, demodulation and monitoring of American digital cable signals according to ITU-T J.83/B standard – Included in basic R&S EFA 70/73 models
FIR coefficient readout firmware (R&S EFA-K25)	– Output of FIR coefficients of the equalizer – Available for R&S EFA 50/53 or option R&S EFA-B20 with R&S EFA-K22 – Coefficient file transfer via RS-232-C interface
M/N NTSC/BTSC demodulator (R&S EFA-B30)	– Meets FCC requirements (group delay correction) – Switchable sound trap – Switchable group delay correction – Switchable synchronous or envelope detector – Integrated BTSC/MTS decoder

TV Test Receiver Family R&S EFA – Specifications, ordering information

Specifications

The relevant data sheet is stored on the CD-ROM.
/DATASHEET/EFA.PDF

Data sheet on CD-ROM

To get back here, please press in the Acrobat Reader toolbar.

Ordering information

DTV

DVB-T Test Receiver [1)] Selective, constellation diagram, output MPEG2 data stream	R&S EFA 40	2067.3004.40
DVB-T Test Demodulator [1)] Broadband, constellation diagram, output MPEG2 data stream	R&S EFA 43	2067.3004.43
ATSC/8VSB Test Receiver [1)] Selective, constellation diagram output MPEG2 data stream	R&S EFA 50	2067.3004.50
ATSC/8VSB Test Demodulator [1)] Broadband, constellation diagram, output MPEG2 data stream	R&S EFA 53	2067.3004.53
DVB-C Test Receiver [1)] Selective, 4/16/32/64/128/256QAM, output MPEG2 data stream, constellation diagram	R&S EFA 60	2067.3004.60
DVB-C Test Demodulator [1)] Broadband, 4/16/32/64/128/256QAM, output MPEG2 data stream, constellation diagram	R&S EFA 63	2067.3004.63
ITU-T J.83/B Test Receiver [1)] Selective, 4/16/32/64/128/256QAM, output MPEG2 data stream, constellation diagram	R&S EFA 70	2067.3004.70
ITU-T J.83/B Test Demodulator [1)] Broadband, 4/16/32/64/128/256QAM, output MPEG2 data stream, constellation diagram	R&S EFA 73	2067.3004.73

ANALOG TV

TV Test Receiver [1)] Standard B/G, dual sound, IF 38.9 MHz, RF 45 MHz to 860 MHz, selective	R&S EFA 12	2067.3004.12
TV Test Demodulator [1)] Standard B/G, dual sound, IF 38.9 MHz, RF 45 MHz to 1000 MHz, broadband	R&S EFA 33	2067.3004.33
TV Test Receiver [1)] Standard D/K, or I (mono), IF 38.9 MHz, RF 45 MHz to 860 MHz, selective	R&S EFA 78	2067.3004.78
TV Test Demodulator [1)] Standard D/K or I (mono), IF 38.9 MHz, RF 45 MHz to 1000 MHz, broadband	R&S EFA 89	2067.3004.89
TV Test Receiver [1)] Standard M/N, mono, selective, RF 45 MHz to 860 MHz, IEEE bus	R&S EFA 90	2067.3004.90
TV Test Demodulator [1)] Standard M/N (mono), broadband, RF 45 MHz to 1000 MHz, IEEE bus	R&S EFA 93	2067.3004.93

Accessories supplied: Lemo Triax adapter to XLR stereo (only when audio signals are available), power cable, operating manual

Options

NICAM Demodulator Std. B/G, D/K	R&S EFA-B2	2067.3610.02
NICAM Demodulator Standard I	R&S EFA-B2	2067.3610.04
RF Selection for Demodulator	R&S EFA-B3	2067.3627.02
MPEG2 Decoder	R&S EFA-B4	2067.3633.02
Video Distributor	R&S EFA-B6	2067.3656.02
Switchable Sound Trap (only R&S EFA 12/33)	R&S EFA-B7	2067.3710.02
COFDM Demodulator (for analog TV units)	R&S EFA-B10	2067.3740.02
Digital Demodulator Platform (for analog TV units)	R&S EFA-B20	2067.3585.02
Std. M/N Demodulator (for digital units)	R&S EFA-B30	2067.3556.02
6 MHz SAW Filter (for digital units)	R&S EFA-B11	2067.3691.00
7 MHz SAW Filter (for digital units)	R&S EFA-B12	2067.3591.00
8 MHz SAW Filter (for DVB-T digital units)	R&S EFA-B13	2067.3579.02
8 MHz SAW Filter (for DVB-C/ATSC/J83/B units)	R&S EFA-B13	2067.3579.03
2 MHz SAW Filter (for digital units)	R&S EFA-B14	2067.3562.00
DVB-C Firmware (for R&S EFA 5x/7x or R&S EFA-B20)	R&S EFA-K21	2067.4000.02
ATSC/8VSB Firmware (for R&S EFA 6x/7x or R&S EFA-B20)	R&S EFA-K22	2067.4017.02
J.83/B Firmware (for R&S EFA 5x/6x or R&S EFA-B20)	R&S EFA-K23	2067.4023.02
FIR Coefficient Readout Firmware (for R&S EFA 5x or R&S EFA-B20 and R&S EFA-K22)	R&S EFA-K25	2067.4046.02

Extras

R&S EFA Calibration values	R&S EFA-DCV	2082.0490.09
R&S EFA-B4 Calibration values	R&S EFA-DCV	2082.0490.15
19" Adapter	R&S ZZA-93	0396.4892.00
Lemo Triax connector (mono) with connecting cable (open)		2067.7451.00
Service manual	R&S ERST.2	2068.0950.24
Bag for units 19", 3 HU, depth 460mm	R&S ZZT-314	1001.0523.00

1) Note: please fill in configuration sheet (available from your local representative) so that your test receiver / demodulator can be tailored to your requirements.

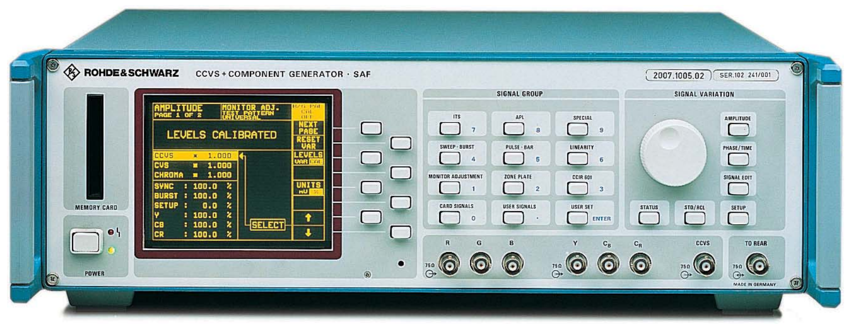
CCVS+Component Generator R&S SAF, CCVS Generator R&S SFF

R&S SAF:

CCVS, YC_BC_R, RGB, S-VHS

R&S SFF: CCVS

Multi-standard generators for all TV applications; optionally PAL-plus and ITU-R BT. 601



R&S SAF (photo 40328-1)

Brief description

TV Generators R&S SAF and R&S SFF are two multistandard instruments (B G/PAL, M/NTSC, M/PAL, N/PAL) suitable for all applications in the field of television. CCVS+Component Generator R&S SAF supplies all test signals and patterns required for video measurements in CCVS, YC_BC_R, RGB and S-VHS formats, for test patterns an aspect ratio of 4:3 or 16:9 being selectable. Where only the CCVS format is required, CCVS Generator R&S SFF can be used.

R&S SAF and R&S SFF also generate all test signals to CCIR Rec. 801, a number of common pathological test signals, and shallow ramps with a resolution of 10 bits. The PALplus test pattern option provides all PALplus reference signals and the bits required for wide screen signalling (WSS).

Both generators afford extensive signal variations via softkey-controlled menus. Such amplitude and phase adjustments of signal components enable testing of gain controls, white-level limiting circuits and video analyzers over the whole range of the devices. User-specific signals can be defined by front-panel entry and stored in the generator or on a memory card.

Function

The generator section is of digital design. A transputer – a high-speed RISC processor – calculates the three components Y, C_B and C_R of all test signals which in CCVS+Component Generator R&S SAF are applied to three D/A converters. An analog matrix converts the three components into the RGB format. Therefore the RGB signals are made available simultaneously with the YC_BC_R components. The digital CCVS in R&S SAF and R&S SFF is determined from the YC_BC_R components in realtime with the aid of two LSI gate arrays.

Digital Video Interface R&S SAF-Z1

The optional Digital Video Interface R&S SAF-Z1 upgrades the R&S SAF and R&S SFF for use in digital TV studios. In addition to the analog video signals, a parallel and two serial digital video signals are thus simultaneously available.

Main features

- Clear menu-guided operation on large-size EL display
- 12 signal groups with up to 8 signal menu pages each; each page may contain 7 signals
- Superposition of hum, sweep, noise or other signals with different clamping modes
- APL and bounce signals with preselectable parameters
- Insertion of external test signals such as teletext or data lines
- Free programming of test-line coding and monitoring
- Entry of texts as source identification or scrolling text
- Program monitoring + substitution pattern
- System compatibility and full remote control capability (IEC625/IEEE488 bus)
- Definition of customer-specific signals by "Signal Edit" via the front panel
- Zone-plate signals, 8 coefficients freely selectable

CCVS+Component Generator R&S SAF, CCVS Generator R&S SFF

Specifications

The relevant data sheet is stored on the CD-ROM.
/DATASHEET/SAF.PDF

Data sheet on CD-ROM

To get back here, please press ⇦ in the Acrobat Reader toolbar.

Ordering information

CCVS+Component Generator	R&S SAF	2007.1005.02
CCVS Generator	R&S SFF	2007.1057.02
Options		
Digital Video Interface	R&S SAF-Z1	2007.1063.02
	R&S SFF-Z1	2007.1063.03
PALplus Test Pattern for R&S SAF and R&S SFF	R&S SAF-B20	2007.1011.02
Calibration Data Documentation	R&S SAF-DCV	2082.0490.02
	R&S SAF-DCV	2082.0490.03
Extras		
32 kbyte Memory Card	R&S ZZM-32	2005.4394.02
512 kbyte Memory Card	R&S ZZM-512	2005.4388.02
Service Kit	R&S SAF-Z	2007.1111.00
	R&S SFF-Z	2007.1105.00

TV Test Transmitter R&S SFM

5 MHz to 1000 MHz

Vision and sound signals

for all common analog AM TV standards

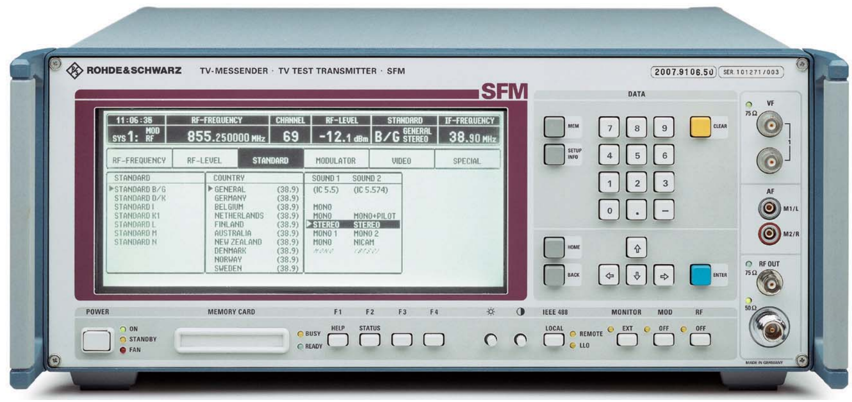


Photo 41846

Brief description

TV Test Transmitter R&S SFM from Rohde& Schwarz supplies vision and sound signals to all common TV standards for the IF (32 MHz to 46 MHz) and RF ranges (5 MHz to 1000 MHz).

Thanks to a very flexible modular concept based on plug-ins, R&S SFM is the compact solution for all analog applications in development, production and servicing. Each R&S SFM frame can accommodate up to ten plug-ins so that standards B/G, D/K, I, L/L', M and N can be implemented in a single R&S SFM.

R&S SFM is ideal for use in EMC measurements: In Europe, EMC requirements are set down in special regulations and laws. Full compliance with prescribed limits is a prerequisite for certification with the European conformity mark CE.

For the American BTSC method, a multiplex signal with a frequency of up to 120 kHz can be applied. The frequency deviation and output level of the sound carriers are also set automatically as per standard.

Many parameters for the vision, NICAM and sound modulators can be set to non-standard values. The display outputs a warning that non-standard parameters are being used; however, compliance with the appropriate standard can be restored with a single keystroke.

Main features

- Generation of TV signals to standards B/G, D/K, I, L/L', M and N, including stereo/dual sound and digital sound (NICAM)
- Double-sideband test modulator for all IFs between 32 MHz and 46 MHz
- Internal audio generator, stereocoder and NICAM generator
- High frequency resolution of 1 Hz for precision offset
- Frequency locking for all oscillators

Operation

R&S SFM outputs all information on a large LCD graphics display; if required an external monitor can be connected. The display is divided into different areas. The currently valid key setting parameters are displayed in the top half, these being frequency, TV channel, output level and the selected standard with the associated vision IF. Below there is the main selection line with menus such as frequency, level and standard. A special menu enables intermodulation measurements and sweep mode to be selected.

R&S SFM is equipped with an IEC/IEEE-bus interface to SCPI and an RS-232-C interface. Thanks to a PC card interface, complete setups can be loaded from or to a memory card. Software updates can be carried out via the serial interface or memory-card interface.

TV Test Transmitter R&S SFM

Specifications

The relevant data sheet is stored on the CD-ROM.
/DATASHEET/SFM.PDF

Data sheet on CD-ROM

To get back here, please press ⬅ in the Acrobat Reader toolbar.

Ordering information

TV Test Transmitter

Basic unit with vision modulator and FM modulator sound 1, without upconverter	R&S SFM	2007.9106.10
Basic unit with vision modulator and FM modulator sound 1, with upconverter 5 MHz to 1000 MHz, 50 Ω	R&S SFM	2007.9106.50
Basic unit with upconverter 5 MHz to 1000 MHz, 50 Ω, without vision/sound modulator	R&S SFM	2007.9106.90

Options

Multistandard plug-in	R&S SFM-B7	2008.0248.02
Sound modulator 2 (switchable FM/AM), including dual-sound coder (IRT)	R&S SFM-B9	2008.0183.02
QPSK sound modulator for NICAM 728 with internal NICAM generator	R&S SFM-B10	2008.0302.02
RF output 75 Ω (switchable)	R&S SFM-B16	2007.9212.02

TV Test Transmitter R&S SFL

5 MHz to 1100 MHz/3300 MHz

Digital signals for use in production

Brief description

The TV Test Transmitter Family R&S SFL is a complete solution for testing digital TV receivers and integrated receiver modules, as well as for testing digital TV links for broadcasting via terrestrial antennas and cable. It covers all main standards currently used worldwide as well as those to be introduced soon.

The standard-conformant test signals exhibit a high level of precision. To determine the full functionality and the performance of your products at their limits, the test signal parameters can be varied within a wide range and provided with predefined errors. Realistic transmission/reception conditions can be reproducibly simulated with the aid of the noise generator option.

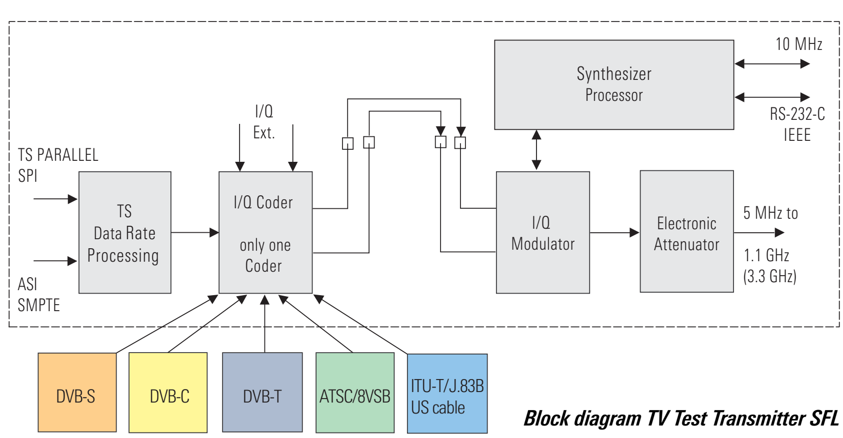
- Different optimized models:
  - R&S SFL-S for standard DVB-S, DVB-DSNG
  - R&S SFL-C for standard DVB-T
  - R&S SFL-T for standard DVB-T
  - R&S SFL-V for standard ATSC/8VSB
  - R&S SFL-J for standard ITU-T/J.83B (US cable)
- Satellite DVB-S, DVB-DSNG
  - QPSK
  - 8PSK
  - 16-QAM
- Cable DVB-C
  - 16-, 32-, 64-, 128-, 256-QAM
- Antenna DVB-T
  - 2K and 8K COFDM
  - 6 MHz, 7 MHz and 8 MHz
  - QPSK, 16QAM, 64QAM
- Antenna ATSC: 8VSB
- Cable ITU-T/J.83B (US cable)
  - 64 QAM, 256 QAM
  - Data Interleaver Level 1 and Level 2

Main features

- Wide frequency range 5 MHz to 1.1 GHz or 3.3 GHz
- Large level range for transmission and receiver measurements
- Wear-free electronic attenuator
- Fast setting times
- Operating parameters modifiable
- Special signals and error signals
- Sweep mode for frequency and level
- Status menu for overview of settings
- Storage of instrument settings
- List function for automatic command sequence, e.g. measurement of frequency and amplitude response
- Online help
- IEC625/IEEE bus, RS-232-C
- Software update via RS-232-C

Applications

The high signal quality and the versatile parameter variation capabilities make the R&S SFL family ideally suited as a standard signal generator for use in production environments. The wide output frequency range allows testing beyond the limits defined by the relevant standard. The benefit of the large level range is that, on the one hand, the functional limits of LSI circuits can be quickly determined and recorded during production;



Block diagram TV Test Transmitter SFL

TV Test Transmitter R&S SFL

on the other hand, it is easy to simulate a receive link for a TV receiver.

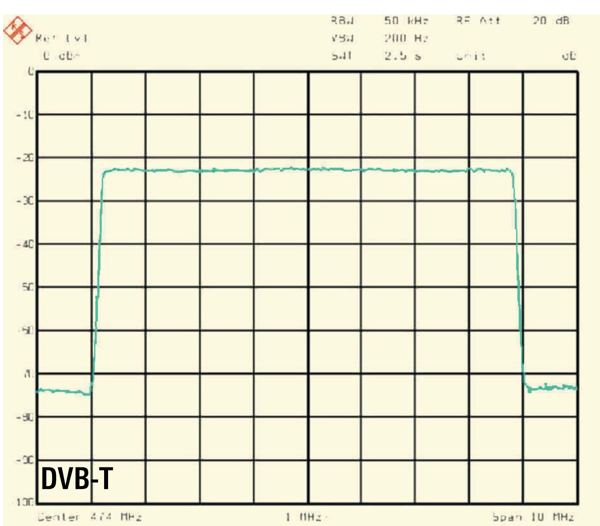
The operating parameters (e.g. roll-off, puncturing, QPSK mode, QAM mode, pilot level, interleaver level, etc) can easily be varied even beyond the limits defined by the relevant standard.
A number of special signals or signals with predefined errors are provided in order to determine the true functional limits or to quickly detect malfunctions; it is also possible to switch off signal characteristics defined in the standard or partial signal functions (e.g. modulation, individual carriers and groups of carriers, pilot, etc).

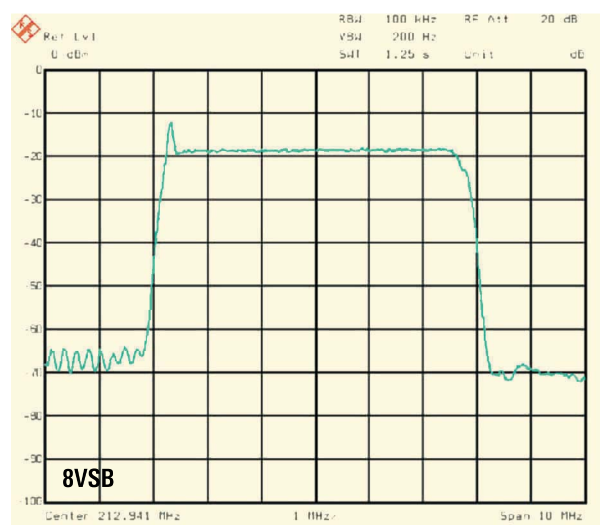
Irrespective of the model, a sweep mode is available for the total frequency range, as well as an external I/Q input for signals with external coding.

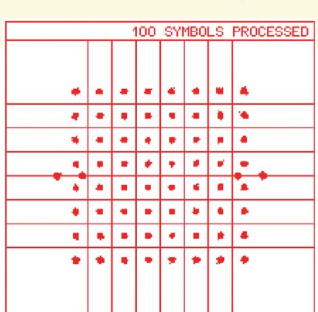
Data inputs

The R&S SFL has a suitable data input for every application. Via the TS PARALLEL (with LVDS format) and SMPTE310 inputs, the input signal is passed on without modification to the coder. The symbol rate directly depends on the input data rate. The SPI and ASI inputs adapt the signal prior to coding to the desired symbol rate with the aid of the stuffing function.

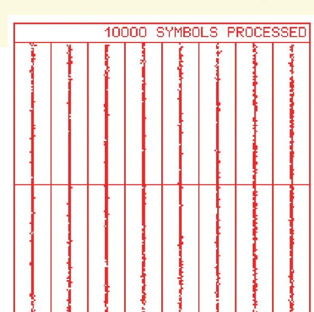
These inputs allow setting of the symbol rate independently of the input data rate, so that the input data rate is independent of the DVB-T/VSB channel bandwidth. To this effect, all null packets are removed. The data rate required for a given symbol rate or bandwidth is obtained by stuffing, i.e. by inserting new null packets. The PCR (program clock reference) values are adapted. A built-in synthesizer ensures an accurate data clock at all inputs. For synchronization to a receiver, an external clock can be applied to ASI and SPI instead of the internal clock.







Coding and mapping for antenna according to EN300744 (DVB-T)



Coding and mapping for antenna according to ATSC Doc A/53 (8VSB)

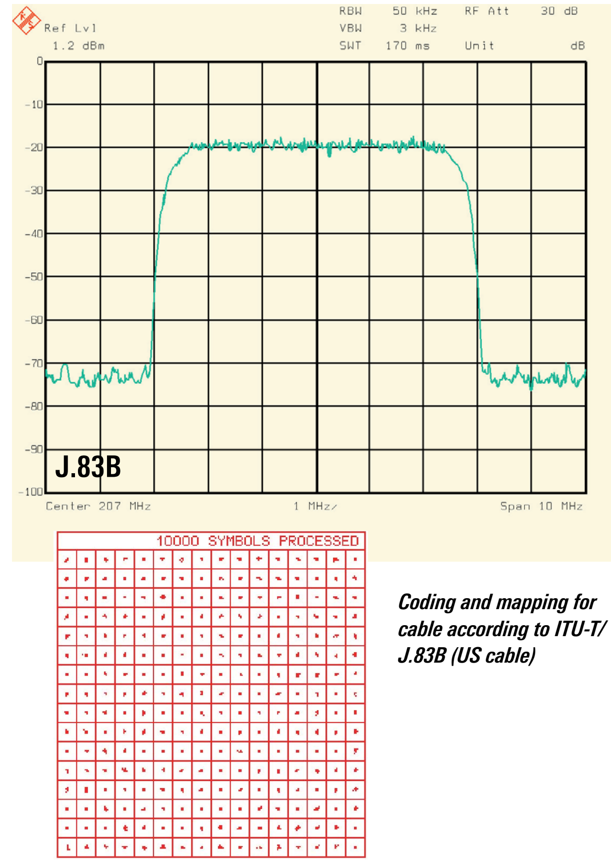
TV Test Transmitter R&S SFL

I/Q modulation

In the I/Q modulator, the orthogonal I and Q components of the RF signal are controlled in amplitude and phase by the analog I and Q signals from the coder. The two RF components are added to give an output signal that can be amplitude- and phase-modulated as required. Assignment of I and Q components can be interchanged in the R&S SFL so that an inverted RF signal is obtained. High demands are placed on the I/Q modulator, particularly regarding high-order quadrature amplitude modulation.

The internal calibration of the R&S SFL warrantes that the I and Q paths have identical gain, the phase is exactly 90° and carrier suppression is at least 50 dB.

Non-ideal behaviour of an I/Q modulator can be simulated by detuning amplitude, phase and carrier leakage in the R&S SFL. As a result, bit errors are produced that allow quality assessment of receivers and demodulators.



Coding and mapping for cable according to ITU-T/J.83B (US cable)

Specifications

The relevant data sheet is stored on the CD-ROM. /DATASHEET/SFL.PDF

Data sheet on CD-ROM

To get back here, please press ⇦ in the Acrobat Reader toolbar.

Ordering information

TV Test Transmitter		
DVB-S/-DSNG	R&S SFL-S	2084.4005.10
DVB-C	R&S SFL-C	2084.4005.15
DVB-T	R&S SFL-T	2084.4005.20
ATSC/8VSB	R&S SFL-V	2084.4005.30
J.83/B	R&S SFL-J	2084.4005.40
Options		
Noise Generator	R&S SFL-N	on request
BER Measurement	R&S SFL-K17	on request
Extras		
Documentation of R&S SFL Calibration Values	R&S SFL-DCV	2082.0490.22
Service Kit		2084.4340.02
Service Manual		2084.4128.24
19" Adapter for rackmounting	R&S ZZA-211	1096.3260.00
Matching Pads 50 Ω/75 Ω		
Matched at both ends, attenuation 5.7 dB, no DC isolation	R&S RAM	0358.5414.02
Matched at one end, attenuation 1.7 dB	R&S RAZ	0358.5714.02
Case (2 HU)	R&S ZZT-214	1109.5119.00

TV Test Transmitter R&S SFQ

0.3 MHz to 3.3 GHz

Digital signals for antenna, satellite and cable

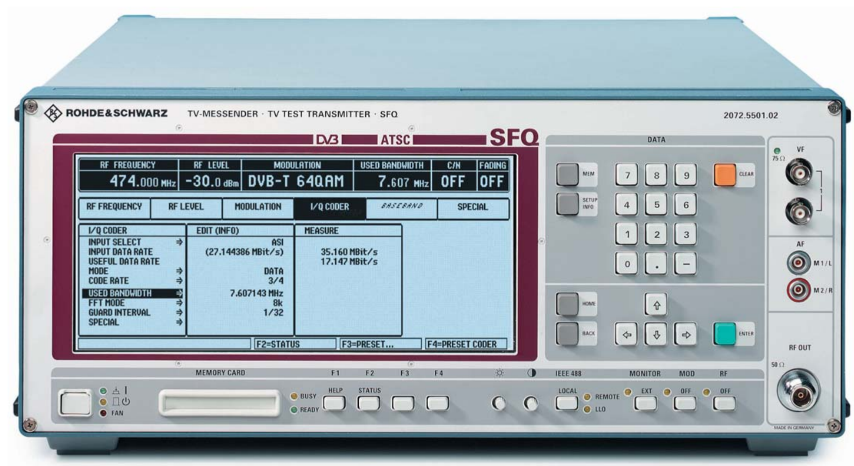


Photo 42591

Brief description

TV Test Transmitter R&S SFQ is a complete solution for testing digital TV links and receivers (set-top boxes). An open-end software system and modular hardware configuration make for future-proofness. The ETSI standards for DVB-T, DVB-S, DVB-DSNG and DVB-C as well as the ATSC/8VSB and ITU-T/J.83B (US cable) standard for DTV are fully complied with. Thanks to its adaptability to future system changes, R&S SFQ is a useful and rewarding investment for your launch onto the digital TV market.

Moreover, R&S SFQ also processes analog frequency-modulated satellite signals in line with PAL, SECAM, NTSC standards. The sound signals are transmitted using analog FM and digital ADR sound subcarriers.

The test signals produced are of high precision and comply with the standards, but can also be varied over a wide range and provided with predefined errors to determine the performance of your products at their limits. The reproducible simulation of real transmission conditions by means of the noise generator and the fading simulator enables the specification of modules under test.

Main features

- Wide output frequency range from 0.3 MHz to 3300 MHz
- Large output level range for transmission, receiver and module measurements
- Standard DVB, ATSC, ITU-T/J.83B signals and FM satellite signals
- Several standards in one unit
- Satellite FM
  - PAL, SECAM, NTSC
  - FM and ADR sound subcarrier
- Antenna DVB-T
  - 2K and 8K COFDM
  - 6/7/8 MHz bandwidth
  - Hierarchical coding
- Antenna ATSC
  - 8VSB
- Cable DVB-C
  - Selectable QAM (quadrature amplitude modulation): 16, 32, 64, 128, 256QAM
- Satellite DVB-S, DVB-DSNG, Turbo coder
  - QPSK, QPSK Turbo
  - 8PSK, 8PSK Turbo
  - 16QAM
- Internal noise generator for high-precision C/N settings
- Internal bit error measurement (BE) for all digital modulation modes (DVB-C, DVB-S, DVB-DSNG, Turbo coder, DVB-T, 8VSB)
- Internal fading simulator
  - 6 or 12 paths
  - Predefined profiles
  - User-definable profiles
- Flexible input interfaces
  - ASI
  - SPI
- Output and input for external I/Q signals

Other features

- Symbol rate 0.1 to 80 MSymbol/s
- Energy dispersal, Reed-Solomon coder and interleaver selectable
- Variable roll-off factor of pulse shaping
- Data, pseudo random bit sequence (PRBS) and null transport stream packets as modulation signal selectable
- Output level: –99 dBm to +4 dBm (CW: +13 dBm)
- Error simulation with I/Q modulation by means of defined signal distortion

TV Test Transmitter R&S SFQ

Applications

Because of its high signal quality and versatile ways of varying parameters, R&S SFQ is ideal as a source for digital terrestrial signals (DVB-T and ATSC), for testing satellite (DVB-S, DVB-DSNG, Turbo coder and FM) and digital cable links (DVB-C), as a standard-signal generator in development, as a reference in quality monitoring, EMC labs, inspection and test centers and for use in production.

The output frequency range allows R&S SFQ to be used as a back-channel generator and covers future extensions of the satellite IF range.

Operational parameters (e.g. roll-off, puncturing rate or QAM mode) can easily be varied. For laboratory applications, values outside those defined in the standard can be selected. For special measurements, it is possible to switch off i.e. interleaver, FEC, modulation, individual carriers or groups of carriers. Sweeps can be performed over the complete RF range.

The analog R&S SFQ supplies frequency-modulated satellite signals conforming to standards. Various TV standards can be selected, and up to six sound subcarriers (FM and ADR) can be integrated. In addition, external sound subcarriers can be applied. Operational parameters are in line with standards; parameters such as amplitude, frequency and deviation are variable. Signals such as noise or energy dispersal can be added. It is thus possible to test satellite links and receivers using standard signals and to check the response to nonstandard signals.

Equipment and options

The basic model 02 of R&S SFQ has to be ordered with at least one coder option, i.e. with

- R&S SFQ-B10 for DVB-T
- R&S SFQ-B21 for DVB-C
- R&S SFQ-B23 for DVB-S, DVB-DSNG and Turbo coder
- R&S SFQ-B12 for ATSC/8VSB
- R&S SFQ-B13 for ITU-T/J.83B (US cable)
- R&S SFQ-B2 for FM Modulation

DVB/VSB options

- DVB-T coder
- DVB-S, DVB-DSNG, Turbo coder
- DVB-C coder
- Hierarchical coding for DVB-T coder
- ATSC/8VSB coder
- ITU-T/J.83B coder (US cable)
- Noise generator
- Fading simulator (6 or 12 paths)
- Input interface (ASI; selectable symbol rate, precise data clock)
- BER
- I/Q output/input

Optional broadband FM modulator

- FM satellite signals to standard
- Standard for FM transmission selectable (PAL, SECAM, NTSC)
- FM sound subcarriers with internal audio generators (two sound subcarriers installed as standard)
- Input for external sound subcarriers
- Input for external FM
- Baseband output
- Option: additional FM sound subcarriers
- Option: ADR (Astra Digital Radio) sound subcarrier with internal MUSICAM generators
- Noise generator

Specifications

The relevant data sheet is stored on the CD-ROM.
/DATASHEET/SFQ.PDF

Data sheet on CD-ROM

To get back here, please press ⬅ in the Acrobat Reader toolbar.

TV Test Transmitter R&S SFQ

Ordering information

TV Test Transmitter (0.3 MHz to 3300 MHz) for

DVB-C	R&S SFQ02+	2072.5501.02
	R&S SFQ-B21	2072.8912.02
DVB-S/-DSNG	R&S SFQ02+	2072.5501.02
	R&S SFQ-B23	2072.5830.02
DVB-T, 2K/8K	R&S SFQ02+	2072.5501.02
	R&S SFQ-B10	2072.6166.02
ATSC/8VSB	R&S SFQ02+	2072.5501.02
	R&S SFQ-B12	2072.6220.02
ITU-T, J.83B (US cable)	R&S SFQ02+	2072.5501.02
	R&S SFQ-B13	2072.6243.02
Broadband FM	R&S SFQ02+	2072.5501.02
	R&S SFQ-B2	2072.6108.02

Options

Please state serial number of unit when submitting new orders for options.

Input Interface (ASI/SPI input and selectable symbol rate, SMPTE310 input), can be retrofitted	R&S SFQ-B6	2072.7679.03
DVB-T Coder, 2K/8K COFDM Modulator, 6 MHz/7 MHz/8 MHz bandwidth (for R&S SFQ delivered before1999 see R&S SFQ-B18)	R&S SFQ-B10	2072.6166.02
DVB-T/Hierarchical Coding	R&S SFQ-B16	2072.5782.02
ATSC Coder, 8VSB (HW + FW)	R&S SFQ-B12	2072.6220.02
ITU-T/J.83B (FW)	R&S SFQ-B9	2072.6143.02
ITU-T/J.83B Coder (HW + FW)	R&S SFQ-B13	2072.6243.02
ATSC/8VSB (FW)	R&S SFQ-B8	2072.6120.02
DVB-C Coder (HW + FW)	R&S SFQ-B21	2081.8912.02
DVB-C (only FW)	R&S SFQ-B22	2072.5824.02
DVB-S/-DSNG Coder (HW + FW)	R&S SFQ-B23	2072.5830.02
DVB-S/-DSNG (only FW)	R&S SFQ-B24	2072.5847.02
I/Q Output/Input	R&S SFQ-B14	2072.6266.02
Power Supply Upgrade for R&S SFQ model 10, delivered before 1999; serial number of R&S SFQ must be stated	R&S SFQ-B18	2072.7191.02
Factory-fitting of R&S SFQ-B18 to R&S SFQs delivered before 1999	R&S SFQ-U11	2072.7040.02
Fading Simulator, paths 1 to 6 (for R&S SFQ delivered before 1999 see R&S SFQ-B18)	R&S SFQ-B11	2072.6189.02
Fading Simulator, paths 7 to 12	R&S SFQ-B11	2072.6189.04
Noise Generator, can be retrofitted and calibrated	R&S SFQ-B5	2072.7579.03
BER Measurement	R&S SFQ-B17	2072.7056.02
Broadband FM Modulator for baseband (PAL, SECAM, NTSC) and FM sound (2 subcarriers)	R&S SFQ-B2	2072.6108.02
2 FM Sound Subcarriers 5 MHz to 9 MHz with 2 audio generators and 2 external audio inputs	R&S SFQ-B3	2072.7379.02
2 ADR Sound Subcarriers 0.1 MHz to 9 MHz with 2 MUSICAM generators and 1 external data input	R&S SFQ-B4	2072.7479.02

Extras

Documentation of R&S SFQ calibration values	R&S SFQ-DCV	2082.0490.12
Cable Set for diversity	R&S SFQ-Z5	2081.9158.02
Common Interface TS OUT	R&S SFQ-Z17	2081.9364.02
Service Kit	R&S SFQ-Z1	2072.5960.02
Service Manual (English)		2072.6489.22
Memory Card 10 Mbyte (Flash)		0048.5877.00
19" Adapter (4 HU) for rackmounting	R&S ZZA-94	0396.4905.00
Matching Pads 50 Ω/75 Ω, 0 Hz to 2.7 GHz, N connectors		
matched at both ends, attenuation 5.7 dB, no DC isolation	R&S RAM	0358.5414.02
matched at one end, attenuation 1.7 dB	R&S RAZ	0358.5714.02

TV Generators R&S SGPF, R&S SGSF, R&S SGMF

Brief description

With its TV Generators R&S SGxF for all traditional colour standards, Rohde & Schwarz has the right unit for any production, studio and service requirement.

Main features

- More than 30 baseband signals
- General-purpose test pattern with optional text insertion for source identification
- Signal output on the front and rear panel
- Remote control of all generator functions via IEC/IEEE bus
- Insertion test signals included in every signal
- Insertion of external test signals into the field blanking interval or application of sweep signals to the active picture area
- Use as test signal inserter with the genlock option fitted

Digital picture generation

With the PAL generator, the three components Y, C_B and C_R are stored for digital generation of the realtime composite colour video signal (CCVS).

For generation of the test signals to PAL, NTSC and SECAM, about 1000 different video lines are stored digitally and can be combined to obtain the desired pattern under program control.

Test signals

For all three generators the assignment of a test signal to a specific line can be programmed via DIP switches. Eight complete test signal configurations can be stored and recalled enabling the user to tackle any measurement task.

Output signal

The signal amplitude can be set via the IEC/IEEE bus or manually by a potentiometer. On all models separate amplifiers ensure decoupling between the front and the rear outputs.

Options

For options see ordering information. Some options cannot be retrofitted. With the genlock option for test signal insertion fitted, switchover to the selected substitution pattern is ensured in the case of program failure.

Specifications

The relevant data sheet is stored on the CD-ROM.
/DATASHEET/SGxF.PDF

Data sheet on CD-ROM

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Ordering information

TV Generator for		
PAL	R&S SGPF	2016.4049.03
SECAM	R&S SGSF	2016.7048.03
NTSC	R&S SGMF	2016.0943.03
Options		
(some options cannot be retrofitted)		
Source Identification	R&S SG.F-B1	2016.1004.02
Test Signal Insertion	R&S SGPF-B2	2016.4278.02
	R&S SGSF-B2	2016.7190.02
	R&S SGMF-B2	2016.1185.02
FuBK Test Pattern	R&S SGPF-B3	2016.4284.02
French		
FrenchFront-panel		
Labelling	R&S SGSF-B3	2016.7225.02
General-purpose Test Pattern		
of 16:9 aspect ratio	R&S SGPF-B4	2016.4290.02
Extras		
Junction Panel		
with bypass	R&S SG.F-Z	2016.1679.02
19" Adapter	R&S ZZA-91	0396.4870.00
Calibration Data		
Documentation	R&S SG.-DCV	2082.0490.04

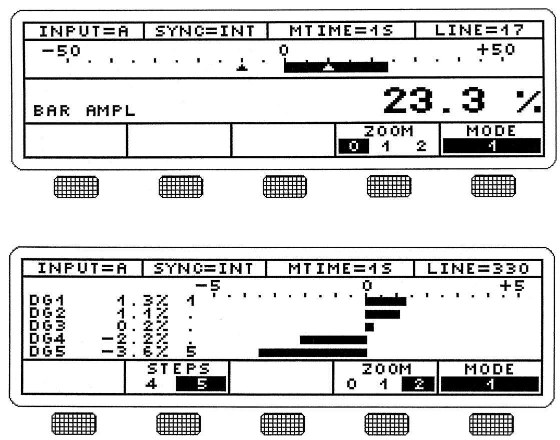
Video Analyzer R&S UAF

Standards B/G, D/K, I, M

Perfection in video analysis:

fast, precise, reliable

Photo 39139



The test results are displayed either in the form of numeric values or as a bar

Brief description

Thanks to its characteristics, Video Analyzer R&S UAF from Rohde&Schwarz meets all requirements as regards high measurement accuracy for the studio and fast measurements down to a few seconds. User-friendly operation and a clear display with graphics support afford straightforward measurements.

Main features

- 3 signal inputs
- 29 video parameters
- Limit monitoring
- Full-field measurements
- Freely selectable test signal
- Memory card, printer interface

The core of the digital section is a microprocessor plus an arithmetic coprocessor. The signal analysis comprises 29 video and test line parameters and covers all important levels as well as linear and nonlinear distortion such as 2T K rating, frequency response and hum. Optionally 50 Hz tilt, 200 ns overshoot, NICAM and dual-sound intermodulation can be measured. The position of the test lines can be freely selected over the entire picture area and in the field blanking interval; storage of up to eight test configurations is possible.

Thanks to its variable integration time, the R&S UAF can be adapted to all test conditions. Using the shortest integration time of less than 1 s, the R&S UAF is for all alignments. In the case of very noisy signals, stable results can be obtained by increasing the integration time to 2.5, 5 or 10 s.

For use in quality and production control of video recorders, the R&S UAF also handles the S-VHS component signals Y/C. Distorted test signals do not affect the operation of the R&S UAF.

Using a plug-in memory card, customer-defined test programs can be loaded and test results stored on the card. Moreover, the memory card permits storage of complete instrument setups.

Operation

The logical arrangement of the R&S UAF front-panel controls offers a clear overview of its functions and ensures ease of operation. Each parameter is assigned its own key. The associated LED above the key blinks if the limit values are exceeded.

The keypad to the left of the display permits the setup menus of the R&S UAF to be selected directly. Such a menu is inserted as a window above the normal result display. Thus it is possible to use the softkeys for changing general settings such as the input, synchronization, printer mode, etc.

The "option" function allows further test parameters, e.g. an external level or future extensions, to be called up.

Special modes are the difference and the reference measurement modes with which signal errors at the input of the device under test can be eliminated. The AUTORUN menu permits test sequences to be programmed on the R&S UAF front panel; these sequences are executed automatically and can be repeated cyclically.

Video Analyzer R&S UAF

Specifications

The relevant data sheet is stored on the CD-ROM.
/DATASHEET/UAF.PDF

Data sheet on CD-ROM

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Ordering information

Video Analyzer	Standard B/G	R&S UAF	2013.0807.02
	Standard D/K	R&S UAF	2028.5780.02
	Standard M	R&S UAF	2028.5774.02
	Standard I	R&S UAF	2028.5768.05
	Other standards	on request	
Accessories supplied		four 75 Ω Terminations RMF2, 32 Kbyte memory card	
Options			
50 Hz tilt, 200 ns overshoot		R&S UAF-B1	2028.6406.02
S/N extension			
552 kHz (NICAM)		R&S UAF-B2	2028.6412.02
242 kHz (dual sound)		R&S UAF-B3	2028.6429.02
Calibration Data Documentation		R&S UAF-DCV	2082.0490.05
Extras			
Memory card 32 Kbyte		ZZM-32	2005.4394.02
512 Kbyte		ZZM-512	2005.4388.02
Service Manual			2013.1684.24

Digital Video Component Analyzer R&S VCA, DTL Analysis R&S VCA-B11

R&S VCA: combined waveform monitor and analyzer

With R&S VCA-B11: additional jitter analysis and spectral measurements

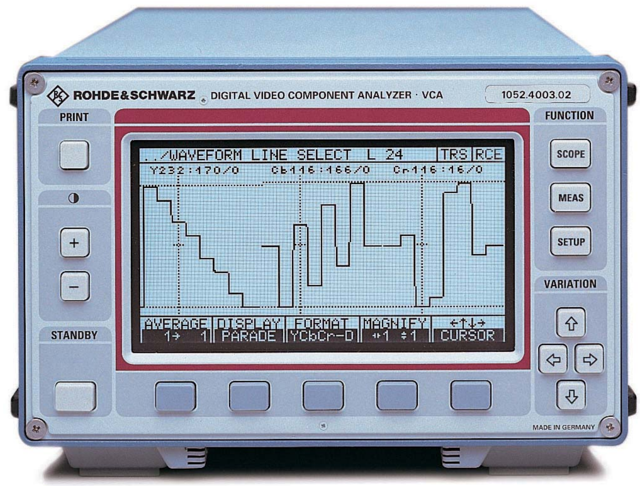


Photo 41575

Brief description

Digital Video Component Analyzer R&S VCA is designed to solve measurement problems in the digital studio, in operation and servicing as well as in the development of digital studio equipment. Combining the characteristics of a waveform monitor and an analyzer and including all conventional display modes, the R&S VCA is suit-able for a great variety of measurements and so makes working with digital video signals easy. An optional remote control unit permits the R&S VCA to be readily integrated into large measuring systems for comprehensive monitoring in the studio.

Main features

- To standards ITU-R BT. 601/656, SMPTE125M/259M, 8 bits, 10 bits, 625/525 lines
- Waveform display
- Numeric output of video data
- Analysis of data frame/contents
- Timing and level measurements
- Hardcopy of screen via external printer
- DTL analysis (optional)
- Remote control (optional)

Equipped with a digital-parallel and a digital-serial video input as well as SCOPE and MEASURE functions, R&S VCA is capable of monitoring the digital video signal at all the transfer points of a digital TV studio. Measurement results are clearly displayed on a large-size monitor. Compared to the purely visual information obtained from an oscilloscope, R&S VCA reads out precise measurement values. A graphic display facilitates evaluation of the results.

SCOPE functions

These functions allow waveforms and numerical values of the digital video signal to be analyzed.

MEASURE functions

These functions are used for monitoring and measuring live signals and for measuring special test signals. In the SCOPE mode, too, two monitoring functions are active in the background for checking the sync frame. The results of measurements on live signals are shown on the ERROR RATE display or on a new type of HISTORY display.

DTL analysis option (VCA-B11)

The DTL analysis option (digital transport layer) allows to search for the physical causes of data errors in serial-digital video signals, with signal jitter playing an important role in this respect. VCA performs jitter measurements according to the demodulator method and also supports measurements to the clock extractor method.

Specifications

The corresponding datasheet is stored on the CD-ROM.
/DATASHEET/R&S VCA.PDF

Data sheet on CD-ROM

To get back here, please press in the Acrobat Reader toolbar.

Ordering information

Digital Video Component Analyzer	R&S VCA	1052.4003.02
Options		
Remote Control (RS-232/RS-422)	R&S VCA-B1	1052.5600.02
DTL Analysis	R&S VCA-B11	1052.5800.02
SWR Bridge 5 MHz to 850 MHz	R&S VCA-Z1	1052.5900.02
Calibration Data Documentation	R&S VCA-DCV	2082.0490.06
Same for R&S VCA-B11	R&S VCA-DCV	2082.0490.07

Video Measurement System R&S VSA

DC to 9 MHz

Compact platform for video signal analysis: measurements of all relevant video parameters in the baseband, graphic and numeric result display, vector and waveform display

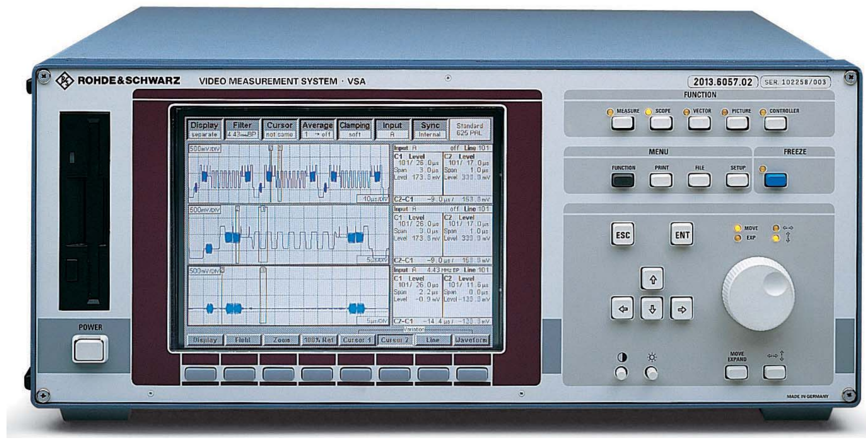


Photo 41802

Brief description

Video Measurement System R&S VSA from Rohde&Schwarz combines the functions of a video analyzer, vectorscope, oscilloscope, monitor and controller (PC) in a 19" desktop.

Fields of applications are

- laboratory and service
- automatic test and monitoring systems
- production and quality assurance

The instrument features convenient operation as well as high measurement accuracy and speed. The compact design makes it also suitable for mobile applications. Thanks to the great number of integrated functions and system interfaces the R&S VSA is an essential tool for measurements and system applications in all fields of video.

In addition to the versatile measurement capabilities provided, the modular software and hardware configuration offers sufficient capacity for future expansions.

Main features

- Four loopthrough video signal inputs with analog 9 MHz bandwidth
- DOS- and Windows-compatible PC with IEC/IEEE-bus controller
- Multitasking operating system
- Connectors for external keyboard and colour monitor
- Colour graphic LCD display
- Two serial interfaces
- SCPI remote control via IEC/IEEE or serial interface
- Printer interface
- 3.5" floppy disk drive (DOS format) for result transfer and software options
- Hard disk
- Modular design with hardware and software options

Five instruments in one

- **Video and FFT analyzer**
- Simultaneous computation of up to **150 different signal parameters**
- Automatic limit monitoring
- Automatic overall measurement of all parameters
- Individual measurements using extended test capabilities
- Test-signal and test-location display
- Standard or reference measurement for each parameter separately
- **3-channel oscilloscope**
- Simultaneous display of up to three video signals in separate displays
- Separate test input for each part display (e.g. components, RGB, YC_BC_R)
- Simultaneous display of the same signal with different time scales in up to three separate windows
- Displayed signal section variable in the x and y direction from 200 ns to 20 ms
- Digital filters for simulating signal manipulations, e.g. all CCIR filters for insertion signal measurements
- Scale automatically matched to the display
- Two cursors for each window: LEVEL, PEAK, SLOPE and PULSE functions allow analysis of complete signal elements

Video Measurement System R&S VSA

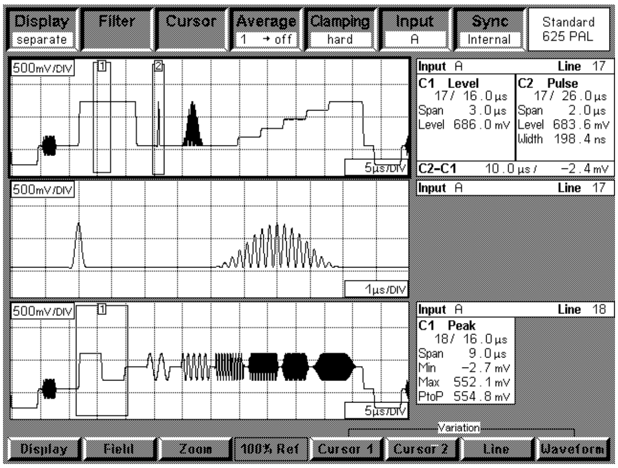


Fig. 1: With a single sin x/x measurement the result display is divided, one part showing the amplitude frequency response and the other the group delay. An info and a cursor window are assigned to each spectrum

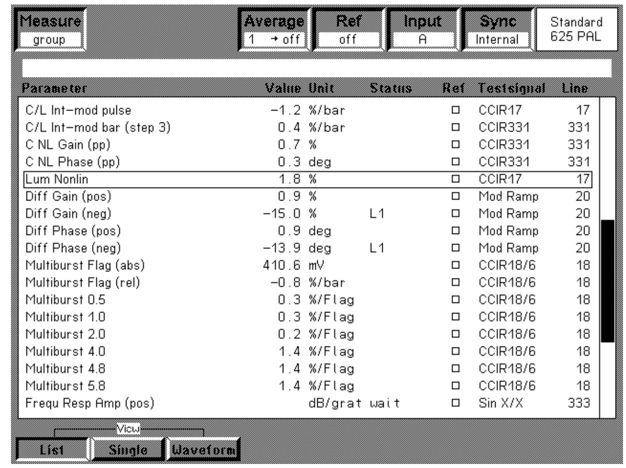


Fig. 2: In the list mode, selected video parameters and their measured values are displayed in the form of a list

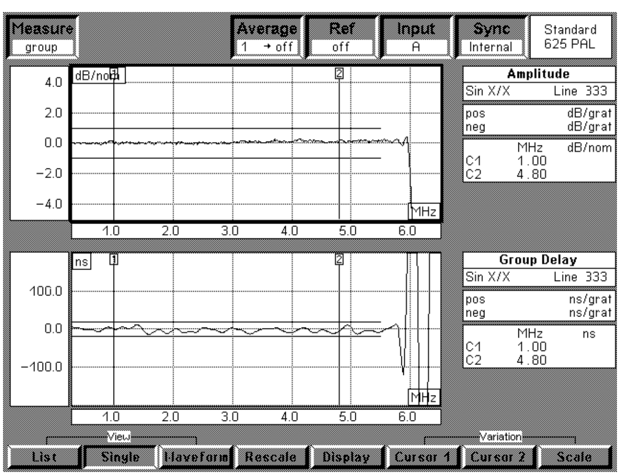


Fig. 3: In the SCOPE mode the screen is divided in a signal, an info and a cursor window. The waveform of one video signal can be displayed simultaneously in up to three windows with continuously variable time and amplitude scaling

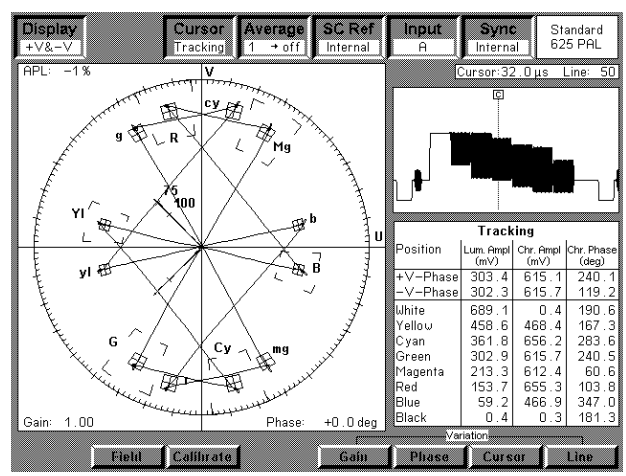
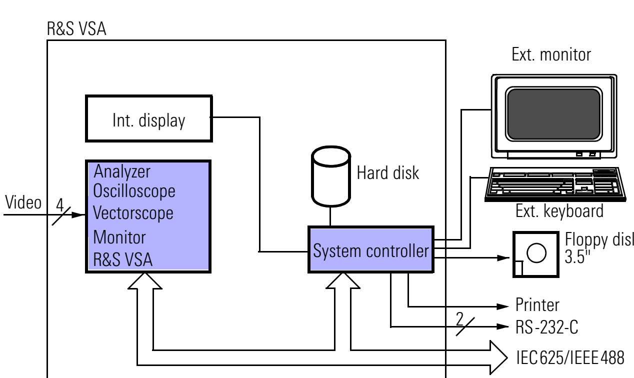


Fig. 4: In the vectorscope function the magnitude and phase of all colour parameters of a video line are shown in a graphics display; the line is also displayed in the waveform window. A cursor line in the waveform display of the video line marks the measurement time for colour subcarrier amplitude and phase. The cursor corresponds to one or two markers in the vector diagram. When the cursor line is shifted, the markers track the vector curve



Video Measurement System R&S VSA

Vectorscope
- Graphic display of all colour parameters of a video line in magnitude and phase
- Accurate measurement of phase difference of two colour signal subcarriers by alternate suppression of colour subcarrier reference
- Permanent waveform display of video line
- Automatic computation and display of all colour subcarrier amplitudes and phases when a standard colour bar signal is applied

Monitor
- Easy identification of selected video signal
- Display of a video signal as monochrome TV picture with eight grey levels
- Simultaneous display of any rollkey-selected video line of the TV picture

System controller
- Comprehensive automatic test system
- Control of external devices via IEC/IEEE bus or serial interface
- Complete PC (DOS + Windows) with integrated IEC/IEEE-bus card
- Computing and measurement functions independent of each other
- Simple switch-over between measurement display and DOS display
- VGA colour monitor and external keyboard avail-able as accessories

Specifications

The relevant data sheet is stored on the CD-ROM.
/DATASHEET/VSA.PDF

Data sheet on CD-ROM

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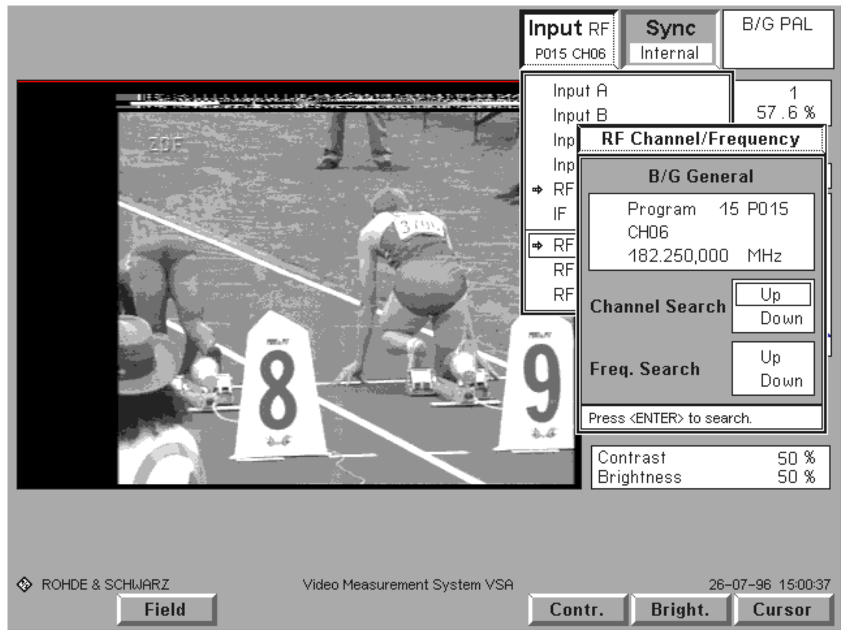
Ordering information

Video Measurement System	R&S VSA	2013.6057.04
Option		
Calibration Data Documentation	R&S VSA-DCV	2082.0490.08

TV Test Receiver Option R&S VSA-B10

47 MHz to 862 MHz

RF parameter measurement and monitoring with Video Measurement System R&S VSA



R&S VSA screen with channel setting of Test Receiver, option R&S VSA-B10

Brief description

TV Test Receiver Option R&S VSA-B10 enhances the Video Measurement System R&S VSA (page 173) for the reception and analysis of RF and IF TV signals. The system allows all important RF and VF quality parameters to be analyzed in a single unit. R&S VSA-B10 can easily be retrofitted – even on site – without calibration and level adjustment and with no problems regarding interfaces or cabling.

R&S VSA with Option R&S VSA-B10 provides the following functions:

- TV test receiver for standards B/G, I, D/K, K1
- Video and FFT analyzer
- 3-channel oscilloscope
- Vectorscope
- Monitor
- System controller

Features of R&S VSA with Option R&S VSA-B10

- RF/video analysis in a single unit
- Measurement of all relevant RF and VF quality parameters
- High-speed analysis
- No external cabling
- Easy to transport
- Little space required
- Uniform user interface for all measurement functions
- RF test parameters displayed in parameter list of R&S VSA
- Display of test receiver configuration on R&S VSA screen

R&S VSA-B10 allows measurement of the following additional parameters:

- Incidental carrier phase modulation (ICPM) of vision carrier
- Vision and sound carrier level and frequency
- Modulation depth of vision carrier (residual carrier) and sound carrier (FM deviation)
- Pilot deviation and frequency
- Pilot decoding

Features of TV test receiver

- Models with 50 Ω or 75 Ω input
- IF input and IF output
- Video and audio outputs
- Dynamic range 40 dBµV to 120 dBµV
- Low-noise and low-distortion mode
- Low-noise preamplifier can be switched on to improve noise figure of receiver

- Video S/N ratio (weighted at 66 dBµV) >56 dB
- Intercarrier S/N ratio (weighted) >46 dB
- Program, channel and frequency entry
- Channel and frequency search

TV Test Receiver Option R&S VSA-B10

- Synthesizer with low phase noise and high frequency resolution (1 Hz)
- Digital frequency control
- Manual and automatic gain control
- Integrated zero clamping for defining vision modulation depth
- Selectable synchronous detector mode with sampled or continuous phase control as well as selectable time constants
- Sound demodulation and decoding according to IRT dual-sound carrier method
- Linear distortion of video frequency response <0.5 dB (luminance/chrominance error <±20 ns)
- Video group-delay correction of receiver and sound deemphasis can be switched off
- Sound monitoring via loudspeaker of basic unit
- Very easy installation in R&S VSA

Specifications

The relevant data sheet is stored on the CD-ROM.
/DATASHEET/VSA-B10.PDF

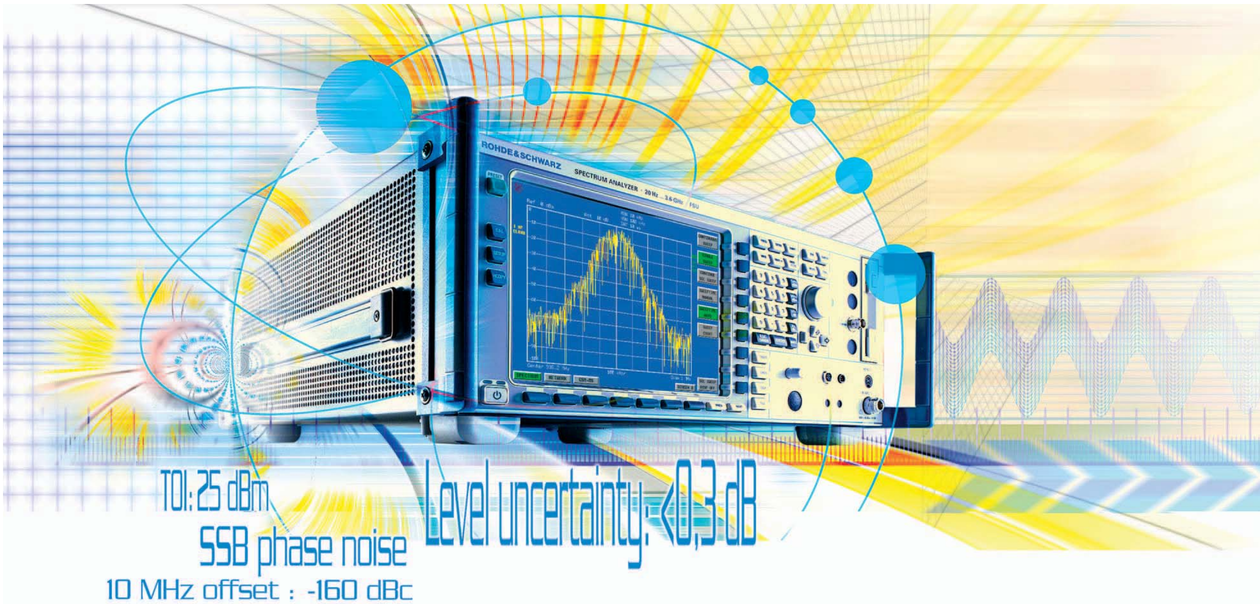
Data sheet on CD-ROM

To get back here, please press ⇐ in the Acrobat Reader toolbar.

Ordering information

TV Test Receiver Option

Standard B/G Europe, dual sound,	50 Ω	R&S VSA-B10	2014.0000.02
IF 38.9 MHz + 33.4/33.158 MHz	75 Ω	R&S VSA-B10	2014.0000.03
Standard B/G Europe, mono sound,	50 Ω	R&S VSA-B10	2014.0000.06
IF 38.9 MHz + 33.4 MHz	75 Ω	R&S VSA-B10	2014.0000.07
Standard B/G Australia, dual sound,	50 Ω	R&S VSA-B10	2014.0000.10
IF 38.9 MHz + 33.4/33.158 MHz	75 Ω	R&S VSA-B10	2014.0000.11
Standard D/K CCIR, dual sound,	50 Ω	R&S VSA-B10	2014.0000.40
IF 38.9 MHz + 32.4/32.642 MHz	75 Ω	R&S VSA-B10	2014.0000.41
Standard D/K CCIR, dual sound,	50 Ω	R&S VSA-B10	2014.0000.42
IF 38.9 MHz + 32.4/32.158 MHz	75 Ω	R&S VSA-B10	2014.0000.43
Standard D/K NICAM,	50 Ω	R&S VSA-B10	2014.0000.44
IF 32.4 MHz			
Standard I UK, mono sound,	50 Ω	R&S VSA-B10	2014.0000.70
IF 38.9 MHz + 32.9 MHz	75 Ω	R&S VSA-B10	2014.0000.71
Standard I SABC, mono sound,	50 Ω	R&S VSA-B10	2014.0000.72
IF 38.9 MHz + 32.9 MHz	75 Ω	R&S VSA-B10	2014.0000.73
Other standards on request.			
Calibration Data Documentation		R&S VSA-DCV	2082.0490.10



Contents of Chapter 4

Contents of Chapter 4

Spectrum Analyzer R&S FSU

20 Hz to 26.5 GHz

High-end spectrum analyzer with unmatched performance

New

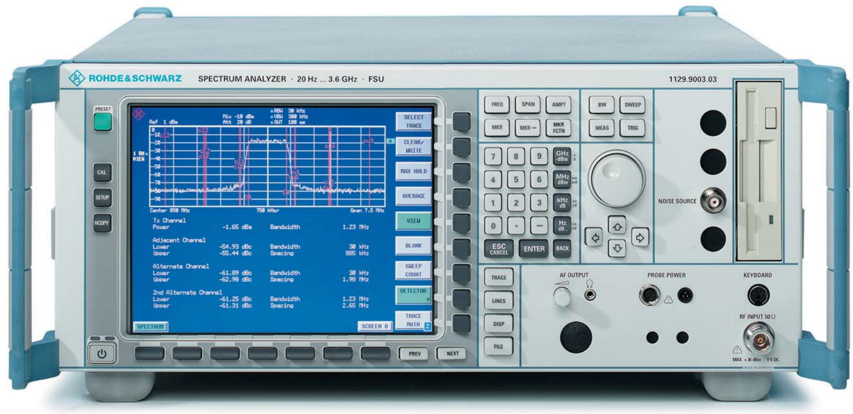


Photo 43663

Brief description

R&S FSU even surpasses the proven excellent RF data of the R&S FSE and R&S FSIQ families. Measurements calling for an extremely wide dynamic range become even simpler, faster and more reliable – in design, quality management and production. R&S FSU can rightly be called the new reference in spectrum analysis, with an unprecedented dynamic range:

- TOI >20 dBm, 25 dBm typ.
- 1 dB compression point (0 dB RF attenuation): +13 dBm
- Displayed average noise level: –158 dBm (1 Hz bandwidth)
- 77 dB ACLR (typ.) for 3GPP
- HSOI 55 dBm typ.
- Phase noise: –160 dBc (1 Hz) typ. at 10 MHz carrier offset

These characteristics make it easy to find small spurious signals even in the presence of strong carriers (e.g. at a base station). For 3GPP adjacent-channel power measurements, a figure of 84 dB ACLR allows good adjacent-channel power ratios to be verified and demonstrated very simply and with high accuracy. The high harmonic second-order intercept point means optimum dynamic range for multichannel cable TV measurements.

Main features

Even in its basic version, R&S FSU offers the functionality and characteristics needed to design, verify and produce 3G mobile radio systems

- Time-domain power in conjunction with channel or RRC filters makes R&S FSU a fully-fledged channel power meter
- Versatile channel/adjacent-channel power measurement functions with wide selection of standards, user-configurable
- CCDF measurement function
- 2.5 ms sweep time in frequency domain
- 1 µs sweep time in time domain
- Measurement points/trace selectable from 155 to 10001
- Time-selective spectrum analysis with gating function
- Fast ACP measurement in time domain
- Statistical signal analysis with CCDF function
- Transducer factor
- High speed measurements
  - Fast ACP test routine in time domain
  - User-configurable list for fast measurements at frequencies of interest
  - Up to 60 measurements/s in time domain via IEC/IEEE bus (including trace data transfer)
  - Fast time domain power measurement using channel or RRC filters
- Full choice of detectors for adaptation to a wide range of signal types
  - RMS (dynamic range 100 dB)
  - AUTO PEAK
  - MIN/MAX PEAK
  - SAMPLE
  - AVERAGE
  - QUASI PEAK (QPK)

The most versatile resolution filter characteristics and largest bandwidth found in a spectrum analyzer

- Standard resolution filters from 10 Hz to 50 MHz in steps of 1, 2, 3, 5
- 32 channel filters with bandwidth from 100 Hz to 5 MHz (DAB)
- RRC filters for NADC and TETRA
- EMI filters: 200 Hz, 9 kHz, 120 kHz
- Fast FFT filters from 1 Hz to 30 kHz

Full range of analysis functions

- TOI marker
- Noise/phase-noise marker
- Split-screen mode with selectable settings
- CCDF measurement function
- Peak list marker for fast search of all peaks within selected frequency range

Spectrum Analyzer R&S FSU

Network capability
- Option **R&S FSU-B16** Standard Network (Ethernet 10/100 BaseT)
- Operating system Windows NT
- PCAnywhere software for remote control by Ethernet
  - All elements of the R&S FSU screen are represented by a soft front panel function
  - Special RSIB interface (Windows and UNIX) links the user´s application to the TCP/IP protocol and acts like an IEC/IEEE-bus driver

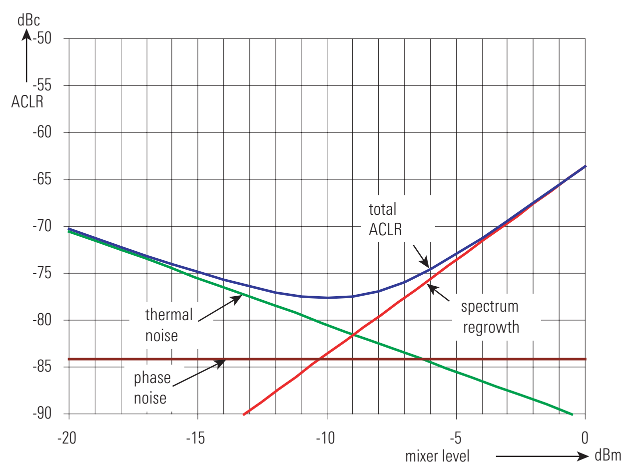
Phase Noise Measurement Software R&S FS-K4
- Automates measurement over a complete offset frequency range
- Determines residual FM from the phase noise characteristic
- No need for an extra phase noise measurement system

Noise Measurement Software FS-K3
- Convenient way to determine the noise figure of amplifiers and frequency-converting UUTs throughout the R&S FSU's frequency range

Standard 3GPP modulation and code domain power measurements
- For BTS/node B signals: Application Firmware R&S FS-K72
- For UE signals: Application Firmware R&S FS-K73
- High measurement speed of 4 s/measurement
- Code domain power and CPICH power
- EVM and PCDE
- Code domain power vs. slot
- EVM/code channel
- Spectrum emission mask

Options

GSM/EDGE modulation measurements (firmware R&S FS-K5)
- Phase/frequency error for GSM
- Modulation accuracy for EDGE with EVM and ETSI-conformant weighting filters, OOS, 95:th percentile, power versus time with synchronization to midamble, spectrum due to modulation and spectrum due to transients



R&S FSU dynamic range for adjacent-channel power measurement on WCDMA signal

Specifications in brief

Data designated "nominal" apply to design parameters and are not tested.

.

	R&S FSU3	R&S FSU8	R&S FSU26
Frequency			
Frequency range			
DC coupled	20 Hz to 3.6 GHz	20 Hz to 8 GHz	20 Hz to 26.5 GHz
AC coupled	1 MHz to 3.6 GHz	1 MHz to 8 GHz	10 MHz to 26.5 GHz
Frequency resolution	0.01 Hz		
Internal reference frequency (nominal) with standard OCXO			
Aging per day 1)	1×10^{-9}		
Total error (per year) 1)	1.8×10^{-7}		
Internal reference frequency (nominal); option R&S FS-B4			
Aging per day 1)	2×10^{-10}		
Total error (per year) 1)	5×10^{-8}		
External reference frequency	1 MHz to 20 MHz, 1 Hz steps		

	R&S FSU3	R&S FSU8	R&S FSU26
Frequency display	with marker or frequency counter		
Marker resolution	0.1 Hz to 10 kHz (dependent on span)		
Frequency counter resolution	0.1 Hz to 10 kHz (selectable)		
Frequency span	0 Hz, 10 Hz to 3.6 GHz	0 Hz, 10 Hz to 8 GHz	0 Hz, 10 Hz to 26.5 GHz
Span resolution/ max. span deviation	0.1 Hz/1 %		
Spectral purity (dBc (1 Hz)), SSB phase noise, f = 640 MHz			
Residual FM	<1 Hz nominal		
Carrier offset			
10 Hz	–73 dBc (1 Hz) typ., with option R&S FS-B4 –86 dBc typ.		
100 Hz	<–90 dBc (1 Hz), –100 dBc (1 Hz) typ.		
1 kHz	<–112 dBc (1 Hz), –116 dBc (1 Hz) typ.		
10 kHz	<–120 dBc (1 Hz), –123 dBc (1 Hz) typ.		
100 kHz	<–120 dBc (1 Hz), –123 dBc (1 Hz) typ.		
1 MHz	<–138 dBc (1 Hz), –144 dBc (1 Hz) typ.		
10 MHz	<–155 dBc (1 Hz) nominal, –160 dBc (1 Hz) typ.		

Spectrum Analyzer R&S FSU

	R&S FSU3	R&S FSU8	R&S FSU26
Sweep			
Span 0 Hz	1 µs to 16000 s in steps of 5%		
Span ≥10 Hz	2.5 ms to 16000 s in steps ≤10%		
Max. deviation of sweep time	3%		
Sampling rate	31.25 ns (32 MHz A/D converter)		
Measurement in time domain	with marker and display lines (resolution 31.25 ns)		
Resolution bandwidth			
Analog filters			
3 dB bandwidths	10 Hz to 20 MHz in 1/2/3/5 sequence, 50 MHz		
Bandwidth error			
10 Hz to 100 kHz	<3%		
200 kHz to 5 MHz	<10%		
10 MHz, 20 MHz	–30% to + 10%		
50 MHz	–30% to +10%	–30% to +10% for f<3.6 GHz –30% to +100% for f>3.6 GHz	
Shape factor –60 dB: –3 dB			
≤100 kHz	<6		
200 kHz to 2 MHz	<12		
3 MHz to 10 MHz	<7		
20 MHz, 50 MHz	<6 nominal		
Video bandwidths	1 Hz to 10 MHz in 1/2/3/5 sequence		
FFT filters			
3 dB bandwidths	1 Hz to 30 kHz in 1/2/3/5 sequence		
Bandwidth error	<5% nominal		
Shape factor –60 dB: –3 dB	<3 nominal		
EMI filters			
6 dB bandwidths	200 Hz, 9 kHz, 120 kHz		
Bandwidth error	<3% nominal		
Shape factor –60 dB : –3 dB	<6 nominal		
Channel filters			
Bandwidths	100, 200, 300, 500 Hz, 1, 1.5, 2, 2.4, 2.7, 3, 3.4, 4, 4.5, 5, 6, 8.5, 9, 10, 12.5, 14, 15, 16, 18 (RRC), 20, 21, 24.3 (RRC), 25, 30, 50, 100, 150, 192, 200, 300, 500 kHz, 1, 1.228, 1.5, 2, 3, 5 MHz		
Shape factor –60 dB : –3 dB	<2 nominal		
Bandwidth error	2% nominal		
Level			
Display range	displayed average noise level to 30 dBm		
Maximum input level			
DC voltage (AC coupling)	50 V		
DC voltage (DC coupling)	0 V		
RF attenuation 0 dB			
CW RF power	20 dBm (= 0.1 W)		
Pulse spectral density	97 dBµV/1 MHz		
RF attenuation ≥10 dB			
CW RF power	30 dBm (= 1 W)		
Max. pulse voltage	150 V		
Max. pulse energy (10 µs)	1 mWs		

	R&S FSU3	R&S FSU8	R&S FSU26
1 dB compression of input mixer (0 dB RF attenuation)	+13 dBm nominal	+13 dBm nominal up to 3.6 GHz	
	–	+10 dBm nominal from 3.6 GHz to 8 GHz	+7 dBm nominal from 3.6 GHz to 26 GHz
Intermodulation			
Third-order intermodulation (Third-order intercept (TOI), level 2 x –10 dBm, Δf >5 x RBW or 10 kHz, whichever is the greater value)			
for f = 10 MHz to 300 MHz	>17 dBm, 20 dBm typ.	>17 dBm, 20 dBm typ.	>17 dBm, 20 dBm typ.
for f = 300 MHz to 3.6 GHz	>+20 dBm, +25 dBm typ.	>+20 dBm, +25 dBm typ.	>+22 dBm, +27 dBm typ.
for f = 3.6 GHz to 8 GHz	–	>+18 dBm, +23 dBm typ.	–
for f = 3.6 GHz to 26.5 GHz	–	–	>+12 dBm, +15 dBm typ.
Second harmonic intercept point (SHI)			
f_{in} ≤100 MHz	>35 dBm		
100 MHz <f_{in} ≤400 MHz	>45 dBm, 55 dBm typ.		
400 MHz< f_{in} ≤500 Hz	>52 dBm, 60 dBm typ.		
500 MHz< f_{in} ≤1 GHz	>45 dBm, 55 dBm typ.		
1 GHz < f_{in} ≤ 1.8 GHz	>35 dBm		
f_{in} > 1.8 GHz	–	>80 dBm nominal	
Displayed average noise level			
(0 dB RF attenuation, RBW 10 Hz, VBW 30 Hz, 20 averages, trace average, span 0 Hz, termination 50 Ω)			
10 MHz to 2 GHz	<–145 dBm, –148 dBm typ.		<–142 dBm, –146 dBm typ.
2 GHz to 3.6 GHz	<–143 dBm, –147 dBm typ.	<–143 dBm, –145 dBm typ.	<–140 dBm, –143 dBm typ.
3.6 GHz to 7 GHz	<–142 dBm, –146 dBm typ.	<–142 dBm, –144 dBm typ.	–
7 GHz to 8 GHz	–	<–140 dBm	–
3.6 GHz to 8 GHz	–	–	<–142 dBm, –146 dBm typ.
8 GHz to 13 GHz	–	–	<–140 dBm, –143 dBm typ.
13 GHz to 18 GHz	–	–	<–138 dBm, –141 dBm typ.
18 GHz to 22 GHz	–	–	<–137 dBm, –140 dBm typ.
22 GHz to 26.5 GHz	–	–	<–135 dBm, –138 dBm typ.
Maximum dynamic range			
1 dB compression to DANL (1 Hz)	170 dB		
Immunity to interference			
Image frequency			
f ≤ 3.6 GHz	>90 dB, >110 dB typ.		
f >3.6 GHz	–	>70 dB, 100 dB typ.	
Intermediate frequency			
f ≤ 3.6 GHz	>90 dB, >110 dB typ.		
3.6 GHz ≤f ≤4.2 GHz	–	70 dB typ.	
f > 4.2 GHz		>70 dB, >90 dB typ.	
Spurious responses (f > 1 MHz, without input signal, 0 dB attenuation)	<–103 dBm		
Other spurious (Δf>100 kHz)			
f_{in} < 2.3 GHz	<–80 dBc (mixer level ≤ –10 dBm)		
2.3 GHz≤ f_{in}<4 GHz	<–70 dBc (mixer level ≤ –35 dBm)		
4 GHz≤f_{in} < 26.5 GHz	<–80 dBc (mixer level ≤ –10 dBm)		
Level display (spectrum mode)			
Screen	625 x 500 pixels (one diagram), max. 2 diagrams with independent settings		

Spectrum Analyzer R&S FSU

	R&S FSU3	R&S FSU8	R&S FSU26
Logarithmic level axis	1 dB, 10 dB to 200 dB in steps of 10 dB		
Linear level axis	10% of reference level per level division, 10 divisions or logarithmic scaling		
Traces	max. 6, with two diagrams on screen, max. 3 per diagram		
Trace detector	Max Peak, Min Peak, Auto Peak (normal), Sample, RMS, Average, Quasi Peak		
Trace functions	Clear/Write, Max Hold, Min Hold, Average		
Number of measurement points	625, settable between 155 and 100001 in steps of about the factor 2		
Setting range of reference level			
Logarithmic level display	–130 dBm to (+5 dBm + RF attenuation), max. 30 dBm, in steps of 0.1 dB		
Linear level display	7.0 nV to 7.07 V in steps of 1%		
Units of level axis	dBm, dBμV, dBmV, dBμA, dBpW (log level display) / μV, mV, μA, mA, pW, nW (linear level display)		
Level measurement error			
Reference error at 128 MHz, RBW ≤100 kHz, reference level –30 dBm			
RF attenuation 10 dB	<0.2 (σ = 0.07) dB		
Frequency response (DC coupling, RF attenuation ≥ 10 dB)			
10 MHz to 3.6 GHz	<0.3 dB (σ = 0.1 dB)[1)]		
3.6 GHz to 8 GHz	–	<1.5 dB (σ = 0.5 dB)[2)]	
8 GHz to 22 GHz	–	–	<2 dB (σ = 0.7 dB)
22 GHz to 26.5 GHz	–	–	<2.5 dB (σ = 0.8 dB)
Attenuator (≥5 dB)	<0.2 dB (σ = 0.07 dB)		
Reference level switching	<0.15 dB (σ = 0.05 dB)		
Display nonlinearity (20 °C to 30 °C, mixer level ≤–10 dBm)			
Logarithmic level display			
RBW ≤100 kHz, S/N >20 dB			
0 dB to –70 dB	<0.1 dB (σ = 0.03 dB)		
–70 dB to –90 dB	<0.3 dB (σ = 0.1 dB)		
10 MHz ≥ RBW ≥ 200 kHz, S/N >16 dB			
0 dB to –50 dB	<0.2 dB (σ = 0.07 dB)		
–50 dB to –70 dB	<0.5 dB (σ=0.17 dB)		
RBW ≥ 10 MHz			
0 dB to –50 dB	<0.5 dB (σ = 0.17 dB)		
Linear level display	5 % of reference level		
Bandwidth switching error (ref. to RBW = 10 kHz)			
10 Hz to 100 kHz	–		
200 kHz to 10 MHz	<0.2 dB (σ = 0.07 dB)		
5 MHz to 50 MHz	<0.5 dB (σ = 0.15 dB)		
FFT 1 Hz to 3 kHz	<0.2 dB (σ = 0.07 dB)		
Total measurement error (0 dB to –70 dB, S/N >20 dB, span/RBW <100, 95 % confidence level) (20 °C to 30 °C, mixer level ≤–10 dBm)			
<3.6 GHz	0.3 dB for RBW ≤ 100 kHz, 0.5 dB for RBW > 100 kHz		
3.6 GHz to 8 GHz	–	<2.0 dB	
8 GHz to 18 GHz	–	–	<2.5 dB
18 GHz to 26.5 GHz	–	–	<3.0 dB
Modulation modes	AM and FM		
Audio output	loudspeaker and headphones output		
Marker hold time in spectrum mode	100 ms to 60 s		

	R&S FSU3	R&S FSU8	R&S FSU26
Trigger			
Span ≥10 Hz			
Trigger source	free run, video, ext., IF level (mixer level >–20 dBm)		
Trigger offset	125 ns to 100 s, resolution 125 ns min. (or 1 % of offset)		
Span = 0 Hz			
Trigger source	free run, video, ext., IF level (mixer level >–20 dBm)		
Trigger offset	± 125 ns to 100 s, resolution 125 ns min., dependent on sweep time		
Max. deviation of trigger offset	± (125 ns + (0.1 % x delay time))		
Gated sweep			
Trigger source	external, IF level, video		
Gate delay	1 μs to 100 s		
Gate length	125 ns to 100 s, resolution min. 125 ns or 1 % of gate length		
Max. deviation of gate length	±(125 ns + (0.05 % x gate length))		
Inputs and outputs (front panel)			
RF input	N female, 50 Ω		
VSWR; RF attenuation ≥10 dB, DC coupling			
f <3.6 GHz	<1.5		
f <8 GHz	–	<2.0	<1.8
f <18 GHz	–	–	<1.8
f <26.5 GHz	–	–	<2.0
RF attenuation <10 dB or AC coupling	1.5 typ.		
Setting range attenuator	0 dB to 75 dB in 5 dB steps		
Probe power supply	+15 V DC, –12.6 V DC + ground, max. 150 mA nominal		
Power supply antennas	5-pin connector		
Supply voltages	±10 V and ground, max. 100 mA nominal		
Keyboard connector	PS/2 female for MF2 keyboard		
AF output	3.5 mm mini jack, 10 Ω, up to 1.5 V, adjustable		
Inputs and outputs (rear panel)			
IF 20.4 MHz	Z_{out} = 50 Ω, BNC female		
Bandwidth			
RBW ≤ 100 kHz	1.5 x resolution bandwidth, min. 2.6 kHz		
10 MHz ≥ RBW ≥ 200 kHz	same as resolution bandwidth		
Level			
RBW ≤ 100 kHz, FFT	–20 dBm at reference level, mixer level >–70 dBm		
10 MHz≥RBW≥ 200 kHz	0 dBm at reference level, mixer level >–50 dBm		
IF 404.4 MHz	Z_{out} = 50 Ω, BNC female; 404.4 MHz IF output active only if RBW >10 MHz		
Bandwidth			
RBW > 10 MHz	same as resolution bandwidth		
Level			
Mixer level ≤ 0 dBm	mixer level –10 dB typ., only active if RBW 20.50 MHz		
Video output	Z_{out} = 50 Ω, BNC female		
Voltage (RBW ≥200 kHz)	0 V to 1 V, full scale (open-circuit voltage), logarithmic scaling		
Ref. frequency output	BNC female, 10 MHz, >0 dBm nominal		
Ref. frequency input	BNC female		
Frequency range	1 MHz to 20 MHz in 1 Hz steps		
Required level	>0 dBm from 50 Ω		
Sweep output	BNC female, 0 V to 5 V, proportional to displayed frequency		
Power supply connector for noise source	BNC female, 0 V and 28 V, switchable, max. 100 mA		
External trigger/ gate input	BNC female, >10 kΩ		
Trigger voltage	1.4 V		

Spectrum Analyzer R&S FSU

	R&S FSU3	R&S FSU8	R&S FSU26
Remote control	interface to IEC 625-2 (IEEE 488.2)		
Serial interface	RS-232-C (COM), 9-pin Sub-D female		
Printer interface	parallel (Centronics-compatible)		
Mouse connector	PS/2 female		
External monitor (VGA)	15-pin Sub-D female		

1) Valid for temperatures between +20 °C and +30 °C; <0.6 dB for temperatures between +5 °C and +45 °C.
2) Valid for temperatures between +20 °C and +30 °C and span <1 GHz; add < 0.5 dB for temperatures between +5 °C and +45 °C or span >1 GHz.

General data

Display	21 cm TFT LCD colour display (8.4")
Resolution	800 x 600 pixels (SVGA resolution)
Pixel failure rate	$<1 \times 10^{-5}$
Mass memory	1.44 Mbyte 3½" disk drive, hard disk
Data storage	>500 instrument settings and traces
Rated temperature range	+5 °C to +40 °C
Limit temperature range	+0 °C to +50 °C
Storage temperature range	–40 °C to +70 °C
Mechanical resistance	
Vibration, sinusoidal	5 Hz to 150 Hz, max. 2 g at 55 Hz; 0.5 g from 55 Hz to 150 Hz
Vibration, random	10 Hz to 100 Hz, acceleration 1 g (rms)
AC power supply	100 V AC to 240 V AC, 3.1 A to 1.3 A, 50 to 400 Hz
Power consumption	140 VA typ.
Dimensions (W x H x D)	435 mm x 192 mm x 460 mm
Weight	15 kg

Optional Extended Environmental Specification R&S FSU-B20

Temperature range (without condensation)

Rated temperature range	0 °C to +50 °C
Limit temperature range	0 °C to +55 °C
Mechanical resistance	
Vibration, random	10 Hz to 300 Hz, acceleration 1.9 g (rms)

Optional Electronic Attenuator R&S FSU-B25

Electronic attenuator	0 dB to 30 dB, 5 dB steps
Preamplifier	20 dB, switchable
Maximum level measurement error	
Frequency response, with preamplifier or electronic attenuator	
10 MHz to 50 MHz	<1 dB
50 MHz to 3.6 GHz	<0.6 dB
3.6 GHz to 8 GHz	<2.0 dB
Reference error at 128 MHz, RBW ≤100 kHz, reference level –30 dBm, RF attenuation 10 dB	
Electronic attenuator	<0.3 dB
Preamplifier	<0.3 dB
Displayed average noise level (RBW=1 kHz, VBW=3 kHz, zero span, sweep time 50 ms, 20 averages, mean marker, normalized to 10 Hz RBW, preamplifier on)	
10 MHz to 2.0 GHz	<–152 dBm
2.0 GHz to 3.6 GHz	<–150 dBm
3.6 GHz to 8.0 GHz	<–147 dBm
Intermodulation (third-order intermodulation, third-order intercept (TOI), electronic attenuator on, $\Delta f > 5 \times$ RBW or 10 kHz)	
10 MHz to 300 MHz	>17 dBm
300 MHz to 3.6 GHz	>20 dBm
3.6 GHz to 8 GHz	>18 dBm

Ordering information

Spectrum Analyzer

20 Hz to 3.6 GHz	R&S FSU3	1129.9003.03
20 Hz to 8 GHz	R&S FSU8	1129.9003.08
20 Hz to 26.5 GHz	R&S FSU26	1129.9003.26

Accessories supplied

Power cable, operating manual, service manual; R&S FSU26: test port adapter with 3.5 mm female (1021.0512.00) and N female (1021.0535.00) connector

Options

Delete Manual	R&S FSU-B0	1144.9998.02
Highly Accurate Reference Frequency	R&S FSU-B4	1144.9000.02
External Generator Control	R&S FSP-B10	1129.7246.02
LAN Interface100BT	R&S FSU-B16	1144.9498.02
Removable Hard Disk	R&S FSU-B18 1)	1145.0242.02
Second Hard Disk for R&S FSU-B18	R&S FSU-B19 2)	1145.0394.02
Extended Environmental Specification	R&S FSU-B20 3)	1155.1606.04
Electronic Attenuator, 0 dB to 30 dB, with integrated 20 dB preamplifier	R&S FSU-B25	1144.9298.02

Software

Noise Measurement Software	R&S FS-K3	1057.3028.02
Phase Noise Measurement Software	R&S FS-K4	1108.0088.02
GSM/EDGE Application Firmware	R&S FS-K5	1141.1496.02
FM Measurement Demodulator	R&S FS-K7	1141.1796.02
3GPP BTS/Node B FDD Application Firmware	R&S FS-K72	1154.7000.02
3GPP-FDD UE Transmitter Test	R&S FS-K73	1154.7252.02
Bluetooth Application Firmware	R&S FS-K8	1141.2568.02
cdma2000 Base Station Test Application Firmware	R&S FS-K82	on request
Service Kit	R&S FSU-Z1	1145.0042.02

1) Factory installation only.
2) Not with R&S FSU-B20.
3) Not with R&S FSU-B18/-B19.

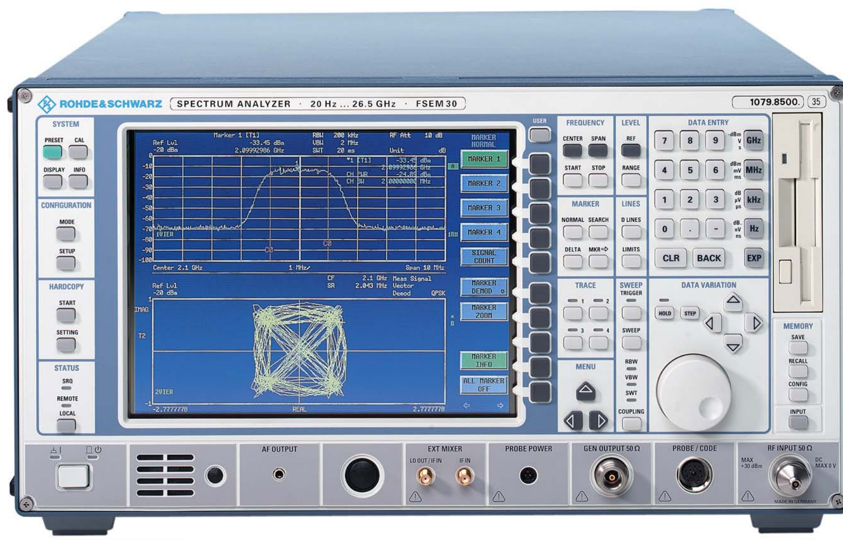
Extras

Microwave Measurement Cable with Adapter Set (for R&S FSU26 only)	R&S FSE-Z15	1046.2002.02
Headphones	–	0708.9010.00
US Keyboard with trackball	R&S PSP-Z2	1091.4100.02
PS/2 Mouse	R&S FSE-Z2	1084.7043.02
Colour Monitor, 17", 230 V	R&S PMC3	1082.6004.04
IEC/IEEE-Bus Cable, 1 m	R&S PCK	0292.2013.10
IEC/IEEE-Bus Cable, 2 m	R&S PCK	0292.2013.20
19" Rack Adapter	R&S ZZA-411	1096.3283.00
Adapter for mounting on telescopic rails (only with 19" Adapter ZZA-411)	R&S ZZA-T45	1109.3774.00
Matching Pads, 75 Ω		
L Section	R&S RAM	0358.5414.02
Series Resistor, 25 Ω	R&S RAZ	0358.5714.02
SWR Bridge, 5 MHz to 3000 MHz	R&S ZRB2	0373.9017.52
SWR Bridge, 40 kHz to 4 GHz	R&S ZRC	1039.9492.52
High-Power Attenuators, 100 W, 3/6/10/20/30 dB	R&S RBU 100	1073.8820.XX (XX=03/06/10/ 20/ 30)
High-Power Attenuators, 50 W 3/6/10/20/30 dB	R&S RBU 50	1073.8895.XX (XX=03/06/10/ 20/ 30)
20 dB, 6 GHz	R&S RDL 50	1035.1700.52

Spectrum Analyzers R&S FSEA, R&S FSEB, R&S FSEM, R&S FSEK

20 Hz to 40 GHz

High-performance analyzers for digital mobile radio and universal applications



R&S FSEM30 (photo 43421-2)

Brief description

R&S FSEA, R&S FSEB, R&S FSEM and R&S FSEK are advanced, high-speed and high-performance analyzers tailored to the requirements of modern digital communication systems. They can also be used as general-purpose analyzers for many applications. High measurement speed, modular design and excellent technical features make for an excellent price/performance ratio.

In addition to measurement functions for digital communication systems, such as 1 µs sweep time in ZERO SPAN mode, pretrigger and trigger delay, gated sweep and adjacent-channel power measurement, these spectrum analyzers feature a wide dynamic range, a very low measurement uncertainty of 1 dB and a low-noise synthesizer.

R&S FSE analyzers have low inherent noise and a wide dynamic range, so that for instance measurement of GSM power ramps is no problem.

An extremely wide intermodulation-free dynamic range of 105 dB (with 10 Hz resolution bandwidth) ensures reliable measurements on highly linear amplifiers as well as correct analysis of broadband complex signals. From the available frequency ranges, the basic models 20 and the high-performance models 30 the right instrument can be chosen for every application. Models 20 can easily be upgraded to give almost the full range of functions of models 30.

To ensure correct measurement of time variants or pulse-modulated signals, the R&S FSE features digital resolution filters (1 Hz to 1 kHz) with a response corresponding to that of analog filters. It additionally provides FFT bandwidths from 1 Hz to 1 kHz (models 30 or models 20 + R&S FSE-B5).

Main features

- Resolution bandwidths 1 Hz (up to 10 MHz), adjustable in steps of 1/2/3/5
- Displayed noise floor down to –150 dBm (R&S FSEA, RBW 10 Hz)
- 3rd-order intercept point +18 dBm typ. (R&S FSEA) 1 dB compression point of RF input +10 dBm
- Phase noise at 10 kHz from carrier: –123 dBc (1 Hz) typ. (R&S FSEA)
- Intermodulation-free dynamic range 105 dB (RBW 10 Hz)
- Total measurement uncertainty up to 1 GHz: <1 dB
- Headphones connector and built-in loudspeaker for AM/FM
- Internal RF trigger for GATED SWEEP measurements
- High speed:
  - FULL SPAN sweep time is 5 ms (for R&S FSEA or R&S FSEB) with a fully synchronized sweep – added speed is not at the expense of frequency accuracy but even enhances it
  - Shortest ZERO SPAN sweep time is 1 µs (100 ns/div) – ideal for high-resolution measurements on pulse edges
  - More than 20 sweeps/s – an optimal prerequisite for fast alignments or applications in production

Spectrum Analyzers R&S FSEA, R&S FSEB, R&S FSEM, R&S FSEK

From AF to microwave

R&S FSEM/K 30 open up the microwave range through to 26.5/40 GHz and retain the excellent characteristics of the 3.5 GHz and 7 GHz basic models:

- Continuous full-span sweep
- Fundamental mixing, low noise floor as well as wide dynamic range up to 26.5 GHz
- Fully synchronized sweep with high frequency accuracy even for FULL SPAN (26.5/40 GHz)
- RF input adapters for N or PC 3.5-mm, or K connector (R&S FSEM or R&S FSEK)

Option R&S FSE-B21 allows frequency range extension of R&S FSEM and R&S FSEK by means of external mixers. Mixers R&S FS-Z60/-Z75/-Z90/-Z110 (up to 110 GHz) are available as extras. Continuous automatic signal identification, which is used to suppress unwanted image frequency bands and mixture products, ensures fast and easy measurements. Due to the built-in diplexer, two-port as well as three-port mixers can be used.

Measurement functions

- Up to 8 markers
- Marker functions for the direct measurement of
  - phase noise and phase power density
  - NEXT MIN/PEAK, NEXT MIN/PEAK RIGHT, NEXT MIN/PEAK LEFT
- Frequency counter with selectable resolution
- LOW NOISE, NORMAL and LOW DISTORTION modes to cater for low-intermodulation and low-noise operation
- Measuring curves printout in background operation or file saving in standard graphic formats
- Simultaneous display of four traces
- Selectable colour setup
- Numerous level and frequency lines
- Split-screen display with independent windows
- Frequency zoom
- Limit lines
- User-configurable menu and keyboard macros
- Adjacent-channel power measurement for up to 7 channels
- RMS detector

R&S FSE works as a Controller

The optional Controller R&S FSE-B15 provides a further VGA card, a memory extension to 64 Mbyte, a serial mouse and a keyboard. With this option, Windows®-NT applications, e.g. statistics programs or spreadsheet analysis, can be installed on R&S FSE. R&S FSE can even be linked to a network using the optional Ethernet Interface R&S FSE-B16.

Complete setups, traces, limit lines and macros can be stored non-volatile on the internal hard disk or on diskette with the built-in 1.44-Mbyte drive.

Operation

A combination of hardkeys and softkeys makes for extremely fast and easy operation. The operating convenience based on a wide variety of evaluation routines and marker functions can be accessed via the menus. There are no complicated tree structures by using menus of lateral structure and fixed control keys. Complete setups and traces, limit lines as well as macros can be stored on the hard disk or on floppy disks.

Overview of configurations and options

The analyzers of the R&S FSE family are of modular design throughout. In the table below the right solution tailored to the needs of the various applications can be found.

Designation, characteristics (hardware)	Type	Order No.	R&S FSEA	R&S FSEB	R&S FSEM	R&S FSEK
Vector Signal Analyzer: Demodulation of digitally modulated signals	R&S FSE-B7	1066.4317.02	❍	❍	❍	❍
Tracking Generator (9 kHz to 3.5 GHz)	R&S FSE-B8	1066.4469.02	❍	–	–	–
Tracking Generator with I/Q Modulator (9 kHz to 3.5 GHz)	R&S FSE-B9	1066.4617.02	❍	–	–	–
Tracking Generator (9 kHz to 7 GHz)	R&S FSE-B10	1066.4769.02	–	❍	–	❍
Tracking Generator with I/Q Modulator (9 kHz to 7 GHz)	R&S FSE-B11	1066.4917.02	–	❍	–	❍

Spectrum Analyzers R&S FSEA, R&S FSEB, R&S FSEM, R&S FSEK

Designation, characteristics (hardware)		Type	Order No.	R&S FSEA	R&S FSEB	R&S FSEM	R&S FSEK
Switchable Attenuator for Tracking Generators R&S FSE-B8/9/10/11 (0 dB to 70 dB)		R&S FSE-B12	1066.5065.02	❍	❍	–	❍
1-dB Attenuator		R&S FSE-B13[1)]	1119.6499.02	❍	❍	❍	❍
Controller inclusive Mouse and Keyboard		R&S FSE-B15[3)]	1073.5696.06	❍	❍	❍	❍
Ethernet Interface	AUI connector, 15 poles Thin-wire connector, BNC RJ-45 connector (Twisted Pair)	R&S FSE-B16[2)]	1073.5973.02 1073.5973.03 1073.5973.04	❍	❍	❍	❍
2nd IEC/IEEE Bus Interface		R&S FSE-B17[2)]	1066.4017.02	❍	❍	❍	❍
Exchangeable Hard Disk		R&S FSE-B18[3)]	1088.6993.02	❍	❍	❍	❍
2nd Hard disk drive for R&S FSE-B18		R&S FSE-B19	1088.7288.22	❍	❍	❍	❍
External Mixer		R&S FSE-B21	1084.7243.02	–	–	❍	❍
Increased Level Accuracy up to 2 GHz		R&S FSE-B22[3)]	1073.5544.02	❍	❍	❍	❍
Broadband Output 741,4 MHz		R&S FSE-B23[3)]	1088.7348.02	❍	❍	❍	❍
44 GHz Frequency Range Extension for R&S FSEK (factory-fitted only)		R&S FSE-B24	1106.3680.02	–	–	–	❍

1) Cannot be retrofitted in R&S FSEM20/R&S FSEK20, in conjunction with option R&S FSE-B22 only factory-fitted.

2) Options R&S FSE-B16 and R&S FSE-B17 require option R&S FSE-B15.

3) Factory-fitted only.

● Fitted in basic model ❍ Option

Designation	Type	Use	Functions
Noise Measurement Software	FS-K3	Noise figure measurements	Measurement of noise figure and temperature to Y-factor method Measurements on frequency converting devices Frequency range same as basic unit, starting from 100 kHz Editor for ENR tables Runs under Windows NT on the internal controller (option) or on an external PC
Phase Noise Measurement Software	FS-K4	Phase noise measurements	Easy to use phase noise measurements Measurement of residual FM an PM Logarithmic plot over 8 decades Runs under Windows NT on the internal controller (option) or on an external PC
Application Firmware	R&S FSE-K10, Mobile R&S FSE-K11, BTS	Mobile radio, transmitter measurements to GSM standards 11.10 and 11.20	Power ramp and power template Spectrum due to modulation/switching Spurious emissions Mean carrier power Phase/frequency error (with option R&S FSE-B7)
Application Firmware Extension	R&S FSE-K20 R&S FSE-K21		EDGE mobile station test EDGE base station test
Application Firmware Extension	R&S FSE-K30 R&S FSE-K31		850-MHz GSM mobile station test 850-MHz GSM base station test

Spectrum Analyzers R&S FSEA, R&S FSEB, R&S FSEM, R&S FSEK

Model-dependent specifications in brief

Frequency	R&S FSEA 30	R&S FSEB 30	R&S FSEM 30	R&S FSEK 30
Frequency range	20 Hz to 3.5 GHz	20 Hz to 7 GHz	20 Hz to 26.5 GHz	20 Hz to 40 GHz
Refer. frequency (aging)	2 x 10^{-7}/year	2 x 10^{-7}/year	2 x 10^{-7}/year	2 x 10^{-7}/year
Spectral purity				
SSB phase noise, referred to 1 Hz bandwidth, f ≤500 MHz				
100 Hz 1)	<–87 dBc	<–81 dBc	<–81 dBc	<–81 dBc
1 kHz 1)	<–107 dBc	<–100 dBc	<–100 dBc	<–100 dBc
10 kHz 1)	<–120 dBc	<–114 dBc	<–114 dBc	<–114 dBc
100 kHz 2)	<–119 dBc	<–113 dBc	<–113 dBc	<–113 dBc
1 MHz 2)	<–138 dBc	<–132 dBc	<–132 dBc	<–132 dBc
Resolution bandwidths				
3 dB bandwidths	1 Hz to 10 MHz	1 Hz to 10 MHz	1 Hz to 10 MHz	1 Hz to 10 MHz
Steps	1/2/3/5	1/2/3/5	1/2/3/5	1/2/3/5
Shape factor 60 : 3 dB (1 kHz to 2 MHz)	<12	<12	<12	<12
Video bandwidths	1 Hz to 10 MHz	1 Hz to 10 MHz	1 Hz to 10 MHz	1 Hz to 10 MHz
Steps	1/2/3/5	1/2/3/5	1/2/3/5	1/2/3/5
Level				
Displayed noise floor, average level (10 Hz bandwidth, 0 dB RF attenuation, VBW = 1 Hz, no signal at RF input)				
20 Hz	–80 dBm	–74 dBm	<–74 dBm	<–74 dBm
1 kHz	–110 dBm	–104 dBm	<–104 dBm	<–104 dBm
10 kHz	–125 dBm	–119 dBm	<–119 dBm	<–119 dBm
100 kHz	–135 dBm	–129 dBm	<–129 dBm	<–129 dBm
1 MHz	<–145 dBm, –150 dBm typ.	<–142 dBm, –145 dBm typ.	<–142 dBm, –145 dBm typ.	<–142 dBm, –145 dBm typ.
10 MHz to 3.5/6 GHz	<–145 dBm, –150 dBm typ.	<–142 dBm, –147 dBm typ.	<–138 dBm, –140 dBm typ.	<–138 dBm, –140 dBm typ.
6 GHz to 7 GHz	—	<–139 dBm	<–135 dBm, –138 dBm typ.	<–135 dBm, –138 dBm typ.
7 GHz to 18 GHz	—	—	<–138 dBm, –140 dBm typ.	<–138 dBm, –140 dBm typ.
18 GHz to 26.5 GHz	—	—	<–135 dBm, –138 dBm typ.	<–135 dBm, –138 dBm typ.
26.5 GHz to 30 GHz	—	—	—	<–120 dBm, –125 dBm typ.
30 GHz to 40 GHz	—	—	—	<–116 dBm, –122 dBm typ.
Max. dynamic range	1 Hz bandwidth	1 Hz bandwidth	1 Hz bandwidth	1 Hz bandwidth
Displayed noise floor at 1 dB compression	165 dB	162 dB	160 dB	160 dB
Max. intermodulation-free range				
50 MHz to 3.5 GHz	115 dB	—	—	—
100 MHz to 26.5 GHz	—	115 dB	112 dB	112 dB
Total measurement uncertainty (0 to 50 dB below reference level, span/RBW <100, rss 95% reliability)				
<1 GHz	<1 dB			
1 GHz to 3,5/7 GHz	<1,5 dB			
Intermodulation				
3rd-order intermod., intermodulation-free dynamic range, level 2 × –20 dBm, Δf >5 × RBW or 10 kHz, whichever is the greater value	>64 dBc for f >50 MHz (T.O.I. >12 dBm, 18 dBm typ.)	>70 dBc for f >150 MHz (T.O.I. ≥15 dBm, 20 dBm typ.)	>74 dBc for f >100 MHz >60 dBc for f >7 GHz (T.O.I. ≥17 dBm, 22 dBm typ.; >10 dBm for f >7 GHz)	
Intermodulation-free range at –40 dBm mixer level	105 dB			
Intercept point k2 (dBm)	>25, >40 typ. for f <50 MHz, >45, >50 typ. for f >50 MHz		>25 for f <150 MHz, >35 typ. >40 for f >150 MHz, >45 typ.	

1) Models 20: valid for span ≤50 kHz, RBW <1 kHz.

2) Valid for span >100 kHz.

Spectrum Analyzers R&S FSEA, R&S FSEB, R&S FSEM, R&S FSEK

Common specifications in brief

Frequency

Frequency display	with marker
Resolution	0.1 Hz to 10 kHz (depending on span)
Frequency counter	measures the marker frequency
Resolution	0.1 Hz to 10 kHz (selectable)
Display range of frequency axis	0 Hz, 10 Hz to full span
Sweep time	
Display range	0 Hz: 1 µs to 2500 s ≥10 Hz: 5 ms to 16000 s
Picture refresh rate	>20 updates/s with 1 trace >15 updates/s with 2 traces
Sampling rate	50 ns (20 MHz A/D converter)
Sweep trigger	free run, single, line, video, gated, delayed, external
Zero span	additionally pretrigger, posttrigger, trigger delay

Level

Display range	noise floor displayed to 30 dBm
Max. input level	
RF attenuation 0 dB/≥10 dB	
DC voltage	0 V
CW RF power	20 dBm (= 0.1 W)/30 dBm (= 1 W)
Pulse spectral density	97 dBµV/MHz
Max. pulse energy (10 µs)	1 mWs/R&S FSEM/K: 0.5 mWs (RF attenuation ≥10 dB)
Max. pulse voltage (RF attenuation ≥10 dB)	R&S FSEA/B: 150 V, R&S FSEM/K: 50 V
1 dB compression of input mixer (0 dB RF attenuation)	+10 dBm nominal
Max. harmonics suppression	90 dB (f >50 MHz)
Level display	
Trace	500 × 400 pixels (one diagram)
Log level axis	10 to 200 dB in 10 dB steps
Linear level axis	10% of reference level per level division, 10 divisions
Setting range of reference level	
Log level display	–130 to +30 dBm in 0.1 dB steps
Linear level display	7 nV to 7.07 V in 1% steps
Units of level axis	dBm, dBµV, dBµA, dBpW (log level display); mV, µV, mA, µA, pW, nW (linear level display)
Pulse amplitude accuracy (single pulses)	
Bandwidth <1 MHz	0.5 dB nominal
≥1 MHz	2 dB nominal

Trigger function

Trigger	free run, line, video, RF, external
Delayed sweep	
Trigger source	free run, line, external, video
Delay time	100 ns to 10 s, 1 µs
Delayed sweep time	2 µs to 1000 s
Gated sweep	
Trigger source	external, RF level
Gate delay	1 µs to 100 s
Gate length	1 µs to 100 s, resolution 1 µs

Demodulation

Modulation modes	AM and FM
Audio output	loudspeaker and headphones output
Marker stop time	100 ms to 60 s

1 dB Attenuator	R&S FSE-B13
Frequency range	max. 7 GHz (stop frequency ≤7 GHz)
Setting range of RF attenuation	0 dB to 70 dB
Step width	1 dB
Additional attenuator uncertainty	<0.1 dB

External Mixer R&S FSE-B21

LO output/IF input (front panel)	SMA female, 50 Ω
LO signal	7.5 GHz to 15.2 GHz
Level	+15.5 dBm ±3 dB
IF signal	741.4 MHz
Full level	–20 dBm
Level measurement uncertainty	<1 dB
IF input (front panel)	SMA female, 50 Ω
Frequency	741.4 MHz
Full level	–20 dBm
Level measurement uncertainty	<1 dB

Inputs and outputs (front panel)

RF input	N female, 50 Ω (R&S FSEA/R&S FSEB), Microwave Adapter System (R&S FSEM/K)
VSWR (RF attenuation >10 dB), f <3.5 GHz	<1.5
Attenuator	0 to 70 dB, selectable in 10 dB steps
Probe power	+15 V/–12.6 V (DC) and ground, ≥150 mA
Power supply and coding connector for antennas etc (antenna code)	12-contact Tuchel connector
Supply voltages	±10 V, max. 100 mA, ground
AF output	jack, adjustable up to 1.5 V (Z_{in} = 10 Ω)

Inputs and outputs (rear panel)

IF 21.4 MHz	BNC female 50 Ω, bandwidth >1 kHz or resolution bandwidth
Level	0 dBm at reference level, mixer level >–60 dBm
Video output	BNC female 50 Ω, 0 to 1 V (open-circuit voltage)
Reference frequency	
Output, usable as input	BNC female 10 MHz, 10 dBm nominal
Input	1/ to /16 MHz, >0 dBm into 50 Ω
Sweep output	BNC female, 0 to 10 V, proportional to displayed frequency
Noise source connector	BNC female, 0/28 V, switch-selected
Ext. trigger/gate input	BNC, –5/+5 V, adjustable
IEC/IEEE bus control	interface to IEC625-2 (IEEE488.2), Command set SCPI 1994.0
Serial interface	RS-232-C interface (COM1 and COM2), 9-contact female connectors
Mouse interface	PS/2-compatible
Plotter [1]	via IEC/IEEE bus or RS-232-C, HP-GL
Printer interface	parallel (Centronics) or serial (RS-232-C)
Keyboard connector	5-contact female for MF2 keyboard
User interface	25-contact Cannon female
Connector for external monitor (VGA)	15-contact female

General data

Display (640 × 480)	24 cm colour LCD (9.5")
Mass memory	3½", 1.44 MByte; hard disk
Power supply, AC	100 to 120 V: 50 Hz to 400 Hz 200 to 240 V: 50 Hz to 60 Hz
Power consumption	170 to 230 VA (depending on model)
Dimensions (W × H × D; 5 HU)	
Models 20	435 mm × 236 mm × 460 mm
Models 30	435 mm × 236 mm × 570 mm
Weight	21.5 to 25,8 kg (depending on model)

Spectrum Analyzers R&S FSEA, R&S FSEB, R&S FSEM, R&S FSEK

Ordering information

Spectrum Analyzer	R&S FSEA30	1065.6000.35
	R&S FSEB30	1066.3010.35
	R&S FSEM30	1079.8500.35
	R&S FSEK30	1088.3494.35
Options		
Low Phase Noise and OCXO (for models 20)	R&S FSE-B4	1073.5396.02
Vector Signal Analyzer	R&S FSE-B7	1066.4317.02
Tracking Generator 3.5 GHz	R&S FSE-B8	1066.4469.02
Tracking Generator 3.5 GHz with I/Q Modulator	R&S FSE-B9	1066.4617.02
Tracking Generator 7 GHz	R&S FSE-B10	1066.4769.02
Tracking Generator 7 GHz with I/Q Modulator	R&S FSE-B11	1066.4917.02
Switchable Attenuator for Tracking Generator	R&S FSE-B12	1066.5065.02
1 dB Attenuator	R&S FSE-B13 [2)]	1119.6499.02
Controller for R&S FSE (mouse and keyboard included (English)	R&S FSE-B15 [1)]	1073.5696.06
Ethernet Interface		
15-contact AUI connector	R&S FSE-B16 [2)]	1073.5973.02
Thin-wire BNC connector	R&S FSE-B16 [2)]	1073.5973.03
RJ-45 connector	R&S FSE-B16 [2)]	1073.5973.04
2nd IEC/IEEE bus Interface for R&S FSE	R&S FSE-B17 [2)]	1066.4017.02
Removable Hard Disk	R&S FSE-B18 [2)]	1088.6993.02
Second Hard Disk for R&S FSE-B18 (firmware included)	R&S FSE-B19	1088.7248.02
External Mixer	R&S FSE-B21	1084.7243.02
Increased Level Accuracy up to 2 GHz	R&S FSE-B22 [3)]	1106.3480.02
Broadband Output 741.4 MHz	R&S FSE-B23 [3)]	1088.7348.02
44 GHz Frequency Range Extension for R&S FSEK	R&S FSE-B24 [3)]	1106.3680.02
Software		
Noise Measurement Software, Windows	R&S FS-K3	1057.3028.02
Phase Noise Measurement Software, Windows	R&S FS-K4	1108.0088.02
GSM Application Firmware, Mobile	R&S FSE-K10	1057.3092.02
GSM Application Firmware, BTS	R&S FSE-K11	1057.3392.02
EDGE Application Firmware, Mobile	R&S FSE-K20 [4)]	1106.4086.02
EDGE Application Firmware, BTS	R&S FSE-K21 [4)]	1106.4186.02
850-MHz GSM Application Firmware Extension, Mobile	R&S FSE-K30	1140.5098.02
850-MHz GSM Application Firmware Extension, BTS	R&S FSE-K31	1140.5198.02
Extras		
Service Kit	R&S FSE-Z1	1066.3862.02
DC Block, 5 MHz to 7000 MHz (Type N)	R&S FSE-Z3	4010.3895.00
DC Block, 10 kHz to 18 GHz, Type N	R&S FSE-Z4	1084.7443.02
2.4-mm female (only for R&S FSEK)	R&S FSE-Z5	1088.1627.02
Microwave Measurement Cable and Adapter Set for R&S FSEM	R&S FSE-Z15	1046.2002.02
Harmonics Mixer 40 GHz to 60 GHz	R&S FS-Z60 [5)]	1089.0799.02
Harmonics Mixer 50 GHz to 75 GHz	R&S FS-Z75 [5)]	1089.0847.02
Harmonics Mixer 60 GHz to 90 GHz	R&S FS-Z60 [5)]	1089.0899.02
Harmonics Mixer 75 GHz to 110 GHz	R&S FS-Z75 [5)]	1089.0947.02
Service Manual	–	1065.6016.24
Headphones	–	0708.9010.00
German Keyboard	R&S PSA-Z2	1007.3001.31
American Keyboard	R&S PSA-Z2	1007.3001.02
PS/2 Mouse	R&S FSE-Z2	1084.7043.02
Colour Monitor, 15", 230 V	R&S PMC3	1082.6004.02
IEC/IEEE bus Cable, 1 m	R&S PCK	0292.2013.10
IEC/IEEE bus Cable, 2 m	R&S PCK	0292.2013.20
19" Rack Adapter with front handles	R&S ZZA-95	0396.4911.00
Transit Case	R&S ZZK-954	1013.9395.00
Transit Case (R&S FSEM 30 and R&S FSEK 30 only)	R&S ZZK-955	1013.9408.00
Matching Pads, 75 Ω		
L section	R&S RAM	0358.5414.02
Series resistor, 25 Ω	R&S RAZ	0358.5714.02
Accessories for current, voltage and field-strength measurement	see accessories for Test Receiver ESS, data sheet PD 0756.9768	
SWR Bridge, 5 MHz to 3000 MHz	R&S ZRB2	0373.9017.52
SWR Bridge, 40 kHz to 4 GHz	R&S ZRC	1039.9492.52
High-Power Attenuators, 100 W, 3/6/10/20/30 dB	R&S RBU 100	1073.8820.xx (xx=03/06/10/20/30)
High-Power Attenuators, 50 W 3/6/10/20/30 dB	R&S RBU 50	1073.8895.xx (xx=03/06/10/20/30)
Preamplifier, 20 MHz to 1000 MHz	R&S ESV-Z3	0397.7014.52
For R&S FSEM only:		
Test-Port Adapter, N (male)	–	1021.0541.00
3.5 mm (male)	–	1021.0529.00
For R&S FSEK only:		
Test-Port Adapter, N (male)	–	1036.4783.00
K (male)	–	1036.4802.00
2.4 mm (male)	R&S FSE-Z5	1088.1627.02

1) Plot function is not available, if R&S FSE-B15 is fitted.

2) Options R&S FSE-B16 and R&S FSE-B17 require option R&S FSE-B15.

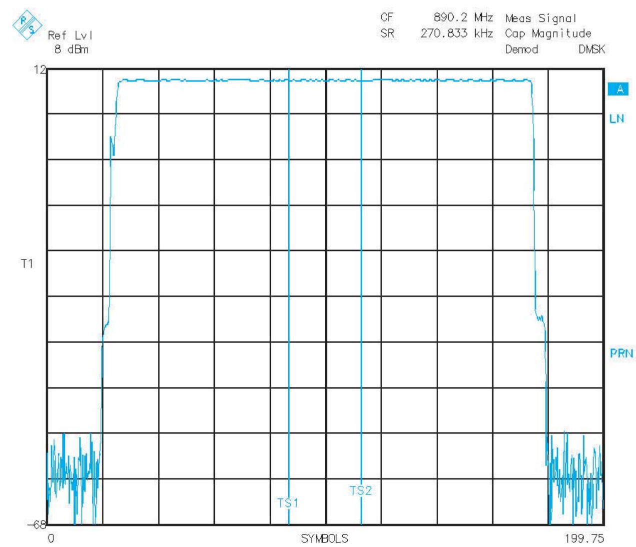
3) Not retrofittable, factory-fitted only.

4) R&S FSE-K10 or R&S FSE-K11 required.

5) For all R&S FSEM/R&S FSEK, option R&S FSE-B21 required.

Vector Signal Analyzer Option R&S FSE-B7 for Spectrum Analyzers R&S FSE

Universal demodulation, analysis and documentation of digital and analog mobile radio signals



Measurement of GSM power ramps to standard with high-precision time reference through synchronization to midamble

Brief description

The vector signal analyzer option upgrades the high-quality Spectrum Analyzers R&S FSE, adding universal demodulation and analysis capability down to bit level for digital mobile radio signals. The option supports all common mobile radio communication standards. Analyzers R&S FSE in conjunction with option R&S FSE-B7 replace several individual instruments:

- high-grade spectrum analyzer
- vector demodulator
- constellation analyzer
- or process controller

Main features

Standards

GSM 1800/PCS 1900, EDGE, NADC, TETRA, PDC, PHS, CDPP, WCPE, CT2, ERMES, FLEX, MODACOM, TFTS, DECT, CDPP, PWT, APCO, cdmaOne

Modulation modes

BPSK, QPSK, DQPSK, π/4-DQPSK, Offset-QPSK, 8-PSK, 8-DPSK, 3π/8-8PSK, MSK/(G)MSK, 2-/4-(G)FSK, 4-FSK, 16-QAM, AM/FM/φM

Optimum representation of results

- In-phase and quadrature signal
- Magnitude, phase
- Eye and trellis diagrams
- Vector diagram
- Constellation diagram
- Table with modulation errors
- Demodulated bits

Benefits at a glance

- All mobile radio standards at a keystroke
- Measurement and analysis of analog modulation signals
- Versatile applications in the lab
- Multi-measurement functions in a single unit
- Efficient in production

Principle of vector signal analysis

The IF signal is digitized by means of a fast A/D converter, allowing purely digital processing of all subsequent analysis steps, thus making them practically error-free and providing high long-term and temperature stability. After A/D conversion, the signal is digitally mixed into the baseband and split into a real and an imaginary component. The complete signal information is thus available for further analysis. The signal is demodulated down to bit level by several DSPs. From the data thus obtained, an ideal signal is calculated. This reference signal is compared with the test signal. The resulting difference signal contains all modulation errors. The sampling rate of the A/D converter is always set to an integer multiple of the symbol rate, which speeds up analysis and contributes towards the high rate of 5 measurements/s.

- Phase error measurements on GSM mobile phones or base stations
- EVM measurements according to standard at EDGE
- Convenient analysis with SYMBOL TABLE/ERROR SUMMARY display
- Measurements on frequency-modulated signals
- Measurement of AM/φM conversion or synchronous phase modulation
- Measurement of transmitter frequency transients

Specifications in brief

Measurement of digital modulation signals

Signal types	continuous signals, TDMA signals
Standards	GSM1800/PCS1900, EDGE, NADC, TETRA, PDC, PHS, CDPP, WCPE, CT2, ERMES, FLEX, MODACOM, TFTS, DECT, CDPP, PWT, APCO, cdmaOne
Modulation modes	BPSK, QPSK, DQPSK, π/4-DQPSK, Offset-QPSK, 8-PSK, 8-DPSK, 3π/8-8PSK, MSK/(G)MSK, 2-/4-(G)FSK, 4-FSK, 16-QAM, AM/FM/φM
Filters	
Filter types	raised cosine, square root raised cosine, Gaussian
Setting range α/B x T	0.2 to 3 in steps of 0.01
Filters to specific standards	
FLEX	Bessel B x T = 1.22 and 2.44
ERMES	Bessel B x T = 1.25
cdmaOne	forward and reverse channel (IS-95)
EDGE	EDGE weighting filter

Measurements (except FSK)
I and Q signals (filtered, synchronized to frequency and symbol clock)
I and Q reference signals (calculated from demodulated bits)
I and Q error (magnitude and phase)
Vector error
Bit stream/modulation error (bits demodulated at ideal decision points and table of all modulation errors)

Measurements with FSK
Frequency-demodulated signal (filtered, synchronized to symbol clock)
FSK reference signal (calculated from demodulated data)
FSK error signal
Data/bit stream/modulation error (symbols demodulated at ideal decision points and table of all modulation errors)

Display modes (except FSK)
Polar diagram: constellation diagram, vector diagram
Time domain: in-phase and/or quadrature signal, magnitude (level), phase, eye diagram, trellis diagram
Error display in time domain: error vector magnitude (EVM) in %, phase/frequency error, in-phase and quadrature signals
Numerical error readout (* rms and peak value): error vector magnitude*, magnitude error*, phase error*, frequency error, I/Q offset, I/Q imbalance, amplitude droop, ρ-factor

Display modes with FSK
Time domain: magnitude (level), frequency deviation, eye diagram (frequency signal)
Error display in time domain: frequency deviation error, magnitude error
Numerical error readout (* rms and peak value): deviation error*, magnitude error, FSK frequency deviation, frequency error, FSK reference deviation

Modulation measurement range

Symbol rate	320 Hz to 2.133 MHz
Testpoints/symbol	
Symbol rate ≤200 kHz	1, 2, 4, 8, 16
200 to ≤400 kHz	1, 2, 4, 8
>400 kHz	1, 2, 4
Memory size, symbol rate ≤1 MHz	max. 16000 samples
>1 MHz	max. 3200 points
Number of demodulated symbols	
Symbol rate ≤1 MHz	max. 1600 symbols (with 4 points/symbol), max. 800 symbols (with 8 points/symbol), max. 400 symbols (with 16 points/symbol)
>1 MHz	max. 600 symbols

Synchronization	**internal symbol clock and frequency/phase**
Trigger	free run, external, video
Trigger offset	pre- or posttrigger
Synchronization on bit sequences	definable bit sequences, max. 32 symbols, TDMA bursts
Synchronization offset	selectable, positive or negative

Measurement of analog modulation signals

Demodulation mode	offline demodulation
Demodulation bandwidth	5 kHz to 2 MHz (5 MHz typ.)
Realtime demodulation	5 kHz to 200 kHz bandwidth in steps of 1, 2, 3, 5
Offline demodulation	5 kHz to 2 MHz (5 MHz) bandwidth in steps of 1, 2, 3, 5
Demodulation length (max. sweep time)	(5000 x 0.7)/(bandwidth/Hz) [s]
Display	AF signal, carrier power (AM AF signal DC-coupled) or modulation summary (table)
Numerical display of	– peak or rms values of modulation depth or deviation of main demodulation – SINAD 1 kHz (only with REAL TIME ON) – AF frequency – carrier power – peak values of supplementary modulations

Level measurements

Peak power	–60 dBm to +30 dBm
Dynamic range for burst measurement (mean power, ref level ≥–10 dBm, peak power = ref level +1 dB, low-noise mode, points/symbol ≤4)	80 dBc – 4 x log (symbol rate/kHz)
Absolute level error	
Average power (0 to –10 dB below reference level)	
f ≤1 GHz	<1 dB
f >1 GHz	see data sheet R&S FSE (total measurement uncertainty)
Relative level error	
Mean power, level	
0 to –10 dB below reference level	0.2 dB
–10 to –50 dB below reference level	(0.0325/dB – 0.125)dB
Time reference (nominal)	
without clock synchronization	<1/(2 x symbol rate x points/symbol) for MSK/GMSK modulation, <1/(2 x symbol rate) for PSK/QAM/FSK modulation
with clock synchronization	<0.001 x 1/(symbol rate)

Measurement times
Readout of detected symbols and numerical modulation errors, synchronized

GSM900/1800/1900, PHS	330 ms/measurement
NADC, TETRA, PDC	600 ms/measurement

Ordering information

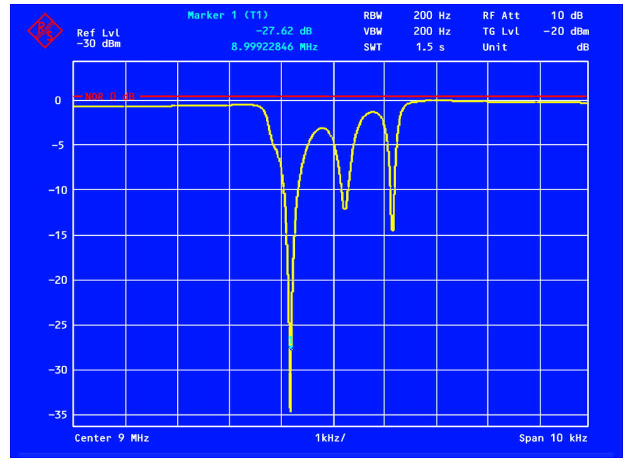
Vector Signal Analyzer	R&S FSE-B7	1066.4317.02
Option for R&S FSE		
Low Phase Noise and OCXO (for models 20)	R&S FSE-B4	1073.5396.02

Tracking Generators R&S FSE-B8 to -B11

Scalar network analysis with

Spectrum Analyzers R&S FSE

9 kHz to 3.5/7 GHz



Measuring the passband and stopband attenuation of a filter

Main features

- ◆ Attenuation measurement range >90 dB, 120 dB typ.
- ◆ I/Q modulator in R&S FSE-B9/-B11 for generating any phase or amplitude modulation modes
- ◆ Output level 0 to –20 dBm, optionally 0 to –90 dBm
- ◆ Frequency offset up to ± 200 MHz

Brief description

The optional Tracking Generators R&S FSE-B8, R&S FSE-B9, R&S FSE-B10 and R&S FSE-B11 enhance the Spectrum Analyzers R&S FSE for selective scalar network analysis. They allow gain, frequency response, ripple, insertion and return loss (with additional SWR bridge) to be measured in a wide dynamic range. In contrast to measurements with broadband scalar network analyzers, the selective measurement method ensures that harmonics and spurious responses of the generator or device under test have no effect on the measurement.

Spectrum Analyzers R&S FSE with built-in tracking generators feature a very low noise floor and hence an extremely wide dynamic range for attenuation measurements. They are thus ideal for instance for measuring shielding effectiveness.

Versatile measurement functions

- ◆ Easy to operate normalization with interpolation
- ◆ Normalization for reflection measurements with open or short, or both
- ◆ Automatic bandwidth measurement ("n dB down" function)
- ◆ Shape factor 60/6 dB or 60/3 dB
- ◆ Tolerance limits with PASS/FAIL evaluation
- ◆ Level range display up to 200 dB for compensation of frequency responses of even large amplitude variation
- ◆ Frequency range settable down to 3 kHz with reduced output level

Overview

Generator	Designation	Order No.	Frequency range	R&S FSEA 30	R&S FSEB30	R&S FSEM30	R&S FSEK30
R&S FSE-B8	Tracking Generator	1066.4469.02	9 kHz to 3.5 GHz	•	–	–	–
R&S FSE-B9	Tracking Generator	1066.4617.02	9 kHz to 3.5 GHz	•	–	–	–
R&S FSE-B10	Tracking Generator	1066.4769.02	9 kHz to 7 GHz	–	•	•	•
R&S FSE-B11	Tracking Generator	1066.4917.02	9 kHz to 7 GHz	–	•	•	•
R&S FSE-B12	Switchable Attenuator	1066.5065.02	9 kHz to 7 GHz	•	•	•	•

Permissible combinations of tracking generators and optional switchable attenuator with Spectrum Analyzers R&S FSE
• Permissible combination – Cannot be installed

Tracking Generators R&S FSE-B8 to -B11

Specifications in brief

Frequency

Frequency range	
R&S FSE-B8, R&S FSE-B9	9 kHz to 3.5 GHz
R&S FSE-B10, R&S FSE-B11	9 kHz to 7 GHz
Min. start frequency	3 kHz typ.
Frequency offset	±200 MHz
Spurious responses	
Harmonics (f >50 MHz)	25 dB
Other	30 dB

Level

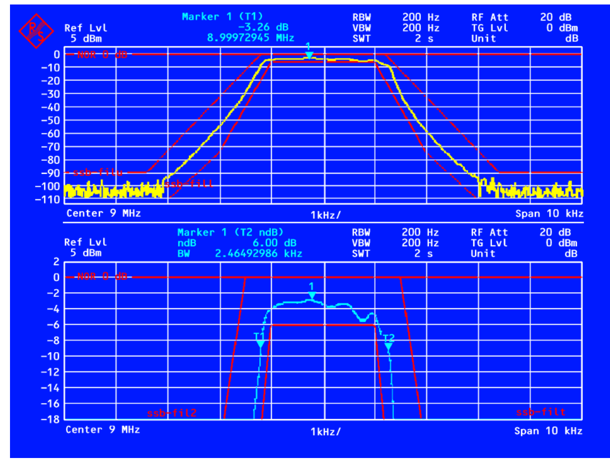
Output level	–20 to 0 dBm (can be set in 0.1 dB steps)
with option R&S FSE-B12	–90 to 0 dBm (can be set in 0.1 dB steps)
Level accuracy	
Frequency response referred to 120 MHz, for sweep time >100 ms and start frequency >2 x RBW and start frequency >SPAN/1000	
Absolute error at 120 MHz, 0 dBm	<1 dB
Without R&S FSE-B12:	
9 kHz to 1 GHz	<2.0 dB
1 GHz to 3.5 GHz	<3.0 dB
3.5 GHz to 7 GHz	<3 dB typ.
Additional frequency response with option R&S FSE-B12:	
9 kHz to 3.5/7 GHz	<1.0 dB

Dynamic and measurement range

Gain measurement range	
Without option R&S FSE-B12	50 dB
With option R&S FSE-B12	120 dB
Attenuation measurement range	
f >10 MHz, RBW = 1 kHz	>90 dB, 120 dB typ.

Modulation

Modulation modes	AM, FM, I/Q (cannot be used simultaneously)
Start frequency	>200 kHz
Amplitude modulation	
Operating mode	EXTERN AM
Modulation depth	0 to 80%
Modulation frequency range	1 kHz to 20 kHz
Frequency modulation	
Operating mode	EXTERN FM
Deviation	max. 1 MHz
Modulation frequency range	1 kHz to 100 kHz with modulation index <2π x 75



Measuring the return loss of a filter

I/Q modulation (with R&S FSE-B9 and -B11 only)

Modulation inputs I and Q	
VSWR	<1.4 typ.
Input voltage for 100% modulation	±0.5V
Modulation frequency response	
f_{mod} = DC to 5 MHz	<1dB
f_{mod} = DC to 10 MHz	<1dB typ.

Ordering information

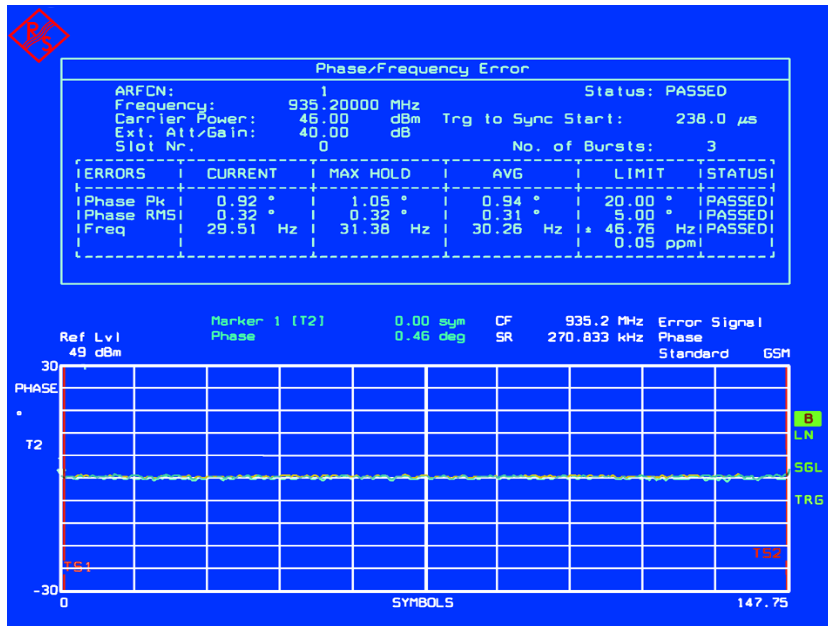
Tracking Generator		
9 kHz to 3.5 GHz	R&S FSE-B8	1066.4469.02
9 kHz to 3.5 GHz, with I/Q Modulator	R&S FSE-B9	1066.4617.02
9 kHz to 7 GHz	R&S FSE-B10	1066.4769.02
9 kHz to 7 GHz, with I/Q Modulator	R&S FSE-B11	1066.4917.02
Switchable Attenuator for Tracking Generators	R&S FSE-B12	1066.5065.02
Extras		
SWR Bridge 40 kHz to 4 GHz	R&S ZRC	1032.9492.52/55
SWR Bridge 50 MHz to 3000 MHz	R&S ZRB2	0373.9017.5x
N Calibration Kit, 0 to 3 GHz, termination, short/open	R&S ZCAN	0800.8515.52/72
Matching Pad 75 Ω, L-section	R&S RAM	358.5414.02
Matching Pad 75 Ω, series resistor 25 Ω	R&S RAZ	0358.5714.02
Extras for I/Q modulation		
Dual Arbitrary Waveform Generator	R&S ADS	1012.4002.02
Software for generation of I/Q signals in conjunction with ADS	R&S IQSIM-K	1013.1642.02

Application Firmware R&S FSE-K10/R&S FSE-K11

GSM transmitter measurements conforming to standards:

R&S FSE-K10 for mobile phones

R&S FSE-K11 for base stations



Measurement of phase/frequency error

Brief description

Spectrum Analyzers R&S FSE with their wide dynamic range and high accuracy, together with optional Vector Signal Analyzer R&S FSE-B7, are ideal for GSM transmitter measurements in development and production. Application Firmware Modules R&S FSE-K10 and R&S FSE-K11 now further simplify operation: complex measurements can be performed exactly in line with standards at a keystroke. The modules take into account all requirements and settings for GSM 900, GSM 1800 (phase I and phase II) and GSM 1900. Operation follows the sequence of measurements as specified in the standards.

Fitted with the application firmware, Spectrum Analyzer R&S FSE automatically sets the frequency limits, measurement bandwidths, sweep times and detectors required for a given standard and the associated measurements. R&S FSE compares results with specified limit values and verifies their compliance. R&S FSEM covers the frequency range up to 27 GHz, which allows the measurement of spurious through to 12.75 GHz.

Main features

- Measurement of RF parameters for GSM 900, GSM 1800 and GSM 1900 in line with:
  - GSM 11.10
  - GSM 11.10-1
  - GSM 11.20
  - GSM 11.21
  - J-STD 007 Air Interface
  - R-GSM
- Firmware modules R&S FSE-K10 and R&S FSE-K11 can be fitted to all models of the R&S FSE family

Covered standards

Standards	R&S FSE-K11 (for base stations)	R&S FSE-K10 (for mobile phones)
P-GSM 900, Phase I	GSM 11.20	GSM 11.10
GSM 1800	GSM 11.20-DCS	ETS 300 020-3
GSM 900/1800, Phase II	GSM 11.21	ETS 300 067-1/GSM 11.10-1
GSM 1900	J-STD-007 Air Interface	J-STD-007 Air Interface
R-GSM, GSM 1800, Phase II+	GSM 11.21	GSM 11.10-1

Application Firmware R&S FSE-K10/R&S FSE-K11

Measurement functions with or without option Vector Signal Analysis R&S FSE-B7

Measurements	FSIQ	R&S FSEx with FSE-B7	R&S FSEx w/o FSE-B7
Phase/frequency error	●	●	–
Mean carrier power with synchronization to midamble	●	●	–
Mean carrier power without synchronization to midamble	●	●	●
Transmitted power versus time (burst timing) with synchronization to midamble	●	●	–
Transmitted power versus time (burst timing) without synchronization to midamble	●	●	●
Spectrum due to modulation	●	●	●
Spectrum due to transients	●	●	●
Spurious emissions	●	●	●

Specifications in brief

Measurements with	R&S FSEA30, FSIQ3	FSEB/M/K30, FSIQ7/26/40

and with options R&S FSE-B7 and R&S FSE-K10 or R&S FSE-K11

Values in [] apply to R&S FSE with optional Increased Level Accuracy R&S FSE-B22 fitted and to R&S FSIQ models.

Phase measurement error rms value	≤0.5°	≤0.7°
peak value	≤1.5°	≤2.1°
Frequency measurement error	1.45 Hz + error of reference frequency relative to carrier	
Mean carrier power versus time		
Measurement error absolute	<0.9 dB [<0.6 dB]	<0.9 dB [<0.6 dB]
relative	<0.55 dB [<0.3 dB]	<0.55 dB [<0.3 dB]
Transmitted power versus time		
Error of 0 dB reference level	<0.9 dB [<0.6 dB]	<0.9 dB [<0.6 dB]
Relative error of reference level, relative to reference level	<0.3 dB (0 to –50 dB), <0.5 dB (–50 to –70 dB)	
Trigger error (with synchronization to midamble)	±0.25 µs [±1/16 bit]	±0.25 µs [±1/16 bit]
Dynamic range (resolution bw 300 kHz)	75 dB	73 dB
Spectrum due to modulation		
Level measurement error absolute, relative to reference level	<0.9 dB [<0.6 dB] (0 to –50 dB) <1 dB (–50 to –70 dB) <1.4 dB (–70 to –95 dB)	
Level measurement error relative		
Δf ≤0.1 MHz	<0.3 dB	<0.3 dB
0.1 MHz ≤Δf ≤1.8 MHz, level difference <50 dB	<0.45 dB	<0.45 dB
1.8 MHz ≤Δf ≤6 MHz, level difference ≥50 dB	<1.3 dB	<1.3 dB
Δf ≥6 MHz	<1.3 dB	<1.3 dB
Dynamic range (carrier power 46 dBm)		
Frequency offset		
200 kHz	78 dB	72 dB
250 kHz	78 dB	72 dB
400 kHz	82 dB	76 dB
600 kHz	87 dB	81 dB
1200 kHz	93 dB	87 dB
1800 kHz	94 dB	88 dB
1800 to 6000 kHz (resolution bandwidth 100 kHz)	90 dB	84 dB
>6 MHz (resolution bandwidth 100 kHz), transmit band	91 dB	87 dB

Spectrum due to transients		
Level measurement error absolute	<0.9 dB [<0.6 dB]	<0.9 dB [<0.6 dB]
relative, level difference <50 dB	<0.45 dB	<0.45 dB
≥50 dB	<1.2 dB	<1.2 dB
Dynamic range (carrier power 46 dBm)		
400 kHz	76 dB	70 dB
600 kHz	81 dB	75 dB
1200 kHz	87 dB	81 dB
1800 kHz	91 dB	85 dB
Spurious emissions		
In transmit band:		
Level measurement error	<1.75 dB [<1.3 dB]	<1.75 dB [<1.3 dB]
Noise floor (peak value) (resolution bandwidth 100 kHz, 46 dBm transmit power)	–40 dBm	–38 dBm
Outside transmit and receive band:		
Level measurement error f ≤2 GHz	<1.75 dB [<1.3 dB]	<1.75 dB [<1.3 dB]
2 GHz <f ≤4 GHz	<1.75 dB (up to 3.5 GHz)	<2.15 dB (up to 7 GHz)
f >4 GHz (up to 12.75 GHz with R&S FSEM/R&S FSEK)	–	<2.2 dB
Noise floor (peak value) (resolution bandwidth 3 MHz, 46 dBm transmit power)	–37 dBm	–35 dBm
In receive band (carrier suppression >25 dB):		
Level measurement error	<1.5 dB	<1.5 dB
Sensitivity (noise indication averaged over 200 sweeps)	–107 dBm	–105 dBm

Ordering information

Application Firmware

for tests on

GSM mobile phones	R&S FSE-K10	1057.3092.02
GSM base stations	R&S FSE-K11	1057.3392.02

The 5-pole resolution filters stipulated by standards are included in all .30 R&S FSE models; .20 models are equipped with 4-pole resolution filters.

Options

Increased Level Accuracy up to 2 GHz for R&S FSE (factory-fitted)	R&S FSE-B22	1106.3480.02
Vector Signal Analyzer	R&S FSE-B7	1066.4317.02

These options are already fitted with Signal Analyzers R&S FSIQ.

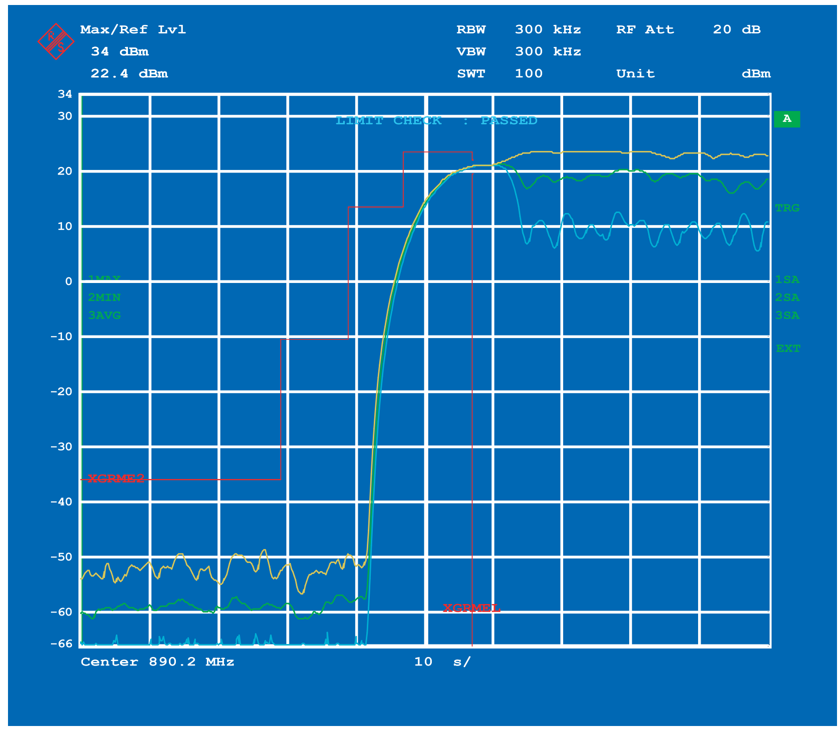
EDGE Application Firmware R&S FSE-K20/K21

For Spectrum Analyzers

R&S FSE and Signal Analyzers

R&S FSIQ with R&S FSE-K10/11

New



Power vs time, rising edge of a burst

Brief description

The firmware modules R&S FSE-K20 and R&S FSE-K21 enhance the measurement functions of firmware modules R&S FSE-K10 and R&S FSE-K11 by modulation measurements on 3π/8 shifted 8PSK-modulated signals in line with the EDGE standard.

The convenient and automatic measurement functions of R&S FSE-K10 and R&S FSE-K11 are now also available for measurements on EDGE signals (see also data sheet R&S FSE-K10/K11):

- Mean carrier power
- Power versus time
- Spectrum due to modulation
- Spectrum due to transients
- Spurious

New measurement functions
- Modulation accuracy measurement including:
- EVM measurement with ETSI-conformal weighting filter
- 95:th-percentile measurement
- Measurement of origin offset suppression
- Limit lines for EDGE conforming to ETSI 05.05

Fitted with these two firmware modules, R&S FSE and R&S FSIQ are convenient one-box solutions for GSM and EDGE RF transmitter measurements. The wide dynamic range, especially for measuring broadband noise and spurious emissions, simplify test setups. Further application firmware modules for IS-95, 3GPP/WCDMA and universal vector signal analysis make R&S FSE and R&S FSIQ ideal multi-standard test platforms.

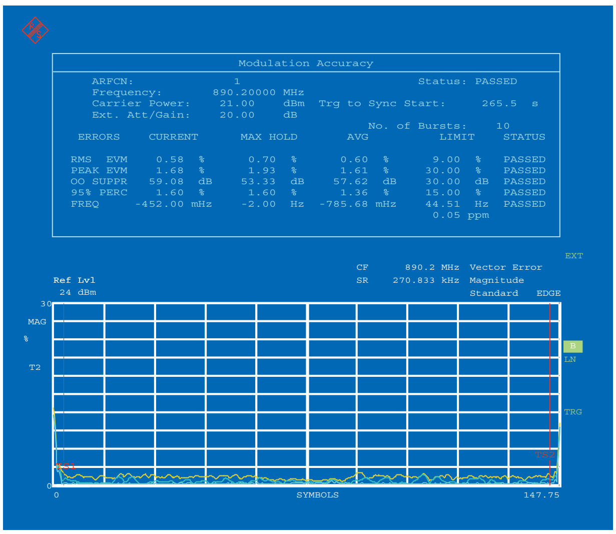
Main features

- EDGE capability added to Application Firmware R&S FSE-K10 and R&S FSE-K11
- Standard-conformal EDGE transmitter measurements
- R&S FSE-K20 for mobile phones, enhancement to R&S FSE-K10
- R&S FSE-K21 for base stations, enhancement to R&S FSE-K11

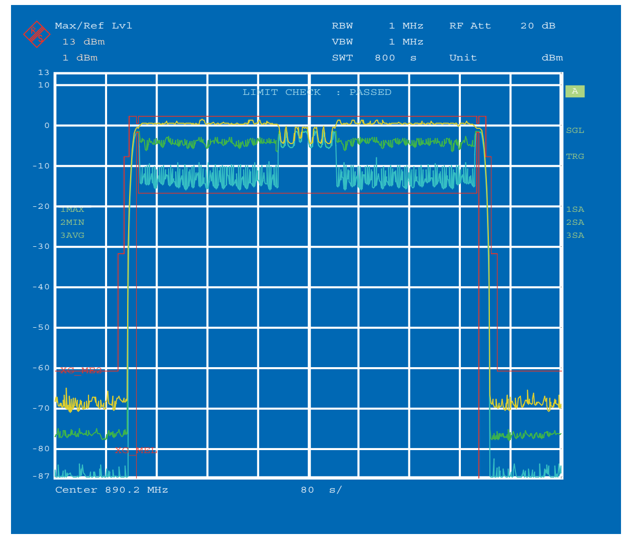
Measurement examples

- **EDGE EVM**
  The error vector magnitude (EVM) is determined over 200 bursts in line with the standard, the error vector being filtered by a special EDGE lowpass filter.
- **95:th-percentile measurement**
  The 95:th-percentile measurement determines the EVM value below which 95% of all EVM values are to be found.
  In R&S FSE-K20 and R&S FSE-K21 this measurement is part of the modulation measurement (EVM).
- **Power vs time with EDGE mask**

EDGE Application Firmware R&S FSE-K20/K21



EDGE Modulation accuracy with EVM and 95:th percentile measurement



Power vs time with EDGE mask

Specifications

The specifications apply to R&S FSE-K20 in conjunction with R&S FSE-K10 and R&S FSE-K21 in conjunction with R&S FSE-K11. They are based on the data sheet specifications of Spectrum Analyzers R&S FSE and Option R&S FSE-B7 as well as Signal Analyzers R&S FSIQ and have not been checked separately. Values given with a tolerance are measurement uncertainties with a confidence level of 95%.

Measurements	R&S FSEA30, R&S FSEB30, R&S FSEM30, R&S FSIQ3, R&S FSIQ7, R&S FSIQ26
Modulation error	
EVM, residual (S/N >40 dB)	
rms	<0.5%
peak	<2.5%
95:th percentile	<2.5%
Origin offset suppression	
Measurement range	–20 dBc to –50 dBc
Frequency error, uncertainty (S/N > 40 dB)	<5 Hz + error of reference frequency
Mean carrier power	
Power measurement uncertainty	
absolute, R&S FSEx	1 dB
relative, R&S FSEx	0.6 dB
absolute, R&S FSIQ or R&S FSEx fitted with R&S FSE-B22	0.5 dB
relative, R&S FSIQ or R&S FSEx fitted with R&S FSE-B22	0.2 dB
Power vs time	
Uncertainty of reference power	0.5 dB
Measurement uncertainty, relative	0.2 dB (0 dB to –50 dB from reference) 0.5 dB (–50 dB to –70 dB from reference)
Trigger uncertainty	¼ symbol
Dynamic range (RBW = 300 kHz)	85 dB (with trace average) >70 dB (with peak hold)

Ordering information

Application firmware R&S FSE-K20 for EDGE measurements on mobiles	R&S FSE-K20	1106.4086.02

Prior to installing R&S FSE-K20 the following options must be fitted:

R&S FSEA, R&S FSEB, R&S FSEM, R&S FSEK:
Vector Signal Analyzer R&S FSE-B7, Application Firmware R&S FSE-K10

R&S FSIQ3, R&S FSIQ7, R&S FSIQ26, R&S FSIQ40:
Application Firmware R&S FSE-K10

Applications Firmware R&S FSE-K21 for EDGE measurements on base stations	R&S FSE-K21	1106.4186.02

Prior to installing R&S FSE-K21 the following options must be fitted:

R&S FSEA, R&S FSEB, R&S FSEM, R&S FSEK:
Vector Signal Analyzer R&S FSE-B7, Application Firmware R&S FSE-K11

R&S FSIQ3, R&S FSIQ7, R&S FSIQ26, R&S FSIQ40:
Application Firmware R&S FSE-K11

Extras

Increased Level Accuracy[1)]	R&S FSE-B22	1106.3480.02
1 dB Attenuator[2)]	R&S FSE-B13	1119.6499.02

1) Only for R&S FSEx, not for R&S FSIQ

2) Not for R&S FSEM 20/R&S FSEK 20; other R&S FSEx models: factory-installed in conjunction with R&S FSE-B22 only, cannot be retrofitted

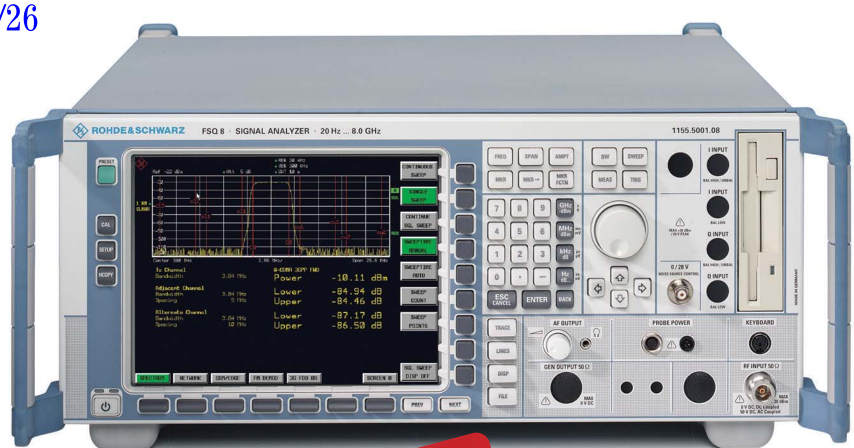
Signal Analyzers R&S FSQ3/8/26

R&S FSQ3: 20 Hz to 3.6 GHz

R&S FSQ8: 20 Hz to 8 GHz

R&S FSQ26: 20 Hz to 26 GHz

Signal analysis with the dynamic range of a high-end spectrum analyzer and a demodulation bandwidth of 28 MHz



R&S FSQ8 (photo 43878-1)

New

Brief description

Future transmission methods in mobile radio and related fields call for wider transmission bandwidths to handle increasing data throughput. Even today, multiple carriers of a GSM or 3GPP base station are often boosted in common power output stages. This reduces the technical effort and costs on the one hand, but increases the bandwidth to be transmitted on the other. In both cases, analysis bandwidths exceeding those provided by present-day spectrum analyzers are required in development and production, while at the same time the dynamic range must satisfy stringent requirements.

The R&S FSQ combines the outstanding spectrum analyzer features and functions of the R&S FSU with a demodulation and analysis bandwidth that has been enhanced to 28 MHz. The R&S FSQ is thus ideal for applications in the development and production of the following:

- Wireless LAN (WLAN)
- 3GPP and GSM-MCPA

The R&S FSQ additionally supports measurements on 2G, 2.5G and 3G mobile radio systems when using application firmware such as:

- R&S FS-K5, GSM/EDGE
- R&S FS-K72, 3GPP FDD BTS
- R&S FS-K73, 3GPP FDD UE

In addition to the broadband demodulation capabilities, the R&S provides the dynamic range that is required for multicarrier measurements or the measurement of spurious emissions at base transceiver stations (BTS).

Main features

- Dynamic range of a high-end spectrum analyzer
  - TOI +25 dBm typ.
  - 1 dB compression +13 dBm
  - 84 dB ACLR/3GPP with noise correction
- Displayed average noise level –158 dBm (1 Hz bandwidth)
- Phase noise –160 dBc (1 Hz) at 10 MHz carrier offset
- 28 MHz I/Q demodulation bandwidth
- 16 Msample I and Q memory
- Statistical signal analysis with CCDF function
- Software for measurements on 802.11a wireless LAN
- I/Q data extraction, e.g. for MCPA adjustment
- Code domain power measurement for 3GPP WCDMA optional
- Versatile resolution filters: Gaussian, FFT, channel, RRC
- RMS detector with 100 dB dynamic range
- Transducer factor for correcting antenna or cable frequency responses
- Full choice of detectors
  - RMS, SAMPLE, AVERAGE
  - AUTO/MAX/PEAK
  - QUASI PEAK (QPK)

Characteristics

A signal analyzer with 28 MHz bandwidth – that says it all

The R&S FSQ features a digital back end that benefits from the progress in ADC and ASIC development. Time-consuming evaluation algorithms are implemented directly in hardware – a prerequisite for fast measurement and high accuracy.

- 14-bit A/D converter 81.6 MHz
- Digital hardware resampler to match the sampling rate to the signal
- Sampling rate from 10 kHz to 81.6 MHz adaptable to the modulation rate
- SFDR >80 dBfs

Signal Analyzers R&S FSQ 3/8/26

- Digital downconversion to baseband with high output bandwidth (28 MHz referred to RF)

Most versatile resolution filter characteristics and largest bandwidth

- Standard resolution filters from 10 Hz to 50 MHz in steps of 1, 2, 3, 5
- FFT filters from 1 Hz to 30 kHz
- 32 channel filters with bandwidths from 100 Hz to 5 MHz
- RRC filters for NADC, TETRA and 3GPP
- EMI filters 200 Hz, 9 kHz, 120 kHz

Full range of analysis functions

- Time domain power in conjunction with channel or RRC filters make the R&S FSQ a full-fledged channel power meter
- TOI marker
- Noise/phase noise marker
- Versatile channel/adjacent-channel power measurement functions with wide selection of standards; user-configurable
- Split-screen mode with selectable settings
- CCDF measurement function
- Peak list marker for fast search of all peaks within the set frequency range (search for spurious)

High measurement speed

- 2.5 ms sweep time in frequency domain
- 1 µs sweep time in time domain
- Number of measurement points/trace selectable between 155 and 10001
- Time-selective spectrum analysis with gating function
- Up to 20 measurements/s in manual mode
- Up to 30 measurements/s in GPIB mode
- Fast ACP measurement in time domain

Interfaces

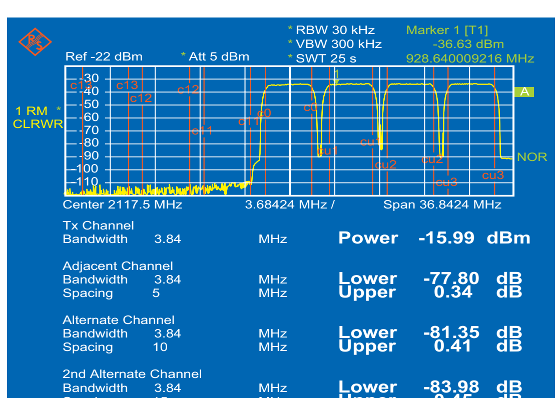
- LAN interface 100BaseT
- GPIB interface, IEEE 488.2
  - SCPI-compatible GPIB command set
  - R&S FSE/R&S FSIQ-compatible GPIB command set
- RS-232-C, 9-pin D-Sub
- VGA output, 15-pin D-Sub

Options

WLAN measurements

The WLAN test software for the R&S FSQ analyzes the I/Q data that has been measured by the R&S FSQ and transferred via the IEC/IEEE bus to an external process controller in line with the requirements of the 802.11a standard:

- Modulation formats BPSK, QPSK, 16QAM and 64QAM
- Modulation measurements
- Amplitude statistics (CCDF) and crest factor
- Transmit spectrum mask
- FFT, also over a selected part of the signal, e.g. preamble
- Payload bit information
- Recording time selectable up to 800 ms
- Trigger: free run, external



Measurement of adjacent-channel power on a 3GPP four-carrier signal with noise correction

Noise Measurement Software R&S FS-K3

R&S FS-K3 is a convenient tool to determine the noise figure of amplifiers and frequency-converting DUTs throughout the frequency range of the R&S FSQ, thus enabling complete documentation. The high linearity and extremely accurate power measurement routines of the R&S FSQ provide precise and reproducible results, making a separate noise figure meter unnecessary.

Phase Noise Measurement Software R&S FS-K4

R&S FS-K4 automates measurement over a complete offset frequency range, and determines residual FM from the phase noise characteristic. In conjunction with the extremely low phase noise of the R&S FSQ, this eliminates in many cases the need for an extra phase noise measurement system that may even be difficult to operate.

GSM/EDGE Application Firmware R&S FS-K5

In conjunction with R&S FS-K5 the R&S FSQ provides complete functionality for RF and modulation measurements in

Signal Analyzers R&S FSQ3/8/26

GSM systems. EDGE, which is generation 2.5, is already included in the R&S FS-K5 option.

- Phase/frequency error for GSM
- Modulation accuracy for EDGE with EVM and ETSI-conformant weighting filters, OOS, 95:th percentile, power versus time with synchronization to midamble, spectrum due to modulation, spectrum due to transients

Standard 3GPP modulation and code domain power measurements

- For BTS/NodeB signals: Application Firmware R&S FS-K72
- For UE signals: Application Firmware R&S FS-K73
- High measurement speed of 1.5 s/measurement typ.
- Code domain power and CPICH power
- EVM and PCDE
- Code domain power vs. slot
- EVM/code channel
- Spectrum emission mask

Network capability

- Standard Network R&S FSU-B16 (Ethernet 10/100 BaseT)
- Operating system Windows NT
- PCAnywhere software for remote control by Ethernet
  - All elements of the R&S FSU screen are represented by a soft front panel function
  - Special RSIB interface (Windows and UNIX) links the user´s application to the TCP/IP protocol and acts like an IEC/IEEE-bus driver

Specifications in brief

Data designated "nominal" apply to design parameters and are not tested. Specification of σ = xx dB refers to standard uncertainty.

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	R&S FSQ3	R&S FSQ8	R&S FSQ26
Frequency			
Frequency range			
DC coupled	20 Hz to 3.6 GHz	20 Hz to 8 GHz	20 Hz to 26.5 GHz
AC coupled	1 MHz to 3.6 GHz	1 MHz to 8 GHz	10 MHz to 26.5 GHz
Frequency resolution		0.01 Hz	
Internal reference frequency (nominal) with standard OCXO			
Aging per day 1)		1×10^{-9}	
Total error (per year) 1)		2×10^{-7}	
Internal reference frequency (nominal); option R&S FS-B4			
Aging per day 1)		2×10^{-10}	
Total error (per year) 1)		5×10^{-8}	
External reference frequency		1 MHz to 20 MHz, 1 Hz steps	
Frequency display		with marker or frequency counter	
Marker resolution		0.1 Hz to 10 kHz (dependent on span)	
Frequency counter resolution		0.1 Hz to 10 kHz (selectable)	
Frequency span	0 Hz, 10 Hz to 3.6 GHz	0 Hz, 10 Hz to 8 GHz	0 Hz, 10 Hz to 26.5 GHz
Span resolution/ max. span deviation		0.1 Hz/1 %	
Spectral purity (dBc (1 Hz)), SSB phase noise, f = 640 MHz			
Carrier offset			
10 Hz		–73 dBc (1 Hz) typ., with option R&S FS-B4 –86 dBc typ.	
100 Hz		<–90 dBc (1 Hz), –100 dBc (1 Hz) typ.	
1 kHz		<–112 dBc (1 Hz), –116 dBc (1 Hz) typ.	
10 kHz		<–120 dBc (1 Hz), –123 dBc (1 Hz) typ.	
100 kHz		<–120 dBc (1 Hz), –123 dBc (1 Hz) typ.	
1 MHz		<–138 dBc (1 Hz), –144 dBc (1 Hz) typ.	
10 MHz		<–155 dBc (1 Hz), –160 dBc (1 Hz) typ.	

	R&S FSQ3	R&S FSQ8	R&S FSQ26
Sweep			
Span 0 Hz		1 µs to 16000 s in steps of 5%	
Span ≥10 Hz		2.5 ms to 16000 s in steps ≤10%	
Max. deviation of sweep time		3%	
Measurement in time domain		with marker and display lines (resolution 31.25 ns)	
Resolution bandwidth			
3 dB bandwidths		10 Hz to 20 MHz in 1/2/3/5 sequence, 50 MHz	
Bandwidth error			
10 Hz to 100 kHz		<3%	
200 kHz to 5 MHz		<10%	
10 MHz, 20 MHz		–30% to + 10%	
50 MHz	–30% to +10%	–30% to +10% for f<3.6 GHz –30% to +100% for f>3.6 GHz	
Shape factor –60 dB: –3 dB			
≤100 kHz		<6	
200 kHz to 2 MHz		<12	
3 MHz to 10 MHz		<7	
20 MHz, 50 MHz		<6 nominal	
Video bandwidths		1 Hz to 10 MHz in 1/2/3/5 sequence	
FFT filters			
3 dB bandwidths		1 Hz to 30 kHz in 1/2/3/5 sequence	
Bandwidth error		<5% nominal	
Shape factor –60 dB: –3 dB		<3 nominal	
EMI filters			
6 dB bandwidths		200 Hz, 9 kHz, 120 kHz	
Bandwidth error		<3% nominal	
Shape factor –60 dB : –3 dB		<6 nominal	
Channel filters			
Bandwidths		100, 200, 300, 500 Hz, 1, 1.5, 2, 2.4, 2.7, 3, 3.4, 4, 4.5, 5, 6, 8.5, 9, 10, 12.5, 14, 15, 16, 18 (RRC), 20, 21, 24.3 (RRC), 25, 30, 50, 100, 150, 192, 200, 300, 500 kHz, 1, 1.228, 1.5, 2, 3, 5 MHz	
Shape factor –60 dB : –3 dB		<2 nominal	
Bandwidth error		2% nominal	

Signal Analyzers R&S FSQ3/8/26

	R&S FSQ3	R&S FSQ8	R&S FSQ26
Level			
Display range	displayed average noise level to 30 dBm		
Maximum input level			
DC voltage (AC coupling)	50 V		
DC voltage (DC coupling)	0 V		
RF attenuation 0 dB			
CW RF power	20 dBm (= 0.1 W)		
Pulse spectral density	97 dBµV/1 MHz		
RF attenuation ≥10 dB			
CW RF power	30 dBm (= 1 W)		
Max. pulse voltage	150 V		
Max. pulse energy (10 µs)	1 mWs		
1 dB compression of input mixer (0 dB RF attenuation)	+13 dBm nominal –	+13 dBm nominal up to 3.6 GHz +10 dBm nominal from 3.6 GHz to 8 GHz	 +7 dBm nominal from 3.6 GHz to 26 GHz
Intermodulation			
Third-order intermodulation (Third-order intercept (TOI), level 2 x –10 dBm, Δf >5 x RBW or 10 kHz, whichever is the greater value)			
for f = 10 MHz to 300 MHz	>17 dBm, 20 dBm typ.	>17 dBm, 20 dBm typ.	>17 dBm, 20 dBm typ.
for f = 300 MHz to 3.6 GHz	>+20 dBm, +25 dBm typ.	>+20 dBm, +25 dBm typ.	>+22 dBm, +27 dBm typ.
for f = 3.6 GHz to 8 GHz	–	>+18 dBm, +23 dBm typ.	–
for f = 3.6 GHz to 26.5 GHz	–	–	>+12 dBm, +15 dBm typ.
Second harmonic intercept point (SHI)			
f_{in} ≤100 MHz	>35 dBm		
100 MHz <f_{in} ≤400 MHz	>45 dBm, 55 dBm typ.		
400 MHz< f_{in} ≤500 Hz	>52 dBm, 60 dBm typ.		
500 MHz< f_{in} ≤1 GHz	>45 dBm, 55 dBm typ.		
1 GHz < f_{in} ≤ 1.8 GHz	>35 dBm		
f_{in} > 1.8 GHz	–	>80 dBm nominal	
Displayed average noise level			
(0 dB RF attenuation, RBW 10 Hz, VBW 30 Hz, 20 averages, trace average, span 0 Hz, termination 50 Ω)			
10 MHz to 2 GHz	<–145 dBm, –148 dBm typ.	<–145 dBm, –148 dBm typ.	<–142 dBm, –146 dBm typ.
2 GHz to 3 GHz	<–143 dBm, –147 dBm typ.	<–143 dBm, –147 dBm typ.	<–140 dBm, –143 dBm typ.
3 GHz to 3.6 GHz	<–142 dBm, –144 dBm typ.	<–142 dBm, –144 dBm typ.	<–140 dBm, –143 dBm typ.
3.6 GHz to 7 GHz		<–140 dBm, –142 dBm typ.	<–141 dBm, –145 dBm typ.
7 GHz to 8 GHz	–	<–140 dBm	<–141 dBm, –145 dBm typ.
8 GHz to 13 GHz	–	–	<–139 dBm, –143 dBm typ.
13 GHz to 18 GHz	–	–	<–137 dBm, –141 dBm typ.
18 GHz to 22 GHz	–	–	<–135 dBm, –138 dBm typ.
22 GHz to 26.5 GHz	–	–	<–133 dBm, –136 dBm typ.
Maximum dynamic range			
1 dB compression to DANL (1 Hz)	170 dB		

	R&S FSQ3	R&S FSQ8	R&S FSQ26
Immunity to interference			
Image frequency			
f ≤ 3.6 GHz	>90 dB, >110 dB typ.		
f >3.6 GHz	–	>70 dB, 100 dB typ.	
Intermediate frequency			
f ≤ 3.6 GHz	>90 dB, >110 dB typ.		
3.6 GHz ≤f ≤4.2 GHz	–	70 dB typ.	
f > 4.2 GHz		>70 dB, >90 dB typ.	
Spurious responses (f > 1 MHz, without input signal, 0 dB attenuation)	<–103 dBm		
Other spurious (Δf>100 kHz)			
f_{in} < 2.3 GHz	<–80 dBc (mixer level ≤ –10 dBm)		
2.3 GHz≤ f_{in}<4 GHz	<–70 dBc (mixer level ≤ –35 dBm)		
4 GHz≤f_{in} < 26.5 GHz	<–80 dBc (mixer level ≤ –10 dBm)		
Level display (spectrum mode)			
Screen	625 x 500 pixels (one diagram), max. 2 diagrams with independent settings		
Logarithmic level axis	1 dB, 10 dB to 200 dB in steps of 10 dB		
Linear level axis	10% of reference level per level division, 10 divisions or logarithmic scaling		
Traces	max. 6, with two diagrams on screen, max. 3 per diagram		
Trace detector	Max Peak, Min Peak, Auto Peak (normal), Sample, RMS, Average, Quasi Peak		
Trace functions	Clear/Write, Max Hold, Min Hold, Average		
Number of measurement points	625, settable between 155 and 100001 in steps of about the factor 2		
Setting range of reference level			
Logarithmic level display	–130 dBm to (+5 dBm + RF attenuation), max. 30 dBm, in steps of 0.1 dB		
Linear level display	7.0 nV to 7.07 V in steps of 1%		
Units of level axis	dBm, dBµV, dBmV, dBµA, dBpW (log level display) / µV, mV, µA, mA, pW, nW (linear level display)		
Level measurement error			
Reference error at 128 MHz, RBW ≤100 kHz, reference level –30 dBm			
RF attenuation 10 dB	<0.2 (σ = 0.07) dB		
Frequency response (DC coupling, RF attenuation ≥ 10 dB)			
10 MHz to 3.6 GHz	<0.3 dB (σ = 0.1 dB)[1)]		
3.6 GHz to 8 GHz	–	<1.5 dB (σ = 0.5 dB)[2)]	
8 GHz to 22 GHz	–	–	<2 dB (σ = 0.7 dB)
22 GHz to 26.5 GHz	–	–	<2.5 dB (σ = 0.8 dB)
Attenuator (≥5 dB)	<0.2 dB (σ = 0.07 dB)		
Reference level switching	<0.15 dB (σ = 0.05 dB)		
Display nonlinearity (20 °C to 30 °C, mixer level ≤–10 dBm)			
Logarithmic level display			
RBW ≤100 kHz, S/N >20 dB			
0 dB to –70 dB	<0.1 dB (σ = 0.03 dB)		
–70 dB to –90 dB	<0.3 dB (σ = 0.1 dB)		
RBW ≥ 200 kHz, S/N >16 dB			
0 dB to –50 dB	<0.2 dB (σ = 0.07 dB)		
–50 dB to –70 dB	<0.5 dB (σ=0.17 dB)		
Linear level display	5 % of reference level		

Signal Analyzers R&S FSQ3/8/26

	R&S FSQ3	R&S FSQ8	R&S FSQ26
Bandwidth switching error (ref. to RBW = 10 kHz)			
10 Hz to 100 kHz		–	
200 kHz to 10 MHz		<0.2 dB (σ = 0.07 dB)	
5 MHz to 50 MHz		<0.5 dB (σ = 0.15 dB)	
FFT 1 Hz to 3 kHz		<0.2 dB (σ = 0.07 dB)	
Total measurement error			
(0 dB to –70 dB, S/N >20 dB, span/RBW <100, 95 % confidence level) (20 °C to 30 °C, mixer level ≤–10 dBm)			
<3.6 GHz		0.3 dB for RBW ≤ 100 kHz 0.5 dB for RBW > 100 kHz	
3.6 GHz to 8 GHz	–	<1.5 dB	
8 GHz to 18 GHz	–	–	<2.0 dB
18 GHz to 26.5 GHz	–	–	<2.5 dB
I/Q data			
Sampling rate		programmable: 10 kHz to 81.6 MHz in 0.1 Hz steps	
ADC resolution		14 bit	
I/Q memory		16 Msample each for I and Q data	
RF path			
Max. information bandwidth		28 MHz	
Harmonic distortion (with full-scale input signal)		<–70 dBc typ.	
3rd order distortion (with two input tones 6 dB below full scale)		<–80 dBc typ.	
LO feedthrough ($f_{I/Q}$ = 81.6 MHz – f_{center}) (mixer level = –10 dBm)		<–65 dBfs typ.	
Aliased DC offset ($f_{I/Q}$ = 20.4 MHz, within ±10 K temperature change after I/Q or total calibration)		<–65 dBfs typ.	
Frequency response (within $^2/_3$ RBW; RBW = 3, 5, 10, 20, 50 MHz)			
f ≤3.6 GHz		0.3 dB typ.	
f >3.6 GHz	–	0.5 dB typ.	
Linear phase error (within $^2/_3$ RBW; RBW = 3, 5, 10, 20, 50 MHz)			
f ≤3.6 GHz		1° dB typ.	
f >3.6 GHz		2° dB typ.	
Modulation modes		AM and FM	
Audio output		loudspeaker and headphones output	
Trigger			
Span ≥10 Hz			
Trigger source		free run, video, ext., IF level (mixer level >–20 dBm)	
Trigger offset		125 ns to 100 s, resolution 125 ns min. (or 1 % of offset)	
Span = 0 Hz			
Trigger source		free run, video, ext., IF level (mixer level >–20 dBm)	
Trigger offset		± 125 ns to 100 s, resolution 125 ns min., dependent on sweep time	
Max. deviation of trigger offset		± (125 ns + (0.1 % x delay time))	
Gated sweep			
Trigger source		external, IF level, video	
Gate delay		1 µs to 100 s	
Gate length		125 ns to 100 s, resolution min. 125 ns or 1 % of gate length	
Max. deviation of gate length		±(125 ns + (0.05 % x gate length))	

	R&S FSQ3	R&S FSQ8	R&S FSQ26
Inputs and outputs (front panel)			
RF input		N female, 50 Ω	
VSWR; RF attenuation ≥10 dB, DC coupling			
f <3.6 GHz		<1.5	
f <8 GHz	–	<2.0	<1.8
f <18 GHz	–	–	<1.8
f <26.5 GHz	–	–	<2.0
RF attenuation <10 dB or AC coupling		1.5 typ.	
Setting range attenuator		0 dB to 75 dB in 5 dB steps	
Probe power supply		+15 V DC, –12.6 V DC + ground, max. 150 mA nominal	
Power supply antennas		5-pin connector	
Supply voltages		±10 V and ground, max. 100 mA nominal	
Keyboard connector		PS/2 female for MF2 keyboard	
AF output		3.5 mm mini jack, 10 Ω, up to 1.5 V, adjustable	
Inputs and outputs (rear panel)			
IF 20.4 MHz		Z_{out} = 50 Ω, BNC female	
RBW ≤ 100 kHz		1.67 x resolution bandwidth, min. 2.6 kHz	
RBW 50 kHz, 100 kHz		400 kHz	
10 MHz ≥ RBW ≥ 200 kHz		same as resolution bandwidth	
Level			
RBW ≤ 100 kHz, FFT		–20 dBm at reference level, mixer level >–70 dBm	
10 MHz≥RBW≥ 200 kHz		0 dBm at reference level, mixer level >–50 dBm	
IF 404.4 MHz		Z_{out} = 50 Ω, BNC female 404.4 MHz IF output active only if RBW >10 MHz	
Bandwidth			
RBW > 10 MHz		same as resolution bandwidth	
Level			
Mixer level ≤ 0 dBm mixer level –10 dB typ., only active if RBW 20.50 MHz			
Video output		Z_{out} = 50 Ω, BNC female	
Voltage (RBW ≥200 kHz)		0 V to 1 V, full scale (open-circuit voltage), logarithmic scaling	
Ref. frequency output		BNC female, 10 MHz, >0 dBm nominal	
Ref. frequency input		BNC female	
Frequency range		1 MHz to 20 MHz in 1 Hz steps	
Required level		>0 dBm from 50 Ω	
Sweep output		BNC female, 0 V to 5 V, proportional to displayed frequency	
Power supply connector for noise source		BNC female, 0 V and 28 V, switchable, max. 100 mA	
External trigger/ gate input		BNC female, >10 kΩ	
Trigger voltage		1.4 V	
Remote control		interface to IEC 625-2 (IEEE 488.2)	
Serial interface		RS-232-C (COM), 9-pin Sub-D female	
Printer interface		parallel (Centronics-compatible)	
Mouse connector		PS/2 female	
External monitor (VGA)		15-pin Sub-D female	

[1] Valid for temperatures between +20 °C and +30 °C; <0.6 dB for temperatures between +5 °C and +45 °C.

[2] Valid for temperatures between +20 °C and +30 °C and span <1 GHz; add < 0.5 dB for temperatures between +5 °C and +45 °C or span >1 GHz.

Signal Analyzers R&S FSQ 3/8/26

General data

	R&S FSQ3	R&S FSQ8	R&S FSQ26
Display	21 cm TFT LCD colour display (8.4")		
Resolution	800 x 600 pixels (SVGA resolution)		
Pixel failure rate	$<1 \times 10^{-5}$		
Mass memory	1.44 Mbyte 3½" disk drive, hard disk		
Rated temperature range	+5 °C to +40 °C		
Limit temperature range	+0 °C to +50 °C		
AC power supply	100 V AC to 240 V AC, 3.1 A to 1.3 A, 50 to 400 Hz		
Power consumption	130 VA typ.	150 VA typ.	
Dimensions (W x H x D)	435 mm x 192 mm x 460 mm		
Weight	14.6 kg	15.4 kg	15.6 kg

Optional Electronic Attenuator R&S FSU-B25

Electronic attenuator	0 dB to 30 dB, 5 dB steps
Preamplifier	20 dB, switchable
Maximum level measurement error	
Frequency response, with preamplifier or electronic attenuator	
10 MHz to 50 MHz	<1 dB
50 MHz to 3.6 GHz	<0.6 dB
3.6 GHz to 8 GHz	<2.0 dB
Reference error at 128 MHz, RBW ≤100 kHz, reference level –30 dBm, RF attenuation 10 dB	
Electronic attenuator	<0.3 dB
Preamplifier	<0.3 dB
Displayed average noise level (RBW=1 kHz, VBW=3 kHz, zero span, sweep time 50 ms, 20 averages, mean marker, normalized to 10 Hz RBW, preamplifier on)	
10 MHz to 2.0 GHz	<–152 dBm
2.0 GHz to 3.6 GHz	<–150 dBm
3.6 GHz to 8.0 GHz	<–147 dBm
Intermodulation (third-order intermodulation, third-order intercept (TOI), electronic attenuator on, $\Delta f > 5 \times$ RBW or 10 kHz)	
10 MHz to 300 MHz	>17 dBm
300 MHz to 3.6 GHz	>20 dBm
3.6 GHz to 8 GHz	>18 dBm

Ordering information

Signal Analyzer

20 Hz to 3.6 GHz	R&S FSQ3	1155.5001.03
20 Hz to 8 GHz	R&S FSQ8	1155.5001.08
20 Hz to 26.5 GHz	R&S FSQ26	1155.5001.26

Accessories supplied

Power cable, operating manual, service manual; R&S FSQ26: test port adapter with 3.5 mm female (1021.0512.00) and N female (1021.0535.00) connector

Options

Highly Accurate Reference Frequency	R&S FSU-B4	1144.9000.02
External Generator Control	R&S FSP-B10	1129.7246.02
Electronic Attenuator, 0 dB to 30 dB, with integrated 20 dB preamplifier	R&S FSU-B25	1144.9298.02

Software

Noise Measurement Software	R&S FS-K3	1057.3028.02
Phase Noise Measurement Software	R&S FS-K4	1108.0088.02
GSM/EDGE Application Firmware	R&S FS-K5	1141.1496.02
FM Measurement Demodulator	R&S FS-K7	1141.1796.02
3GPP BTS/Node B FDD Application Firmware	R&S FS-K72	1154.7000.02
UE FDD Application Firmware	R&S FS-K73	on request
W-LAN Application Software		on request

Extras

Headphones	–	0708.9010.00
US Keyboard with trackball	R&S PSP-Z2	1091.4100.02
PS/2 Mouse	R&S FSE-Z2	1084.7043.02
Colour Monitor, 17", 230 V	R&S PMC3	1082.6004.04
IEC/IEEE-Bus Cable, 1 m	R&S PCK	0292.2013.10
IEC/IEEE-Bus Cable, 2 m	R&S PCK	0292.2013.20
19" Rack Adapter	R&S ZZA-411	1096.3283.00
Adapter for mounting on telescopic rails (only with 19" Adapter ZZA-411)	R&S ZZA-T45	1109.3774.00
Matching Pads, 75 Ω		
L Section	R&S RAM	0358.5414.02
Series Resistor, 25 Ω	R&S RAZ	0358.5714.02
SWR Bridges		
SWR Bridge, 5 MHz to 3000 MHz	R&S ZRB2	0373.9017.52
SWR Bridge, 40 kHz to 4 GHz	R&S ZRC	1039.9492.52
High-Power Attenuators, 100 W,		
3/6/10/20/30 dB (XX=03/06/10/20/ 30)	R&S RBU 100	1073.8820.XX
High-Power Attenuators, 50 W		
3/6/10/20/30 dB (XX=03/06/10/20/ 30)	R&S RBU 50	1073.8895.XX
20 dB, 6 GHz	R&S RDL 50	1035.1700.52

Signal Analyzer R&S FSIQ

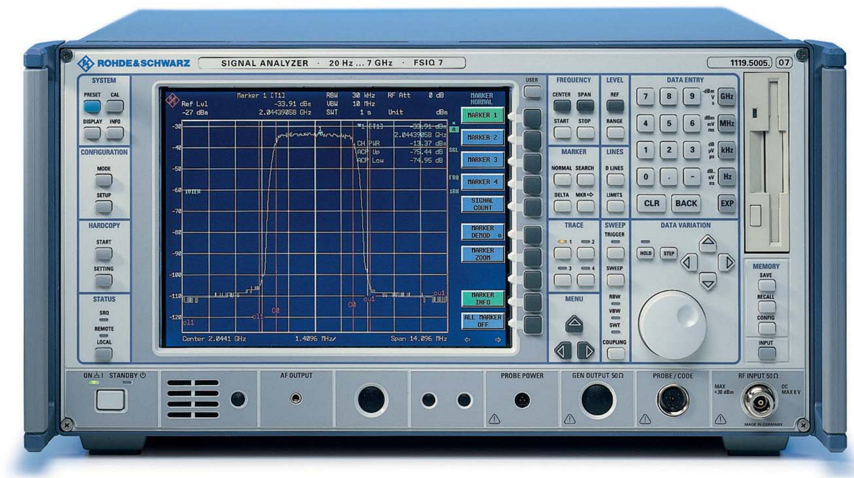
R&S FSIQ3: 20 Hz to 3.5 GHz

R&S FSIQ7: 20 Hz to 7 GHz

R&S FSIQ26: 20 Hz to 26 GHz

75 dB ACPR for WCDMA

The one box solution in signal analysis



R&S FSIQ7 (photo 43185-3)

Brief description

R&S FSIQ provides in a single unit comprehensive and easy-to-use measurement functions in the frequency time and modulation domain.

Frequency domain

In the frequency domain, R&S FSIQ measures intermodulation and harmonics with great accuracy. The high 3rd-order intercept point in conjunction with the extremely low noise floor yields an intermodulation-free dynamic range of >110 dB and ensures reliable performance of even sophisticated measurements. The excellent dynamic range and the optimized phase noise values make the R&S FSIQ an ideal tool for ACPR (adjacent channel power ratio) measurements in all mobile radio systems and in particular for WCDMA. The maximum ACPR value for WCDMA in 4.096 MHz bandwidth is 75 dB and is already attained at –12 dBm input level.

The RMS detector available for all bandwidths up to 10 MHz is the ideal tool for precise power measurements whatever the waveform. Channel power and adjacent-channel power can accurately be measured and displayed irrespective of any signal statistics. Typical measurement problems such as the high and uncertain crest factor in CDMA systems can thus be eliminated and the true RMS value be displayed.

Time domain

In the time domain, R&S FSIQ features all modern capabilities of burst analysis in TDMA systems; gate functions, trigger delay and integrated RF trigger in conjunction with a short sweep time of 1 µs ensure precise measurement of the timing characteristics from signals of all main mobile radio systems.

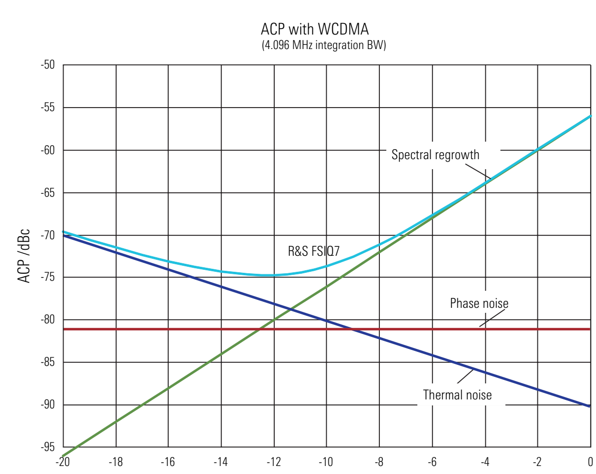
Thanks to the wide range of bandwidths available up to 10 MHz the effect of the measuring instrument becomes negligible – in particular in the case of measurements on broadband systems.

Various marker functions in conjunction with editable gated sweeps allow RMS, average and peak measurements to be carried out over any selectable time.

Modulation domain

In the modulation domain, the integrated vector signal analyzer provides diverse measurements on signals with digital or analog modulation. The variety of settings that can be called simply at a keystroke covers 18 mobile radio standards from GSM, NADC, IS-95 through to WCDMA. These convenient presettings make it superfluous for the user to spend valuable time in looking up specifications and go towards enhancing the measurement reliability.

Display of the results caters to practically each and every need: in addition to vector and constellation diagrams, I/Q signal and eye/trellis diagrams, tables with



Signal Analyzer R&S FSIQ

modulation errors including the demodulated bit sequence are particularly useful. EVM (error vector magnitude), phase and frequency error, waveform factor and I/Q offset are output as numeric values, with RMS and peak value being shown separately.

Besides the mobile radio standards, R&S FSIQ can also be used as a general- purpose measurement demodulator for non-standard modulation methods. The list of the 13 digital demodulators available ranges from BPSK, QPSK and (G)MSK through to 16QAM. With a symbol rate selectable up to 6.4 Msymbol/s and cosine and root-cosine filters adjustable in 0.01 step width, configuration of customized systems is no problem.

Main features

Spectrum analysis

- Spectrum analysis with ultra-wide dynamic range for sophisticated ACPR measurements: NF = 18 dB/TOI = +20 dBm (R&S FSIQ7); figure of merit
- 75 dB ACPR dynamic range for WCDMA (4.096 MHz integration bandwidth)
- 82 dB ACPR in 4.096 MHz integration bandwidth for alternate channel
- Total measurement uncertainty <1 dB up to 2.2 GHz, <1.5 dB up to 7 GHz
- Resolution bandwidth 1 Hz to 10 MHz in 1/2/3/5 steps
- 5-pole resolution filters with high selectivity
- FFT filter with 1 Hz to 1 kHz RBW for fast measurements
- Displayed average noise floor –150 dBm typ. in 10 Hz bandwidth

Vector signal analysis

- Integrated vector signal analyzer for universal analysis of digital and analog modulated signals BPSK to 16QAM, (G)MSK, AM, FM, PM
- Vector signal analyzer for WCDMA
- Symbol rate up to 6.4 Msymbol/s

General-purpose signal analysis

- High-speed synthesizer with 5 ms sweep time for FULL SPAN (R&S FSIQ3/7)
- Fast time domain analysis with 1 µs zero span sweep time
- True RMS detector for precise and repeatable measurements of any signal type
- High display update rate up to 25 sweeps/s
- Large colour display with high resolution (24 cm/9.5" TFT)

Specifications in brief

Common data

Aging per day	$1 \cdot 10^{-9}$
Aging per year[1)]	$2 \cdot 10^{-7}$
Marker resolution	0.1 Hz to 10 kHz (dependent on span)
Frequency counter resolution	0.1 Hz to 10 kHz (selectable)
Display range for frequency axis	0 Hz, 10 Hz to full span
Display range with digital demodulation	
Number of displayed symbols	
Symbol rate ≤1 MHz	max. 1600 symbols (4 points per symbol)
Symbol rate >1 MHz to <3.2 MHz	½ x symbol rate / MHz x 1000 symbols in steps of 100 symbols
Symbol rate ≥3.2 MHz	max. 1600 symbols (4 points per symbol)
Display range with analog demodulation	(3500/demodulation bandwidth/Hz) s
Sweep	
Display range 0 Hz	1 µs to 2500 s in 5% steps
Display range ≥10 Hz	5 ms to 16 000 s in steps ≤10%
Sampling rate	50 ns (20 MHz A/D converter)
Number of pixels (x axis)	500

Resolution bandwidths with spectrum display	
Analog filter	
3 dB bandwidths	1 Hz to 10 MHz in 1/2/3/5 steps
Shape factor 60:3 dB	
<1 kHz	<6
1 kHz…2 MHz	<12
>2 MHz	<7
Video bandwidths	1 Hz to 10 MHz in 1/2/3/5 steps
FFT filter	
3 dB bandwidths	1 Hz to 1kHz in 1/2/3/5 steps
Shape factor 60:3 dB	2.5 nominal
Max. display range	100 dB
Inherent spurious response	< –100 dBm
Level	
Display range	noise floor displayed to 30 dBm
Maximum input level	
RF attenuation 0 dB	
DC voltage	0 V
CW RF power	20 dBm (= 100 mW)
Pulse spectral density	97 dBµV/MHz
RF attenuation ≥10 dB	
DC voltage	0 V
CW RF power	30 dBm (=1W)
Max. pulse voltage	150 V
Max. pulse energy (10 µs)	1mWs (R&S FSIQ3/7) 0.5 mWs (R&S FSIQ26)

Signal Analyzer R&S FSIQ

1 dB compression of input mixer (0 dB RF attenuation)

Intermodulation	+10 dBm nominal at f >150 MHz

Level display

Screen	500 x 400 pixel (one diagram), max. 2 diagrams with independent settings
Log level axis	10 to 200 dB, in steps of 10 dB
Linear level axis	10% of reference level per level division, 10 divisions or logarithmic scaling
Trace	max. 4 (with two diagrams on screen, max. 2 per diagram)
Trace detector	Max Peak, Min Peak, Auto Peak (Normal), Sample, RMS, Average
Trace functions	Clear/Write, Max Hold, Min Hold, Average

Setting range of reference level

Logarithmic level display	–130 dBm to 30 dBm, in steps of 0.1 dB
Linear level display	7.0 nV to 7.07 V in steps of 1%
Units of level axis	dBm, dBμV, dBmV, dBpW (log level display) V, A, W, dBμA (linear level display)

Total measurement error (0 to –50 dB, span/RBW <100) (rss, 95% confidence level)

< 2.2 GHz	<1 dB
2.2 GHz to 3.5/7 GHz	<1.5 dB
7 GHz to 18 GHz	<2.5 dB
18 GHz to 26.5 GHz	<3 dB

Measurement of digital modulation signals

Modulation formats

BPSK, QPSK, Offset QPSK, DQPSK, π/4DQPSK, 8PSK, D8PSK, 3π/8-8PSK,16 QAM, MSK, GMSK, 2R&S FSK, 2GR&S FSK, 4R&S FSK, 4GR&S FSK

Selectable Standards

WCDMA, 3GPP, IS-95 CDMA forward/reverse, GSM, EDGE, NADC, TETRA, PDC, PHS,CDPD, DECT, PWT, APCO25, CT2, ERMES, FLEX, MODACOM,TFTS

Filters

Filtering	raised cosine, square root raised cosine, Gaussian
Setting range α/B x T	0.14 to 1 in steps of 0.01
Filters to specific standards	
FLEX	Bessel B x T = 1.22 and 2.44
ERMES	Bessel B x T = 1.25
IS 95 CDMA	forward and reverse channel
APCO 25 FM	
EDGE	weighting filter

Symbol rate

Symbol rate	320 Hz to 6.4 MHz (symbol rate x (1+ α)) < 8 MHz
Samples/symbol	
Symbol rate ≤200 kHz	1, 2, 4, 8, 16
200 kHz < Symbol rate ≤400 kHz	1, 2, 4, 8
Symbol rate >400 kHz	1, 2, 4
Synchronization	internal to symbol clock and frequency/phase

Level measurements with digital demodulation

Peak power range	–60 dBm to +30 dBm
Absolute level error	
Mean power(0 dB to –10 dB below reference level)	
f ≤ 2.2 GHz	1 dB
2.2 GHz to 7 GHz	1.5 dB
7 GHz to 18 GHz	2.5 dB (R&S FSIQ7/26)
18 GHz to 26.5 GHz	3 dB (R&S FSIQ7/26)

Dynamic range for burst measurement

(mean power, ref. level ≥10 dBm, power = ref. level +1 dB, low-noise mode, points/symbol <4, nominal values

	WCDMA	60 dB
	GSM	74 dB
	NADC	78 dB
	TETRA	79 dB

Time reference (nominal)

without clock synchronization	
MSK/GMSK modulation,	<1/(2 x symbol rate · points/symbol)
PSK/QAM/R&S FSK modulation	<1/(2 x symbol rate)
with clock synchronization	<0.001 x 1/(symbol rate)

Residual error in modulation measurements

(data valid for level from reference level – 6 dB, S/N >60 dB, α/BT = 0.3 to 0.7, number of demodulated symbols >100, averaging ≥10, analog bandwidth >10 x symbol rate, input frequency >15 x symbol rate, local suppression at 0 Hz input frequency adjusted), symbol rate (1+α) ≤ 8 MHz

Frequency error	± (symbol rate × 5 × 10-6 + 0.1 Hz + reference error × carrier frequency)
I/Q offset error	0.2% (–54 dB)

Error with modulation standard

GSM900/1800/1900	phase error ≤0.5° rms, typ. <1.5° peak
NADC, CDPD	EVM ≤0.5% rms, typ. <1.5% peak
TETRA, PDC, PHS	EVM ≤0.7% rms, typ, <2% peak
PWT	EVM ≤1% rms, typ. <3% peak
IS-95 CDMA,	forward/reverse channel ρ factor ≥ 0.9995
WCDMA	EVM ≤1.8% rms, typ. <5% peak

Measurement of analog modulation signals

Demodulation bandwidth	
Realtime demodulation	5 kHz to 200 kHz in steps of 1,2,3,5
Offline demodulation	5 kHz to 5 MHz in steps of 1,2,3,5
Demodulation length (max. sweep time)	3500/(demod. bandwidth/Hz) s

Readout

Trace with AF signal, carrier power (AM DC-coupled), or modulation summary (table) with numerical display of: peak and rms values of modulation depths or deviations of main demodulation;

SINAD value 1 kHz (only with realtime demodulation); AF frequency; carrier power; peak values of incidental modulation

The following specifications are valid for demodulation bandwidth ≤2 MHz, resolution bandwidth ≥5 x demodulation bandwidth, RF input level ≤–10 dBm, reference level setting = peak input level + 0 to +6 dB.

Amplitude demodulation

Range	up to 100%
AF	
Offline demodulation	0.001 to 0.2 x demod. BW
Realtime demodulation	30 Hz to 0.2 x demod. BW, max. 20 kHz

Frequency demodulation

Deviation range	max. 0.4 x demodulation bandwidth
AF	
Offline demodulation	DC/0.001to 0.2 x demod. bandwidth
Realtime demodulation	DC/30 Hz to 0.2 x demodulation bandwidth, max. 20 kHz

Signal Analyzer R&S FSIQ

Phase demodulation

Deviation range	up to 10 rad
AF Offline demodulation	DC/0.001 to 0.1 x demodulation bandwidth <(0.4 x demod. BW)/(phase deviation/rad)
Realtime demodulation	200 Hz to 0.1 x demod. BW, max. 15 kHz < (0.4 x demod. BW)/(phase deviation/rad), smaller limit values apply

Measurement of unmodulated carrier power

Measurement error, (ref. level to ref. level –30 dB)	1.5 dB

SINAD measurements

Realtime demodulation, AF = 1 kHz ± 4 x 10^{-4} x demod. BW	
Error with 6 to 54 dB SINAD	±1 dB + error due to demodulator SINAD

Display of AF frequencies

Range	
Offline demodulation	0.001 to 0.3 x demodulation bandwidth
Realtime demodulation max. 20 kHz	30 Hz to 0.3 x demodulation bandwidth
Resolution	1 mHz to 1 Hz
Error (S/N ≥40 dB)	$1 \cdot 10^{-6}$ x demod.BW + error of reference frequency +1 mHz ±1 digit
AF filters	
Realtime demodulation	
Lowpass	3 kHz, 15 kHz (Butterworth, 12 dB/oct.)
Highpass	30 Hz, 300 Hz (6 dB/oct.)
Weighting filters	CCITT P.53, C message
Offline demodulation	
Lowpass (12 dB/oct.)	5%, 10%, 25% of demod. bandwidth

Audio demodulation

Modulation modes	AM and FM
Audio output	speaker and phone jack
Marker stop time in spectrum mode	100 ms to 60 s
Squelch	adjustable with level line

Trigger functions

Trigger Span ≥10 Hz	free run, line, video, RF level, external
Span = 0 Hz	plus pretrigger, posttrigger, trigger delay
with digital demodulation	plus burst trigger and synchronization to bit sequence (max. 32 symbols)
with analog demodulation	plus trigger to demodulated AF
Gated sweep, trigger source	external, RF level
Gate delay	1 µs to 100 s
Gate length	1 µs to 100 s, resolution min. 1 µs or 1% of gate length
Error of gate length	±(1 µs + (0.05% x gate length))

Inputs and outputs (front panel)

RF input	N female, 50 Ω
R&S FSIQ26 only	adapter system, 50 Ω, N/3.5 mm male and female
VSWR (RF attenuation >0 dB)	<1.5 (f <3.5 GHz)
Attenuator	0 dB to 70 dB, switchable in 10 dB steps
Probe power supply	+15/–12.6 V DC, max. 150 mA
Supply and coding connector for antennas, etc)	±10 V, max. 100 mA, ground
AF output	Z_{out} = 10 Ω, JK34 jack

Reference frequency	
Output, usable as input	BNC female, 10 MHz, 10 dBm nom.
Input	1 MHz to 16 MHz, >0 dBm from 50 Ω
Sweep output	BNC female, 0 V to +10 V, proportional to displayed frequency
Power supply for noise source	BNC female, 0 V and 28 V, switched
External trigger/gate input	BNC female, >10 kΩ –5 V to +5 V, adjustable
IEC/IEEE bus remote control	IEC 625-2 (IEEE 488.2), SCPI 1994.0
Serial interface	RS-232-C (COM1 and COM2)
Mouse interface	PS/2 compatible
Printer interface	parallel (Centronics compatible) or serial (RS-232-C)
Keyboard connector	5-pin DIN female for MF2 keyboard
User interface	25-pin Canon female
Connector for external monitor (VGA)	15-pin female

Model-dependent data

3rd-order intermodulation

Intermodulation-free dynamic range, level 2 x –20 dBm, Δf >5 x RBW or 10 kHz, whichever is the greater value

R&S FSIQ3	>64 dBc for f >100 MHz (TOI >12 dBm, 18 dBm typ.)
R&S FSIQ7	>70 dBc for f >150 MHz (TOI >15 dBm, 20 dBm typ.)
R&S FSIQ26	>74 dBc for f >150 MHz (TOI >17 dBm, 22 dBm typ.) >60 dBc for f >7 GHz (TOI >10 dBm)

Intercept-Punkt K2 >25 dBm, >35 dBm typ. for f <150 MHz; >40 dBm, >45 dBm typ. for f >150 MHz

Spectral purity (dBc (1 Hz)) SSB phase noise, f ≤500 MHz, for carrier offset >1 MHz see diagram on next page

Carrier-Offset	R&S FSIQ3	R&S FSIQ7	R&S FSIQ26
100 Hz	<–87	<–81	<–81
1 kHz	<–107	<–100	<–100
10 kHz	<–120	<–114	<–114
100 kHz [1]	<–119	<–113	<–113
1 MHz [1]	<–138	<–132	<–132

Displayed average noise level (DANL)

(0 dB RF attenuation, RBW10 Hz, VBW = 1 Hz, 20 averages, trace average, span 0 Hz, termination 50 Ω, in dBm)

	R&S FSIQ3	R&S FSIQ7	R&S FSIQ26
10 MHz to 6 GHz	<–145, –150 typ.	<142, –147 typ.	<–138, –140 typ.
6 GHz to 7 GHz	–	<–139	<–135, –138 typ.
7 GHz to 18 GHz	–	–	<–138, –140 typ.
18 GHz to 26,5 GHz	–	–	<–135, –138 typ.

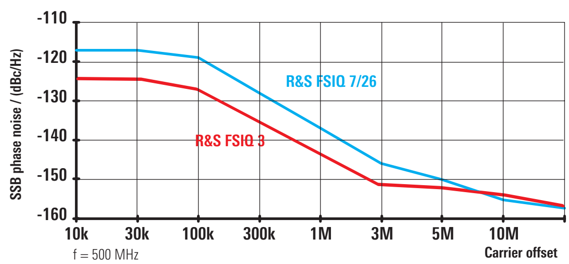
Maximum dynamic range

1 dB compression to DANL (1 Hz)

R&S FSIQ3	R&S FSIQ7	R&S FSIQ26
170 dB	165 dB	165 dB

1) Values valid for span >100 kHz.

Signal Analyzer R&S FSIQ



Typ. phase noise for R&S FSIQ 3 (red) and R&S FSIQ 7/26 (blue)

Inherent error on modulation measurements
General modulation modes (except R&S FSK)
Error vector magnitude (EVM) and magnitude error (f < 1 GHz) [1]

Symbol rate 1)	**R&S FSIQ 3**	**R&S FSIQ 7/26**
≤30 kHz	0.5% rms	0.7% rms
30 kHz to 300 kHz	1% rms	1.4% rms
300 kHz to 1 MHz	2% rms	2.8% rms
1 MHz to 4.2 MHz	2% rms	2% rms
4.2 MHz to 6.4 MHz	2.4% rms	2.4% rms
Phase error (f<1 GHz) [2]		
Symbol rate		
≤30 kHz	0.3° rms	0.4° rms
30 kHz to 300 kHz	0.5% rms	0.7% rms
300 kHz to 1 MHz	1.5% rms	2% rms
1 MHz to 4.2 MHz	1.5% rms	2% rms
4.2 MHz to 6.4 MHz	2% rms	2.8% rms

General data

Display	24 cm colour display TFT (9.5")
Resolution	640 x 480 pixels (VGA resolution)
Mass memory	1.44 Mbyte 3½" FDD, hard disk
Rated temperature range	+5°C to +40°C
Power supply	200 V to 240 V: 50 Hz to 60 Hz, 100 V to 120 V: 50 Hz to 400 Hz,
Power consumption	195 VA to 245 VA (depends on model)
Dimensions (W x H x D)	
R&S FSIQ 3/7	435 mm x 236 mm x 460 mm
R&S FSIQ 26	435 mm x 236 mm x 570 mm
Weight	24 kg to 27.1 kg (depends on model)

Ordering information

Signal Analyzer		
20 Hz to 3.5 GHz	R&S FSIQ3	1119.5005.13
20 Hz to 7 GHz	R&S FSIQ7	1119.5005.17
20 Hz to 26.5 GHz	R&S FSIQ26	1119.6001.27
Accessories supplied		
R&S FSIQ3/7/26	keyboard, mouse, power cable, operating manual, fuses, Windows NT 4.0	
R&S FSIQ26 additional		
Testport adapter 3,5-mm female	–	1021.0512.00
Testport adapter N female	–	1021.0535.00
Options, Software (Windows)		
7 GHz Frequency Extension for R&S FSIQ 3	R&S FSE-B2	1073.5044.02
Tracking Generator 3.5 GHz	R&S FSE-B8 [3]	1066.4469.02
Tracking Generator 3.5 GHz with I/Q modulator	R&S FSE-B9 [3]	1066.4617.02
Tracking Generator 7 GHz	R&S FSE-B10 [4]	1066.4769.02
Tracking Generator 7 GHz with I/Q modulator	R&S FSE-B11 [4]	1066.4917.02
Switchable Attenuator for Tracking Generator	R&S FSE-B12	1066.5065.02
1 dB Attenuator	R&S FSE-B13	1119.6499.02
Ethernet Interface 15-contact, AUI	R&S FSE-B16	1073.5973.02
Thin-wire, BNC	R&S FSE-B16	1073.5973.03
RJ-45 connector	R&S FSE-B16	1073.5973.04
2nd IEC/IEEE Bus Interface	R&S FSE-B17	1066.4017.02
Removable Hard Disk	R&S FSE-B18	1088.6993.02
Second Hard Disk for R&S FSE-B18 (firmware included)	R&S FSE-B19	1088.7248.02
Additional Memory and Compute Power for Firmware R&S FSIQK71	R&S FSIQB70	1119.6747.02
External Mixer Input/Output for R&S FSIQ 26	R&S FSE-B21	1084.7243.02
Noise Measurement Software	R&S FS-K3	1057.3028.02
Phase Noise Measurement Software	R&S FSE-K4	1108.0088.02
GSM Test Software, Mobile	R&S FSE-K10	1057.3092.02
GSM Test Software, BTS	R&S FSE-K11	1057.3392.02
EDGE-Application Firmware, Mobile	R&S FSE-K20 [5]	1106.4086.02
EDGE-Application Firmware, BTS	R&S FSE-K21 [5]	1106.4186.02
cdmaOne (IS-95) Code-Domain Power	R&S FSIQK71 [6]	1126.4498.02
3GPP (BTS, FDD) Code-Domain Power	R&S FSIQK72 [5]	1126.4746.02

1) For frequencies >1 GHz the specified values have to be multiplied by $10^{0.552 \times \lg (f/\mathrm{GHz} / 1\ \mathrm{GHz})}$.

2) For frequencies >1 GHz the specified values have to be multiplied by $10^{0.354 \times \lg (f/\mathrm{GHz} / 1\ \mathrm{GHz})}$.

3) For R&S FSIQ3 only.

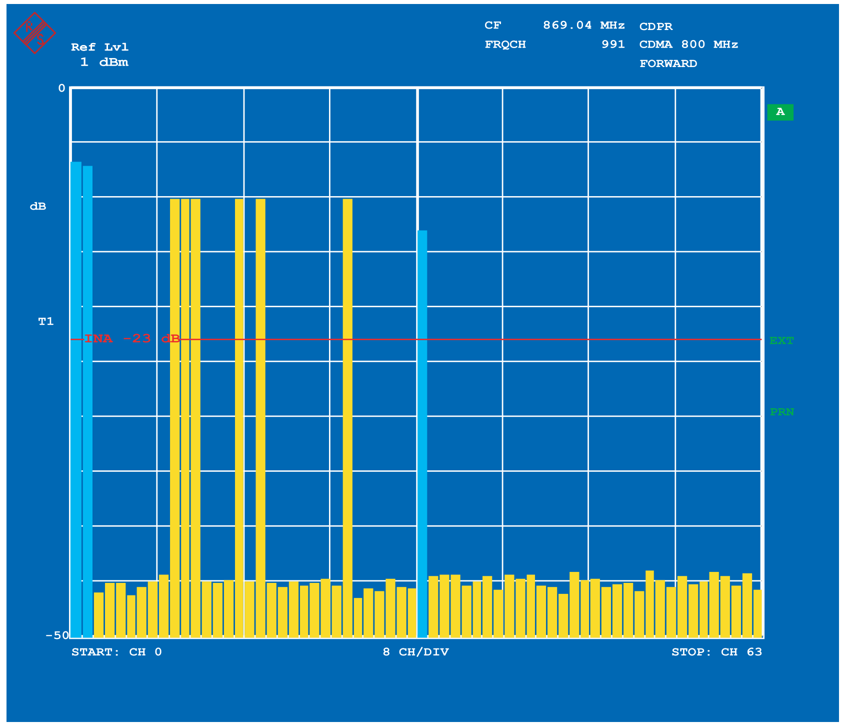
4) For R&S FSIQ7 and R&S FSIQ26 only.

5) R&S FSE-K11 or R&S FSE-K11 required.

6) R&S FSIQB70 required.

Application Firmware R&S FSIQK71

cdmaOne code-domain power measurement on base stations with Signal Analyzer R&S FSIQ



Code-domain power: 64 Walsh code channels are displayed simultaneously

Brief description

Application Firmware R&S FSIQK71 for Signal Analyzers R&S FSIQ allows to characterize the Walsh code channels of a CDMA base station to US standards TIA/EIA-97-B/C.

- Simultaneous measurement of code-domain power of 64 channels and bargraph result display
- Measurement of time and phase offset error relative to pilot signal (nominal test case with 9 Walsh code channels)
- Measurement of pilot time alignment
- Easy operation thanks to common menu structure for cdmaOne measurements available in R&S FSIQ

Application Firmware R&S FSIQK71 further extends the wide range of applications offered by the R&S FSIQ models and now even allows code-domain power measurements on cdmaOne signals. Complex tests as those stipulated for CDMA base stations by the TIA/EIA-97-B/C standard can be performed by using R&S FSIQ and R&S FSIQK71.

Application Firmware R&S FSIQK71 also offers a common selection menu for all available cdmaOne measurements, which makes operation a great deal easier. An additional menu provides the functions already implemented in the basic unit for the determination of the channel and adjacent-channel power, and the waveform quality (ρ factor) besides the code-domain power (Table 1).

The powers of the individual code channels are displayed either as a bargraph (64 channels) or in tables (9 channels). The test interval can be selected from 1k chips to 24k chips and is adapted to the S/N ratio of the CDMA signal in the auto mode.

Measurements	Without R&S FSIQK71	With R&S FSIQK71 (R&S FSIQB70 prerequisite)
Total power	●	●
ACPR	●	●
Pilot channel power	–	●
Waveform quality (ρ factor)	●	●
Forward link frequency tolerance	–	●
Pilot time tolerance	–	●
Pilot channel to code channel time tolerance	–	●
Pilot channel to code channel phase tolerance	–	●
Code-domain power	–	●

Measurement functions with and without Application Firmware R&S FSIQK71

Application Firmware R&S FSIQK71

Specifications

Measurements	R&S FSIQ3, R&S FSIQ7, R&S FSIQ26, R&S FSIQ40	Test specifications and permissible measurement uncertainty for measuring equipment to TIA/EIA-97-B/C
Channel power measurement		
Channel bandwidth		
Default	1.23 MHz	
Range	1 kHz to 1000 MHz	
Power range (1.23 MHz bandwidth)	–90 dBm to +30 dBm (S/N ≥10 dB)	–70 dBm to +47 dBm
Absolute error (95% confidence level)		
0 dB to –50 dB from ref. Level	<0.5 dB	±1 dB
Relative error (same channel, input attenuator fixed)		
Input level (ref. level = 0 dB)		
0 dB to –50 dB	<0.3 dB	±1.5 dB
–50 dB to –70 dB	<0.5 dB	
Adjacent-channel power measurement		
Power range at RF input	–50 dBm to +30 dBm	
Dynamic range (nominal, referred to channel power in 1.23 MHz bandwidth)		
Offset frequency / Channel bandwidth		
±750 kHz / 30 kHz	84 dB (–23 dBm mixer level [1])	
±885 kHz / 30 kHz	84 dB (–23 dBm mixer level [1])	
±1.25MHz / 12.5 kHz	87 dB (–24 dBm mixer level [1])	
±1.98MHz / 30 kHz	85 dB (–23 dBm mixer level [1])	
±2.25MHz / 1 MHz	74 dB (–18 dBm mixer level [1])	
Relative ACPR error		
0 dB to –50 dB	<0.3 dB	±1.5 dB
–50 dB to –70 dB	<0.5 dB	
Waveform quality measurement		
ρ factor	≥0.9995	

[1] Mixer level = mean power in 1.23 MHz bandwidth at RF input – RF attenuation.

Measurements	R&S FSIQ3, R&S FSIQ7, R&S FSIQ26, R&S FSIQ40	Test specifications and permissible measurement uncertainty for measuring equipment to TIA/EIA-97-B/C
Code-domain power measurement		
Range at RF input (total power)	+30 dBm to –50 dBm	
Test interval range	1024, 2048 to 24k chips	Nx64 chips, N≥20
Code-domain power (test interval 2048 chips/ 1.25 ms)		12.4.2.2
Display dynamic range	10 dB to 100 dB, settable, default 50 dB	
Accuracy (Walsh channel power within 20 dB of total power	±0.3 dB	
Resolution	0.01 dB	
Frequency error	±10 Hz (excludes frequency reference of analyzer)	±10 Hz
Pilot time alignment (from even second trigger to start of PN sequence)		
Range	–13.33 ms to 13.33 ms	
Accuracy	±135 ns	±135 ns
Resolution	10 ns	
Code-domain timing offset (pilot to code-channel time tolerance)		
Range	±50 ns	
Accuracy	±10 ns	±10 ns
Code-domain phase offset (pilot to code-channel phase tolerance)		
Range	±150 mrad	
Accuracy	±10 mrad	±10 mrad

Ordering information

Application Firmware R&S FSIQK71 can be integrated into any member of the R&S FSIQ family. Option R&S FSIQB70, which provides additional memory capacity and a higher computing power, is the precondition to operate the application firmware.

Application Firmware to test cdmaOne base stations	R&S FSIQK71	1126.4498.02
Extensions required to operate Application Firmware R&S FSIQK71	R&S FSIQB70	1119.6747.02

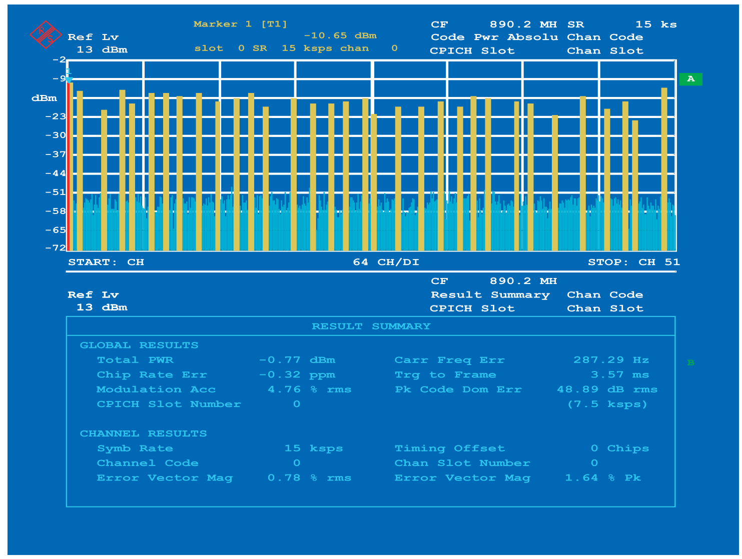
For further options and recommended extensions see R&S FSIQ data sheet (PD 0757.4160).

WCDMA/3GPP Application Firmware R&S FSIQ-K72/-K73

New

Transmitter measurements on 3GPP equipment with Signal Analyzer R&S FSIQ

- **R&S FSIQ-K72 needed for base station testing**
- **R&S FSIQ-K73 needed for user equipment (UE) testing**



Code domain power measurement at a signal with 32 active channels

Brief description

Application Firmwares R&S FSIQ-K72/-K73 enhance the wide range of applications of the Signal Analyzer R&S FSIQ to include code domain power and modulation measurements on 3GPP/FDD signals. All transmitter measurements required according to 3GPP Specification TS 25.141 V3.5.0 can thus be performed by a single instrument.

Measurement	FSIQ with FSIQ-K		
	Std.	72	73
Maximum output power	x		
CPICH power accuracy		x	N/A
Frequency error	x[2]	x	x[3]
Power control dynamic range		x	
Total power dynamic range		x	N/A
Occupied bandwidth	x		
Spectrum emission mask	x[1]	x	x
ACLR	x		
Spurious emissions	x[1]		
Error vector magnitude	x[2]	x	x
Peak code domain error		x	x

Code domain power measurements
The main application of R&S FSIQ-K72/-K73 is the determination of the power in the individual code channels referred to as code domain power measurement. The power ratios between the individual channels for instance can be checked for compliance with the nominal values. The power of the different codes is shown versus the code number. The width of the displayed bargraph intuitively provides information about the occupied code domain and the spreading factor.

Measurement of modulation quality: peak code domain error and EVM
To obtain the peak code domain error (PCDE), the vector error between the measured signal and the ideal reference signal is determined and projected to the codes of a specific spreading factor. With R&S FSIQ-K72/-K73, the spreading factor for the PCDE measurement can be selected by the user.

For a signal with e.g. only one P-CCPCH without SCH, the EVM can be determined with the normal vector signal analysis function of the R&S FSIQ. The modulation accuracy measurement returns a modulation error value for the total signal, whereas the symbol EVM function yields the individual vector errors of the active channels.

Automatic detection of active channels and their data rate
The scrambling code, which is user-selectable on the R&S FSIQ, must be known for the code domain power measurement. 3GPP/FDD signals may use different spreading factors and data rates in the various channels. The data rates are automatically detected by R&S FSIQ-K72/-K73 and need not be known beforehand.

1) These measurements can be performed with basic functions of the R&S FSIQ, without any 3GPP-specific setting functions.

2) These measurements can be performed on a 3.84 MHz QPSK signal (e.g. only P-CCPCH without SCH or one DPCCH and one DPDCH).

3) UE frequency relative to frequency received from BS.

WCDMA/3GPP Application Firmware R&S FSIQ-K72/-K73

Specifications in brief

R&S FSIQ-K72

Measurement		Test specs and permissible measurement uncertainty to 3GPP TS 25.141 V3.5.0
Code domain power (applies to code domain power and code domain power vs slot)		
Total signal power, measurement uncertainty	<0.6 dB	6.2.1 <0.7 dB
CPICH power, measurement uncertainty	<0.7 dB	6.2.2 <0.8 dB
Code power, measurement uncertainty		
Absolute	<0.7 dB	
Relative	<0.1 dB	<0.1 dB
Frequency error		6.3, 6.7.1
Measurement range	<1 kHz	<12 Hz
Uncertainty (S/N >40 dB)	<1.5 Hz + error of reference frequency	
Modulation accuracy (composite EVM)		
Measurement range	1.5% to 25%	12.5% to 25%
Inherent EVM	<1.5%	
Measurement uncertainty	<0.5%	<2.5%
Peak code domain error		6.7.3
Measurement range	0 dB to –60 dB	–33 dB
Inherent PCDE	–60 dB	
Measurement uncertainty	<1 dB (0 dB to –40 dB)	<1 dB
Output power		6.2.1
Measurement uncertainty, absolute	<0.6 dB	<0.7 dB
Measurement uncertainty, relative	<0.2 dB	
Occupied bandwidth (99%)		6.5.1
Measurement uncertainty	<85 kHz	<100 kHz
ACLR (adjacent channel leakage ratio)(3.84 MHz BW)		6.5.2.2
5 MHz offset		45 dB
Dynamic range	75 dB	
Measurement uncertainty	<0.5 dB (ACLR <60 dB)	<0.8 dB
10 MHz offset		50 dB
Dynamic range	82 dB	
Measurement uncertainty	<0.5 dB (ACLR <60 dB)	<0.8 dB
Spurious emissions		
Level uncertainty		
<2.2 GHz	<1 dB	
2.2 GHz to 4 GHz	<1.5 dB	
>4 GHz	<2.5 dB	
Spectrum emission mask	<1.5 dB	

R&S FSIQ-K73

Measurement		Test specs and permissible measurement uncertainty to 3GPP TS 34.121 V3.4.0
Code domain power (applies to code domain power and code domain power vs slot)		
Maximum output power	<0.6 dB	5.2 <0.7 dB
Minimum output power		5.4.3 <1 dB
Code power, measurement uncertainty		
Absolute	<0.7 dB	
Relative	<0.1 dB	<0.1 dB over 1.5 dB range
	<0.3 dB	<0.3 dB over 12 dB range
Frequency error		5.3
Measurement range	<1 kHz	<10 Hz
Uncertainty (S/N >40 dB)	<1.5 Hz + error of reference frequency	
Modulation accuracy (composite EVM)		
Measurement range	1.5% to 25%	12.5% to 25%
Inherent EVM	<1.5%	
Measurement uncertainty	<0.5%	<2.5%
Peak code domain error		5.1.3
Measurement range	0 dB to –60 dB	–15 dB
Inherent PCDE	–60 dB	
Measurement uncertainty	<1 dB (0 dB to –40 dB)	<1 dB
Output power		5.2
Measurement uncertainty, absolute	<0.6 dB	<0.7 dB
Measurement uncertainty, relative	<0.2 dB	
Occupied bandwidth (99%)		5.8
Measurement uncertainty	<85 kHz	<100 kHz
ACLR (adjacent channel leakage ratio)(3.84 MHz BW)		5.10
5 MHz offset		32.2 dB
Dynamic range	75 dB	
Measurement uncertainty	<0.5 dB (ACLR <60 dB)	<0.8 dB
10 MHz offset		42.2 dB
Dynamic range	82 dB	
Measurement uncertainty	<0.5 dB (ACLR <60 dB)	<0.8 dB
Spurious emissions		
Level uncertainty		
<2.2 GHz	<1 dB	<1.5 dB
2.2 GHz to 4 GHz	<1.5 dB	<2 dB
>4 GHz	<2.5 dB	<4 dB
Spectrum emission mask	<1.5 dB	

Ordering information

Application Firmwares R&S FSIQ-K72/-K73 can be integrated into any member of the R&S FSIQ family. Option R&S FSIQ-B70, memory extension and DSP, is a prerequisite for operating the application firmware. Additional modifications may become necessary if R&S FSIQ-B70 is retrofitted.

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Designation	Type	Order No.
Application Firmware 3GPP BTS Code Domain Power Measurements for R&S FSIQ	R&S FSIQ-K72	1126.4746.02
Application Firmware 3GPP UE Code Domain Power Measurements for R&S FSIQ	R&S FSIQ-K73	1153.1009.02
DSP and IQ Memory Extension 2 x 512 k	R&S FSIQ-B70	1119.6747.02
Extras		
1 dB Attenuator for R&S FSE/R&S FSIQ	R&S FSE-B13	1126.4746.02
High-Power Attenuator 20 dB, 50 W, 0 Hz to 6 GHz	R&S RDL50	1035.1700.52

Spectrum Analyzers R&S FSP

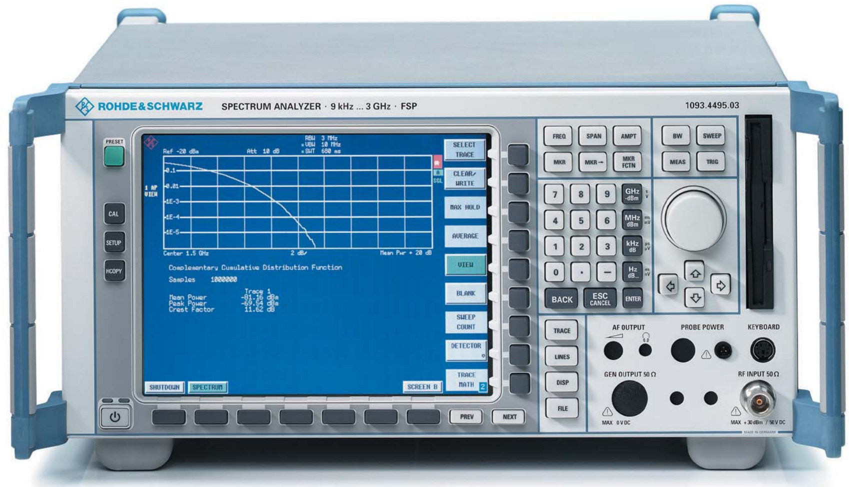
9 kHz to 3/7/13.6/30/40 GHz

The new medium-class standard:

Unparalleled range of functions

High measurement speed

Maximum in precision



R&S FSP3 (photo 43389-2)

Brief description

With the new R&S FSP family, the well-known advantages of high-end Analyzers R&S FSE and R&S FSIQ have been systematically integrated into the medium class of analyzers. R&S FSP sets the standard for the medium class regarding the vital criteria of functionality, measurement speed and accuracy. The use of innovative techniques such as an highly integrated front-end and fully digital signal processing in the back end, together with ASICs developed by Rohde & Schwarz, has resulted in a product of top-class specifications and high reliability.

All important functions and interfaces are implemented as standard. R&S FSP features future-oriented characteristics such as an RMS detector and a CCDF routine for fast statistical measurements on digitally modulated signals not offered by any other medium-class spectrum analyzer.

Main features

The R&S FSP Spectrum Analyzers are outstanding for their innovative measurements and a host of standard functions. Instead of a wide choice of options, R&S FSP offers as standard all the functions and interfaces you may expect from a state-of-the art spectrum analyzer:

- Largest colour display in its class
- Resolution bandwidths from 1 Hz to 10 MHz
- Highly selective digital and FFT filters
- Quasi-peak detector and EMI bandwidths
- Convenient documentation of results as a hardcopy or file in PC-compatible formats
- Interfaces: GPIB, Centronics, RS-232-C
- Automatic test routines for measuring TOI, OBW, phase noise and ACP(R)
- Split screen with separate settings and up to 3 traces per screen
- Editable limit lines including PASS/FAIL indication
- Fast measurements in the time domain: minimum sweep time 1 µs
- Gated sweep for measurements on TDMA signals

On top of this, R&S FSP features as standard the following unique attributes:

- RMS detector for fast and reproducible power measurements on digitally modulated signals in frequency and time domain
- Statistical measurement functions for determining crest factor and CCDF (complementary cumulative distribution function)

Featuring such a wealth of functions, R&S FSP offers state-of-the-art spectrum analysis at an extremely attractive price-performance ratio.

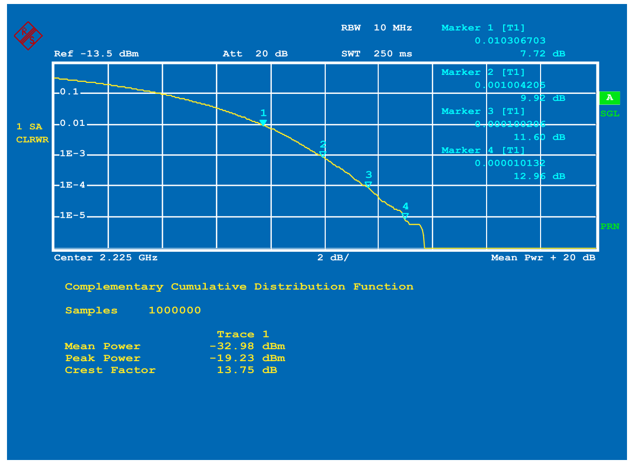
Speed

Time is a finite resource – so high measurement speed is indispensable for competitiveness and cost-effective testing. Here, too, the new R&S FSP offers characteristics that make it top of the class:

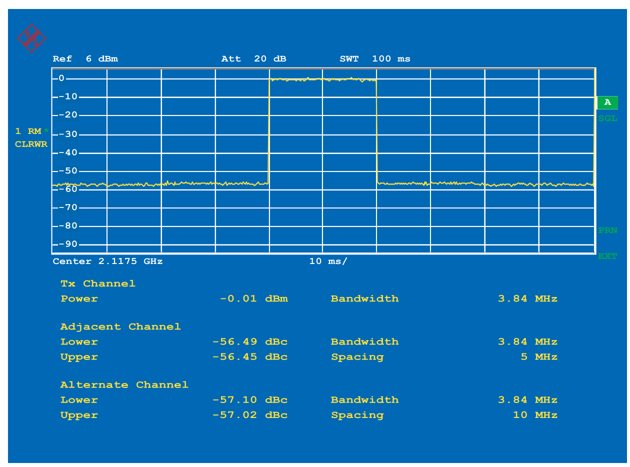
- Up to 30 measurements/s on GPIB interface including trace transfer of 501 binary data
- 70 measurements/s on GPIB interface in zero span mode including trace transfer of 501 binary data
- Minimum sweep time of 2.5 ms
- 1 µs time domain measurements
- Unique fast ACP mode for high-speed ACPR measurements in time domain using the standard-stipulated test filters

With 30 measurements/s in manual operation and digital filters with sweep time 2.5 times faster than comparable analog filters, R&S FSP will also help in your day-to-day work to develop your product much faster.

Spectrum Analyzers R&S FSP



FSP is the first spectrum analyzer to offer statistical analysis of signals by means of the complementary cumulative distribution function (CCDF) as standard and at an impressively high speed. FSP furnishes in only 250 ms the exact CCDF characteristic, average and peak power as well as the crest factor over 1 million measured values



Adjacent-channel power ratio (ACPR) measurements, which many mobile radio standards stipulate for components and units, are implemented in R&S FSP by means of automatic test routines. All settings, measurements and filters required for a selected standard are activated at a keystroke

Performance

Modern communication systems are required to achieve optimum spectral efficiency at high data rates. For the 3rd generation of CDMA mobile radio systems currently under development this is achieved, among other things, by high-precision power control.

R&S FSP is the ideal partner in development and production, featuring the smallest level measurement uncertainty of all spectrum analyzers on the market, as well as excellent RF characteristics:

- 0.5 dB total measurement uncertainty allows higher tolerances for the DUT, thus increasing production yield
- 0.07 dB linearity uncertainty (1 σ) is ideal for precise measurements, for example of gain control and ACPR
- RMS detector with 100 dB dynamic range measures power fast and accurately irrespective of the signal shape – almost like a thermal power sensor
- The displayed average noise level of –155 dBm (1 Hz) typ. is attained without the use of preamplifiers and thus without any reduction in dynamic range.
- –145 dBc (1 Hz) typ. phase noise at 10 MHz offset offers optimum conditions for ACPR measurements on W-CDMA systems.

Resolution bandwidths of up to 100 kHz are fully digital and provide – in addition to high selectivity – an ideal basis for accurate (adjacent-) channel measurements thanks to a maximum bandwidth deviation of 3%.

Open for the PC world …

- PC-compatible screenshots, no conversion software needed
- Windows™ printer support
- LabWindows driver
- LabView driver
- Software
- SCPI-compatible
- R&S FSE/R&S FSIQ-compatible GPIB command set
- GPIB command set with search function on CD-ROM

Electronic attenuator for high production throughput

The optional Electronic Attenuator R&S FSP-B25 (only for R&S FSP3 and R&S FSP7) supplements the standard mechanical attenuator and provides a wear-and-tear-free setting range of 30 dB in 5 dB steps. The option does away with frequent switching of the mechanical attenuator as called for in high production throughput and so increases the availability and reliability of the measurement facility. The integrated switchable 20 dB preamplifier allows high-sensitivity measurements in the useful frequency range from 10 MHz to 7000 MHz.

Spectrum Analyzers R&S FSP

LAN interface

With the aid of the optional LAN Interface R&S FSP-B16, R&S FSP can be connected to common networks such as 100Base-T so that functions like file logging on network drives or documentation of measurement results via network printer are available. In addition, R&S FSP can be remote-controlled via LAN.

Support

- After-sales service
- 3-year warranty
- 2-year calibration cycle
- Customized training
- Pre-sales support
- Solution-oriented consulting
- Leasing

Specifications in brief

Specifications are valid under the following conditions:
15 minutes warm-up time at ambient temperature, specified environmental conditions met, calibration cycle adhered to, and total calibration performed.
Data without tolerances: typical values only.
Data designated "nominal" apply to design parameters and are not tested.
Data designated "σ = xx dB" are shown as standard deviation.

Frequency

		R&S FSP3	R&S FSP7	R&S FSP13	R&S FSP30	R&S FSP40
Frequency range	9 kHz to	3 GHz	7 GHz	13.6 GHz	30 GHz	40 GHz

Frequency resolution	0.01 Hz
Reference frequency internal (nominal)	
Aging per year[1]	1 x 10^{-6}
Temperature drift	1 x 10^{-6}
with option R&S FSP-B4 (OCXO)	
Aging per year[1]	1 x 10^{-7}
Temperature drift	1 x 10^{-8}
External reference frequency	10 MHz
Frequency display	with marker or frequency counter
Marker resolution	span/500
Max. deviation (sweep time >3 x auto sweep time)	± (frequency x reference error + 0.5% x span + 10% x resolution bandwidth + ½ (last digit))
Frequency counter resolution	0.1 Hz to 10 kHz (selectable)
Count accuracy (S/N >25 dB)	±(frequency x reference error + ½ (last digit))

		R&S FSP3	R&S FSP7	R&S FSP13	R&S FSP30	R&S FSP40
Frequency span	0 Hz, 10 Hz to	3 GHz	7 GHz	13.6 GHz	30 GHz	40 GHz
Max. span deviation		0.1%				

Spectral purity (dBc (1 Hz))

SSB phase noise, f = 500 MHz	
Carrier offset 100 Hz	<–84, –90 typ.
1 kHz	<–100, –108 typ.
10 kHz	<–106, –113 typ.
100 kHz[2]	<–110, –113 typ.
1 MHz[2]	<–120, –125 typ.
10 MHz	–145 typ.
Residual FM f = 500 MHz, RBW 1 kHz, Sweep time 100 ms	3 Hz typ.

[1] After 30 days of operation.

[2] Valid for span >100 kHz.

Sweep time

Span ≥10 Hz	2.5 ms to 16000 s in steps of 10%
Error	1%
Span 0 Hz	1 µs to 16000 s in steps of 5%
Resolution	125 ns

Typical values for SSB phase noise (referred to 1 Hz bandwidth)

Offset	f_{in}= 3 GHz	f_{in}= 7 GHz	f_{in}= 13 GHz	f_{in}= 22 GHz	f_{in}= 26 GHz	f_{in}= 40 GHz
100 Hz	–74 dBc	–67 dBc	–61 dBc	–57 dBc	–55 dBc	–52 dBc
1 kHz	–100 dBc	–94 dBc	–88 dBc	–84 dBc	–82 dBc	–79 dBc
10 kHz	–108 dBc	–104 dBc	–98 dBc	–94 dBc	–92 dBc	–91 dBc
100 kHz	–108 dBc	–106 dBc	–100 dBc	–96 dBc	–94 dBc	–92 dBc
1 MHz	–118 dBc	–118 dBc	–112 dBc	–108 dBc	–106 dBc	–102 dBc

Resolution bandwidths

Bandwidths	10 Hz to 10 MHz (–3 dB), in 1, 3 sequence
EMI bandwidths	200 Hz, 9 kHz, 120 kHz (–6 dB)

Bandwidth accuracy

≤100 kHz	<3%
300 kHz to 3 MHz	<10%
10 MHz	+10%, –30%

Shape factor -60 dB:-3 dB

≤100 kHz	<5:1 (Gaussian filter)
300 kHz to 3 MHz	<15:1 (4-pole synchronously tuned filters)
10 MHz	<7:1

Shape factor -60 dB:-6 dB

EMI bandwidths	<5:1
Video bandwidths	1 Hz to 10 MHz in 1, 3 sequence

FFT filter

Bandwidths	1 Hz to 30 kHz (–3 dB) in 1, 3 sequence
Bandwidth accuracy	5%, nominal
Shape factor -60 dB:-3 dB	2.5:1 nominal

Level

Display range	displayed average noise level to 30 dBm

Maximum input level

RF attenuation 0 dB	
DC voltage	50 V (R&S FSP3/7), 0 V (FSP13/30/40)
CW RF power	20 dBm
Pulse spectral density	97 dBµV (1 MHz)
RF attenuation ≥10 dB	
CW RF power	30 dBm
Max. pulse voltage	150 V (R&S FSP3/7), 50V (FSP13/30/40)
Max. pulse energy (10 µs)	1 mWs (FSP/7), 0.5 mWs (FSP13/30/40)

Spectrum Analyzers R&S FSP

1 dB compression of input mixer

RF attenuation 0 dB, f>200 MHz 0 dBm nominal

Intermodulation

3rd-order intermodulation

Intermodulation-free dynamic range, level 2 x –30 dBm, Δf > 5 x RBW or 10 kHz, whichever the greater value

	R&S FSP3	R&S FSP7	R&S FSP13	R&S FSP30	R&S FSP40
20 MHz to 200 MHz	>70 dBc, TOI >5 dBm				
200 MHz to 3 GHz	>74 dBc, TOI >7 dBm (10 dBm typ.)				
3 GHz to 7 GHz	–	>80 dBc, TOI >10 dBm (15 dBm typ.)			
7 GHz to 20 GHz	–	–	>80 dBc, TOI >10 dBm		
20 GHz to 30 GHz	–	–	–	>76 dBc, TOI>8 dBm	>80 dBc, TOI>10dBm
30 GHz to 40 GHz	–	–	–	–	>80 dBc, TOI>10dBm
with optional Electronic Attenuator R&S FSP-B25 switched on					
20 MHz to 200 MHz	>74 dBc, TOI >7 dBm		–		
200 MHz to 3 GHz	>80 dBc, TOI >10 dBm		–		
3 GHz to 7 GHz	>84 dBc, TOI >12 dBm		–		
Second harmonic intercept point (SHI)					
<100 MHz	>25 dBm				
100 MHz to 3 GHz	>35 dBm				
3 GHz to 7 GHz	–	>45 dBm			
7 GHz to 13.6 GHz	–	–	45 dBm typ.		
13.6 GHz to 30 GHz	–	–	–	45 dBm typ.	
30 GHz to 40 GHz	–	–	–	–	45 dBm typ

Displayed average noise level

	R&S FSP3	R&S FSP7	R&S FSP13	R&S FSP30	R&S FSP40
(0 dB RF attenuation, RBW 10 Hz, VBW 1 Hz, 20 averages, trace average, span 0 Hz, termination 50 Ω)					
9 kHz	<–95 dBm				
100 kHz	<–100 dBm				
1 MHz	<–120 dBm, –125 dBm typ.				
10 MHz to 1 GHz (in dBm)	<–142, –145 typ.	<–140 dBm, –145 dBm typ.			
1 GHz to 3 GHz (in dBm)	<–140, –145 typ.	<–138 dBm, –143 dBm typ.			
3 GHz to 7 GHz (in dBm)	–	<–138, –143 typ.	<–135 dBm, –145 dBm typ.		<–135 dBm
7 GHz to 13.6 GHz	–	–	<–132 dBm, –138 dBm typ.		<–132 dBm
13.6 GHz to 20 GHz	–	–	–	–	<–120 dBm
13.6 GHz to 22 GHz (in dBm)	–	–	–	<–120, –130 typ.	–
20 GHz to 30 GHz	–	–	–	–	<–120 dBm
22 GHz to 30 GHz (in dBm)	–	–	–	<–115, –123 typ.	–
30 GHz to 40 GHz	–	–	–	–	<–112 dBm

Displayed average noise level with preamplifier on (option R&S FSP-B25)

10 MHz to 2 GHz	<–152 dBm	–
2 GHz to 7 GHz	<–150 dBm	–

Immunity to interference

Image frequency	>70 dB
Intermediate frequency (f <3 GHz)	>70 dB
Spurious response (f >1 MHz, without input signal, 0 dB attenuation))	<–103 dBm
Other spurious (with input signal, (mixer level <–10 dBm, Δf >100 kHz)	f <7 GHz: <-70 dBc f <13.6 GHz: <–64 dBc f <30 GHz: <–56 dBc

Level display

Screen	501 × 400 pixels (one diagram), max. 2 diagrams with independent settings
Log level scale	10 dB to 200 dB, in steps of 10 dB
Linear level scale	10% of reference level per level division, 10 divisions
Traces	max. 3, with two diagrams on screen max. 3 per diagram
Trace detector	Max peak, Min Peak, Auto Peak, Sample, Quasi-Peak, Average, RMS
Trace functions	Clear/Write, Max Hold, Min Hold, Average

Setting range of reference level

Logarithmic level display	–130 dBm to 30 dBm, in steps of 0.1 dB
Linear level display	70.71 nV to 7.07 V in steps of 1%
Units of level scale	dBm, dBmV, dBµV, dBµA, dBpW (log level display), mV, µV, mA, µA, pW, nW (linear level display)

Max. uncertainty of level measurement

at 128 MHz, –30 dBm (RF attenuation 10 dB, RBW 10 kHz, ref. level –20 dBm) <0.2 dB (σ = 0.07 dB)

	R&S FSP3	R&S FSP7	R&S FSP13	R&S FSP30	R&S FSP40
Frequency response					
<50 kHz	<+0.5/–1.0 dB				
50 kHz to 3 GHz	<0.5 dB (σ = 0.17 dB)				
3 GHz to 7 GHz	–	<2 dB (σ = 0.7 dB)	–	–	–
7 GHz to 13.6 GHz	–	–	<2.5 dB[1]		
13.6 GHz to 30 GHz	–	–	–	<3 dB[1]	
30 GHz to 40 GHz	–	–	–	–	<4 dB[1]

Attenuator	<0.2 dB (σ = 0.07 dB)
Reference level switching	<0.2 dB (σ = 0.07 dB)

[1] RF attenuation 10 dB, sweep time >1 s/1 GHz.

Display nonlinearity LOG/LIN (S/N >16 dB)

RBW ≤100 kHz	
0 dB to –70 dB	<0.2 dB (σ = 0.07 dB)
–70 dB to –90 dB	<0.5 dB (σ = 0.17 dB)
RBW ≥300 kHz	
0 dB to –50 dB	<0.2 dB (σ = 0.07 dB)
–50 dB to –70 dB	<0.5 dB (σ = 0.17 dB)

Bandwidth switching uncertainty (ref. to RBW = 10 kHz)

10 Hz to 100 kHz	<0.1 dB (σ = 0.03 dB)
300 kHz to 10 MHz	<0.2 dB (σ = 0.07 dB)
1 Hz to 3 kHz, FFT	<0.2 dB (σ = 0.03 dB)

Spectrum Analyzer R&S FSP

Trigger functions

Span ≥10 Hz

Trigger source	free run, video, external, IF level
Trigger offset	125 ns to 100 s, resolution 125 ns min. (or 1% of offset)

Span = 0 Hz

Trigger source	free run, video, external, IF level
Trigger offset	±125 ns to 100 s, resolution 125 ns min., dependent on sweep time
Max. deviation of trigger offset	±(125 ns + (0.1% x delay time))

Gated sweep

Trigger source	external, IF level, video
Gate delay	1 µs to 100 s
Gate length	125 ns to 100 s, resolution min. 125 ns or 1% of gate length
Max. deviation of gate length	±(125 ns + (0.05% x gate length))

Inputs and outputs (front panel)

RF input	N female, 50 Ω
R&S FSP3/7/13	N female, 50 Ω
R&S FSP30/40	test port system 50 Ω, N female, 3.5 mm female
VSWR (RF attenuation>0 dB)	
f <3 GHz/7 GHz/13 GHz	1.5:1/2.0:1/2.5:1
f <30 GHz/40 GHz	3.0:1
Input attenuator	0 dB to 70 dB in 10 dB steps
Probe power supply	+15 V DC, –12.6 V DC and ground, max. 150 mA
Keyboard connector	PS/2 female for MF2 keyboard
AF output (optional)	3.5 mm mini jack, 10 Ω
Open-circuit voltage	up to 1.5 V, adjustable

Inputs and outputs (rear panel)

IF 20.4 MHz	Z_{out} = 50 Ω, BNC female
Level RBW ≤100 kHz, FFT	–10 dBm at reference level, mixer level >–60 dBm
RBW ≥300 kHz	0 dBm at reference level, mixer level >–60 dBm
Reference frequency output	BNC, 10 MHz, 0 dBm nominal
Reference frequency input	BNC, 10 MHz, min. 0 dBm, 50 Ω
Power supply for noise source	BNC, 0 V and 28 V, selectable
External trigger/gate input	BNC, >10 kΩ, TTL level
IEC/IEEE bus control	interface to IEC-625-2 (IEEE 488.2), command set SCPI 1997.0
Serial interface	RS-232-C (COM), 9-pin sub-D
Printer interface	parallel (Centronics)
Mouse connector	PS/2 female
Connector for ext. monitor (VGA)	15-pin sub-D

Tracking Generator R&S FSP-B9

Unless specified otherwise, specifications are not valid for the frequency range from –3 x RBW to +3 x RBW, however at least not valid from –9 kHz to +9 kHz.

Frequency

Frequency range	9 kHz to 3000 MHz
Frequency offset setting range	±150 MHz
Resolution	1 Hz

Spectral purity

SSB phase noise, f = 500 MHz, carrier offset 100 kHz	
Normal mode	–90 dBc (1 Hz) typ.
With FM modulation switched on	–70 dBc (1 Hz) typ.

Level

Level range	–30 dBm to 0 dBm in 0.1 dB steps
Level range with AM	–30 dBm to –6 dBm in 0.1 dB steps
Max. deviation of output level, 128 MHz, 0 dBm	<1 dB

Frequency response

Output level 0 dBm, 100 kHz to 2 GHz	<1 dB
Output level 0 dBm to –25 dBm, 9 kHz to 3 GHz	<3 dB

Dynamic range

Attenuation measurement range, RBW=1 kHz, f >10 MHz	120 dB

Spurious

Harmonics, output level –10 dBm	–30 dBc typ.
Nonharmonics, output level 0 dBm	–30 dBc typ.

Electronic Attenuator R&S FSP-B25 (only for R&S FSP3 and FSP7)

Frequency

Frequency range	10 MHz to 7000 MHz
Input attenuator range (mechanical)	0 dB to 75 dB in 5 dB steps
Electronic attenuation range	0 dB to 30 dB in 5 dB steps
Preamplifier	20 dB, switchable

Displayed average noise level with preamplifier on

(0 dB RF attenuation, RBW 10 Hz, VBW 1 Hz, 20 averages, trace average, span 0 Hz, termination 50 Ω)

10 MHz to 2 GHz	<–152 dBm
2 GHz to 7 GHz	<–150 dBm

Intermodulation with electronic attenuator on

3rd-order intermodulation, intermodulation-free dynamic range, level 2 x –30 dBm, Δ_f > 5 x RBW or 10 kHz, whichever the greater value

Frequency	
20 MHz to 200 MHz	>74 dBc, TOI >7 dBm
200 MHz to 3 GHz	>80 dBc, TOI >10 dBm
3 GHz to 7 GHz	>84 dBc, TOI >12 dBm

Max. deviation of level measurement

128 MHz, –30 dBm (RF attenuation 10 dB, RBW 10 kHz, reference level –20 dBm),

preamplifier on	<0.2 dB (σ = 0.07 dB)
Electronic attenuator	<0.2 dB (σ = 0.07 dB)

Frequency response with preamplifier, electronic attenuator

10 MHz to 3 GHz	<1.0 dB (σ = 0.33 dB)
3 GHz to 7 GHz	<2 dB (σ = 0.7 dB)

Spectrum Analyzer R&S FSP

General data

Display	21 cm TFT colour display (8.4")
Resolution	640 x 480 pixels (VGA resolution)
Pixel failure rate	$<2 \times 10^{-5}$
Mass memory	1.44 Mbyte 3 ½" disk drive (built-in), hard disk
Data storage	>500 instrument settings and traces
Temperature ranges	
Rated temperature range	+5 °C to +40 °C
Limit temperature range	+5 °C to +45 °C
Power supply	
AC supply	100 V AC to 240 V AC, 50 Hz to 400 Hz, 3.1 A to 1.3 A
Typical power consumption	
R&S FSP3	70 VA
R&S FSP7	120 VA
R&S FSP13, R&S FSP30	
R&S FSP40	150 VA
Dimensions (W x H x D)	412 mm x 197 mm x 417 mm
Weight	
R&S FSP3	10.5 kg
R&S FSP7	11.3 kg
R&S FSP13, R&S FSP30, R&S FSP40	12 kg

Ordering information

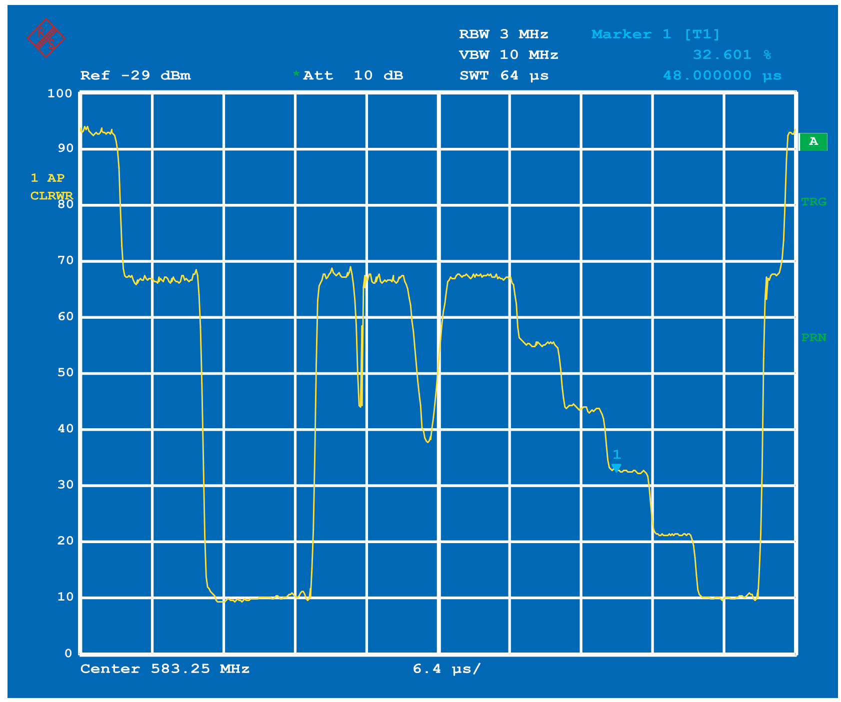
Spectrum Analyzer		
9 kHz to 3 GHz	R&S FSP 3	1093.4495.03
9 kHz to 7 GHz	R&S FSP 7	1093.4495.07
9 kHz to 13.6 GHz	R&S FSP 13	1093.4495.13
9 kHz to 30 GHz	R&S FSP 30	1093.4495.30
9 kHz to 40 GHz	R&S FSP 40	1093.4495.40
Accessories supplied		
Power cable, operating manual, service manual		
Options		
Delete Manuals	R&S FSP-B0	1129.8394.02
Rugged case, carrying handle (factory-fitted)	R&S FSP-B1	1129.7998.02
AM/FM Audio Demodulator	R&S FSP-B3	1129.6491.02
OCXO Reference Frequency	R&S FSP-B4	1129.6740.02
TV Trigger/RF Power Trigger	R&S FSP-B6	1129.859.4.02
Internal Tracking Generator 9 kHz to 3 GHz, IQ modulator, for all R&S FSP models	R&S FSP-B9	1129.6991.02
External Generator Control for all R&S FSP models	R&S FSP-B10	1129.7246.02
LAN Interface 100BT for all R&S FSP models (factory-fitted	R&S FSP-B16	1129.8042.02
Electronic Attenuator, 0 dB to 30 dB, 5 dB steps, integrated preamplifier for R&S FSP3 and R&S FSP7	R&S FSP-B25	1129.7746.02
Software		
Noise Measurement Software	R&S FS-K3	1057.3028.02
Phase Noise Measurement Software	R&S FS-K4	1108.0088.02
GSM/EDGE Application Firmware, Mobile	R&S FS-K5	1141.1496.02
AM/FM Measurement Demodulator	R&S FS-K7	1141.1796.02
3GPP BTS/Node B FDD Application Firmware	R&S FS-K72	1154.7000.02
3GPP-FDD UE Transmitter Test	R&S FS-K73	1154.7252.02
Bluetooth Application Firmware	R&S FS-K8	1141.2568.02
cdma2000 Base Station Test Application Firmware	R&S FS-K82	on request
Extras		
Headphones	–	0708.9010.00
US Keyboard with trackball	R&S PSP-Z2	1091.4100.02
PS/2 Mouse	R&S FSE-Z2	1084.7043.02
Colour Monitor, 15", 230 V	R&S PMC3	1082.6004.02
IEC/IEEE bus Cable, 1 m	R&S PCK	0292.2013.10
IEC/IEEE bus Cable, 2 m	R&S PCK	0292.2013.20
19" Rack Adapter	R&S ZZA 478	1096.3248.00
Trolley	R&S ZZK-1	1014.0510.00
Transit bag	R&S ZZT473	1109.5048.00
Matching Pads, 75 Ω		
L Section	R&S RAM	0358.5414.02
Series Resistor, 25 Ω[1)]	R&S RAZ	0358.5714.02
SWR Bridge, 5 MHz to 3000 MHz	R&S ZRB2	0373.9017.52
SWR Bridge, 40 kHz to 4 GHz	R&S ZRC	1039.9492.52
High-Power Attenuators, 100 W 3/6/10/20/30 dB	R&S RBU 100 (XX=03/06/10/20/ 30)	1073.8820.XX
High-Power Attenuators, 50 W 3/6/10/20/30 dB	R&S RBU 50 (XX=03/06/10/20/ 30)	1073.8695.XX
For R&S FSP30, R&S FSP40		
Test port Adapter, 3.5 mm male	–	1021.0529.00
Test port Adapter, N male	–	1021.0541.00

1) Taken into account in device function RF INPUT 75 Ω.

TV Trigger/RF Power Trigger R&S FSP-B6

Makes the Spectrum Analyzers R&S FSP suitable for analog TV measurement applications

New



Amplitude of RF carrier in line 17

Brief description

Option R&S FSP-B6 makes the Spectrum Analyzers R&S FSP suitable for analog TV measurement applications and provides a settable RF level trigger for measurements on pulsed RF signals that are used in TDMA transmission systems.

Main features

Analog TV applications

- Standards B/K, D/K, I, L and M
- Trigger to even, odd field or any line
- Measurement of modulation quality
- CCVS signal output
- Trigger to external CCVS signal

RF power trigger

- Large trigger bandwidth
- Settable trigger level
- Measurement on TDMA systems without trigger output

TV trigger

Measurements on analog TV signals require triggering to specific lines in the video signal. To this end, option R&S FSP-B6 provides a trigger signal from a TV demodulator. Triggered to the desired line (horizontal sync) or a field (vertical sync), R&S FSP displays the TV video signal in the time domain. So it is easy to measure the vision carrier amplitude in lines 17 or 18 for instance. The high level accuracy and the excellent display linearity of R&S FSP ensure high-precision measurements.

R&S FSP is fitted with a CCVS connector at the rear panel, thus allowing a visual assessment of the picture quality on a connected monitor. The connector is also used as an input to trigger R&S FSP to an external CCVS signal.

RF power trigger

Using this feature R&S FSP can be triggered by means of an RF level. The bandwidth available for triggering is ± 40 MHz about the R&S FSP center frequency. The trigger level can be set in a range of 40 dB. This makes it very easy for the user to measure for instance the spectrum due to modulation of TDMA signals such as GSM or EDGE. A trigger from the DUT is not required and also quite often not available. Therefore elaborate additional circuits are not required to generate a trigger signal.

In conjunction with the comprehensive R&S FSP trigger functions such as pre-trigger and trigger-delay, the wide range of resolution bandwidths (10 Hz to 10 MHz) and the high display resolution (min. 31.25 ns), pulsed signals can be investigated in detail with minimum effort.

TV Trigger/RF Power Trigger R&S FSP-B6

Specifications

The specifications below describe the data valid as of firmware version 1.20 or higher and are a supplement to the R&S FSP data sheet, PD 0757.5137. Data designated "nominal" apply to design parameters and are not tested.

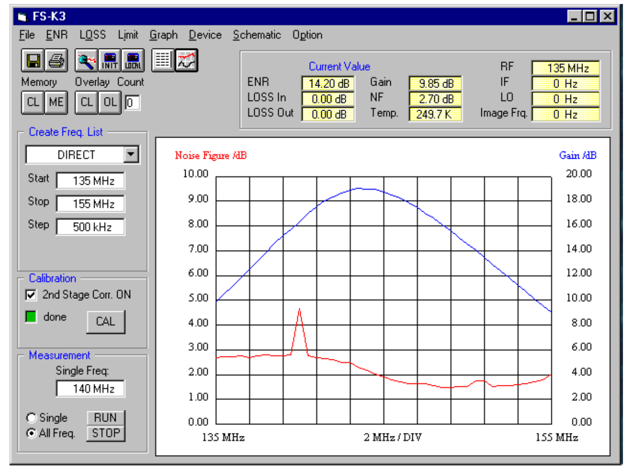
RF trigger	
Trigger source	RF level
Trigger level	
Setting range	40 dB, settable in 1 dB steps
Max. deviation of trigger level (f_{in} ≤3 GHz)	4 dB, nominal
RF bandwidth	80 MHz
TV trigger	
Trigger source	internal TV demodulator, video polarity selectable or external CCVS signal
Standards	B/G, D/K, I, L, M
Level range	
RF input	–10 dBm to –40 dBm (mixer level)
CCVS input	500 mV to 2 V (V_{pp})
Triggering	vertical and horizontal TV sync signals, any line within a 625- or 525-line system
CCVS input and output	BNC female
Output voltage	1 V (V_{pp}) into 75 Ω

Ordering information

TV Trigger/RF Power Trigger	R&S FSP-B6	1129.8594.02

Noise Measurement Software R&S FS-K3

Outperforming any conventional noise measurement system



Measurements on a GaAs preamplifier show an anomaly at 140 MHz, whose cause is easily traceable in the spectrum analyzer mode

Brief description

Spectrum Analyzers R&S FSE and R&S FSP as well as Signal Analyzers R&S FSIQ from Rohde & Schwarz feature high sensitivity and level accuracy – in conjunction with switchable, calibrated noise sources – and are thus ideal for automatic measurement of noise figure and gain. Noise Measurement Software R&S FS-K3 provides the high-grade analyzers with features otherwise only offered by special noise measurement systems. At a given frequency or in a selectable frequency range the following parameters can be measured:

- Noise figure in dB
- Noise temperature in K
- Gain in dB

The combination of Noise Measurement Software R&S FS-K3 and Analyzers R&S FSE, R&S FSIQ or R&S FSP offers the following advantages over conventional noise measurement systems:

- Frequency range up to 26.5 GHz (depending on analyzer model) for noise measurements in the microwave range without need for an additional downconverter
- Resolution bandwidths variable in steps of 1/2/3/5 (R&S FSP: 1/3) for optimum matching to narrowband DUTs

Measurements on frequency-converting DUTs, e.g. low-noise converters

R&S FS-K3 allows the noise figure and the gain for instance of LNCs for direct satellite reception to be measured without any problems despite the great frequency difference of 10 GHz typ. between the input and output. A particular asset in these measurements is the extremely wide dynamic range, allowing the direct determination of gain values up to 60 dB.

Specifications

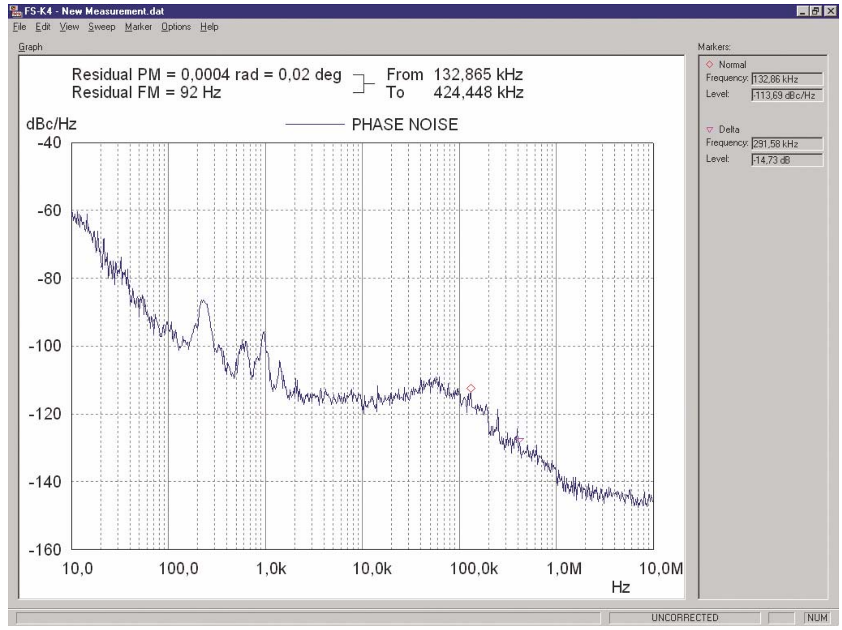
Frequency range	100 kHz to 26.5 GHz (depending on analyzer model)
Measurement bandwidth	1 kHz to 5 MHz
Noise measurements	
Level range	0 to 25 dB
Resolution	0.01 dB
Measurement accuracy	±0.2 dB (preamplification 20 dB, noise figure 5 dB, bandwidth 1 MHz)
Gain measurements	
Level range	0 to 60 dB
Resolution	0.01 dB
Measurement accuracy	±0.2 dB (preamplification 20 dB, noise figure 5 dB, bandwidth 1 MHz)
Required hardware and software	
Analyzers	R&S FSEA, R&S FSEB, R&S FSEM, R&S FSIQ3, R&S FSIQ7, R&S FSIQ26 or R&S FSP3, R&S FSP7, R&S FSP13, R&S FSP30
Recommended noise source	NoiseCom 346 (on request)
Power supply	via 28 V connector on rear panel of R&S FSE/R&S FSIQ/R&S FSP (BNC)
Preamplifier	gain approx. 20 dB, noise figure max. 5 dB
Control via external PC/IEEE bus	
CPU	80 486 or better
RAM	≥4 Mbyte
Graphics card	VGA or better
Software	Windows 3.x, 95/98/NT
Interface	IEC 625-1 (IEEE 488)
Interface card	National Instruments AT/TNT/PC card
Control via Spectrum Analyzer	
R&S FSE	Computer Function R&S FSE-B15 (DDE interface of Windows)
R&S FSIQ	no options required
R&S FSP	keyboard PSP-Z2

Ordering information

Noise Measurement Software	R&S FS-K3	1057.3028.02
Options		
Computer Function for R&S FSE (Windows NT)	R&S FSE-B15	1073.5696.06
2nd IEC/IEEE bus Interface	R&S FSE-B17	1066.4017.02
Noise source	on request	

Note: R&S FSE with R&S FSE-B15 or R&S FSIQ requires the optional 2nd IEC/IEEE bus interface to control a signal generator (e.g. SMIQ) in case of mixer measurements.

Phase Noise Measurement Software R&S FS-K4



Phase noise measurements with Spectrum Analyzers R&S FSE/R&S FSIQ/R&S FSP/ R&S FSU and EMI Test Receivers R&S ESIB/ESPI

Brief description

The Phase Noise Measurement Software R&S FS-K4 extends the measurement capabilities of Rohde & Schwarz Spectrum Analyzers and EMI Test Receivers to give a phase noise tester. The R&S FSE and the R&S FSU are ideal for this purpose because of their low inherent phase noise and noise figure.

Main features

- User-editable sweep settings
- Fast residual FM/φM measurements
- Comprehensive marker functions
- Storage of results and settings
- Detailed screen printouts

Specifications

Averaging

RBW:VBW ratio in video averaging	1:10, 1:1, 10:1
Trace averaging	implemented
Smoothing window	1 to 199 points

Carrier offset frequency range/number of decades

The maximum number of decades that can be represented in a phase noise diagram is defined by the carrier offset frequency range.

Analyzer and test receiver models	FSEA30, FSEB30 FSIQ3/7, ESIB7 FSP3/7, ESPI3/7	FSEM30, FSEK30 FSIQ26, ESIB26/40 FSP13/30	FSU3/8
Lower offset limit	10 Hz	10 Hz	3 Hz
Upper offset limit	1 GHz	10 GHz	1 GHz
Max. number of decades	8	9	9

Nominal measurement accuracy (RSS error, 95% confidence level)

Minimum phase noise level 95 dB below reference level, FFT deactivated, return loss of source >14 dB (VSWR <1.5: 1), signal-to-noise ratio ≥10 dB

Center frequency	≤3.5 GHz	≤7 GHz	≤18 GHz	≤26.5 GHz	≤40 GHz
Offset ≤10 MHz	1.5 dB	1.6 dB	1.9 dB	1.9 dB	1.9 dB
Offset >10 MHz	1.8 dB	2 dB	2.9 dB	3.4 dB	3.9 dB

Repeatability (95% confidence level) ±0.8 dB

RBW:VBW 10:1, trace averaging <15, smoothing window ≥9

System phase noise

A systematic measurement uncertainty is introduced by the inherent phase noise of the measuring instrument.

System Requirements

Control via external PC/IEEE bus	Windows 9x/NT4.0/2000 (English version) IEEE488 interface AT/TNT/PCMCIA IEEE card
Control via R&S FSE	Controller R&S FSE-B15 for R&S FSE

Control via R&S FSIQ, R&S FSP, R&S FSU, ESIB, ESPI

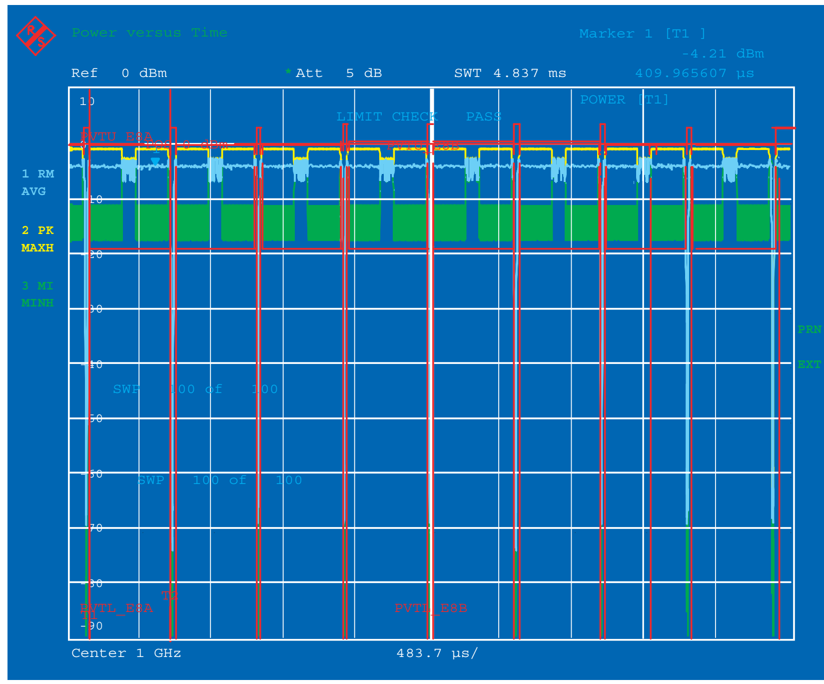
Ordering Information

Phase Noise Measurement Software	R&S FS-K4	1108.0088.02
Recommended options for R&S FSE		
Controller for R&S FSE (Windows NT, English)	R&S FSE-B15	1073.5696.06
Increased Level Accuracy up to 2 GHz	R&S FSE-B22	1106.3480.02

GSM/EDGE Application Firmware R&S FS-K5 for R&S FSP

New

The solution for easy and fast GSM and EDGE measurements



Power-versus-time measurement: details of burst can be zoomed – rising edge, falling edge, high resolution display of top of burst

Brief description

The Application Firmware R&S FS-K5 allows the user to perform the most important GSM and EDGE transmitter measurements with the push of a button:

- Phase/frequency error (GSM)
- Modulation accuracy (EDGE) including 95:th percentile and origin offset suppression
- Power-versus-time
- Carrier power
- Modulation spectrum
- Transient spectrum
- Spurious emissions

Only very few parameters have to be set manually such as carrier frequency, reference level, external attenuator. R&S FS-K5 can be installed in all models of the R&S FSP spectrum analyzer family:

R&S FSP3
9 kHz to 3 GHz:
Covers the basic TX frequency range

R&S FSP7
9 kHz to 7 GHz:
Adds harmonics measurement capability

R&S FSP13
9 kHz to 13 GHz
Covers the entire spurious emissions frequency range

R&S FSP30
9 kHz to 30 GHz:
Adds microwave link frequency ranges

The application firmware can be used throughout the total frequency range of the basic spectrum analyzer. This covers all GSM bands of interest such as GSM900, GSM1800, GSM1900, R-GSM, GSM 450 and even IF frequencies used in transmitters and receivers.

Features and benefits

R&D, development

- Ideal development tool with easy-to-use GSM measurement functions in a cost-effective analyzer. The workhorse for every engineer.

Low measurement uncertainty for high confidence

- <0.5 dB total level uncertainty and <0.7° phase error for GSM

Standard-conformant measurements for performance verification

- Phase/frequency error (GSM), modulation accuracy (EDGE) and power-versus- time measurement with synchronization to midamble.

Designed for speed

- Fast modulation spectrum routine for frequency list mode: ± 1.8 MHz/200 bursts in <25 seconds

Really portable – usable anywhere

- Lightweight, <11 kg with R&S FSP3
- Comprehensive documentation and storage of results and hard copies on internal hard disk, print or transfer to a PC later – even via LAN /Ethernet

Trigger functions to meet many demands

- Simplified test setup, no trigger from device under test necessary
- IF power trigger for gated measurements

GSM/EDGE Application Firmware R&S FS-K5 for R&S FSP

Specifications

- Specifications are guaranteed under the following conditions:
- 15 minutes warmup time at ambient temperature, specified environmental conditions met, calibration cycle adhered to, and total calibration performed.
- Data designated "nominal" apply to design parameters and are not tested.
- The specifications below apply to R&S FSP3, R&S FSP7, R&S FSP13 and R&S FSP30 equipped with R&S FS-K5. They are based on the data sheet specifications of Spectrum Analyzers R&S FSP and are not checked separately. Level measurement uncertainties given with a tolerance are measurement uncertainties with a confidence level of 95%. Data without tolerances are typical values at 900 MHz.
- The specified level measurement errors do not take into account systematic errors due to the reduced S/N ratio.

Measurement	Specification	Test specification and permissible measurement uncertainty acc. to I-ETS 300 609-1
Phase/frequency error (GMSK modulation)		11.10.1 13.1
Phase error, floor (S/N >40 dB)		
RMS	<0.7 °	
Peak	<2 °	
Phase error, uncertainty (S/N >40 dB)		
RMS	<0.2 °	<1.5 °
Peak	<0.7 °	<5 °
Frequency error uncertainty (S/N >40 dB)	<1.5 Hz + error of reference frequency	± 10 Hz
Modulation accuracy (3π/8 shifted 8PSK modulation)		
EVM, residual (S/N >40 dB)		
RMS	<0.5%	
Peak	<1.5%	
95:th percentile	<1.5%	
Resolution	0.03%	
Frequency error uncertainty (S/N >40 dB)	<1 Hz + error of reference frequency	
Origin offset suppression (S/N >40 dB)		
Measurement range	–20 dBc to –50 dBc	
Mean carrier power		11.10.1 13.3
Absolute level uncertainty (–50 dBm to +30 dBm, 10 MHz to 3 GHz)	0.5 dB	1 dB
Relative level uncertainty (from 0 dB to –50 dB from reference level)	0.2 dB	0.7 dB
Power versus time		11.10.1 13.3
Uncertainty of reference	0.5 dB	1 dB
Relative uncertainty		0.7 dB
0 to –50 dB from reference	0.2 dB	
–50 to –70 dB from refer.	0.5 dB	
Internal symbol timing uncertainty	<37 ns	
Trigger reference uncertainty	¼ bit	¼ bit
Dynamic range (RBW = 600 kHz)	70 dB (with trace average) 60 dB (with peak hold)	

Measurement	Specification	Test specification and permissible measurement uncertainty acc. to I-ETS 300 609-1
Spectrum due to modulation		11.10.1 13.4
Level measurement uncertainty		
Absolute (–50 dBm to +30 dBm, 10 MHz to 3 GHz)	<0.5 dB	1 dB
Relative[1]		
Δf ≤0.1 MHz	<0.2 dB	0.5 dB
0.1 MHz<Δf≤1.8 MHz (0 dBc to –70 dBc)	<0.2 dB	0.7 dB
1.8 MHz <Δf≤ 6 MHz	<0.5 dB	1.5 dB
Δf≥6 MHz	<0.5 dB	2 dB
Dynamic range (carrier power = 30 dBm)		
Frequency offset		
200 kHz	65 dB	
400 kHz	67 dB	
600 kHz	68 dB	
1200 kHz	72 dB	
1800 kHz	76 dB	
1.8 MHz to 6 MHz (RBW = 100 kHz)	76 dB to 84 dB	
>6 MHz (RBW = 100 kHz)	84 dB	
Spectrum due to transients		11.10.1 13.4
Level measurement uncertainty		
Absolute (–50 dBm to + 30 dBm, 10 MHz to 3 GHz)	<0.5 dB	1.5 dB
Relative		
0 dB to 50 dB from reference level	<0.2 dB	0.7 dB
>50 dB from reference level	<0.5 dB	1.5 dB
Dynamic range with 30 dBm mean carrier power		
Frequency offset		
400 kHz	62 dB	
600 kHz	64 dB	
1200 kHz	68 dB	
1800 kHz	71 dB	

1) Does not include the level uncertainty due to R&S FSP inherent noise.

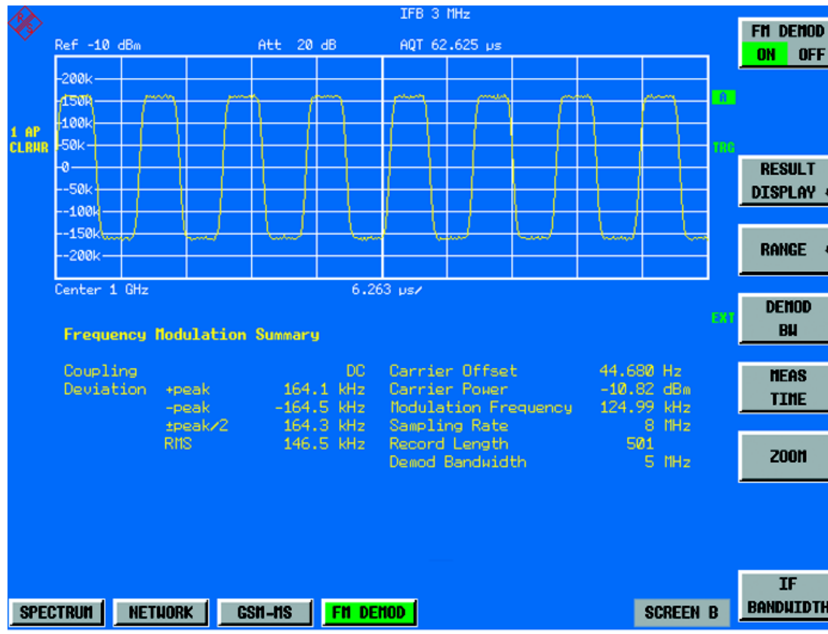
Ordering information

GSM Mobile Station Test Application Firmware for Spectrum Analyzer R&S FSP	R&S FS-K5	1141.1496.02

FM Measurement Demodulator R&S FS-K7

New

FM Measurement Demodulator for Spectrum Analyzer R&S FSP for determining analog modulation parameters



Bluetooth modulation characteristics: The frequency deviation of the signal is determined for a specified bit sequence (...1111 0000...or 10101010...) and displayed as a measured trace and in numerical form

Brief description

Option R&S FS-K7 adds FM demodulation to the functions of Spectrum Analyzer R&S FSP. The universal characteristics of the digital measurement demodulator open up a wide range of applications, e.g. measurements of synthesizer settling or frequency deviation. This makes R&S FSP with option R&S FS-K7 ideal for measuring modulation characteristics such as those required in the development and production of *Bluetooth* modules.

Main features

Display

- Frequency modulation (FM) or carrier power as a function of time
- RF spectrum (FFT)
- Table with numeric values for peak and RMS deviation,
  modulation frequency (AF), carrier offset, carrier power

Features

- Digital measurement demodulator with wide bandwidth range from 12.5 kHz to 10 MHz
- Restoration of sampled signal with high
  measurement accuracy
- Ideal for production and development of *Bluetooth* modules
- Great memory depth for long measurement sequences
  (I/Q memory 2x 128 ksample)

Measurements

The measurement results can be subsequently displayed as

- Frequency (FM) or carrier power versus time or as an
- RF spectrum (FFT)

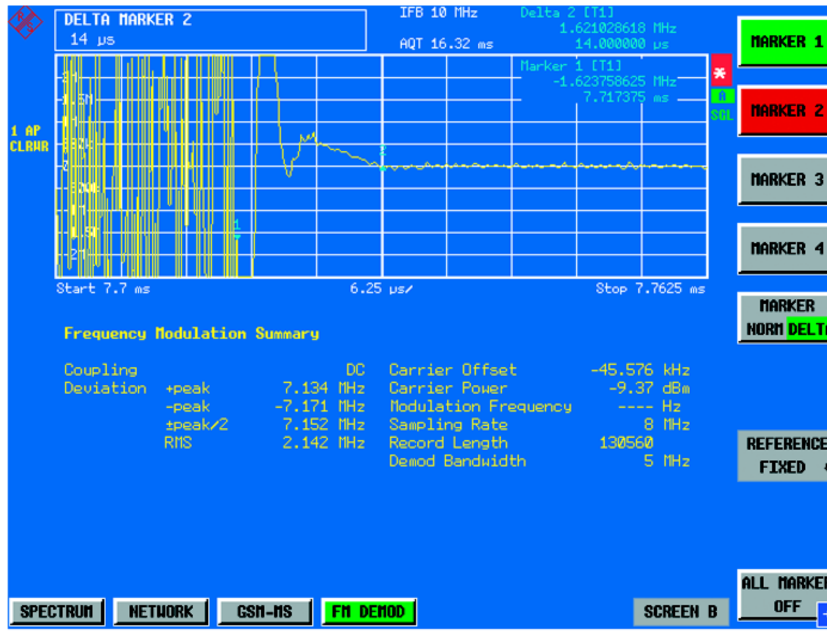
The main modulation parameters such as frequency deviation (peak, RMS), modulation frequency or carrier power are also numerically indicated in a table.

The sampled signal is restored and the signal is displayed in its original form. The sampling rate is automatically matched to the demodulation bandwidth.

Sequences with a length of up to 8.3 s (demodulation bandwidth 12.5 kHz) or 65 ms (demodulation bandwidth 1.6 MHz) can be recorded in the large I/Q memory of the R&S FSP. This allows long bit sequences, such as occur with *Bluetooth* signals, to be completely investigated. The demodulated data can also be read out via GPIB,
RS-232-C or LAN and processed on an external PC.

The FM and RF level trigger function with a wide dynamic range provides special trigger capabilities. This also allows signals to be tested for which no external trigger signal is available.

FM Measurement Demodulator R&S FS-K7



***Transient response of synthesizer:* With the FM measurement demodulator function, the transient response of a synthesizer can be measured in digital communication systems like GSM or Bluetooth transmitters**

Specifications

Measurement of analog modulation signals

Demodulation bandwidth	12.5 kHz to 10 MHz
Max. record time	
Demod. bandw. ≤1.6 MHz	≥85 s/(demod. bandwidth/kHz)
Demod. bandw. > 1.6 MHz	≥34 s/(demod. bandwidth/kHz)
Readout	trace with frequency or RF power versus time, RF spectrum and table with numerical display of: peak and rms values of deviation, modulation frequency, carrier offset, carrier power (power of unmodulated carrier)

Frequency demodulation

AF	DC to 5 MHz (max. 0.5 x demod. bandwidth)
Deviation range	5 MHz (max. 0.5 x demod. bandwidth)
Deviation uncertainty	
AF + dev. ≤0.5 x demod. bandw. and AF ≤0.1 x IF bandwidth	<3% of result + residual FM

Residual FM [1)]

Demodulation bandwidth ≤200 kHz, rms	
RF ≤1 GHz	80 Hz, typ.
RF >1 GHz	80 Hz x √(f/1 GHz), typ.

Carrier power versus time

AF	DC to 5 MHz (max. 0.5 x demod. bandwidth)
Display range	noise floor to +30dBm
Max. dynamic range	
Demod. bandwidth 200 kHz	75 dB, typ.
Display nonlinearity	
S/N >16 dB	0.2 dB, typ.
Incidental AM with FM	
AF + dev. ≤0.5 x demod. bandw. and deviation ≤0.1 x IF bandwidth	0.1dB + residual AM, typ.

Unmodulated carrier power

Measurement uncertainty	
S/N >16 dB, RF=50 kHz to 3 GHz	1 dB, typ.

AF

Range	≤5 MHz (max. 0.5 x demod. bandwidth)
Resolution	5 digits
Uncertainty	0,1 %

RF spectrum

Span	12.5 kHz to 10 MHz
Resolution bandwidth (FFT filters)	1 Hz to 10 MHz
Shape factor 60:3 dB	2.5 nominal

Ordering information

FM Measurement Demodulator for R&S FSP	R&S FS-K7	1141.1796.02

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1) RF input level ≥(reference level/dBm –10) dBm and RF input level ≥(RF attenuation/dB –30) dBm.

WCDMA 3GPP Application Firmware R&S FS-K72

New

Transmitter measurements on 3GPP equipment and modules with Spectrum Analyzer R&S FSU

Peak code domain error measurement:

The peak code domain error is projected to the codes of the highest spreading factors. The maximum value of all codes per slot is displayed.

Brief description

Application Firmware R&S FS-K72 enhances the range of applications of the Spectrum Analyzer R&S FSU to include code domain power and modulation measurements on 3GPP FDD signals. All transmitter measurements required according to 3GPP Specification TS 25.141 can thus be performed by a single instrument.

Main features

- Adds measurement functions according to the 3GPP specifications for the FDD mode to the R&S FSU analyzer family
- The R&S FS-K72 option provides the functionality needed for base station testing and the related parameters:
- Code domain power (code domain analyzer)
- Code domain power versus time
- Error vector magnitude (EVM)
- Peak code domain error
- Timing offset
- Featuring a wide dynamic range for adjacent channel power and high-precision RMS power measurements, the R&S FSU is an ideal tool for WCDMA base station transmitter measurements in development and production

Applications

Code domain power measurements
The main application of R&S FS-K72 is the determination of the power in the individual code channels referred to as code domain power measurement. The power ratios between the individual channels, for instance, can be checked for compliance with the nominal values. Moreover, this measurement is a very efficient tool for detecting impairments such as clipping or intermodulation that are not obvious from the spectrum alone.

The power of the different codes is shown versus the code number.

To investigate power control, the power characteristic in a code channel can be displayed versus all slots of a frame (10 ms).

Measurement of modulation quality: peak code domain error and EVM
Two different measurements are stipulated in the 3GPP Specification TS 25.141 for determining the modulation quality:

- EVM (error vector magnitude)
- Peak code domain error

The code domain power measurement offers an in-depth analysis for a WCDMA signal with several active channels. The composite EVM measurement returns a modulation error value for the total signal, whereas the symbol EVM function yields the individual vector errors of the active channels.

To obtain the peak code domain error (PCDE), the vector error between the measured signal and the ideal reference

WCDMA 3GPP Application Firmware R&S FS-K72

signal is determined and projected to the codes of a specific spreading factor. With R&S FS-K72, the spreading factor for the PCDE measurement can be selected by the user.

Automatic detection of active channels and their data rate

The scrambling code, which is user-selectable on the R&S FSU, must be known for the code domain power measurement. 3GPP FDD downlink signals may use different spreading factors and data rates in the various channels. The data rates are automatically detected by R&S FS-K72 and need not be known beforehand.

Spectrum measurements over wide dynamic range

The R&S FSU is a powerful analyzer for WCDMA signals even without Application Firmware R&S FS-K72 and, of course, retains these functions when fitted with R&S FS-K72. An RMS detector integrated as standard allows precise transmitter power measurements irrespective of the waveform.

Thanks to its extremely wide dynamic range the R&S FSU is the ideal analyzer for out-of-band emissions that have to be detected for instance by means of adjacent-channel power measurements. Noise correction yields a value of 84 dB in the adjacent channel which exceeds by far the values prescribed by the specification.

Measurements cannot only be performed on systems but also on individual components such as amplifiers which have to meet more stringent requirements.

Specifications in brief

The specifications below apply to the R&S FSU3, R&S FSU8. They are based on the data sheet specifications of the Spectrum Analyzer R&S FSU and have not been checked separately.

Measurement		Test specifications and permissible measurement uncertainty to 3GPP TS 25.14
Code domain power (applies to code domain power and code domain power vs slot)		
Total signal power, measurement uncertainty	<0.3 dB	**6.2.1** <0.7 dB
CPICH power, measurement uncertainty	<0.4 dB	**6.2.2** <0.8 dB
Code power; measurement uncertainty		
Absolute	<0.4 dB	
Relative	<0.1 dB	<0.1 dB
Frequency error		**6.3, 6.7.1**
Measurement range	<1 kHz	<12 Hz
Uncertainty (S/N > 40 dB)	<1.5 Hz + error of reference frequency	
Composite EVM		
Measurement range	1.5% to 25%	12.5% to 25%
Inherent EVM	<1.5%	
Measurement uncertainty	<0.5%	<2.5%
Peak code domain error		**6.7.3**
Measurement range	0 dB to –60 dB	–33 dB
Inherent PCDE	–60 dB	
Measurement uncertainty	<1 dB (0 dB to –40 dB)	<1 dB
Output power		**6.2.1**
Measurement uncertainty		
Absolute	<0.3 dB	<0.7 dB
Relative	<0.1 dB	

Measurement		Test specifications and permissible measurement uncertainty to 3GPP TS 25.14
Occupied bandwidth (99%)		**6.5.1**
Measurement uncertainty	<85 kHz	<100 kHz
ACLR (adjacent channel leakage ratio) (3.84 MHz BW)		**6.5.2.2**
5 MHz offset		45 dB
Dynamic range	75 dB	
Measurement uncertainty	<0.5 dB (ACLR <60 dB)	<0.8 dB
10 MHz offset		50 dB
Dynamic range	82 dB	
Measurement uncertainty	<0.5 dB (ACLR <60 dB)	<0.8 dB
Spurious emissions		
Level uncertainty		
<3.6 GHz	<0.5 dB	
3.6 GHz to 8 GHz	<2.5 dB	
Spectrum emission mask	<1 dB	

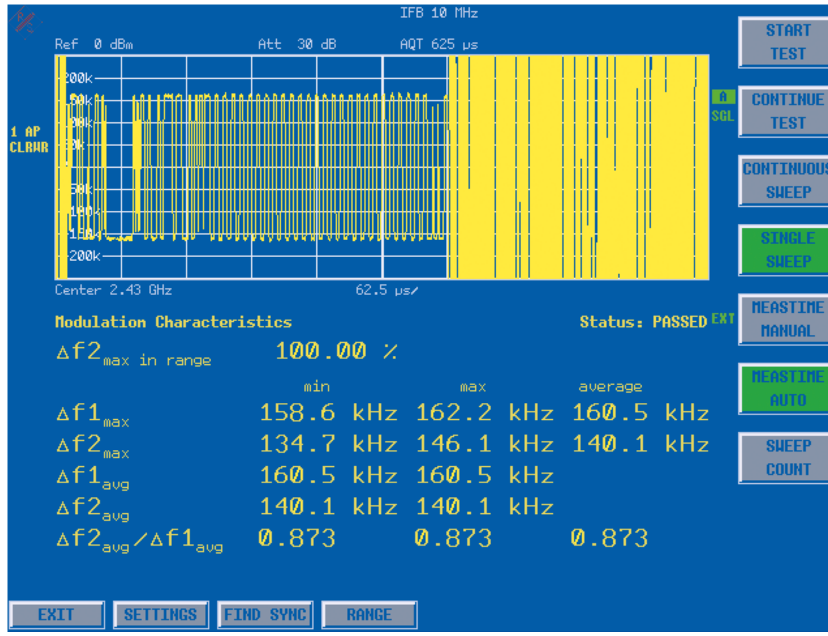
Ordering information

Application Firmware R&S FS-K72 can be integrated into any member of the R&S FSU family.

WCDMA 3GPP Application Firmware BTS Code Domain Power Measurements for R&S FSU	R&S FS-K72	1154.7000.02
Extra		
High-Power Attenuator 20 dB, 50 W, 0 GHz to 6 GHz	R&S RDL50	1035.1700.52

Bluetooth Application Firmware R&S FS-K8

Bluetooth transmitter measurements with Spectrum Analyzers R&S FSP and R&S FSU



Measurement of modulation characteristics

Brief description

Application Firmware R&S FS-K8 enhances the range of applications of the Spectrum Analyzers R&S FSP and R&S FSU to include measurements on *Bluetooth* transmitters. All measurements are carried out in line with the *Bluetooth* RF Test Specification (*Bluetooth* SIG) Rev. 0.91. Integrated limit value monitoring is provided for all measurements and allows analysis of the results in the development and production of *Bluetooth* modules.

Main features

- Enhanced measurement functionality for the spectrum analyzers of the R&S FSP and R&S FSU families in line with *Bluetooth* RF Test Specification (*Bluetooth* SIG) Rev. 0.91
- Measurement functions
  - Output power
  - Adjacent channel power (ACP)
  - Modulation characteristics
  - Initial carrier frequency tolerance (ICTF)
  - Carrier frequency drift
- Simultaneous display of traces and all numerical measurement results
- Automatic limit value monitoring
- Ideal for use in development and production of *Bluetooth* modules

Measurements

Output power
This measurement is provided for determining the maximum and average output power of the device under test during a burst. A complete packet is recorded in the time domain. The peak power is determined from the total trace contents, whereas the average power is derived from at least 20% to 80% of the burst. Triggering is effected to the sync word.

Adjacent channel power (ACP)
This measurement is provided for determining the power of all adjacent channels. The power of up to 79 channels in total can be measured (39 lower channels + TX channel + 39 upper channels).

Modulation characteristics
This measurement is provided for determining the maximum frequency deviation of all 8-bit test sequences of the payload. In addition, the average value of the maximum frequency deviations per packet is calculated and displayed.

Initial carrier frequency tolerance
This measurement is provided for determining the carrier offset of the four preamble bits. In accordance with the RF test specification, the carrier offset is calculated from the midpoint of the first preamble bit to the midpoint of the bit following the preamble.

Carrier frequency drift
This measurement is provided for determining the maximum frequency drift between the average value of the preamble bits and an arbitrary 10-bit group of the payload. The maximum drift rate of the payload is determined in addition.

Bluetooth Application Firmware R&S FS-K8

Specifications

The specifications below are based on the data sheet specifications of the Spectrum Analyzer R&S FSP and have not been checked separately.
Specifications apply under the following conditions:
15 minutes warmup time at ambient temperature, specified environmental conditions met, calibration cycle adhered to and internal calibration performed.
Data with tolerances denotes measurement uncertainties with a confidence level of 95%.
Unless otherwise stated, specifications are quoted for an RF input level +30 dBm to –50 dBm within the *Bluetooth* band (ISM) 2400 MHz to 2483.5 MHz and default settings.

Output power

Measurements	average and peak power to *Bluetooth* RF Test Specification
Level range	+30 dBm to –50 dBm
Level uncertainty	<0.7 dB (s = 0.25 dB)
Packet type	longest supported (DH1, DH3, DH5)
Payload	PRBS9
Synchronization	RF burst or preamble
Trigger	IF power, external, free run

Modulation characteristics

Measurements	FM deviation according to *Bluetooth* RF Test Specification Δf1max, Δf2max, Δf1avg, Δf2avg and Δf2avg/Δf1avg
Deviation range	±250 kHz
Deviation uncertainty	<3 kHz (signal level >–25 dBm, 10 averages)
Packet type	longest supported (DH1, DH3, DH5)
Payload	10101010 and 11110000, auto detect
Synchronization	preamble
Trigger	IF power, external, free run

Initial carrier frequency tolerance (ICFT)

Measurements	ICFT to *Bluetooth* RF Test Specification
Measurement range	±250 kHz
Uncertainty	<2 kHz + carrier frequency x reference error (signal level >–30 dBm)
Packet type	DH1
Payload	PRBS9
Synchronization	preamble
Trigger	IF power, external, free run

Carrier frequency drift

Measurements	carrier frequency drift to *Bluetooth* RF Test Specification drift / packet and drift / 50 µs
Measurement range	±250 kHz
Uncertainty	<2 kHz (signal level > –30 dBm)
Packet type	all supported (DH1, DH3, DH5)
Payload	10101010
Synchronization	preamble
Trigger	IF power, external, free run

Adjacent channel power (ACP)

Measurements	adjacent channel power according to *Bluetooth* RF Test Specification
Level range	max. +20 dBm
Packet type	DH1
Payload	PRBS9
Synchronization	none
Trigger	external, free run

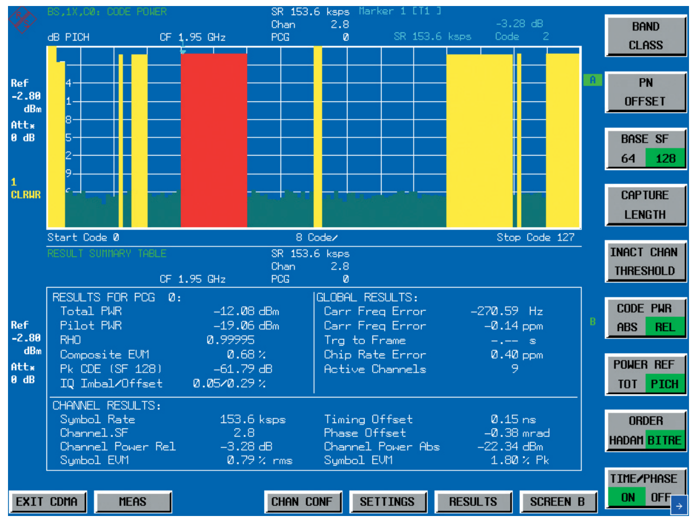
Ordering information

***Bluetooth* Application Firmware for Measurements with R&S FSP and R&S FSU**	R&S FS-K8	1157.2568.02

cdma2000 Base Station Test Application Firmware R&S FS-K82

Transmitter measurements on cdma2000 base stations and modules with Signal Analyzer R&S FSQ and Spectrum Analyzers R&S FSU and R&S FSP

New



Brief description

Application Firmware R&S FS-K82 can be installed on all models of the Signal Analyzers R&S FSQ and Spectrum Analyzers R&S FSU and R&S FSP. It enhances the range of applications to include code domain power and modulation measurements on cdma2000 signals for radio configurations 1 to 5.

Measurement	R&S FSU/ FSP/ FSQ	R&S FSU/ FSP/FSQ with R&S FS-K82
Maximum output power	x	x
Frequency error		x
Power control dynamic range		x
Total power dynamic range		x
Occupied bandwidth	x	x
Spectrum emission mask		x
ACLR	x	x
Spurious emissions	x	
Rho		x
Error vector magnitude		x
Peak code domain error		x

Main features

- Adds measurement functions in line with 3GPP2 specifications to the R&S FSU, R&S FSQ and R&S FSP analyzer families
- Provides the functionality needed for base station testing as well as the related parameters
  - Code domain power (code domain analyzer)
  - Code domain power versus time
  - Rho
  - Error vector magnitude (EVM)
  - Peak code domain error
  - Power versus symbol
  - Symbol constellation
  - Channel table
  - Code domain error power

Code domain power measurements

The main application of R&S FS-K82 is the determination of the power in the individual code channels referred to as code domain power measurement. The power ratios between the individual channels, for instance, can be checked for compliance with the nominal values. Moreover, this measurement is a very efficient tool for detecting transmitter impairments such as clipping or intermodulation that are not obvious from the spectrum alone.

R&S FS-K82 also supports the analysis of orthogonal transmit diversity signals. Not only the signals for the separate antennas can be studied, but also the combined signal as it is seen by a mobile receiver.

The power of the different codes can be shown versus the code number. This is called Hadamard order. The code powers can also be displayed in bit reversed order which intuitively provides information about how much of the code domain is occupied by each single user.

Measurement of modulation quality: rho, peak code domain error and EVM
Three different measurements are commonly used in cdma2000 systems for determining the modulation quality:
- EVM (error vector magnitude)
- Rho
- Peak code domain error

cdma2000 Base Station Test Application Firmware R&S FS-K82

The composite EVM measurement returns a modulation error value for the total signal, whereas the symbol EVM function yields the individual vector errors of the active channels.

Rho is the correlation between the measured signal and the ideal reference signal and is a measure of the overall modulation quality.

To obtain the peak code domain error (PCDE), the vector error between the measured signal and the ideal reference signal is determined with a selectable base spreading factor of 64 or 128.

Automatic detection of active channels and their data rate
With the channel configuration tool the user can define the active channels, which improves the capabilities to measure under difficult signal conditions.

Band class settings
The frequency band classes 0 to 9 as specified by the standard are user-selectable, so that the correct limits are set in the ACLR and spectrum emission mask measurements.

Spectrum emission mask
To perform this measurement in line with the 3GPP2 specifications, the R&S FS-K82 provides an automatic function that gives a pass/fail result. If requested by the band class setting, the limits depend on the channel power.

Spectrum measurements over wide dynamic range
The RMS detector integrated as standard allows accurate transmitter power measurements irrespective of the waveform. Measurements cannot only be performed on systems but also on individual components such as amplifiers which have to meet more stringent requirements.

Remote control
All measurements can be remote-controlled. The results and demodulated data bits can be transferred via the IEEE bus.

Specifications

The specifications below apply to the R&S FSUx (R&S FSU3/8/26), R&S FSQx (R&S FSQ3/8/26) and R&S FSPx (R&S FSP3/7/13/30/40). They are based on the data sheet specifications of the Spectrum Analyzer R&S FSQ, R&S FSU and R&S FSP and have not been checked separately. Specifications apply under the following conditions:
15 minutes warmup time at ambient temperature, specified environmental conditions met, calibration cycle adhered to and internal calibration performed. Data with tolerances are measurement uncertainties with a confidence level of 95%. The specified level measurement errors do not take into account systematic errors due to reduced S/N ratio.

Measurement	R&S FSP	R&S FSU/FSQ
Code domain power (applies to code domain power and code domain power versus slot)		
Total signal power, measurement uncertainty	<0.5 dB	<0.3 dB
Pilot power, measurement uncertainty	<0.6 dB	<0.4 dB
Code power, measurement uncertainty		
Absolute	<0.6 dB	<0.4 dB
Relative	<0.1 dB	<0.1 dB
Frequency error		
Measurement range	<1 kHz	<1 kHz
Measurement uncertainty (S/N >40 dB)	<1.5 Hz + error of reference frequency	<1.5 Hz + error of reference frequency
Composite EVM		
Measurement range	1.5% to 25%	1% to 25%
Inherent EVM	<1.5%	<1%
Measurement uncertainty	<0.5% of reading	<0.25% of reading
Peak code domain error		
Measurement range	0 dB to –55 dB	0 dB to –60 dB
Inherent PCDE	–55 dB	–60 dB
Measurement uncertainty	<1 dB (0 dB to –40 dB)	<1 dB (0 dB to –40 dB)
Output power		
Measurement uncertainty		
Absolute	<0.5 dB	<0.3 dB
Relative	<0.2 dB	<0.1 dB
Occupied bandwidth (99%)		
Measurement uncertainty	<85 kHz	<85 kHz
Spurious emissions		
Level uncertainty		
<3.6 GHz	<0.5 dB	<0.5 dB
3.6 GHz to 13 GHz	<2.5 dB	<2.5 dB

Ordering information

Application Firmware R&S FS-K82 can be integrated into any member of the R&S FSU, R&S FSQ or R&S FSP families.

cdma2000 Base Station Test Application Firmware	R&S FS-K82	1157.2316.02
Extras		
High-Power Attenuator 20 dB, 50 W, DC to 6 GHz	RDL50	1035.1770.52

Handheld Spectrum Analyzer R&S FSH3

100 kHz to 3 GHz

Robust, portable spectrum analyzer that can be used in the field

New

Photo 43888-2

Brief description

The R&S FSH3 is the ideal spectrum analyzer for rapid, high-precision, cost-effective signal investigations. It provides a large number of measurement functions and so can handle anything from the installation or maintenance of a mobile radio base station, through on-site fault location in RF cables to development and service – an extensive range of applications.

Main features

- High measurement accuracy
- Best RF characteristics in this class
- Colour display, 320 x 240 pixels
- Connection between PC and R&S FSH3 via interference-free, RS-232-C optical interface
- High measurement comfort
  - Marker
  - Delta marker
  - Noise marker
  - Frequency counter
- Simple menu-based operation via softkeys
- Four hours operating time on battery power
- Storage of up to 100 traces and setups
- Easy data transfer to PC
- Robust edge protection, stable carrying handle

Options and applications

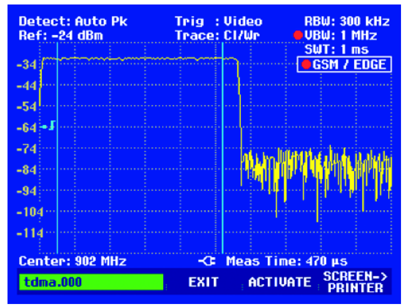
Two versions of the R&S FSH3 are available – one with an internal tracking generator and one without. The tracking generator extends the R&S FSH3's range of applications to cover distance-to-fault (DTF) measurements on cables and scalar network analysis. A power sensor is available as an accessory for high-precision power measurements to 8 GHz. The table below indicates which configuration is required for each application.

Product/application	**TDMA power measurement**	**Channel-power measurement**	**Power measurement up to 8 GHz**	**Measurement on cables (distance-to-fault)**	**Scalar network analysis (transmission)**	**Scalar network analysis (reflection)**
R&S FSH3	•	•				
R&S FSH3 incl. tracking generator	•	•			•	
R&S FSH3 incl. tracking generator + SWR Bridge R&S FSH-Z2 + DTF Function R&S FSH-B1	•	•		•	•	•
R&S FSH3 + Power Sensor R&S FSH-Z1	•	•	•			
R&S FSH3 incl. tracking generator + Power Sensor R&S FSH-Z1 + SWR Bridge R&S FSH-Z2 + DTF Function R&S FSH-B1	•	•	•	•	•	•

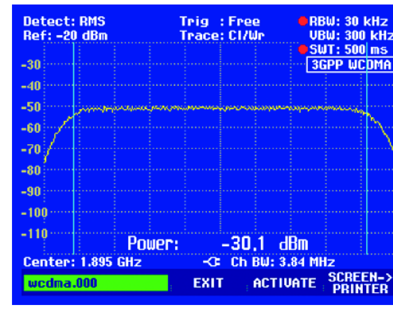
Handheld Spectrum Analyzer R&S FSH 3

R&S FSH View Software

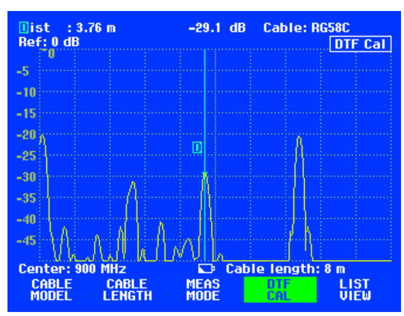
- R&S FSH View software for Windows 98/ME/NT/2000/XP
- Rapid and simple transfer of measurement data from the R&S FSH 3 to a PC and vice versa
- Data export in ASCII or MS Excel formats
- Printout of relevant data via Windows (screenshot of the R&S FSH 3's display for documentation)
- Graphics data stored in standard formats (.bmp, .pcx, .png, .wmf)
- Permanent and continuous transfer of sweeps to the PC; facilities for subsequent analysis (markers, zoom, etc)
- Unlimited memory capacity for traces and other measurement information; comparison of new and old measurements
- Generation of cable data with a built-in cable editor; downloading to the R&S FSH 3 for distance-to-fault measurements



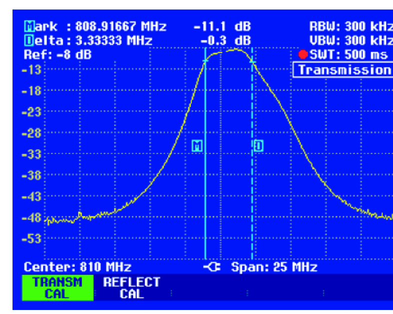
TDMA POWER function performs time-domain power measurements in these timeslots. All the settings required for the GSM and EDGE standards are predefined.



After a few preliminary settings have been made, a single keystroke starts the R&S R&S FSH3's spectrum measurement inside the channel, using a resolution bandwidth that is small relative to the channel bandwidth.



Distance-to fault measurement for rapidly and accurately determining the distance to any defects in an RF cable.



R&S FSH3 with built-in tracking generator can be used to determine the transmission characteristics (i.e. attenuation or gain) of twoports such as cables, filters, amplifiers, etc, rapidly and with a minimum of effort.

Specifications in brief

Frequency	
Frequency range	100 kHz to 3 GHz
Reference frequency, Aging	2 ppm/year
Frequency counter, resolution	1 Hz
Span	10 kHz to 3 GHz, 0 Hz
Spectral purity	
SSB phase noise, f = 500 MHz, 20°C...30°C	
30 kHz carrier offset	< 85 dBc/(1 Hz)
100 kHz carrier offset	<100 dBc/(1 Hz)
1 MHz carrier offset	<120 dBc/(1 Hz)
Sweep time	
Span ≥10 kHz	100 ms to 1000 s
Span = 0 Hz	1 ms to 100 s
Bandwidths	
Resolution bandwidths (–3 dB)	1 kHz to 1 MHz in 1, 3 steps
Video bandwidths	10 Hz to 1 MHz in 1, 3 steps

Amplitude	
Display range	average noise floor displayed to +20 dBm
RF input	
Maximum permitted DC voltage	50 V
Maximum permitted power	20 dBm, 30 dBm (1 W) for max. 3 s
Intermodulation-free range	70 dB (+15 dBm IP3)
Displayed average noise floor	typ. –116 dBm
Spurious response (reference level ≤–10 dBm, f > 30 MHz, RBW ≤100 kHz)	<–80 dBm
Image frequency (carrier offset > 1 MHz)	<–70 dBc (nominal)
Level display	
Reference level	–80 to +20 dBm in 1-dB steps
RF attenuation	0 to 30 dB, in 10 dB steps, automatically coupled to the reference level
Display range	100 dB, 50 dB, 20 dB, linear
Display units (log. scale)	dBm, dBµV, dBmV
Display units (linear scale)	µV, mV, V, nW, µW, mW, W
Traces	1 trace and 1 memory trace
Level display error (ref. level –50 dB)	1.5 dB (+20°C to +30°C)
Trace detector	Auto Peak, Max Peak, Sample, RMS

Handheld Spectrum Analyzer R&S FSH3

Markers	1 marker and 1 delta marker
Marker functions	peak, next peak, marker to center
Marker displays	normal (level), noise marker, frequency counter (count)
Trigger	free-running, video, external
Audio demodulation	AM and FM
Inputs	
RF Input	N connector, female, 50 Ω
SWR (10 MHz to 3 GHz)	typ. 1,5
Trigger input	BNC connector, female, TTL
Outputs	
Headphones output	3.5 mm mini jack, max. 1.5 V, 10 Ω
Tracking generator (only model .13)	N connector, female
Frequency range	10 MHz to 3 GHz
Output level	–20 dBm (nominal), 50 Ω (nominal)
Interfaces	
Optical RS-232-C interface	1200, 2400, 9600, 19200, 38400, 57600, 115200 baud
Power sensor	7-pin connector (Binder 712)
Power sensor R&S FSH-Z1	
Frequency range	10 MHz to 8 GHz
SWR (+18 to +28°C, 30 MHz to 2.4 GHz	< 1.13
Maximum input power	
Average power	400 mW (+26 dBm)
Peak power	1 W (+30 dBm) (<10 µs, 1% duty cycle)
Measurement range	200 pW to 200 mW
Signal weighting	average power
Absolute measurement uncertainty (sinus signals, no zero offset)	
+18°C to +28°C	< 2.5 % (0.11 dB)
0°C to +50°C	< 4.5 % (0.19 dB)
General data	
Display	14 cm (5,7") colour LCD
Resolution	320 x 240 pixel
Memory	CMOS RAM
Setup and traces	100
Power supply	
External power supply (R&S R&S FSH-Z33)	100 V AC to 240 V AC, 50 Hz to 60 Hz, 400 mA
External DC voltage	15 V to 20 V
Internal battery (NiMH battery)	6 V to 9 V
Operating time with fully charged battery	4 h without tracking generator 3.5 h with tracking generator
Battery charging time	4 h
Battery life time	300 to 500 charging cycles
Operating temperature range	
Battery operation	0°C to +50°C
Operation with power supply	0°C to +40°C
Dimensions (W x H x D)	170 mm x 120 mm x 270 mm
Weight	2.5 kg

Ordering information

Handheld Spectrum Analyzer		
100 kHz to 3 GHz	R&S FSH3	1145.5850.03
100 kHz to 3 GHz, with tracking generator	R&S FSH3	1145.5850.13

Accessories supplied
External power supply, battery pack (integral), RS-232-C optical cable, headphones, CD-ROM with control software R&S FSH View and documentation, quick start manual

Option		
Distance-to-fault Measurement, incl. 1 m cable and calibration termination, R&S FSH-Z2 required	R&S FSH-B1	1145.5750.02
Extras		
Power sensor	R&S FSH-Z1	1155.4505.02
SWR Bridge and Power Divider 10 MHz to 3 GHz	R&S FSH-Z2	1145.5767.02
Matching Pad 50/75 Ω, 0 to 2700 MHz	R&S RAZ	0358.5714.02
12-V Cigarette-Lighter Adapter	R&S FSH-Z21	1145.5873.02
Serial/Parallel Converter	R&S FSH-Z22	1145.5880.02
RF cable, 1 m, N connectors, for R&S FSH-B1	R&S FSH-Z20	1145.5867.02
Carrying Bag	R&S FSH-Z25	1145.5896.02
Short Circuit for calibrating, for R&S FSH-Z2	R&S FSH-Z30	1145.5773.02
50-Ω Load Standard, for R&S FSH-B1	R&S FSH-Z31	1145.5780.02
Battery Pack	R&S FSH-Z32	1145.5796.02
Power Supply	R&S FSH-Z33	1145.5809.02
RS-232-C Optical Cable	R&S FSH-Z34	1145.5815.02
CD-ROM with Control Software R&S FSH View and documentation	R&S FSH-Z35	1145.5821.02
Headphones	R&S FSH-Z36	1145.5838.02

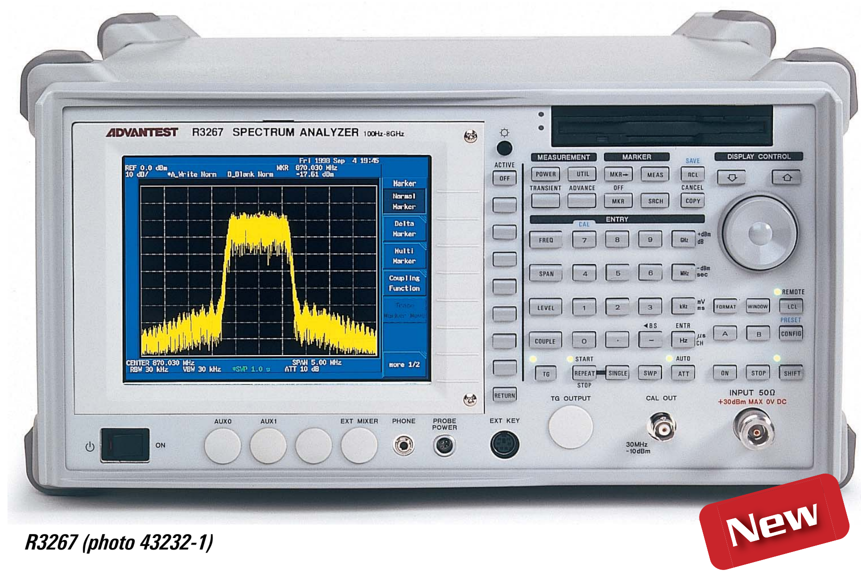
Spectrum Analyzers R3264/3267/3273

9 kHz to 3.5 GHz (R3264)

100 Hz to 8 GHz (R3267)

100 Hz to 26.5 (31.8) GHz (R3273)

General purpose spectrum analyzers with option to retrofit digital demodulation capability



R3267 (photo 43232-1)

Brief description

The spectrum analyzer series from Advantest comprises general-purpose spectrum analyzers with the frequency ranges 9 kHz to 3.5 GHz (R3264), 100 Hz to 8 GHz (R3267) and 100 Hz to 26.5 GHz (R3273). All analyzers are fully synthesizer-controlled (DDS) featuring high frequency span accuracy (<±0.2% typ.), phase noise <–145 dBc (1 Hz) and noise floor –154 dBm (1 Hz). The concept features YIG tuned preselector filter from 1.6 GHz and 5 dB step attenuation (R3267).

High signal purity and wide dynamic range are some of the outstanding specifications of this analyzer series meeting the high demands for the future telecommunication market.

The concept of the analyzer is based on a general-purpose analyzer with the option to retrofit digital demodulation capability meeting the requirements of 2nd and 3rd generation digital telecommunication. Systems like GSM EDGE, DECT, IS-95, WCDMA (3GPP), cdma200, 1 x EV-DO, *Bluetooth* and further systems are available as easy software upgrades via built-in 3½" FDD.

The analyzer series features simple keystroke (macro) functions for measuring ACP, OBW, power (channel, total and average) as RMS voltage calculated values, as well as harmonics, spurious, two-tone signal and phase noise measurements, counter function and several other functions.

The detector circuit contains 4 different detector types (positive, negative, sample and normal), and the two simultaneous traces allow two different detectors to be assigned. The analyzer series is equipped with a wide range of resolution filters (1 Hz to 10 MHz) meeting the various needs on the market. To satisfy the demand for fast time domain sweep, the analyzer has a 40 Mbps ADC featuring sweep times from 20 ms to 1000 s and 1 µs to 1000 s in zero span mode.

The analyzer is equipped with a 3½" FDD and a 6.5" TFT colour liquid crystal display with refresh rate of 20 traces/s. GPIB and RS-232-C interface as well as parallel ports and VGA output are standard.

The frequency range of the R3273 can be extended in with external mixers up to 60 GHz (level correction possible) and up to 325 GHz (tuning possible).

The digital standard options come standard with I/Q baseband inputs (DC to 2.5 MHz for each channel) for I/Q baseband analysis.

Overview of digital communication standards

The concept of the R3264, R3267 and R3273 is a combination of high performance spectrum analysis and modulation analysis in a single instrument.

The basic unit plus a hardware platform for digital standards (option 1) is needed to perform the modulation analysis.

The following standards can be implemented in the R3264, R3267 and R3273:

- Option 61: cdmaOne
- Option 62: WCDMA/3GPP
- Option 63: GSM/EDGE/DECT
- Option 64: IS-136/PDC/PHS
- Option 65: cdma2000
- Option 66: *Bluetooth*
- Option 76: HDR (1 x EV-DO)

CdmaOne (Option 61)
- Channel (F-domain) power
- Gated output (T-domain) power
- Tx power
- On/off ratio
- Occupied bandwidth (OBW)
- ACP due to transients
- Waveform quality
- Code domain power
- In-band/out-band spurious
- T-domain spurious
- Graphics analysis (constellation diagram, eye diagram, EVM versus chip, magnitude and phase error versus chip)

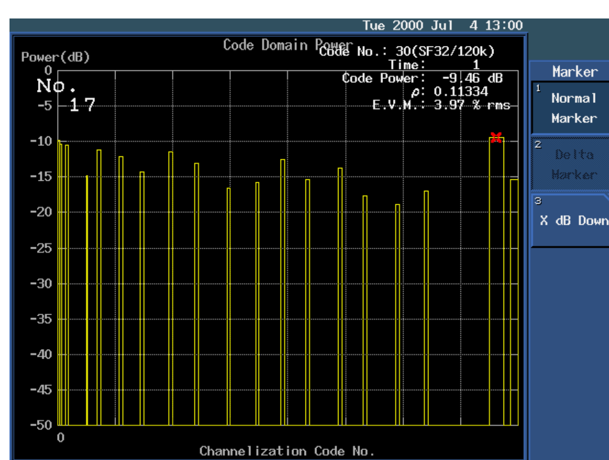
Special features
- RF and baseband IQ measurements possible
- All channel assignments covered

WCDMA/3GPP (Option 62)
- Channel (F-domain) power
- Gated output (T-domain) power
- Tx power
- On/off ratio
- Occupied bandwidth (OBW)
- Adjacent-channel power ratio (ACPR)
- In-band spurious
- Out-band spurious
- T-domain spurious
- Peak/crest factor, CCDF (complementary cumulative distribution function)
- Waveform quality ρ
- Time alignment error τ
- Carrier frequency error
- I/Q origin offset
- Magnitude and phase Error (normal and peak)
- Error vector magnitude EVM (normal and peak)
- Code domain power with auto rate and auto channel detection
- Time code domain power
- Graphical analysis (constellation diagram, eye diagram, EVM versus chip, magnitude and phase error versus chip)
- Primary CPICH power

Special features
- RF and baseband IQ measurements possible
- All channel assignments covered
- Uplink and downlink
- Measurement on slot or frame
- Auto channel and auto rate detection

GSM/EDGE/DECT (Option 63)
- Channel (F-domain) power
- Gated output (T-domain) power
- On/off ratio
- Spurious in frequency domain
- Spurious in time domain
- Spectrum due to switching transients
- Spectrum due to modulation
- Power versus time (with TSC Trigger)
- Tx power
- GSM
  - Phase and frequency error
  - Graphical analysis (constellation diagram, eye diagram, Trellis diagram, phase error versus bit, FFT of phase error, frequency versus bit, frequency eye)
  - Demodulated data
- EDGE
  - Magnitude and phase error (normal and peak)
  - Error vector magnitude EVM (normal and peak)
  - Burst amplitude droop
  - Carrier frequency error
  - I/Q origin offset
  - Graphical analysis (constellation diagram, eye diagram, magnitude and phase error versus symbol, EVM versus symbol)
  - Demodulated data
- DECT
  - Frequency deviation
  - Graphical analysis (frequency versus bit, frequency eye)
  - Demodulated data

3GPP total result



Code domain power measurement for 3GPP

Special features
- RF and baseband I/Q measurements possible
- All channel assignments covered
- TSC synchronization (GSM/EDGE)
- Multi-burst measurements (GSM/EDGE)
- Base station and mobile station

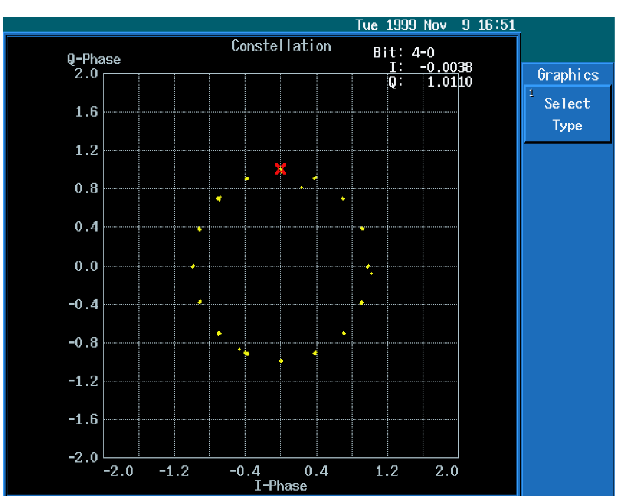
IS-136/PDC/PHS (Option 64)
- Channel (F-domain) power
- Gated output (T-domain) power
- On/off ratio
- Spurious in frequency domain
- Spurious in time domain
- Occupied bandwidth (OBW)
- Adjacent-channel power (ACP)
- Modulation accuracy
- Carrier frequency error
- I/Q origin offset
- Bit error rate
- Power versus time
- Tx power
- Graphics analysis

Cdma2000 (Option 65)
- Channel (F-domain) power
- Gated output (T-domain) power
- Tx power
- On/off ratio
- Occupied bandwidth (OBW)
- Adjacent-channel power ratio (ACPR)
- In-band/out-band spurious
- T-domain spurious
- Peak/crest factor, CCDF (complementary cumulative distribution function)
- Waveform quality ρ
- Time alignment error τ
- Carrier frequency error
- I/Q origin offset
- Magnitude and phase error (normal and peak)
- Error vector magnitude EVM (normal and peak)
- Code domain power
- Code domain error

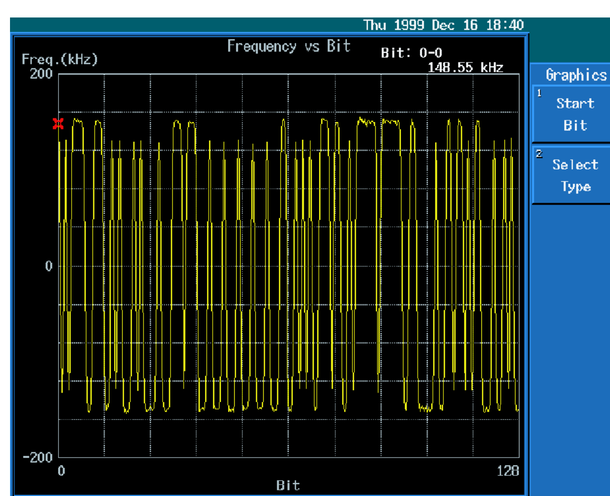
***Bluetooth* (Option 66)**
- Channel (F-domain) power
- Gated output (T-domain) power
- Tx power
- On/off ratio
- Occupied bandwidth (OBW)
- Spurious in frequency domain
- Spurious in time domain
- Due to transients
- Due to modulation
- Lock-up time / settling time measurement
- FM deviation (maximum and minimum)
- Frequency error
- Graphics analysis (spectrum due to modulation, frequency versus bit, frequency eye)
- Demodulated data

Special features
- RF and baseband IQ measurements possible
- All channel assignments covered
- Hopping catch mode
- Variable burst length
- LAP synchronization possible

HDR (1 x EV-DO, option 67)
- Idle and active slot measurements
- Channel power (frequency domain)
- Power versus time mask (time domain)
- On/off ratio
- Occupied bandwidth (OBW)
- Spectrum mask
- Waveform quality ρ
- Time alignment error τ
- Carrier frequency error
- Code domain power
- Spurious
- CCDF (complementary cumulative distribution function

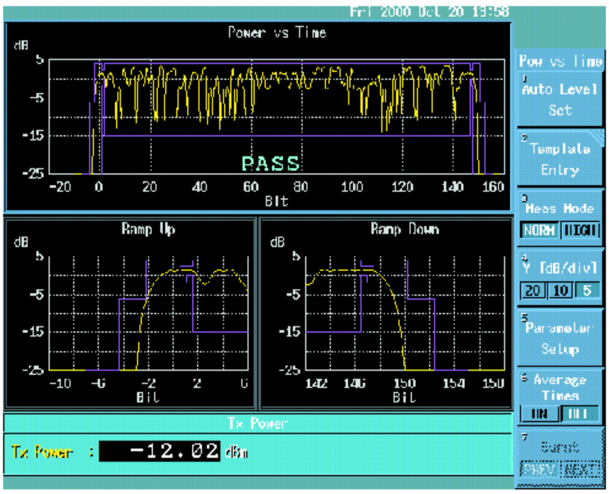


Constellation diagram for EDGE



Frequency versus bit measurement for Bluetooth

Spectrum Analyzers R3264/3267/3273



Power versus time measurement for EDGE

Specifications

Frequency

Frequency range	R3264	9 kHz to 3.5 GHz
	R3267	100 Hz to 8 GHz
	R3273	100 Hz to 26.5 (31.8) GHz
Frequency bands		100 Hz to 3.5 GHz N = 1
		1.6 to 8 GHz N = 1
		7.4 to 15.4 GHz N = 2
		15.4 to 26.5 GHz N = 4
Preselector	R3267	selectable from 1.6 GHz
	R3273	from 3.6 GHz
Frequency accuracy		±(f x reference frequency + span x 1% + 0.15 x RBW + 10 Hz)
Counter		
Resolution		1 Hz to 1 kHz
Accuracy		±(marker frequency x ref. frequency accuracy + 5 Hz x N + 1 LSD) (S/N ≥25 dB, span ≤200 MHz)
Reference frequency		$\pm 1 \times 10^{-7}$/year
with option 21 (0°C to 50°C)		$\pm 2 \times 10^{-8}$/year, $\pm 5 \times 10^{-9}$/day
with option 22		$\pm 3 \times 10^{-10}$/day
with option 23		$\pm 1 \times 10^{-10}$/month
Span		200 Hz to 8/26.5 (31.8) GHz, zero span
Inaccuracy		≤±1%
Frequency stability		
Residual FM		≤3 x N Hz p-p/100 ms

Spectral purity (SSB phase noise [-dBc (1 Hz)]

Carrier offset	<1 GHz	<2.6 GHz	<7.5 GHz	<26.5 GHz
1 kHz	<100	<100	<98	<83
10 kHz	<113	<110	<108	<98
100 kHz	<118	<118	<112	<100
1 MHz	<135	<135	<135	<123

Resolution bandwidths (3 dB)	
Range	1 Hz to 10 MHz; 1-to-3 increments
Selectivity (60:3 dB)	<15:1
Video bandwidth	1 Hz to 10 MHz; 1-to-3 increments

Level

Display range		+30 dBm to displayed average noise level
Max. input level		+30 dBm, ±0 V DC
Display range		
Log		10; 5; 2; 1; 0,5 dB/div 10 x 10 grid
Linear		10% of reference level per division
Reference level range		
Log		–140 dBm to +60 dBm, in steps of 0.1 dB
Linear		+22.4 nV to 223.6 V
RF input attenuator (range)		
	R3264, R3267	0 to 75 dB, in 5 dB steps
	R3273	0 to 70 dB, in 10 dB steps

Sweep

Sweep time		20 ms to 1000 s zero span 1 µs to 1000 s
Accuracy		±3%
Trigger modes		free-run, line, video, external, IF in zero span mode additionally trigger delay (pretrigger/posttrigger)
Sweep modes		continuous, single-shot, window sweep
Gated sweep		
Gate position		100 ns to 1 s, 100 ns resolution
Gate width		1 µs to 1 s, 100 ns resolution external trigger, external gate
Delayed sweep		100 ns to 1 s, 100 ns resolution
Displayed average noise level (RBW 100 Hz; VBW 10 Hz; ATT 0 dB)		<–90 dBm, 1 to 10 kHz <–100 dBm, 10 kHz to 1 MHz <–125 dBm, 1 MHz to 10 MHz <–130 dBm + f [GHz] dB 10 MHz to 3.5 GHz <–125 dBm, 3.5 GHz to 8 GHz
	R3273	<–122 dBm, 7.4 GHz to 15.4 GHz <–120 dBm, 15.4 GHz to 22 GHz <–117 dBm, 22 GHz to 26.5 GHz
1 dB compression point of input mixer		
	R3267	>0 dBm, 100 MHz to 8 GHz
	R3273	>0 dBm, 100 MHz to 3.5 GHz >–10 dBm, 3.5 GHz to 7.5 GHz >–3 dBm, 7.5 GHz to 26.5 GHz
2nd-order interfering signals		
–30 dBM mixer level		≤–70 dBc, 10 MHz to 3.5 GHz
–10 dBM mixer level (R3267)		≤–90 dBc, 1.6 GHz to 8 GHz
–10 dBM mixer level (R3273)		≤–100 dBc, >3.5 GHz
3rd-order intermodulation		
100 MHz to 1 GHz		≤–80 dBc
1 GHz to 3.5 GHz		≤–85 dBc
1.6 GHz to 8 GHz		≤–90 dBc (R3267)
3.5 GHz to 7.5 GHz		≤–70 dBc (R3273)
Other interfering signals at input		≤–100 dBm, 1 MHz < f <3.5 GHz
Residual response (ATT 0 dB, input terminated with 50 Ω)		≤–90 dBm, f >3.5 GHz

Amplitude accuracy

Calibration signal	30 MHz
Accuracy	–10 dBm ± 0.3 dB
Frequency response (ATT =10 dB)	
50 MHz to 2.6 GHz	≤±1.0 dB
1.5 GHz to 8 GHz	≤±1.5 dB
7.4 GHz to 15.4 GHz	≤±3.5 dB
15,4 GHz to 26.5 GHz	≤±4.0 dB
Scale accuracy/linearity error	(after autocalibration)
Log	≤±0.85 dB/90 dB ≤±0.2 dB/1 dB
Lin	5% of reference level
Input attenuator switching error	≤±1.1 dB/10 dB (20 dB to 70 dB) max. 2.0 dB, f <12.4 GHz max. 3.5 dB, f >12.4 GHz

Spectrum Analyzers R3264/3267/3273

RBW switching error (after autocalibration)	≤±0.3 dB, RBW ≥100 Hz
IF gain error (after autocalibration)	<±0.5 dB, >–50 dBm
Total level accuracy (REF –50 dBm to 0 dBm, ATT = 10 dB, 2 dB/div, RBW = 300 kHz, f <3.5 GHz)	±1.5 dB, ±1 dB typ.

Inputs/outputs

RF input	N female, 50 Ω (R3273: adapter system, 3.5 mm)
VSWR (ATT ≥10 dB)	≤1.5 (100 kHz to 3.5 GHz) ≤2.0 (>3.5 GHz)
Calibration output	30 MHz, –10 dBm
Connector	BNC female, 50 Ω
10 MHz reference (input/output)	–5 dBm to +5 dBm
Connector	BNC female, 50 Ω (rear panel)
External trigger and gate input	TTL, 10 kΩ (nominal), DC-coupled
Connector	BNC female (rear panel)
Trigger output	TTL level, BNC female
IF output (BNC female)	21.4 MHz, bandwidth same as RBW 421.4 MHz, BW approx. 20 MHz (3 dB)
X output (sweep)	–5 V to 5 V sawtooth f_{START} to f_{STOP}
Connector	BNC female, 1 kΩ
Y output	2 V full-scale deflection (100 dB) BNC female, 220 Ω
AF output	subminiature female earphone output (rear panel) max. 0.2 W into 32 Ω (nominal) option 05: AM/FM demodulator, internal loudspeaker
Probe power output	±12.6 V, 100 mA, 4-pin, power supply for active probes
IEC/IEEE bus	IEEE488 bus connector (rear panel)
Serial interface (RS-232-C)	D-SUB 9-pin (rear panel)
VGA monitor output	D-SUB 15-pin (rear panel)
Printer interface	D-SUB 25-pin (rear panel) ESC/P; PCL printer

Digital communication standards

cdmaOne analysis	option 61

Waveform quality measurement

Frequency range	30 MHz to 3.0 GHz
Input level	–30 dBm to +30 dBm (total power in ATT AUTO mode)
Forward link	
Waveform quality ρ	measurement uncertainty <±0.0015
Time alignment error τ	measurement uncertainty <±300 nsec
Carrier frequency error	<± (reference frequency accuracy x carrier frequency + 10 Hz) (in Expand mode within carrier frequency ±4 kHz)
Reverse link	
Waveform quality ρ	measurement uncertainty <±0.003
Time alignment error τ	measurement uncertainty <±300 nsec
Carrier frequency error	<± (reference frequency accuracy x carrier frequency +10 Hz) (within carrier frequency ±4 kHz)

Code domain power measurement

In 15-97 "Base Station Test Mode" measurement

Frequency range	30 MHz to 3.0 GHz
Input level	–30 dBm to +30 dBm (total power in ATT AUTO mode)
Precise mode (measured with 64 x 20 chips)	
Power i	measurement uncertainty <±0.1 dB (however, τ i =0)
Carrier frequency error	<± (reference frequency accuracy x carrier frequency + 10 Hz) (in Expand mode within carrier frequency ±4 kHz)
τ i	measurement uncertainty <±10 nsec
Δθi	measurement uncertainty <±10 mrad
Normal mode (measured with 64 x 20 chips)	
Power i	measurement uncertainty <±0.1 dB (however, τ i =0)
Carrier frequency error	<± (reference frequency accuracy x carrier frequency + 10 Hz) (in Expand mode within carrier frequency ±4 kHz)

WCDMA analysis	option 62

WCDMA measurement

Frequency range	30 MHz to 3.0 GHz
Input level	–40 dBm to +30 dBm (total power in ATT manual mode)

WCDMA, BS signal

Waveform quality	measurement uncertainty <0.002
Modulation accuracy	residual vector error <3%
Code domain power	measurement uncertainty <±0.1 dB

WCDMA, UE signal

Waveform quality	measurement uncertainty <0.001
Modulation accuracy	residual vector error <3%

QPSK measurement

Frequency range	30 MHz to 3.0 GHz
Input level	–40 dBm to +30 dBm (total power in ATT manual mode)
Waveform quality	measurement accuracy <0.001
Modulation accuracy	residual vector error; <3%

I/Q input

Input level range	0.25 V to 0.9 V V_{pp} (however, ±0.47 V or less)
Input impedance	50 Ω (nominal), DC coupling, AC coupling
Modulation accuracy	residual vector error <3%

GSM/DECT analysis	option 63

GSM measurement

Applicable modulation system	GMSK (GSM, DCS1800, PCS1900)
Frequency range	30 MHz to 3.0 GHz
Input level	–30 dBm to +30 dBm
Frequency error	range <±10 kHz accuracy <± (reference frequency accuracy x carrier frequency + 5 Hz)
Phase error	Range ≤±30° (peak) accuracy ≤±5° (peak), ≤±1° (rms)

Spectrum Analyzers R3264/3267/3273

DECT measurement	
Applicable modulation system	GFSK (DECT)
Frequency range	30 MHz to 3.0 GHz
Input level	–30 dBm to +30 dBm
Frequency deviation	measurement uncertainty <± (reference frequency accuracy x carrier frequency + 10 kHz) for max./min. deviation
Frequency error	measurement uncertainty <± (reference frequency accuracy x carrier frequency + 10 kHz)
Jitter measurement	measurement uncertainty <±0.1 psec, the jitter between bursts (PP→PP, RFP→RFP, RFP→PP) is measured
PDC/PHS/IS-136 analysis	option 64
PDC/IIS-136 measurement	
Frequency range	30 MHz to 3.0 GHz
Input level	–30 dBm to +30 dBm
Frequency error	measurement uncertainty ± (reference frequency accuracy x carrier frequency + 5 Hz) range <±1.4 kHz (Normal) <±5 kHz (Expand)
Modulation accuracy	measurement uncertainty <± (1% + measured value x 2%)
Transfer speed	<1 ppm
PHS measurement	
Frequency range	30 MHz to 3.0 GHz
Input level	–30 dBm to +30 dBm
Frequency error	measurement uncertainty ± (reference frequency accuracy x carrier frequency + 20 Hz) range <±13 kHz (Normal) <±50 kHz (Expand)
Modulation accuracy	measurement uncertainty <± (1% + measured value x 2%)
cdmaOne analysis	option 61

General data

Floppy disk drive	3.5"; MS-DOS format
Display	16.5 cm (6.5"), 1000 x 700 pixels, 104 x 76 mm grid (W x H), 2 simultaneous display memories A and B, quasi-analog display, split screen, auxiliary line editor, date/time, colour selection, setting parameters (switch-selected)
Analysis functions	marker, delta marker, multimarkers (10), signal track, peak search, next peak, offset input for frequency and level, display line, reference line, limit lines with pass/fail comparator, 10 memories for setups and traces, averaging, noise measurements, harmonics measurement, power measurements, OBW and ACP measurements, autotune, autotest, calibration routines, transducer input
Operating temperature range	0°C to 50°C
Storage temperature range	–20°C to +60°C
Relative humidity	<85%
AC supply	115/230 V AC autom. switchover
115 V AC	90 V to 132 V
230 V AC	198 V to 250 V
Line frequency	50 Hz to 60 Hz
Power consumption	<300 VA
Dimensions (H x W x D)	approx. 177 mm x 350 mm x 420 mm, excluding feet and front cover
Weight	<18 kg

Ordering information

Spectrum Analyzer	
9 kHz to 3.5 GHz	R3264
100 Hz to 8 GHz	R3267
100 Hz to 26.5 GHz	R3273

Options

01	Hardware Platform for Digital Modulation Analysis
02	PC Card Drive (instead of floppy drive)
08	Test Source Control for R3562
11	High-Accuracy Power Measurement for 3GPP (Option 62), ±0.4 dB
16	External Mixer, 26.5 GHz to 40 GHz, WR 28 (R3273 only)
17	External Mixer, 40 GHz to 60 GHz, WR 19 (R3273 only)
21	Precision Frequency Reference ±5 x 10-9/day, ±2x 10-8/year
22	Precision Frequency Reference ±3 x 10^{-10} /day
23	Rubidium Reference Oscillator ±1 x 10^{-10} / month
25	Reference Converter for 3G Node B
61	CDMA (IS95) Analysis
62	WCDMA Analysis (3GPP)
63	GSM/EDGE/DECT Analysis
64	PDC/PHS/IS-136 Analysis
65	cdma2000 Analysis
66	*Bluetooth* Analysis
67	HDR (1 x EV-DO) Analysis
73	FM Deviation Measurement
74	Tracking Generator Frequency range: 100 kHz to 3.5 GHz Output power: –50 dBm to 0 dBm, in steps of 0.1 dB Accuracy: <±0.5 dB Frequency response: <±3.0 dB Harmonics: <-20 dBc RF input protection, power sweep
86	19" Rack Adapter

Extras

Transit case		
Service manual		
IEC/IEEE bus Cable	408JE-101/102	
VSWR Bridge 5 MHz to 3000 MHz	ZRB2 (R&S)	1039.9492.x

Spectrum Analyzer R3131A

9 kHz to 3 GHz

General-purpose analyzer for use in development, production, testshop, service and training; thanks to special filters also suitable for EMC precertification measurements

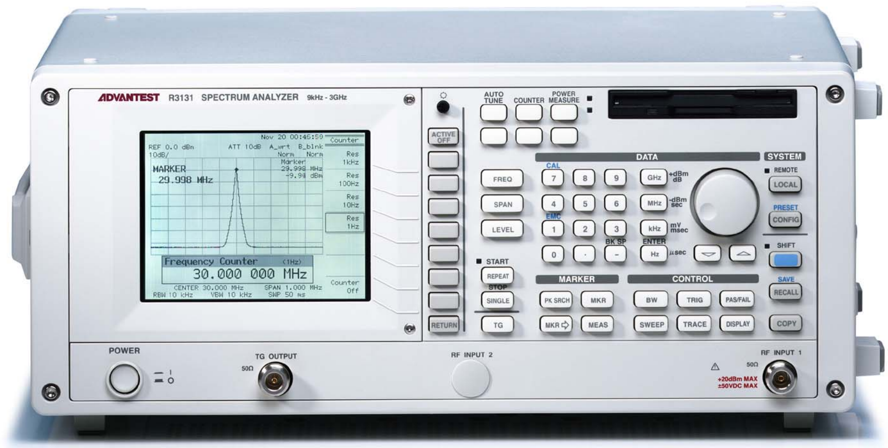


Photo 43157-2

Brief description

Spectrum Analyzer R3131A features the performance of a medium-class analyzer but at lower costs. With its wide frequency range from 9 kHz to 3 GHz it is suitable for many applications. Thanks to a highly stable synthesizer-controlled LO it satisfies exacting requirements in lab and system use. Its 19" size makes it particularly suitable for use in systems.

Operation, functions

Clear arrangement of the control elements and keys predominantly without multiple assignment make for great ease of operation. The basic model provides a large variety of measurement and marker functions as well as a built-in frequency counter. It also features the 6 dB bandwidth of 9 kHz and 120 kHz and a QP detector for EMC measurements.

Disk drive, printer support, RS-232-C and IEEE488 interfaces are standard. An optional tracking generator allows scalar network analysis.

Specifications in brief

Frequency range	9 kHz to 3 GHz
Reference oscillator	
Aging	>±2x10^{-6}/year
Resolution bandwidths	300 Hz to 1 MHz/auto, (6 dB) 9/120 kHz
Shape factor	<15 : 1
Frequency span	1 kHz to 300 MHz, zero span
Residual FM	<100 Hz/0.1 s (zero span)
Input level	+30 dBm to displayed average noise level/±50 V (DC), option 40: +40 dBm
Displayed average noise level	–113 +2f [GHz] dBm (1 kHz bandwidth) (f>1 MHz)
Intermodulation	<–70 dBc at –30 dBm (>10 MHz)
Spurious responses	–100 dBm (>1 MHz)
Phase noise	–100 dBc (1 Hz measurement bandwidth) at 20 kHz from carrier
Frequency response	<±0.5 dB (>100 kHz)
Reference level	–64 to +40 dBm/0.1 dB steps
Amplitude display units	dBm, dBmV, dBμV, Watt, Volt
Level resolution	10, 5, 2, 1 dB/div, linear
RF attenuator	0 to 50 dB in 10 dB steps
Video filter	10 Hz to 1 MHz, 1 to 10 steps
Sweep time	50 ms to 500 s, zero span
Frequency counter resolution	1 Hz to 1 kHz
Tracking generator	
Frequency range	100 kHz to 3 GHz
Output level range	–59.9 to 0 dBm, 0.1-dB steps
General data	
Remote control interface	IEEE488, RS-232-C
Power supply	100/240 V, 50 to 60 Hz
Power consumption	150 VA
Dimensions (W x H x D)	424 mm x 177 mm x 300 mm
Weight	12 kg

Ordering information

Spectrum Analyzer	R3131A
Options	
Tracking Generator	74
Extras	
EMC software (Windows)	EPS9980
IEC/IEEE bus Cable 1 m	408JE-101
IEC/IEEE bus Cable 2 m	408JE-102
Transit Case	R16080M
19"-Rack Adapter	A02468

BasePak+ - for all measurements on antenna installations

Complete hardware and software for full qualification measurements on antennas

Brief description

BasePak+ is an ideal tool for measuring transmit and receive signals and for qualification measurements on antennas of analog and digital transmission systems. BasePak+ is a combination consisting of Advantest Spectrum Analyzer U3641 and tracking generator (see page 245), Windows software, SWR bridge and further accessories. It allows measurement and monitoring of the receive spectrum, measurement of SWR and transmission characteristics as well as detection of cable faults using FDR (frequency domain reflectometry).

Measurement capabilities

- Spectrum
- Transmission
- SWR
- Faults in cables
- Optional burst analysis

All measurements are carried out using a small-size and lightweight spectrum analyzer controlled from a notebook. Results can be stored in the notebook and recalled later. This allows fast comparisons to be made and changes recognized immediately. Through the use of Windows the data can be output on all commercial-type printers and even be integrated in other programs.

Ordering information

BasePak+ consisting of:		
Advantest Spectrum Analyzer	U3641, U3641-74	
Battery	U4000-B5	
Battery Charger	U4000-C4	
Accessory case with		
RSWinTDR Software		
SWR Bridge	ZRB2	0373.9017.5x
Coupler		
Calibration kit		
Cables		

Options (for U3641)	
Internal controller	15
Improved reference frequency	20
100/300 Hz resolution bandwidths	26
TV demodulator including option 78	72
Broadband FM demodulator	73
Tracking generator	74
Channel input	78

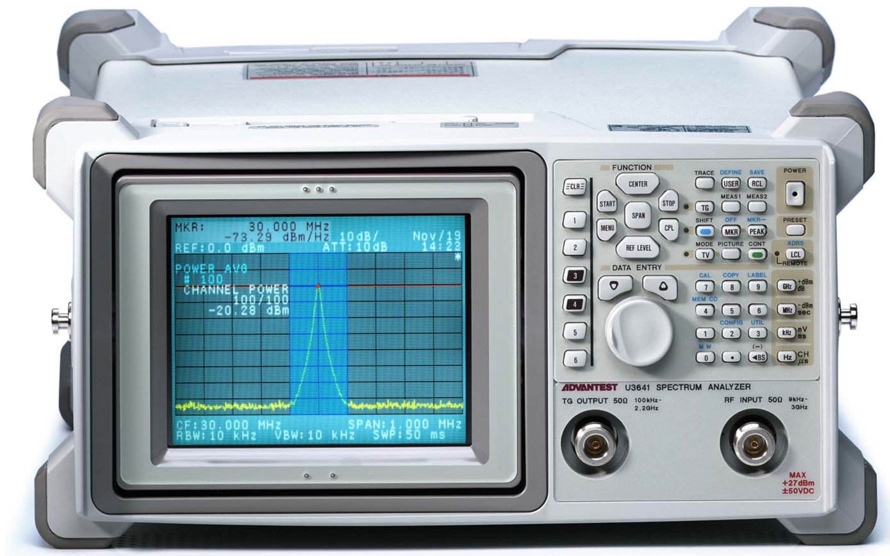
Extras (for U3641)		
Battery 60 Wh	U4000-B5	
Charger for 2 batteries B5	U4000-C4	
Charger for 4 batteries B5	U4000-C5	
Charger for 4 batteries B5 and diagnostic module	U4000-C6	
Memory Card 256 k	A09508	
GSM MS Application		
Program for Internal Controller	PU36410300-IC	
GSM/PCN BS application		
Program for Internal Controller	PU36410310-IC	
Display Hood	R16601	
DC Connecting Cable	A01434	
SWR Bridge	ZRB2	0373.9017.5x
Transit Case	R16072	
Carrying Case	R16216	
Front Cover	A02806	

Spectrum Analyzers U3641, U3661

U3641: 9 kHz to 3 GHz

U3661: 9 kHz to 26.5 GHz

Lightweight, portable analyzers with synthesizer accuracy for mobile use



U3641 (photo 42774)

Brief description

Spectrum Analyzers U3641 and U3661 (Advantest) feature exceptional characteristics such as:

- Size and weight: only 148 mm x 291 mm x 330 mm and 6.5 kg/8.3 kg (without battery or power supply unit)
- Three types of power supply possible: AC supply, battery (up to 1.5 h/1 h) or direct DC supply
- 15.2 cm (6 inch) colour LCD
- Integrated preamplifier with a gain of >25 dB
- Full dynamic range, e.g. for GSM pulse measurements
- Two memory card drives to PCMCIA standard for saving measurement results and instrument settings

The main technical features at a glance

- Optional OCXO reference oscillator with aging of 2×10^{-8}/day
- Operation independent of AC supply

Measurements on mobile radio base stations

- Dynamic range >70 dB for measuring the power ramp of GSM base stations
- SWR measurements on antennas in conjunction with tracking generator and SWR Bridge ZRB2 (see page 273)
- With BasePak hardware and software package (see page 244): SWR measurements and detection of cable faults using FDR (frequency domain reflectometry)
- Precision measurement of pulse power with the aid of various power measurement functions
- Different power measurement functions
- Gated sweep for display of spectrum due to modulation or switching
- GSM application software for optional controller (only U3641)

Radiomonitoring

- High sensitivity through built-in preamplifier up to 3 GHz for measurements down to –135 dBm with 1 kHz resolution bandwidth
- Input of antenna correction factors and limit curves
- Output of all results also in dBµV
- Ideal combination with Rohde & Schwarz antennas

Modularity through retrofittable options

Options and their functions	Option
Internal controller	15 (only U3641)
Improved reference frequency	20 (not usable with option 73)
100 Hz, 300 Hz RBW additionally	26
CDMA measurements at a key stroke	60 (not usable with option 72)
TV demodulator including screen display	72 (not usable with option 72)
FM deviation measurements	73 (not usable with option 20, only U3641)
Tracking generator 100 kHz to 2.2 GHz (2.7 GHz typ.)	74
Channel input	78

Spectrum Analyzer U3641, U3661

Specifications in brief

Internal reference oscillator	standard
Frequency drift in temperature range 0 to +50°C	≥± 1 x 10^{-5}
Aging	≥± 2 x 10^{-6}
OCXO reference oscillator	option 20
Frequency drift in temperature range 0 to +50°C	≥± 1 x 10^{-7}
Aging	≥± 2 x 10^{-8}
Frequency	
Frequency range	
U3641	9 kHz to 3 GHz
U3661	9 kHz to 26.5 GHz
Resolution bandwidths	1 kHz to 3 MHz, wide (5 MHz)/auto
option 26	100 Hz, 300 Hz
Shape factor	15 : 1
Frequency span	1 kHz to 3.2 GHz/zero span
Residual FM	≤60 Hz pp/100 ms
Max. input level	
Preamplifier off	≥±27 dBm
Preamplifier on	≥±13 dBm
Sweep time	50 ms to 1000 s
	50 µs to 100 s Zero Span
Tracking generator	option 74
Frequency range	100 kHz to 2.2 GHz
Output level	0 to –31 dBm in 1 dB steps
Level accuracy	≤±0.5 dB at 30 MHz
Frequency response	≤±0.7 dB up to 1 GHz
	≤±1.5 dB from 100 kHz to 2.2 GHz
General data	
Operating temperature range	0 to 50°C
Storage temperature range	–20 to +60°C
EMC	complies with the requirements of the European EMC Directives EN 55011 and EN 61326-1
Permissible humidity	<85% non-condensing
Power supply	200 to 240 V AC ±10%, 48 to 66 Hz
	100 to 120 V AC ±10%, 48 to 66 Hz
	10 to 16 V DC at XLR connector
Power consumption	approx. 60 W
Dimensions (W x H x D)	148 mm x 291 mm x 330 mm
Weight	approx. 6.9 kg without battery, without power supply

Ordering information

Spectrum Analyzer		
50 Ω	U3641	
75 Ω	U3641N	
50 Ω	U3661	
Options		
Internal controller	15 (only for U3641)	
Improved reference frequency	20	
100/300 Hz resolution bandwidths	26	
CDMA measurements	60	
TV demodulator including option 78	72	
Broadband FM demodulator	73 (only for U3641)	
Tracking generator	74	
Channel input	78	
Extras		
Battery 60 Wh	U4000-B5	
Charger for 2 batteries B5	U4000-C4	
Charger for 4 batteries B5	U4000-C5	
Charger for 4 batteries B5 and diagnostic module	U4000-C6	
Memory card 256 k	A09508	
GSM MS application		
Program for Internal Controller	PU36410300-IC	
GSM BS application		
Program for Internal Controller	PU36410310-IC	
CATV application		
Program for Internal Controller	PU36414001-IC	
Display Hood	R16601	
DC Connecting Cable	A01434	
SWR Bridge	ZRB2	0373.9017.5x
Transit Case	R16072	
Carrying Case	R16216	
Front Cover	A02806	

Distortion signals, frequency response	**U3641**	**U3661 band 0 (N = 1)**	**U3661 band 1 (N = 1)**	**U3661 band 2 (N = 2)**	**U3661 band 4 (N = 4)**
Frequency range	9 kHz to 3 GHz	9 kHz to 3.2 GHz	3.0 GHz to 7.1 GHz	6.7 GHz to 14.5 GHz	13.7 GHz to 26.5 GHz
Noise floor RBW 1 kHz, ATT 0 dB, VBW 10 Hz	Preamplifier off: ≤–117 dBm + 2.7 f[GHz]dB Preamplifier on: ≤–135 dBm + 4.3 f[GHz]dB	–118 dBm + 2f [GHz] >1 MHz	–115 dBm	–110 dBm	–105 dBm
Intermodulation	Preamplifier off: ≤–70 dBc Preamplifier on: ≤–70 dBc	–70 dBc <1.7 GHz –80 dBc >1.7 GHz	–100 dBc	–100 dBc	–100 dBc
Internal distortion signals	Preamplifier off: ≤–100 dB Preamplifier on: ≤–105 dB	–100 dBm >1 MHz	–90 dBm	–90 dBm	–90 dBm
Phase noise	≤–100 dBc (1 Hz) (10 kHz carrier offset)	≤–100 dBc (1 Hz) + 20 logN	≤–100 dBc (1 Hz) + 20 logN	≤–100 dBc (1 Hz) + 20 logN	≤–100 dBc (1 Hz) + 20 logN
Frequency response	Preamplifier off: ≤±1.0 dB (100 kHz to 2.7 GHz) ≤±2.0 dB (9 kHz to 3 GHz) Preamplifier on: ≤±1.0 dB (100 kHz to 2.7 GHz) ≤±2.0 dB (9 kHz to 3 GHz)	±2 dB	±1.5 dB	±3.5 dB	±4 dB

Spectrum Analyzers R3132/N, R3162, R3172, R3182

R3132: 9 kHz to 3 GHz

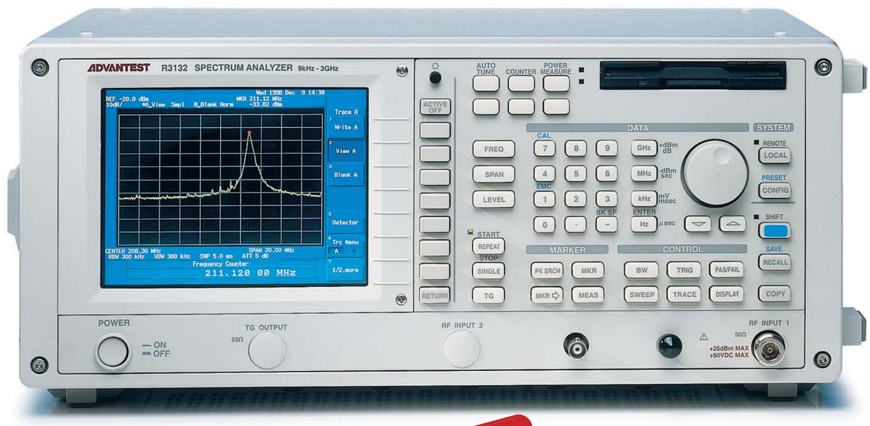
R3132N: 9 kHz to 3 GHz

R3162: 9 kHz to 8 GHz

R3172: 9 kHz to 26.5 GHz

R3182: 9 kHz to 40 GHz

Multi-purpose analyzers for universal uses in development, production, testshop and service



R3132 (photo 43265-1)

New

Brief description

The medium-class Spectrum Analyzers of series R31x2 from Advantest from 9 kHz up to 40 GHz are powerful allrounders suitable for a wide variety of applications for manual as well as system operation. They constitute cost-effective measurement solutions in the development, production and service of communication products, consumer electronics and in EMC precertification measurements. These analyzers offer very good characteristics in terms of signal resolution, noise floor and dynamic range.

A wide range of analysis functions affords great ease of operation. The growing importance of radio systems in particular makes increasing demands on spectrum analyzers. This aspect has been taken into account by fast sweep time in the zero span, gated sweep, adjacent-channel power measurements and spectrum mask with predefined settings.

Options can be fitted to match individual requirements.

Main features

- A TFT colour screen with a diagonal of 16.5 cm facilitates reading and signal identification
- The noise floor of –131 dBm at 30 Hz resolution bandwidth and as low as –146 dBm with the internal preamplifier switched on allows the analysis of even very weak signals in the range up to 3 GHz
- The ≥8 GHz models incorporate a preselector which does not deteriorate the noise floor
- The sweep time of only 20 ms with a repetition rate of 20 traces/s ensures fast operation, so variations in alignment can be perceived in an almost analog way
- Wide dynamic range with 100 dB logarithmic display range
- The RF input attenuator can be switched up to 8 GHz in 5 dB steps permitting optimization of the intermodulation-free dynamic range
- Resolution bandwidths of 1 kHz to 3 MHz, 10 MHz in zero span; bandwidths of 30 Hz, 100 Hz and 300 Hz are optionally available
- The frequency span error is smaller than 1% due to direct digital synthesis (DDS)
- AM/FM demodulator with loudspeaker and headphone connector
- An IEC/IEEE bus and an RS-232-C interface with fast data transmission are provided as standard interfaces
- The MS-DOS-compatible floppy disk drive allows the storage of setting parameters and traces in CSV format for integration into Windows applications
- The standard parallel printer interface with PCL and ESC/P formats permits the documentation of measurement results
- Flexible trigger modes for TV applications; model R3132N with 75 Ω input impedance
- Integrated EMC functions enable EMC precompliance testing with 6 dB resolution bandwidths of 200 Hz (optional), 9 kHz, 120 kHz and 1 MHz and quasi-peak detectors
- The frequency range of models R 3172 and R 3182 can be extended up to 110 GHz by means of two-diode mixers. These mixers have been designed especially for use with the Advantest Spectrum Analyzers R 3172 and R 3182 and feature low conversion loss. Compared to conventional single-diode mixers, the measurement sensitivity

Spectrum Analyzers R3132/N, R3162, R3172, R3182

can be considerably improved. To simplify entering frequency-dependent conversion loss parameters on the analyzer, the values are supplied on a diskette ready to read in. A software preselector in the enhanced frequency range of the R 3172 and R 3182 provides for suppression of unwanted image frequencies and allows unambiguous identification of the input signal

- With integrated option 73, all analyzers of this family provide broadband FM demodulation capability. In the frequency range extended by external mixers, signals with a frequency deviation of up to 500 MHz can be demodulated peak-to-peak. Typical FMCW radar signals as used in the automobile industry (adaptive cruise control ACC) can be tested for their deviation and linearity characteristics
- With a weight of 15 kg to 18 kg, the analyzers are the right choice for laboratory applications as well as on-site servicing. The front and rear panels provide protection against damage during transport

Measurement functions

- Built-in counter with 1 Hz resolution; no separate frequency counter needed
- PASS/FAIL comparator function for visual checking of compliance with defined limit values
- Autotune function for centering the strongest signal on the screen at a keystroke and displaying it on an expanded frequency range
- Various power measurements at a keystroke
- Further single-knob control functions, e.g. for occupied bandwidth OBW, % AM, % AM video, FM deviation
- Channel setting for TV and mobile radio systems
- Automatic spurious and S/N ratio measurement in selectable frequency ranges
- Noise measurements for the determination of noise levels or the signal purity of oscillators, normalized to the system bandwidth
- Split-screen display with separate windows

Operation

The control keys on the front panel are logically arranged and easy to operate. There are practically no double assignments. The combination of hardkeys and softkeys allows fast and simple operation and offers a variety of signal processing functions. Results are displayed in a separate window for ease of reading. The instruments can be accommodated in 19" rack adapters for use in systems.

Options

- Narrow resolution bandwidths 30/100/300 and 200 Hz (6 dB)
- 3-GHz tracking generator for all models up to 26.5 GHz, expanding the built-in analyzer functions by scalar transmission measurements and matching measurements on components
- Fast sweep of 50 µs for measurements on demodulated pulsed and burst signals in the time domain
- Precision frequency reference
- External mixers up to 110 GHz (only R3172 and R3182)
- Broadband FM demodulation

Specifications

Frequency		
Frequency range	R3132	9 kHz to 3 GHz
	R3132N	9 kHz to 2.2 GHz, nutzbar bis 3 GHz
	R3162	9 kHz to 8 GHz
	R3172	9 kHz to 26.5 GHz
	R3182	9 kHz to 40 GHz
Frequency error		± (f x reference frequency + span x 1% + 0.15 x RBW + 60 Hz)
Counter		
Resolution		1 Hz to 1 kHz
Error		±(marker frequency x ref. frequency uncertainty + 1 LSD) (S/N ≥25 dB, span ≤200 MHz)

Reference frequency	$\pm 2 \times 10^{-6}$/year
with Option 20	$\pm 1 \times 10^{-7}$/year $\pm 1 \times 10^{-5}$ (0°C to 50°C)
Span	
Range	1 kHz to 3 (8, 26.5, 40) GHz, zero span
Measurement uncertainty	≤±1%
Frequency stability	
Residual FM	≤60 Hz p-p/100 ms
with Option 20	≤20 Hz p-p/100 ms
Signal purity	
Sideband noise (SSB), f<8 GHz	
10 kHz carrier offset	≤100 dBc (1 Hz)
20 kHz	≤105 dBc (1 Hz)
100 kHz	≤118 dBc (1 Hz), typ.
1 MHz	≤135 dBc (1 Hz), typ.

Spectrum Analyzers R3132/N, R3162, R3172, R3182

Resolution bandwidths (3 dB)	
Range	1 kHz to 3 MHz; in 1 to 3 sequence 10 MHz for zero span
with Option 27	30/100/300 Hz
Selectivity (60:3 dB)	< 15 : 1
6 dB bandwidth	9 kHz, 120 kHz, 1 MHz
with Option 27	200 Hz
Video bandwidth	10 Hz to 3 MHz, 1 to 3 sequence

Level

Display range	+30 dBm down to displayed average noise level
Max. input level	
Preamplifier OFF	+30 dBm, ±50 V DC max. (0 V DC R3162/72/82)
R3132N	+134 dBμV, ±50 V DC max.,
Preamplifier ON	+13 dBm, ±50 V DC max. (0 V DC R3162/72/82)
Display range	
Log	10, 5, 2, 1 dB/div 10 x 10 grid
Linear	10%/div of reference level
Reference level range	
Preamplifier OFF	
Log	–64 dBm to +40 dBm, 0.1 dB steps
Linear	+141.1 μV to 22.36 V
Preamplifier ON	
Log	–82 dBm to +20 dBm, 0.1 dB steps
Linear	+17.8 μV to 281.5 mV
RF input divider (range)	
R3132/N	0 to 50 dB, 5 dB steps
R3162	0 to 75 dB, 5 dB steps
R3172	0 to 70 dB, 10 dB steps
R3182	0 to 70 dB, 10 dB steps

Sweep

Sweep time	20 ms to 1000 s (R3172/82: 10 ms at deviation ≤100 MHz) zero span 50 μs to 1 s
Sweep error	±1%
Trigger functions	free run, line, video, external, TV-H/V, with zero span also trigger delay (pre-/post trigger)
Sweep types	repeating, one-time, window sweep
Detector	normal (max./min.), sample, positive/negative peak

Dynamic range

Inherent noise	
RBW 1 kHz; VBW 10 Hz; ATT 0 dB	
1 MHz to 3.3 GHz	
Preamplifier OFF	<–118 dBm + 2 f [GHz] dB
Preamplifier ON	<–132 dBm + 3 f [GHz] dB
Displayed average noise level	
R3162	
3.3 GHz to 8 GHz,	<–115 dBm + 0.5 f [GHz] dB
R3172	
3.3 GHz to 7.1 GHz	<–115 dBm + 0.5 f [GHz] dB
7 GHz to 14.7 GHz	<–111 dBm
14.5 GHz to 22 GHz	<–107 dBm
22 GHz to 26.5 GHz	<–104 dBm
R3182	
3.2 GHz to 7.1 GHz	<–115 dBm
7 GHz to 14.7 GHz	<–113 dBm
14.5 GHz to 27 GHz	<–110 dBm
26.5 GHz to 30 GHz	<–107 dBm
29.5 GHz to 40 GHz	<–106 dBm
1 dB compression of input mixer (f >100 MHz and <3 GHz)	>0 dBm (mixer input level)
RF input with preamplifier ON	>–25 dBm
2nd order interference signal	
100 to 800 MHz	≤–75 dBc (R3172/82: ≤–70 dBc), –30 dBm mixer level
0.8 to 3.3 GHz	≤–80 dBc, –30 dBm mixer level
> 3.3 GHz	≤–100 dBc (R3182: ≤–95 dBc), –10 dBm mixer level ≤–70 dBc (f >3.3 GHz)
3rd order intermodulation	≤–80 dBc, –30 dBm input (frequency 200 MHz to 3.3 GHz, offset of both signals >50 kHz)
3rd order intercept point, TOI	>10 dBm
2nd order intercept point, SHI	>50 dBm
Other input interference	≤–70 dBc, ≤–60 dBc (>18 GHz)
Inherent spurious	
1 MHz to 3.3 GHz	≤–100 dBm (Preamplifier OFF)
f > 3.3 GHz	≤–90 dBm, ATT 0 dB, input terminated with 50 Ω
1 MHz to 3.3 GHz	≤–105 dBm (Preamplifier ON)

Amplitude error

Calibration signal	30 MHz
Error	–20 dBm ±0.3 dB
Frequency response (ATT = 10 dB, relative to 30 MHz and following automatic calibration), preamplifier OFF	
100 kHz to 3 GHz	≤±0.5 dB
9 kHz to 3,3 GHz	≤±1.5 dB
3,3 GHz to 7,1 GHz	≤±1.6 dB
7,1 GHz to 14,7 GHz	≤±1.8 dB
14,7 GHz to 27 GHz	≤±2.5 dB
27 GHz to 30 GHz	≤±3.0 dB
30 GHz to 40 GHz	≤±3.5 dB
Scale fidelity/linearity (following internal calibration)	≤±0.5 dB (0 to –20 dB)
Log	≤±1.5 dB/90 dB ≤±1.0 dB/10 dB ≤±0.2 dB/1 dB
Linear	5% of reference level
Input divider (switching error relative to an attenuation of 10 dB at 30 MHz)	≤±0.3 dB (0 to 50 dB)
Resolution bandwidth switching error (following internal calibration)	≤±0.5 dB
IF amplification error (following internal calibration)	<±0.5 dB
Total level error (REF = –50 to 0 dBm, ATT = 10 dB, 2 dB/div., RBW = 300 kHz, f = 100 kHz to 3 GHz)	±1.5 dB (R3132N to 2.2 GHz)

Interfaces

RF input	
R3132/N, R3162	N female
R3172	SMA female
R3182	K female
Impedance	50 Ω, (R3132N: 75 Ω)
VSWR (Preamplifier OFF)	
100 kHz to 3.3 GHz, ATT ≥10 dB	≤1.5 : 1
3.2 GHz to 27 GHz, ATT ≥10 dB	≤2.0 : 1
26.5 kHz to 40 GHz, ATT ≥10 dB	≤2.2 : 1
9 kHz to 3.3 GHz	≤1.5 : 1 (Preamplifier ON)
Calibration output	BNC connector, 50 Ω (R3132N: 75 Ω)
Frequency, level	30 MHz, –20 dBm
10 MHz reference input	BNC connector at rear panel, 50 Ω
Level range	0 dBm to +16 dBm

Spectrum Analyzers R3132/N, R3162, R3172, R3182

External trigger and gate input	BNC connector at rear panel 10 kΩ (nominal), DC-coupled
Y output	0 to 2 V (100 dB), BNC connector, rear panel
AF output	subminiature headphone connector at rear panel, 0.2 W max. into 8 Ω (nominal)
External mixer output	R3182 standard, R3172 optional
Frequency range	4 GHz to 7.6 GHz
Level, impedance, connector	>+8 dBm, 50 Ω, SMA female
AM/FM demodulation, internal loudspeaker	
Probe power output	±12 V, 100 mA, 4 pin, power supply for active sensors
IEC/IEEE bus	IEEE-488-bus connector, rear panel
Serial interface	RS-232, D-SUB 9 pin, rear panel
VGA monitor output	D-SUB 15 pin, rear panel
Printer interface	D-SUB 25 pin, rear panel ESC/P; PCL printer
Disk drive	3.5''; MS-DOS format

Tracking generator option

R3132/3162/3172	100 kHz to 3 GHz
R3132N	100 kHz to 2.2 GHz
Output power	0 to –59.9 dBm, 0.1 dB steps
Frequency response	<±1.5 dB
Harmonics	<–20 dBc

Broadband FM demodulation option

Input level	>–50 dBm
FM deviation	
Internal mixer mode	10 kHz to 2.5 MHz
External mixer mode	10 kHz to 500 MHz
Nonlinearity	≤2% of full scale, 0.2% typ.
Demodulation bandwidth (3 dB)	≥300 kHz

External mixer option

Frequency range	
26.5 GHz to 40 GHz	option 16
40 GHz to 60 GHz	option 17
50 GHz to 75 GHz	option 18
75 GHz to 110 GHz	option 19
Displayed average noise level (RBW 1 kHz, VBW 10 Hz)	
≤–99 dBm	option 16
≤–93 dBm	option 17
≤–90 dBm	option 18
≤–85 dBm	option 19 (75 GHz to 85 GHz)
≤–80 dBm	option 19 (85 GHz to 110 GHz)
Frequency response	±5 dB typ.
Maximum input level	+20 dBm (LO+RF input signal)

General data

Screen	16,5 cm (6.5 ")
Resolution	1000 x 700 pixels
Grid (W x H)	104 x 76 mm
	2 screen memories A and B, split screen, auxiliary line editor, date/clock, colour selection, setting parameters (can be switched off)
Evaluation functions	marker, delta marker, multimarker (10), signal track, peak search, next peak, offset settable for frequency and level, display line, reference line, limit traces with comparator pass/fail, 10 memories for setting configurations and traces, averaging, noise measurements, power measurements, OBW and ACP measurements, auto-tune, automatic selftest, calibration routines, transducer selectable
Operating temperature range	0° to 50°C
Storage temperature range	–20°C to + 60°C
Relative humidity	<85%
Power supply	automatic switching between 100 V AC and 220 V AC
100 V AC	90 V to 132 V, 50 to 60 Hz
220 V AC	198 V to 250 V, 50 to 60Hz
Power consumption	<150 to 200 VA
Dimensions (W x H x D)	424 mm x 177 mm x 300 mm, without feet, without connectors
Weight	15 kg to 18 kg, depending on model and options fitted

Ordering information

Spectrum Analyzer

50 Ω, 9 kHz to 3 GHz	R3132
75 Ω, 9 kHz to 2.2 (3) GHz	R3132N
50 Ω, 9 kHz to 8 GHz	R3162
50 Ω, 9 kHz to 26.5 GHz	R3172
50 Ω, 9 kHz to 40 GHz	R3182

Options

Connector for external mixer	3 (only R3172, R3182 standard)
External mixer 26.5 GHz to 40 GHz	16 (only R3172 and R3182)
External mixer 40 GHz to 60 GHz	17 (only R3172 and R3182)
External mixer 50 GHz to 75 GHz	18 (only R3172 and R3182)
External mixer 75 GHz to 110 GHz	19 (only R3172 and R3182)
Precision frequency reference	20
Resolution bandwidths 30/100/300 Hz	27
Sweep time for zero span 50 µs to 1 s	29
FM demodulation	73
Tracking generator	74 (not for model R3182)

Extras

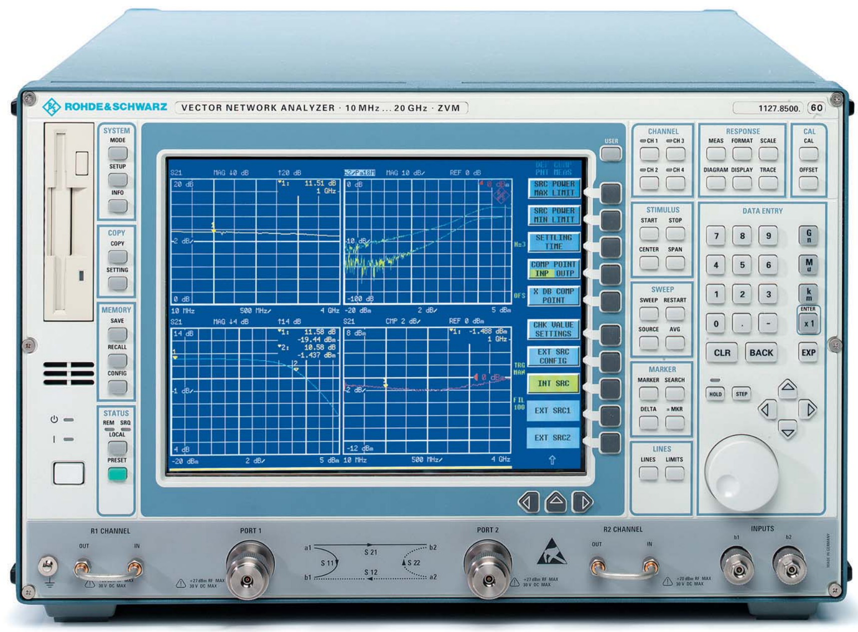
Transport case	R16080M or R16083
19" rack adapter	A02468
IEC/IEEE bus cable	408JE-101/102
VSWR bridge, 5 to 3000 MHz	ZRB2 (Rohde&Schwarz)
N cable, BNC cable, filter	

Vector Network Analyzers R&S ZVM, R&S ZVK

R&S ZVM: 10 Hz to 20 GHz

R&S ZVK: 10 Hz to 40 GHz

Extremely fast, high-precision and versatile vector network analyzers



R&S ZVM (photo 43453-2)

Brief description

R&S ZVM and R&S ZVK extend the frequency range of the Rohde&Schwarz network analyzers to 20 GHz and 40 GHz. Their outstanding performance in terms of speed, dynamic range and accuracy shows already in standard applications such as S-parameter or group delay measurements. This is enhanced by a wealth of measurement, display and logging functions. In addition, R&S ZVM and R&S ZVK can be used for complex measurement tasks, for example measurements on frequency-converting DUTs (conversion loss, intermodulation, spurious) and nonlinear measurements (intercept point and compression point).

Short measurement times

A powerful microprocessor system combined with ultra-fast synthesizers makes for extremely short measurement times even with a large number of test points and small measurement bandwidths. This in conjunction with short IEC/IEEE bus access and transfer times considerably speeds up automated test and production sequences.

Wide dynamic range

The extremely low-noise front end, using fundamental mixing, yields a dynamic range that, with appropriate configuration, by far exceeds the specified values of 115 dB and 110 dB. This exceptionally wide range makes it possible to measure RF components with high stopband attenuation and achieve high accuracy also at low power levels.

Measurements on linear and nonlinear components

The system concept of R&S ZVM and R&S ZVK with two independent synthesizers for the generator and receiver sections enables versatile measurements with excellent accuracy, wide dynamic range and high measurement speed on linear and nonlinear DUTs such as amplifiers and mixers. Three generators (one internal, two external) can be configured and controlled independently of each other. The fundamental mixing concept of R&S ZVM and R&S ZVK and the resulting high selectivity make additional external filters superfluous. The receiver will even detect weak signals such as intermodulation products and spurious, since the full sensitivity and dynamic range of R&S ZVM and R&S ZVK are available also for frequency-converting DUTs.

Typical measurements on amplifiers, frequency converters, multipliers, dividers, synthesizers etc are:

- K factor
- Power added efficiency (PAE)
- Sidebands of mixers with fixed or tracking IF
- Any harmonics versus frequency or power
- Intermodulation products of amplifiers and mixers (e.g. IP3, IP5, IP7...)
- Spurious
- Mixture products of DUTs with multiple frequency conversion, multipliers, dividers and combinations of such components

Vector Network Analyzers R&S ZVM, R&S ZVK

	R&S ZVM	R&S ZVK
Frequency range	10 MHz to 20 GHz	10 MHz to 40 GHz
Frequency resolution	100 µHz	
Impedance	50 Ω	
Test ports	PC 3.5 male	2.92 mm male
Measurement time (normalized)	<0.5 ms/point	<0.7 ms/point
Output power	+5 dBm/+2 dBm to –85 dBm	0 dBm/–5 dBm to –85 dBm
Power uncertainty	<1 dB to 2 dB	
Dynamic range* **(IF bandwidth 10 Hz)** *When using direct receiver access, dynamic range and sensitivity are increased to 10 dB typ.	>85 dB (<0.5 GHz) >115 dB (0.5 GHz to 8 GHz) >110 dB (8 GHz to 16 GHz) >100 dB (16 GHz to 20 GHz)	>80 dB (<0.5 GHz) >110 dB (0.5 GHz to 8 GHz) >105 dB (8 GHz to 16 GHz) >90 dB (16 GHz to 20 GHz) >90 dB (20 GHz to 28 GHz) >80 dB (28 GHz to 40 GHz)
Measurement bandwidths	1 Hz to 10 kHz (in 9 steps) and 26 kHz	
Calibration techniques	TOM, TRM, TNA, TOM-X, AutoKal (all Rohde&Schwarz patents), TRL, TOSM, normalization techniques	

Embedding and de-embedding of virtual networks, CAE software

The Virtual Embedding Networks option enables virtual embedding of arbitrary linear two-port networks into the test setup.

In testing for example components that have to be matched to a given impedance, an automatic embedding process allows the necessary matching network to be taken into account through mathematical algorithms of R&S ZVM and R&S ZVK. Conversely, by de-embedding, the influence of a known network can be eliminated.

The required data (*.S1P, *.S2P, *.S4P, *.flp) are obtained from a measurement of the existing network or generated by CAE tools from the theoretical model.

Time-domain measurements

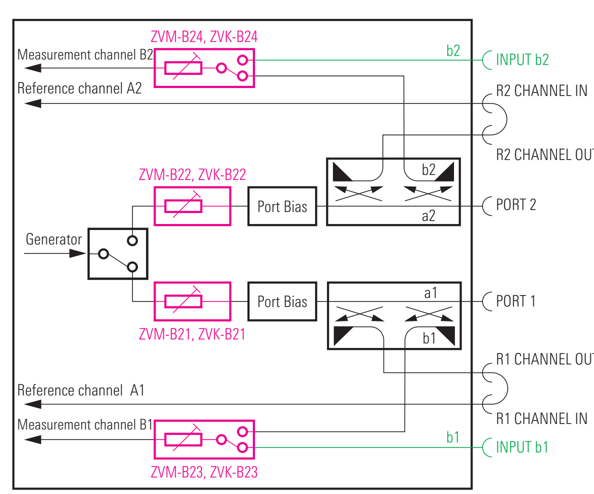
By transforming measurement data from the frequency to the time domain, discontinuities or impedances along the DUT can be displayed as a function of DUT length. With a maximum number of 2001 points, R&S ZVM and R&S ZVK can measure even very long DUTs with high resolution. Five filters allow the location of a discontinuity and the sidelobe suppression to be determined with optimum resolution. The S-parameters of a given discontinuity can be displayed in the time domain by setting a window (gating).

Special calibration techniques

R&S ZVM and R&S ZVK feature modern calibration techniques patented by Rohde&Schwarz that allow full two-port calibration using fewer or only partially known standards. This simplifies the design of calibration standards used for example in test fixtures or on wafers. Thus calibration in non-coaxial systems can be performed with a minimum of effort at maximum accuracy and dynamic range.

Internal PC and Ethernet

R&S ZVM and R&S ZVK are based on Windows NT. The user has complete access to the hard disk, the floppy disk drive and all interfaces of the internal PC. This allows, for example, the connection of an external monitor, the installation of any type of printer, or the use of software tools on R&S ZVM or R&S ZVK for result processing or control of the network analyzers via the IEC/IEEE bus or an internal RSIB data bus. R&S ZVM and R&S ZVK can thus act as controllers of their own or for a complete test or production system. Moreover, the internal PC enables control and data exchange via Ethernet.



Test set of R&S ZVM and R&S ZVK

Vector Network Analyzers R&S ZVM, R&S ZVK

Specifications

Unless otherwise stated, specifications apply to test ports PORT 1 and PORT 2, a nominal output power of –10 dBm at the source port and an IF bandwidth ≤10 kHz.

Especially important data are framed in blue

Measurement range

Characteristic impedance	50 Ω
Port connectors	
R&S ZVM	3.5 mm (male)
R&S ZVK	2.92 mm (male)

Frequency	
Range R&S ZVM	10 MHz to 20 GHz
Range R&S ZVK	10 MHz to 40 GHz
Uncertainty	$4 \times 10^{-6} + 1 \times 10^{-6}$ x operating time in years
Resolution	100 μHz
Number of test points (selectable)	1 to 2001

Measurement time per point with min. 400 points and IF bandwidth of	R&S ZVM 10 Hz	R&S ZVK 10 kHz	10 kHz
with system error correction	<200 ms	<0.9 ms	<1.1 ms
normalized	<100 ms	<0.5 ms	<0.7 ms

Dynamic range (without system error correction, without optional attenuator) at IF bandwidth of	R&S ZVM 10 Hz	R&S ZVM 10 kHz	R&S ZVK 10 Hz	ZVK 10 kHz
up to 500 MHz	>75 dB	>45 dB	>70 dB	>40 dB
500 MHz to 8 GHz	>115 dB	>85 dB	>110 dB	>80 dB
8 GHz to 16 GHz	>110 dB	>80 dB	>105 dB	>75 dB
16 GHz to 20 GHz	>100 dB	>70 dB	>90 dB	>60 dB
20 GHz to 28 GHz			>90 dB	>60 dB
28 GHz to 40 GHz			>80 dB	>50 dB

Measurement bandwidths (IF bandwidths)	1 Hz to 10 kHz (half-decade steps) and 26 kHz (full)

Measurement accuracy

R&S ZVM uncertainty of transmission measurements
after system error correction
Specifications are based on a matched DUT, an IF bandwidth of 10 Hz, and a nominal output power of –10 dBm at the source port.

10 MHz to 500 MHz	
for +15 dB to –25 dB	0.2 dB or 2°
for –25 dB to –35 dB	1 dB or 6°
500 MHz to 8 GHz	
for +15 dB to +5 dB	0.2 dB or 2°
for +5 dB to –50 dB	0.1 dB or 1°
for –50 dB to –65 dB	0.2 dB or 2°
for –65 dB to –80 dB	1 dB or 6°
8 GHz to 16 GHz	
for +15 dB to –55 dB	0.2 dB or 2°
for –55 dB to –70 dB	1 dB or 6°
16 GHz to 20 GHz	
for +12 dB to +5 dB	0.3 dB or 3°
for +5 dB to –30 dB	0.2 dB or 2°
for –30 dB to –45 dB	0.3 dB or 3°
for –45 dB to –60 dB	1 dB or 6°

R&S ZVM uncertainty of reflection measurements
after system error correction
Specifications are based on an isolating DUT, an IF bandwidth of 10 Hz, and a nominal output power of –10 dBm at the source port.

10 MHz to 20 GHz	
for +10 dB to +3 dB	0.6 dB or 4°
for +3 dB to –15 dB	0.4 dB or 3°
for –15 dB to –25 dB	1 dB or 6°
for –25 dB to –35 dB	3 dB or 20°
Variation of data trace at 0 dB per Kelvin of temperature variation	<0.2 dB or <2°

R&S ZVK uncertainty of transmission measurements
after system error correction
Specifications are based on a matched DUT, an IF bandwidth of 10 Hz, and a nominal output power of –10 dBm at the source port.

10 MHz to 500 MHz	
for +10 dB to –15 dB	0.2 dB or 2°
for –15 dB to –30 dB	1 dB or 6°
500 MHz to 8 GHz	
for +10 dB to +5 dB	0.2 dB or 2°
for +5 dB to –45 dB	0.1 dB or 1°
for –45 dB to –60 dB	0.2 dB or 2°
for –60 dB to –75 dB	1 dB or 6°
8 GHz to 16 GHz	
for +10 dB to –50 dB	0.2 dB or 2°
for –50 dB to –65 dB	1 dB or 6°
16 GHz to 28 GHz	
for +5 dB to –20 dB	0.2 dB or 2°
for –20 dB to –35 dB	0.3 dB or 3°
for –35 dB to –50 dB	1 dB or 6°
28 GHz to 40 GHz	
for +5 dB to –10 dB	0.2 dB or 2°
for –10 dB to –25 dB	0.3 dB or 3°
for –25 dB to –40 dB	1 dB or 6°

R&S ZVK uncertainty of reflection measurements
after system error correction
Specifications are based on an isolating DUT, an IF bandwidth of 10 Hz, and a nominal output power of –10 dBm at the source port.

10 MHz to 20 GHz	
for +5 dB to –15 dB	1 dB or 6°
for –15 dB to –30 dB	3 dB or 20°
20 GHz to 40 GHz	
for +5 dB to 0 dB	2 dB or 15°
for 0 dB to –10 dB	1 dB or 6°
for –10 dB to –25 dB	3 dB or 20°
Variation of data trace at 0 dB per Kelvin of temperature variation	<0.2 dB or <2°

Vector Network Analyzers R&S ZVM, R&S ZVK

Effective system data

Frequency range	50 MHz to 20 GHz		above 20 GHz
	R&S ZVM	R&S ZVK	R&S ZVK
Directivity	>46 dB	>42 dB	>38 dB
Source match	>36 dB	>36 dB	>33 dB
Reflection tracking	<0.1 dB	<0.1 dB	<0.1 dB
Load match	>46 dB	>42 dB	>38 dB
Transmission tracking	<0.1 dB	<0.1 dB	<0.2 dB

Output power

Range without optional generator step attenuator	R&S ZVM	R&S ZVK
up to 16 GHz	–20 to +5 dBm	–20 to 0 dBm
above 16 GHz	–20 to +2 dBm	–20 to –5 dBm
Uncertainty at –10 dBm		
without optional power calibration	2 dB	2 dB
150 MHz to 16 GHz in temperature range 20°C to 26°C	1 dB	1 dB
Linearity (referred to –10 dBm)	<1 dB	<1 dB
above 150 MHz in temperature range 20°C to 26°C	<0.4 dB	<0.4 dB
Resolution	0.1 dB	0.1 dB

Spectral purity

Harmonics		
at maximum nominal source power	R&S ZVM	R&S ZVK
up to 10 GHz	<–23 dBc	<–20 dBc
10 GHz to 20 GHz	<–17 dBc	<–15 dBc
above 20 GHz		<–25 dBc
at –10 dBm source power		
up to 10 GHz	<–30 dBc	<–30 dBc
above 10 GHz	<–25 dBc	<–25 dBc
Spurious	<–35 dBc	<–35 dBc

SSB phase noise
1 Hz bandwidth,10 kHz from carrier

up to 150 MHz	<–100 dBc
150 MHz to 1 GHz	<–90 dBc
above 1 GHz	<–90 dBc + 20 x log (f/GHz) <–78 dBc at 4 GHz <–72 dBc at 8 GHz <–64 dBc at 20 GHz <–58 dBc at 40 GHz (R&S ZVK)

Residual FM
RMS weighting from 10 Hz to 3 kHz

up to 150 MHz	<2 Hz
150 MHz to 1 GHz	<5 Hz
1 GHz to 2 GHz	<10 Hz
2 GHz to 4 GHz	<20 Hz
4 GHz to 8 GHz	<40 Hz
8 GHz to 20 GHz	<80 Hz
20 GHz to 40 GHz (R&S ZVK)	<160 Hz

Input level

Maximum nominal input level

without optional receiver step attenuator	+5 dBm
with receiver step attenuator set to 0 dB	+5 dBm
with receiver step attenuator set to ≥30 dB	+27 dBm

Level measurement uncertainty (without optional power calibration)
in temperature range 20 °C to 26 °C

up to 500 MHz	for +5 dBm to –45 dBm	2 dB
500 MHz to 16 GHz	for +5 dBm to –70 dBm	2 dB
16 GHz to 20 GHz	for +5 dBm to –50 dBm	2 dB
20 GHz to 28 GHz	for +5 dBm to –50 dBm (R&S ZVK)	3 dB
above 28 GHz	for +5 dBm to –30 dBm (R&S ZVK)	4 dB

Damage level

without optional receiver step attenuator	+27 dBm
with receiver step attenuator set to 0 dB	+27 dBm
with receiver step attenuator set to ≥30 dB	+30 dBm

Damage DC current/voltage 0.5 A or 30 V

RMS noise level at IF bandwidth 10 Hz

up to 500 MHz	<–80 dBm
500 MHz to 8 GHz	<–110 dBm
8 GHz to 16 GHz	<–105 dBm
16 GHz to 20 GHz	<–95 dBm
20 GHz to 28 GHz (R&S ZVK)	<–95 dBm
above 28 GHz (R&S ZVK)	<–85 dBm

Match (without system error correction)

up to 50 MHz	>10 dB
50 MHz to 8 GHz	>12 dB
8 GHz to 20 GHz	>10 dB
above 20 GHz (R&S ZVK)	>8 dB

Reference channel inputs

R CHANNEL IN

	R&S ZVM	R&S ZVK
Connectors	SMA (female)	2.92 mm (female)
Match	>12 dB	>8 dB
Maximum nominal input level	+5 dBm	+5 dBm
Damage level	+20 dBm	+20 dBm

Display

Screen	26 cm colour LCD
Resolution	640 x 480 x 256
Sweep modes	frequency, power, and time
Parameter formats (examples)	S parameters and derived quantities like SWR, impedance, admittance, group delay, etc, as well as nonlinear parameters (optional) like n dB compression point, SOI and TOI. Complex parameters are displayed either in a complex form or formatted to magnitude, phase, real or imaginary part
Diagrams (examples)	Cartesian: linear, simple or double logarithmic, segmented polar: linear, logarithmic or segmented, Smith (any zoom), inverted Smith, Charter
Scaling (examples)	0.001 dB/ to 50 dB/ 1 m°/ to 200 k°/ 1 pU/ to 1 GU/ (automatically variable number of grid lines through MAX/MIN scaling)
Multichannel display	up to 4 independent display channels (CH1 to CH4)
Screen formats (examples)	overlay, dual channel split, quad channel split

Markers	8 normal markers or 7 delta markers for each display channel
Marker resolution	4 significant digits
Marker formatting	selectable, independent of trace formatting
Automatic marker functions	marker tracking, marker search, marker target, band filter functions (Q, shape factor, etc)
Trace mathematics	all four arithmetical operations with up to three operands
Display lines	horizontal lines, circles or radial lines
Limit lines	pairs of curves formed from line segments in Cartesian diagrams, any circles in polar diagrams

Further connectors (rear panel)

PORT BIAS 1/2	DC bias inputs for PORT 1/2
EXT TRIGGER	input for external trigger signal
LEVEL	input for external level control
DC MEAS INPUTS DC 1/2	DC measurement inputs
EXT FREQ REF IN	input for external reference frequency
EXT FREQ REF OUT	output of internal reference frequency
EXTERNAL GENERATOR	Connectors for high-speed control of an external generator from Rohde& Schwarz families
BLANK (input)	TTL signal
TRIGGER (output)	TTL signal
ANALYZER MONITOR	IBM-PC-compatible VGA connector for analyzer screen
PC MONITOR	IBM-PC-compatible VGA connector for PC screen
MOUSE	IBM-PC-compatible PS/2 connector
KEYBOARD	IBM-PC-compatible 5-contact DIN connector
USER (input/output)	16 bit TTL, user-programmable, 25-contact sub-D
COM 1/ COM 2	IBM-PC-compatible serial interfaces, RS-232-C, 9-contact sub-D
IEC BUS	remote-control interface IEEE488, IEC625, 24-contact (for general applications)
IEC SYSTEM BUS	remote-control interface IEEE488, IEC625, 24-contact (for control of generators, e.g. as local oscillators in mixer measurements)
LPT	IBM-PC-compatible printer interface, Centronics, 25-contact sub-D
MULTIPORT	control of optional three-port and four-port adapters

General data

Temperature loading	
Specs complied with	5°C to 40°C
Operational	0°C to 50°C
Storage temperature range	–40°C to +70°C
	meets IEC68-2-1, IEC68-2-2
Calibration interval	1 year
Power supply	100 V to 120 V (AC) with tolerance ±10%, 6 A, 50 Hz to 400 Hz with tolerance –6 % and +10% or 200 V to 240 V (AC) with tolerance ±10%, 3 A, 50 Hz to 60 Hz with tolerance –6% and +10%
	safety class I to VDE411
Power consumption	280 W (standby: 10 W)
Test mark	VDE, GS, CSA, CSA-NRTL/, CE mark
Dimensions (W x H x D)	435 mm x 281 mm x 584 mm
Weight	30 kg

Option overview

Option	Type	Features and benefits
AutoKal	R&S ZVR-B1	Full two-port calibration within a few seconds
Time Domain	R&S ZVR-B2	Localization of discontinuities, determination of reflection coefficients of discontinuities as a function of length/delay, supplementary function for calibration, tuning of filters, optimization of connectors, etc
Mixer Measurements	R&S ZVR-B4	Easy converter and mixer measurements (conversion gain) Convenient measurements of amplifier and mixer products vs. frequency (spurious, harmonics, intermodulation products, etc)
Nonlinear Measurements	R&S ZVR-B5	Display of compression point and SOI/TOI versus frequency
Power Calibration	R&S ZVR-B7	High absolute power accuracy of generators (internal and external) and receivers for amplifier and mixer measurements
3-Port Adapter	R&S ZVR-B8	Measurements of 3-port devices such as duplex filters
Virtual Embedding Networks	R&S ZVR-K9	Replacing various test fixtures with physical matching networks by one single standard fixture and virtual networks High accuracy and reproducibility, e.g. in SAW filter measurements
4-Port Adapter	R&S ZVR-B14	Simultaneous measurement of two 2-port devices Measurements on diplexers
Ethernet Interface for internal PC	R&S FSE-B16	Control and data transfer of R&S ZVM or R&S ZVK via Ethernet
IEC/IEEE bus Interface for internal PC	R&S FSE-B17	Control of R&S ZVM or R&S ZVK and external test equipment by internal PC
Generator Step Attenuator PORT 1	R&S ZVM-B21, R&S ZVK-B21	Decrease of minimum generator output power down to –90 dBm at PORT 1
Generator Step Attenuator PORT 2	R&S ZVM-B22, R&S ZVK-B22	Decrease of minimum generator output power down to –90 dBm at PORT 2
Receiver Step Attenuator PORT 1	R&S ZVM-B23, R&S ZVK-B23	Increase of maximum receiver input power at PORT 1 to +27 dBm Direct access to measurement channel b1
Receiver Step Attenuator PORT 2	R&S ZVM-B24, R&S ZVK-B24	Increase of maximum receiver input power at PORT 2 to +27 dBm Direct access to measurement channel b22

Vector Network Analyzers R&S ZVM, R&S ZVK

Ordering information

Order designation	Type	Frequency range	Order No.
Analyzers			
Vector Network Analyzer 4-channel, 50 Ω, active test set	R&S ZVM	10 MHz to 20 GHz	1127.8500.60
Vector Network Analyzer 4-channel, 50 Ω, active test set	R&S ZVK	10 MHz to 40 GHz	1127.8651.60
Options			
Time Domain	R&S ZVR-B2	–	1044.1009.02
Mixer Measurements[1]	R&S ZVR-B4	–	1044.1215.02
Nonlinear Measurements	R&S ZVR-B5	–	1044.1321.02
Power Calibration[2]	R&S ZVR-B7	–	1044.1544.02
Virtual Embedding Networks[3]	R&S ZVR-K9	–	1106.8830.02
Ethernet AUI for internal PC	R&S FSE-B16	–	1073.5973.02
Ethernet BNC for internal PC	R&S FSE-B16	–	1073.5973.03
Ethernet RJ45 for internal PC	R&S FSE-B16	–	1073.5973.04
IEC/IEEE bus Interface for internal PC	R&S FSE-B17	–	1066.4017.02
Generator Step Attenuator for R&S ZVM, PORT 1	R&S ZVM-B21	–	1128.1009.11
Generator Step Attenuator for R&S ZVM, PORT 2	R&S ZVM-B22	–	1128.1009.21
Receiver Step Attenuator for R&S ZVM, PORT 1[4]	R&S ZVM-B23	–	1128.1009.12
Receiver Step Attenuator for R&S ZVM, PORT 2[5]	R&S ZVM-B24	–	1128.1009.22
Generator Step Attenuator for R&S ZVK, PORT 1	R&S ZVK-B21	–	1128.1409.11
Generator Step Attenuator for R&S ZVK, PORT 2	R&S ZVK-B22	–	1128.1409.21
Receiver Step Attenuator for R&S ZVK, PORT 1[4]	R&S ZVK-B23	–	1128.1409.12
Receiver Step Attenuator for R&S ZVK, PORT 2[5]	R&S ZVK-B24	–	1128.1409.22
R&S ZVM, R&S ZVK accessories			
Test Cables (pairs)			
PC3.5 (f)/PC3.5 (m), 50 Ω (for R&S ZVM)[6]	R&S ZV-Z14	0 Hz to 26.5 GHz	1134.4093.02
2.92 mm (f)/2.92 mm (m), 50 Ω (for R&S ZVK)[6]	R&S ZV-Z15	0 Hz to 40 GHz	1134.4193.02
Calibration Kits			
PC3.5 (for R&S ZVM)	R&S ZV-Z32	0 Hz to 26.5 GHz	1128.3501.02
PC3.5 incl. Sliding Matches (for R&S ZVM)	R&S ZV-Z33	0 Hz to 26.5 GHz	1128.3518.02
2.92 mm (for R&S ZVK)	R&S ZV-Z34	0 Hz to 40 GHz	1128.3530.02
2.92 mm incl. Sliding Matches (for R&S ZVK)	R&S ZV-Z35	0 Hz to 40 GHz	1128.3547.02
N, 50 Ω	R&S ZV-Z21	0 Hz to 18 GHz	1085.7099.02
TRL Supplementary Kit, N, 50 Ω	R&S ZV-Z26	0.4 GHz to 18 GHz	1085.7318.02
TRL Supplementary Kit, PC3.5, 50 Ω	R&S ZV-Z27	0.4 GHz to 26.5 GHz	1085.7401.02
TOM-X Supplementary Kit, N, 50 Ω	R&S ZV-Z28	0 Hz to 18 GHz	1085.7499.03
TOM-X Supplementary Kit, PC3.5, 50 Ω	R&S ZV-Z29	4 GHz to 26.5 GHz	1085.7647.03
Sliding Matches			
N (m), 50 Ω	R&S ZV-Z41	1.7 GHz to 18 GHz	1085.8095.02
N (f), 50 Ω	R&S ZV-Z41	1.7 GHz to 18 GHz	1085.8095.03
PC3.5 pair m, f (for R&S ZVM)	R&S ZV-Z42	0 Hz to 26.5 GHz	1128.3524.02
2.92 mm pair m, f (for ZVK)	R&S ZV-Z44	0 Hz to 40 GHz	1128.3553.02
General accessories			
Hardware Options N, 50 Ω			
AutoKal[7]	R&S ZVR-B1	0 Hz to 8 GHz	1044.0625.02
3-Port Adapter[7]	R&S ZVR-B8	0 Hz to 4 GHz	1086.0000.02
4-Port Adapter (2 x SPDT)[7]	R&S ZVR-B14	0 Hz to 4 GHz	1106.7510.02
4-Port Adapter (SP3T)[7]	R&S ZVR-B14	0 Hz to 4 GHz	1106.7510.03
Test Cables (pairs)			
N (m)/N (m), 50 Ω	R&S ZV-Z11	0 Hz to 18 GHz	1085.6505.03
N (m)/N (m), 75 Ω	R&S ZV-Z12	0 Hz to 4 GHz	1085.6570.02
N (m)/PC3.5 (m), 50 Ω	R&S ZV-Z13	0 Hz to 18 GHz	1134.3997.02
Calibration Kits			
N, 50 Ω	R&S ZCAN	0 Hz to 3 GHz	0800.8515.52
N, 75 Ω	R&S ZCAN	0 Hz to 3 GHz	0800.8515.72
Attenuators			
1 W	R&S DNF	0 Hz to 12.4 GHz	0272.4X10.50[8]
50 W	R&S RBU 50	0 Hz to 2 GHz	1073.8695.XX[9]
100 W	R&S RBU 100	0 Hz to 2 GHz	1073.8495.XX[9]
Matching Pads, N, 50 Ω → N, 75 Ω			
Series Resistor	R&S RAZ	0 Hz to 2.7 GHz	0358.5714.02
L Section	R&S RAM	0 Hz to 2.7 GHz	0358.5414.02
Various Accessories, N, 50 Ω			
T Check	R&S ZV-Z60	0 Hz to 4 GHz	1108.4990.50
Bias Network	R&S ZV-Z61	2 MHz to 4 GHz	1106.8130.02
DC Block	R&S FSE-Z3	5 MHz to 7 GHz	4010.3895.00
Power Splitter 2 x 50 Ω	R&S RVZ	0 Hz to 2.7 GHz	0800.6612.52
External SWR-Bridges			
N (f), 50 Ω	R&S ZRA	40 kHz to 150 MHz	1052.3607.52
N (f), 50 Ω	R&S ZRB2	5 MHz to 3 GHz	0373.9017.52
N (f), 75 Ω	R&S ZRB2	5 MHz to 2 GHz	0802.1018.73
N (f), 50 Ω	R&S ZRC	40 kHz to 4 GHz	1039.9492.52
N (f), 75 Ω	R&S ZRC	40 kHz to 2.5 GHz	1039.9492.72
Miscellaneous			
Transit Case	R&S ZZK-965	–	1013.9437.00
19"-Rack Adapter with front handles	R&S ZZA-96	–	0396.4928.00

1) Harmonics and arbitrary frequency conversion measurement included.

2) Power meter and sensor required.

3) Only for R&S ZVR, R&S ZVC, R&S ZVM, R&S ZVK.

4) Comprises test port 'Input b1', for bypassing coupler at PORT 1.

5) Comprises test port 'Input b2', for bypassing coupler at PORT 2.

6) For ruggedized port.

7) Two adapters PC 3.5 (f)/N (f) or 2.92 mm (f)/N (f) required.

8) X = 0: 3 dB, X = 1: 6 dB, X = 2: 10 dB, X = 3: 20 dB, X = 4: 30 dB.

9) XX = 03: 3 dB, XX = 06: 6 dB, XX = 10: 10 dB, XX = 20: 20 dB, XX = 30: 30 dB.

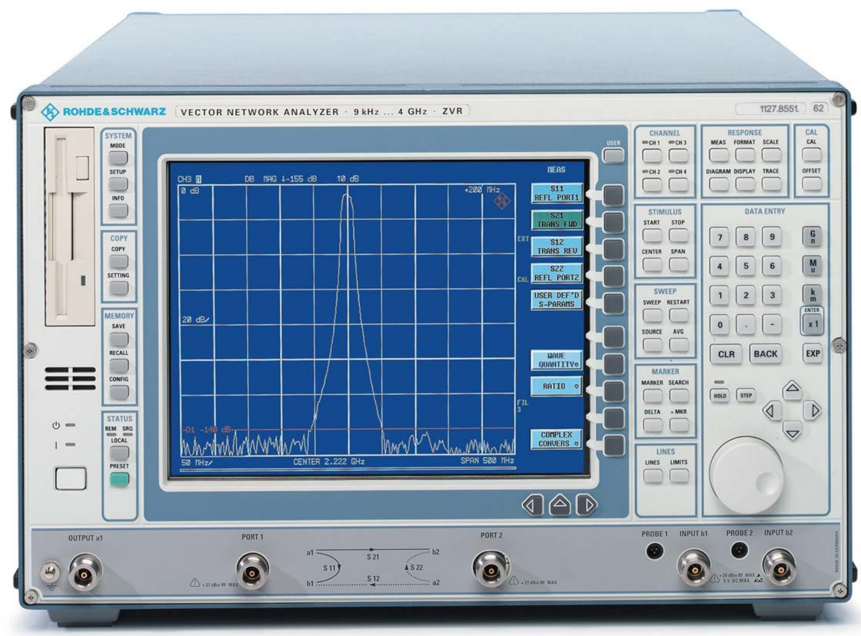
Vector Network Analyzers R&S ZVC, R&S ZVCE, R&S ZVR, R&S ZVRE, R&S ZVRL

R&S ZVRx:

(10 Hz) 9 kHz to 4 GHz

R&S ZVCx: 20 kHz to 8 GHz

Extremely fast, high-precision and versatile vector network analyzers



R&S ZVR (photo 43462-3)

Brief description

The family comprises the five Vector Network Analyzers R&S ZVRL, R&S ZVRE and R&S ZVR as well as R&S ZVCE and R&S ZVC which extend the frequency range to 8 GHz. All models are compact instruments with integrated generator, test set and receiver, each tailored to a different field of application.

R&S ZVRL – the lean model

R&S ZVRL comprises a test set with one SWR bridge, two measurement channels and a reference channel for measuring the magnitude and phase of the forward S-parameters S_{11} and S_{21}.

R&S ZVRE and R&S ZVCE – the economy models

The test set of these models comprises two SWR bridges or directional couplers, an RF switch, two measurement channels and one reference channel. They measure the magnitude and phase of all four S-parameters of a DUT, allow a full two-port calibration (TOSM) and have an exceptionally high accuracy and wide dynamic range.

R&S ZVR and R&S ZVC – the universal models

R&S ZVR and R&S ZVC comprise a test set with two SWR bridges or directional couplers, an RF switch, two measurement channels and – unlike R&S ZVRE and R&S ZVCE – two reference channels.

With this configuration a variety of novel calibration procedures, e.g. TNA, can be performed, which considerably improve the accuracy particularly in non-coaxial applications. R&S ZVR and R&S ZVC are the all-rounders of the family and suitable for applications in R&D and production no matter how sophisticated.

R&S ZVC and R&S ZVCE can be ordered with active or passive SWR bridges instead of active couplers. In comparison with couplers, SWR bridges considerably improve the uncorrected port matching below 1 GHz.

Main features

- High measurement speed (in fast mode <125 µs/testpoint)
- Low inherent noise (–130 dBm)
- Wide dynamic range (>130 dB)
- Fast IEC/IEEE bus(<10 ms)
- High frequency resolution (10 µHz)
- Short calibration times (<20 s)
- Active colour LCD (26 cm)

Dynamic range >130 dB

Thanks to fundamental mixing, the useful dynamic range of the R&S network analyzers is more than 25 dB better than that achieved by conventional sampling techniques. Because of the low-noise front end, the R&S ZVR models attain a dynamic range of >130 dB, so transmission measurements on DUTs with extremely high stopband attenuation can be performed at high speed – even at low input levels.

High sweep rate

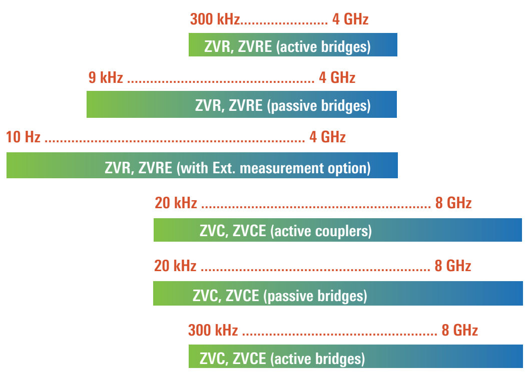
The high measurement speed allows more than 25 sweeps/s with 200 points. This gives a real analog feeling for tuning sensitive DUTs in real time. The short measurement time of <125 µs per point considerably increases the throughput in automatic test systems.

Vector Network Analyzers R&S ZVC, R&S ZVCE, R&S ZVR, R&S ZVRE, R&S ZVRL

Fast IEC/IEEE bus

Reading out a single marker value via the IEC/IEEE bus takes only 10 ms, reading out complete trace data (200 values) less than 30 ms, which speeds up complex, computer-controlled measurements.

Wide frequency range



Short calibration times

With the new R&S calibration method AutoKal a simple through-connection of the test ports is sufficient to perform automatic full two-port calibration. This calibration takes only some seconds (including computation of error parameters) and cuts time and operating errors to a minimum.

Innovative calibration techniques

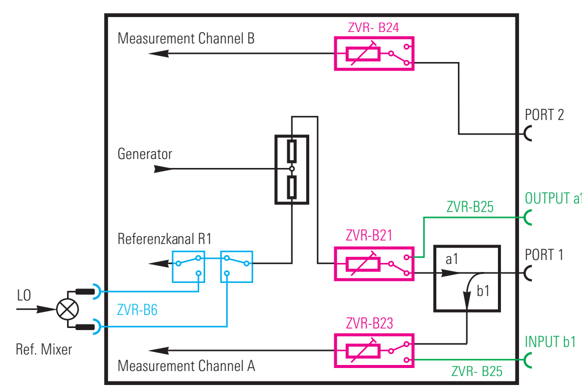
R&S ZVR and R&S ZVC provide an additional number of modern calibration methods (TOM, TRM, TRL, TNA). Unlike classic TOSM (12-term), they require only three different standards which may be partly unknown. This opens new application fields.

Mixer and amplifier measurements

Due to the use of two independent synthesizers for generator and receiver and the ability to control two external generators, a variety of measurements can be performed at full dynamic range (up to 140 dB) and speed on frequency-converting DUTs, e.g. mixing loss or intermodulation products of mixers. Thanks to the special receiver principle used by Rohde & Schwarz analyzers, add-ons like filters are not required for the suppression of spurious.

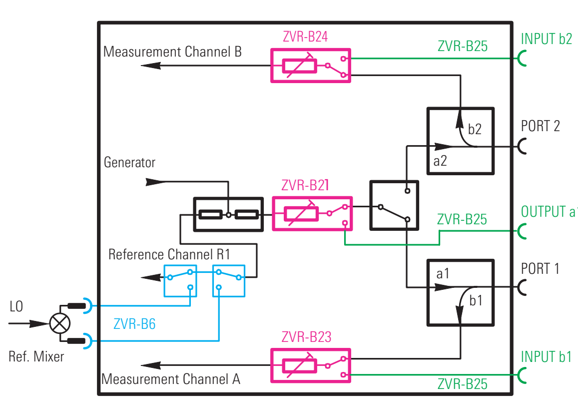
Integrated PC

The PC board with peripheral interfaces such as keyboard, mouse and external monitor as well as the use of Windows NT as operating system are now standard in the network analyzers. The PC mode gives free access to the hard disk and PC programs on R&S ZVR. This function considerably simplifies operation, processing and data logging. The optional Ethernet link, integrated printer drivers and IEC/IEEE bus control programs stored on R&S ZVR substantially extend the application range and improve performance.

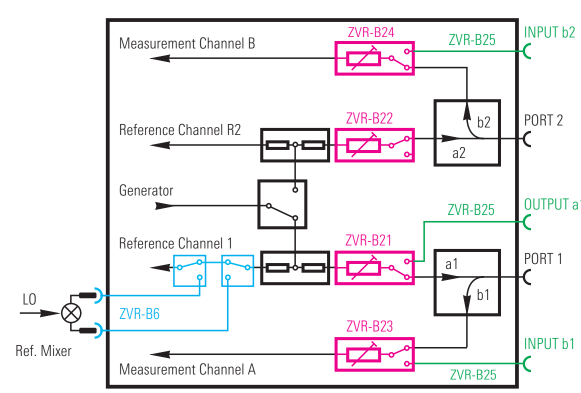


Test set ZVRL

System configuration



Test Set ZVRE and ZVCE



Test Set ZVR and ZVC

Vector Network Analyzers R&S ZVC, R&S ZVCE, R&S ZVR, R&S ZVRE, R&S ZVRL

Specifications

Unless otherwise stated, specifications apply to test ports PORT 1 and PORT 2, a nominal power of –10 dBm at the test port and a receiver bandwidth ≤10 kHz.

▶ **The arrow marks important data**

Frequency range, measurement speed, dynamic range

Frequency range	
Without External Measurements option	
R&S ZVRL, R&S ZVRE, R&S ZVR	
with passive SWR bridges	
50 Ω or 75 Ω	9 kHz to 4 GHz
with active SWR bridges	
50 Ω or 75 Ω	300 kHz to 4 GHz
▶ R&S ZVCE, R&S ZVC	
with passive SWR bridges 50 Ω	20 kHz to 8 GHz
with active SWR bridges 50 Ω	300 kHz to 8 GHz
with active couplers 50 Ω	20 kHz to 8 GHz
With External Measurements option	
R&S ZVRL, R&S ZVRE, R&S ZVR	10 Hz to 4 GHz
R&S ZVCE, R&S ZVC	20 kHz to 8 GHz
Frequency uncertainty	$<4 \times 10^{-6} + 1 \times 10^{-6}$/a
Resolution	10 μHz

Measurement speed (above 2 MHz)			
Number of points	1 to 2001 (selectable)		
Measurement time per point	**Receiver bandwidth (IFBW)**		
	3 kHz	**10 kHz**	**26 kHz**
▶ with system error correction	<1080 μs	<480 μs	<360 μs
normalized	<540 μs	<240 μs	<210 μs
fast mode			
with system error correction	–	–	<240 μs
▶ normalized	–	–	<125 μs

Dynamic range (without system error correction)
R&S ZVRL, R&S ZVRE, R&S ZVR
(Models R&S ZVRL and R&S ZVRE: at receiver bandwidth 10 Hz values are reduced by 5 dB)

	Receiver bandwidth		
With passive SWR bridges 50 Ω	**10 Hz**	**3 kHz**	**10 kHz**
20 kHz to 200 kHz	>65 dB, >110 dB typ.	–	–
200 kHz to 20 MHz	>110 dB	>90 dB	>85 dB
▶ 20 MHz to 3 GHz	>120 dB	>100 dB	>95 dB
3 GHz to 4 GHz	>110 dB	>90 dB	>85 dB
With External Measurements option			
50 Hz to 200 kHz	>75 dB	–	–
200 kHz to 20 MHz	>110 dB	>95 dB	>90 dB
▶ 20 MHz to 1 GHz	>130 dB	>110 dB	>105 dB
1 GHz to 3 GHz	>120 dB	>100 dB	>95 dB
3 GHz to 4 GHz	>110 dB	>95 dB	>90 dB

R&S ZVCE, R&S ZVC
(Model R&S ZVCE: at receiver bandwidth 10 Hz values are reduced by 5 dB)

	Receiver bandwidth		
With active SWR bridges 50 Ω			
300 kHz to 20 MHz	>95 dB	>75 dB	>70 dB
20 MHz to 3 GHz	>115 dB	>95 dB	>90 dB
3 GHz to 4 GHz	>105 dB	>85 dB	>80 dB
4 GHz to 6 GHz	>100 dB	>80 dB	>75 dB
6 GHz to 8 GHz	>95 dB	>75 dB	>70 dB
With External Measurement option			
20 kHz to 200 kHz	>75 dB	–	–
200 kHz to 20 MHz	>110 dB	>95 dB	>90 dB
20 MHz to 1 GHz	>130 dB	>110 dB	>105 dB
1 GHz to 3 GHz	>120 dB	>100 dB	>95 dB
3 GHz to 4 GHz	>110 dB	>95 dB	>90 dB
4 GHz to 6 GHz	>105 dB	>90 dB	>85 dB
6 GHz to 8 GHz	>100 dB	>85 dB	>80 dB

Stability of measurement trace	
per degree temperature variation	<0.05 dB or 0.4 °
R&S ZVCE, R&S ZVC	<0.1 dB or 1 °
Receiver bandwidths	
(IF bandwidth IFBW) ◀	1 Hz to 10 kHz (half-decade steps) and 26 kHz (full)

Measurement accuracy

The following data are valid between 20°C and 30 °C provided the instrument has reached thermal equilibrium (about 1 h after switch-on) and the temperature has not varied by more than 1 degree after calibration.

R&S ZVRE and R&S ZVR (bidirectional network analyzers)

Accuracy of transmission measurements after full two-port system error correction (TOSM)
Specifications are based on a matched DUT and refer to a nominal source power of –10 dBm at the test port.

Test set 50 Ω (active or passive SWR bridges available 20 kHz to 300 kHz (passive SWR bridges only) 300 kHz to 4 GHz

at 10 Hz receiver bandwidth		
for +10 dB to +3 dB		<1 dB or 6 °
for +3 dB to –5 dB		<0.2 dB or 1 °
for –5 dB to –60 dB ◀	(passive)	<0.05 dB or 0.4 °[1)]
for –5 dB to –60 dB	(active)	<0.2 dB or 1 °
for +3 dB to –40 dB		<0.025 dB typ.
for –60 dB to –70 dB		<0.2 dB or 1 °
for –70 dB to –80 dB	(R&S ZVRE)	<1 dB or 6 °
for –70 dB to –85 dB	(R&S ZVR)	<1 dB or 6 °

1) <1 ° for 300 kHz to 1 MHz.

Vector Network Analyzers R&S ZVC, R&S ZVCE, R&S ZVR, R&S ZVRE, R&S ZVRL

R&S ZVRE and R&S ZVR – Accuracy of reflection measurements after system error correction (TOSM or full one-port)
Specifications are based on an isolating DUT and refer to a nominal source power of –10 dBm at the test port.

Test set 50 Ω (active or passive SWR bridges available)
It is assumed that the return loss of the match used for calibration is >40 dB (effective system data: directivity D_{eff} >40 dB, test port match S_{eff} >26 dB).

20 kHz to 4 GHz (passive SWR bridges), 300 kHz to 4 GHz (active SWR bridges)

for +10 dB to +3 dB	<1 dB or 6 °
for +3 dB to –15 dB	<0.4 dB + 0.04 dB·f/GHz, <3 ° + 0.4°·f/GHz
for –15 dB to –25 dB	<1 dB or 6 °
for –25 dB to –35 dB	<3 dB or 20 °

Test set 75 Ω (active or passive SWR bridges available)
It is assumed that the return loss of the match used for calibration is >40 dB (effective system data: directivity D_{eff} >40 dB, test port match S_{eff} >26 dB.

20 kHz to 4 GHz (passive SWR bridge), 300 kHz to 4 GHz (active SWR bridge)

for +10 dB to +3 dB	<1,5 dB or 10 °
for +3 dB to –10 dB	<0.7 dB + 0.04 dB·f/GHz, <5 ° + 0.4°·f/GHz
for –10 dB to –20 dB	<1 dB or 6 °
for –20 dB to –30 dB	<3 dB or 20 °

R&S ZVCE and R&S ZVC (bidirectional network analyzers)

Accuracy of transmission measurements after full two-port system error correction (TOSM)

Analyzers with SWR bridges
Specifications are based on a matched DUT and refer to a nominal source power of –10 dBm at the test port.

300 kHz to 4 GHz at 10 Hz receiver bandwidth

for +3 dB to –60 dB	<0.2 dB or 1°
for +3 dB to –40 dB	<0.025 dB typ.
for –60 dB to –70 dB	<0.2 dB or 1°
for –70 dB to –80 dB (R&S ZVCE)	<1 dB or 6°
for –70 dB to –85 dB (R&S ZVC)	<1 dB or 6°

4 GHz to 8 GHz at 10 Hz receiver bandwidth

for +3 dB to –35 dB	<0.2 dB or 2°
for +3 dB to –30 dB	<0.025 dB typ.
for –35 dB to –45 dB (R&S ZVCE)	<1 dB or 6°
for –35 dB to –50 dB (R&S ZVC)	<1 dB or 6°

Analyzers with couplers
Specifications are based on a matched DUT and refer to a nominal source power of **–20 dBm** at the test port.

20 kHz to 10 MHz at 10 Hz receiver bandwidth

for +10 dB to +3 dB	<1 dB or 6 °
for +3 to –20 dB (–55 dB typ.)	<0.2 dB or 2 °
for –20 to –30 dB (–65 dB typ.)	<0.5 dB or 4 °
for –30 to –45 dB (–80 dB typ.)	<1 dB or 6 °

10 MHz to 4 GHz at 10 Hz receiver bandwidth

for +10 dB to +3 dB	<1 dB or 6 °
for +3 dB to –50 dB	<0.2 dB or 1 °
for +3 dB to –40 dB	<0.025 dB typ.
for –50 dB to –60 dB	<0.5 dB or 4 °
for –60 dB to –70 dB (R&S ZVCE)	<1 dB or 6 °
for –60 dB to –75 dB (R&S ZVC)	<1 dB or 6 °

4 GHz to 8 GHz at 10 Hz receiver bandwidth

for +10 dB to +3 dB	<1 dB or 6 °
for +3 dB to –45 dB	<0.2 dB or 2 °
for +3 dB to –40 dB	<0.025 dB typ.
for –45 dB to –55 dB (R&S ZVCE)	<1 dB or 6 °
for –45 dB to –60 dB (R&S ZVC)	<1 dB or 6 °

R&S ZVCE and R&S ZVC – Accuracy of reflection measurements after system error correction (TOSM or full one-port)

Analyzers with SWR bridges
Specifications are based on an isolating DUT and refer to a nominal source power of **–10 dBm** at the test port.

300 kHz to 8 GHz

for +3 dB to –10 dB	<0.4 dB + 0.04 dB·f/GHz, <3 ° + 0.4°·f/GHz
for –10 dB to –20 dB	<1 dB or 6 °
for –20 dB to –30 dB	<3 dB or 20 °

Analyzers with couplers
Specifications are based on an isolating DUT and refer to a nominal source power of **–20 dBm** at the test port. It is assumed that the return loss of the match used for calibration is >40 dB
(effective system data: directivity D_{eff} >40 dB, test port match S_{eff} >30 dB).

20 kHz to 8 GHz

for +10 dB to +3 dB	<1 dB or 6 °
for +3 dB to –10 dB	<0.4 dB + 0.04 dB·f/GHz, <3 ° + 0.4°·f/GHz
for –10 dB to –20 dB	<1 dB or 6 °
for –20 dB to –30 dB	<3 dB or 20 °

R&S ZVRL (unidirectional network analyzer)

Accuracy of transmission measurements after system error correction (one-path two-port)
Specifications are based on a matched DUT and refer to a nominal source power of –10 dBm at the test port.

Test set 50 Ω (only passive SWR bridge available)

20 kHz to 300 kHz at 10 Hz receiver bandwidth

for +10 to –45 dB (–80 dB typ.)	<1 dB or 6 °

300 kHz to 4 GHz at 10 Hz receiver bandwidth

for +10 dB to +3 dB	<1 dB or 6 °
for +3 dB to –75 dB	<0.2 dB or 1 °

R&S ZVRL – Accuracy of transmission measurements after system error correction (full one-port or one-path two-port)
Specifications are based on an isolating DUT and refer to a nominal source power of –10 dBm at the test port.

Vector Network Analyzers R&S ZVC, R&S ZVCE, R&S ZVR, R&S ZVRE, R&S ZVRL

Test set 50 Ω (only passive SWR bridge available)
It is assumed that the return loss of the match used for calibration is >46 dB (effective system data: directivity D_{eff} >46 dB, test port match S_{eff} >30 dB).

20 kHz to 4 GHz

for +10 dB to +3 dB	<1 dB or 6°
for +3 dB to –15 dB	<0.4 dB + 0.04 dB·f/GHz, <3° + 0.4°·f/GHz
for –15 dB to –25 dB	<1 dB or 6°
for –25 dB to –35 dB	<3 dB or 20°

Effective system characteristics (above 200 kHz)

These data are valid between 20°C and 30°C provided the instrument has reached thermal equilibrium (about 1 h after switch-on) and the temperature variation is not more than 1 degree after calibration.

R&S ZVRE, R&S ZVR, R&S ZVCE, R&S ZVC (bidirectional network analyzers)

after full two-port system error correction (TOSM)

	ZVRE, ZVR	ZVCE, ZVC
Directivity	>46 dB [1]	>40 dB [2]
Source match	>40 dB [3]	>36 dB [4]
Load match	>46 dB [1]	>40 dB
Transmission tracking	<0.04 dB	<0.06 dB
Reflection tracking	<0.04 dB	<0.06 dB

R&S ZVRL (unidirectional network analyzer)

after system error correction (one-path two-port) with test set 50 Ω

Directivity	>46 dB
Source match (PORT 1)	>30 dB
Load match (PORT 2)	>18 dB
Transmission tracking	<0.2 dB
Reflection tracking	<0.06 dB

Output power

Power range (without options)

R&S ZVRL, R&S ZVRE, R&S ZVR with test set 50 Ω	–25 dBm to 0 dBm
R&S ZVCE, R&S ZVC with SWR bridges	
300 kHz to 6 GHz	–25 dBm to –5 dBm
6 GHz to 8 GHz	–25 dBm to –8 dBm
R&S ZVCE, R&S ZVC with couplers	
20 kHz to 6 GHz	–25 dBm to 0 dBm
6 GHz to 8 GHz	–25 dBm to –3 dBm

Uncertainty (at –10 dBm)
These data are valid between 20°C to 30°C.

up to 2 MHz	<1 dB
above 2 MHz	<0.5 dB

1) Return loss of matched load >46 dB.

2) Return loss of matched load >40 dB.

3) Phase deviation of open standard <1°.

4) Phase deviation of open standard <1.6°.

Linearity above 40 kHz (referred to –10 dBm)

0 dBm to –15 dBm	<0.4 dB
–15 dBm to –25 dBm	<0.6 dB

Spectral purity

Harmonics	ZVRL, ZVRE, ZVR	ZVCE, ZVC
At maximum output power		
40 kHz to 70 MHz	<–22 dBc	<–25 dBc
70 MHz to 400 MHz	<–25 dBc	<–25 dBc
above 400 MHz	<–30 dBc	<–25 dBc
At –10 dBm output power		
up to 600 MHz	<–35 dBc	<–35 dBc
above 600 MHz	<–40 dBc	<–35 dBc

Spurious <–40 dBc

SSB phase noise
1 Hz bandwidth, 10 kHz from carrier

up to 10 MHz	<–110 dBc
10 MHz to 150 MHz	<–100 dBc
150 MHz to 1 GHz	<–90 dBc
above 1 GHz	<–90 dBc +20·log(f/GHz) (<–78 dBc at 4 GHz, <–72 dBc at 8 GHz)

Residual FM
RMS weighting from 10 Hz to 3 kHz

up to 10 MHz	<1 Hz
10 MHz to 150 MHz	<2 Hz
150 MHz to 1 GHz	<5 Hz
1 GHz to 2 GHz	<10 Hz
2 GHz to 4 GHz	<20 Hz
above 4 GHz	<40 Hz

Input level

Maximum nominal input level	Receiver step attenuator 0 dB	≥30 dB
Without options	0 dBm	–
With Receiver Step Attenuator option	0 dBm	+27 dBm

Max. permissible input level		
Without options	+27 dBm	–
With Receiver Step Attenuator option	+27 dBm	+30 dBm

Max. permissible DC current/voltage

With passive test set (internal DC short R_{in} <0.1 Ω)	0.5 A
With active test set	0.5 A or 30 V

RMS noise level (50 Ω, without options)

Frequency range	Receiver bandwidth	Noise level
9 kHz to 50 kHz	1 kHz	<–75 dBm
50 kHz to 200 kHz	3 kHz	<–70 dBm
200 kHz to 20 MHz	3 kHz	<–90 dBm
20 MHz to 3 GHz	3 kHz	<–100 dBm
3 GHz to 4 GHz	3 kHz	<–90 dBm
4 GHz to 8 GHz	3 kHz	<–80 dBm

Vector Network Analyzers R&S ZVC, R&S ZVCE, R&S ZVR, R&S ZVRE, R&S ZVRL

System error correction techniques

All analyzer models offer simple normalizations for reflection and transmission measurements, One-path two-port calibration and a full one-port calibration (3-term). Full two-port calibration TOSM (12-term) can be carried out with models R&S ZVRE and R&S ZVCE. R&S ZVR and R&S ZVC offer the greatest variety of modern system error correction methods. Apart from the techniques already mentioned, the following full two-port procedures are available: TOM, TRM, TRL, TNA, TOM-X (15-term). The names indicate the standards used for calibration.

T = Through	R = Reflect
O = Open	L = Line
S = Short	N = Network
M = Match	A = Attenuator

TOM-X (X = crosstalk) is an extension of the TOM method. It considers all possible crosstalk between the four receiver channels (full model). This technique is particularly effective in the elimination of crosstalk and thus increases the dynamic range of the system. However, it is quite an elaborate technique. Alternatively, the new automatic calibration procedure AutoKal (R&S patent) is available as an option for R&S ZVRE, R&S ZVR, R&S ZVCE and R&S ZVC.

General data

Temperature	5°C to 40°C, complying with specs 0°C to 50°C, functions maintained
Power supply	90 V to 132 V (AC), 47 to 440 Hz or 180 V to 264 V (AC), 47 to 66 Hz
Power consumption	max. 400 VA (standby: 10 W)
Dimensions (W x H x D), weight	435 mm x 281 mm x 584 mm, 30 kg

Options

Option	Type	R&S ZVRL	R&S ZVRE	R&S ZVR	R&S ZVCE	R&S ZVC
Automatic Calibration AutoKal	R&S ZVR-B1	–	●	●	●	●
Time Domain	R&S ZVR-B2	●	●	●	●	●
Mixer Measurements	R&S ZVR-B4	●	●	●	●	●
Nonlinear Measurements	R&S ZVR-B5	●	●	●	●	●
Reference Channel Ports	R&S ZVR-B6	●	●	●	●	●
Power Calibration	R&S ZVR-B7	●	●	●	●	●
3-Port Adapter	R&S ZVR-B8	●	●	●	●*	●*
Virtual Embedding Networks	R&S ZVR-K9	–	–	●	–	●
Increased Output Power for Port 1	R&S ZVR-B10	●	●	●	●	●
4-Port Adapter	R&S ZVR-B14	●	●	●	●*	●*
Ethernet for integrated PC	R&S FSE-B16	●	●	●	●	●
IEC/IEEE bus Interface for integrated PC	R&S FSE-B17	●	●	●	●	●
Generator Step Attenuator PORT1	R&S ZVR-B21	●	●	●	●	●
Generator Step Attenuator PORT2	R&S ZVR-B22	–	–	●	–	●
Receiver Step Attenuator PORT1	R&S ZVR-B23	●	●	●	●	●
Receiver Step Attenuator PORT2	R&S ZVR-B24	●	●	●	●	●
External Measurements	R&S ZVR-B25	●	●	●	●	●
Service Kit	R&S ZVR-Z1	●	●	●	●	●

● Available * up to 4 GHz

Ordering information

Order designation	Type	Frequency range	Order No.
Vector Network Analyzers (test sets included, up to 4 GHz)			
3-channel, unidirectional, 50 Ω, passive	R&S ZVRL	9 kHz to 4 GHz	1127.8551.41
3-channel, bidirectional, 50 Ω, passive	R&S ZVRE	9 kHz to 4 GHz	1127.8551.51
3-channel, bidirectional, 50 Ω, active	R&S ZVRE	300 kHz to 4 GHz	1127.8551.52
4-channel, bidirectional, 50 Ω, passive	R&S ZVR	9 kHz to 4 GHz	1127.8551.61
4-channel, bidirectional, 50 Ω, active	R&S ZVR	300 kHz to 4 GHz	1127.8551.62
3-channel, bidirectional, 50 Ω, active, couplers	R&S ZVCE	20 kHz to 8 GHz	1127.8600.50
3-channel, bidirectional, 50 Ω, passive, SWR bridges	R&S ZVCE	20 kHz to 8 GHz	1127.8600.51
3-channel, bidirectional, 50 Ω, active, SWR bridges	R&S ZVCE	300 kHz to 8 GHz	1127.8600.52
4-channel, bidirectional, 50 Ω, active, couplers	R&S ZVC	20 kHz to 8 GHz	1127.8600.60
4-channel, bidirectional, 50 Ω, passive, SWR bridges	R&S ZVC	20 kHz to 8 GHz	1127.8600.61
4-channel, bidirectional, 50 Ω, active, SWR bridges	R&S ZVC	300 kHz to 8 GHz	1127.8600.62
Alternative test sets (up to 4 GHz)			
75-Ω SWR Bridge for R&S ZVRL (instead of SWR bridge, 50 Ω, passive) [1)]			
75 Ω, passive	R&S ZVR-A71	9 kHz to 4 GHz	1043.7690.18
75-Ω Bridge Pairs for R&S ZVRE and R&S ZVR (instead of bridge pairs, 50 Ω) [1)]			
75 Ω, passive	R&S ZVR-A75	9 kHz to 4 GHz	1043.7755.28
75 Ω, active	R&S ZVR-A76	300 kHz to 4 GHz	1043.7755.29
Options			
AutoKal	R&S ZVR-B1	0 to 8 GHz	1044.0625.02
Time Domain	R&S ZVR-B2	same as analyzer	1044.1009.02
Mixer measurements[2)]	R&S ZVR-B4	same as analyzer	1044.1215.02
Nonlinear Measurements	R&S ZVR-B5	same as analyzer	1044.1321.02
Reference Channel Ports	R&S ZVR-B6	same as analyzer	1044.1415.02
Power calibration[3)]	R&S ZVR-B7	same as analyzer	1044.1544.02
3-Port Adapter	R&S ZVR-B8	0 to 4 GHz	1086.0000.02
Virtual Embedding Networks	R&S ZVR-K9	–	1106.8830.02
Increased Output Power for Port1for R&S ZVR and R&S ZVRL[4)]	R&S ZVR-B10	same as analyzer	1106.6495.02
Increased Output Power for Port1 for R&S ZVRE[4)]	R&S ZVR-B10	same as analyzer	1106.6495.03

Vector Network Analyzers R&S ZVC, R&S ZVCE, R&S ZVR, R&S ZVRE, R&S ZVRL

Order designation	Type	Frequency range	Order No.
Increased Output Power for Port1 for R&S ZVC[4]	R&S ZVR-B10	same as analyzer	1106.6495.04
Increased Output Power for Port1 for R&S ZVCE[4]	R&S ZVR-B10	same as analyzer	1106.6495.05
4-Port Adapter (2 x SPDT)	R&S ZVR-B14	0 to 4 GHz	1106.7510.02
4-Port Adapter (SP3T)	R&S ZVR-B14	0 to 4 GHz	1106.7510.03
Ethernet AUI for integr. PC	R&S FSE-B16	–	1073.5973.02
Ethernet BNC for integr. PC	R&S FSE-B16	–	1073.5973.03
Ethernet RJ 45 for integr. PC	R&S FSE-B16		1073.5973.04
IEC/IEEE bus Interface for integrated PC	R&S FSE-B17	–	1066.4017.02
Generator Step Attenuator PORT 1	R&S ZVR-B21	same as analyzer	1044.0025.11
Generator Step Attenuator PORT 2 [5]	R&S ZVR-B22	same as analyzer	1044.0025.21
Receiver Step Attenuator PORT 1	R&S ZVR-B23	same as analyzer	1044.0025.12
Receiver Step Attenuator PORT 2	R&S ZVR-B24	same as analyzer	1044.0025.22
External Measurements, 50 Ω [6]	R&S ZVR-B25	10 Hz to 4 GHz (R&S ZVR/E/L) 20 kHz to 8 GHz (R&S ZVC/E)	1044.0460.02
Service Kit [7]	R&S ZVR-Z1		1044.1650.02
Extras			
Test Cables (pairs)			
N male, 50 Ω	R&S ZV-Z11	0 to 18 GHz	1085.6505.03
N male, 75 Ω	R&S ZV-Z12	0 to 4 GHz	1085.6570.03
3.5 mm male, N male, 50 Ω	R&S ZV-Z13	0 to 18 GHz	1134.3997.02
3.5 mm male, 3.5 mm male, 50 Ω	R&S ZV-Z14	0 to 26.5 GHz	1134.4093.02
Calibration Kits			
N, 50 Ω	R&S ZV-Z21	0 to 18 GHz	1085.7099.02
N, 50 Ω	R&S ZCAN	0 to 3 GHz	0800.8515.52
N, 75 Ω	R&S ZCAN	0 to 3 GHz	0800.8515.72
F male	R&S ZV-Z24	0 to 3 GHz	1085.7001.02
PC 3.5	R&S ZV-Z30	0 to 26.5 GHz	1134.4293.02
TRL Suppl. Kit, N, 50 Ω	R&S ZV-Z26	0.4 GHz to 18 GHz	1085.7318.02
TRL Suppl. Kit, PC 3.5	R&S ZV-Z27	0.4 to 26.5 GHz	1085.7401.02
TOM-X Suppl. Kit, N, 50 Ω	R&S ZV-Z28	0 to 18 GHz	1085.7499.03
TOM-X Suppl. Kit, PC 3.5	R&S ZV-Z29	0 to 26.5 GHz	1085.7647.03
Sliding Loads			
N male, 50 Ω	R&S ZV-Z41	1.7 GHz to 18 GHz	1085.8095.02
N female, 50 Ω	R&S ZV-Z41	1.7 GHz to 18 GHz	1085.8095.03
PC 3.5 male	R&S ZV-Z43	1.7 to 26.5 GHz	1085.8195.02
PC 3.5 female	R&S ZV-Z43	1.7 to 26.5 GHz	1085.8195.03
Attenuators, N, 50 Ω			
1 W	R&S DNF	0 to 12.4 GHz	0272.4X10.50
50 W [7]	R&S RBU50	0 to 2 GHz	1073.8695.XX
100 W [7]	R&S RBU100	0 to 2 GHz	1073.8495.XX
Matching Pads, 50 Ω → 75 Ω			
Series resistor	R&S RAZ	0 to 2.7 GHz	0358.5714.02
L-section	R&S RAM	0 to 2.7 GHz	0358.5414.02
Accessories			
T Check	R&S ZV-Z60	0 to 4 GHz	1108.4990.50
Bias Network	R&S ZV-Z61	2 MHz to 4 GHz	1106.8130.02
DC Block	R&S FSE-Z3	5 MHz to 7 GHz	4010.3895.00
Power Splitter, 2 x 50 Ω	R&S RVZ	0 to 2.7 GHz	0800.6612.52
External SWR Bridges [8]			
50 Ω, N female	R&S ZRA	40 kHz to 150 MHz	1052.3607.52
50 Ω, N female	R&S ZRB 2	5 MHz to 3 GHz	0373.9017.52
75 Ω, N female	R&S ZRB 2	5 MHz to 2 GHz	0802.1018.73
50 Ω, N female	R&S ZRC	40 kHz to 4 GHz	1039.9492.52
75 Ω, N female	R&S ZRC	40 kHz to 2.5 GHz	1039.9492.72
Miscellaneous			
Transit Case	R&S ZZK-965	–	1013.9437.00
19" Rack Adapter with front handles	R&S ZZA-96	–	396.4928.00

1) To be ordered together with R&S ZVR/E/L.

2) Harmonic measurements included.

3) Power meter and sensor required.

4) Only together with R&S ZVR-B23 and R&S ZVR-B24.

5) For R&S ZVR or R&S ZVC only (see page 8).

6) Attenuators required (page 8).

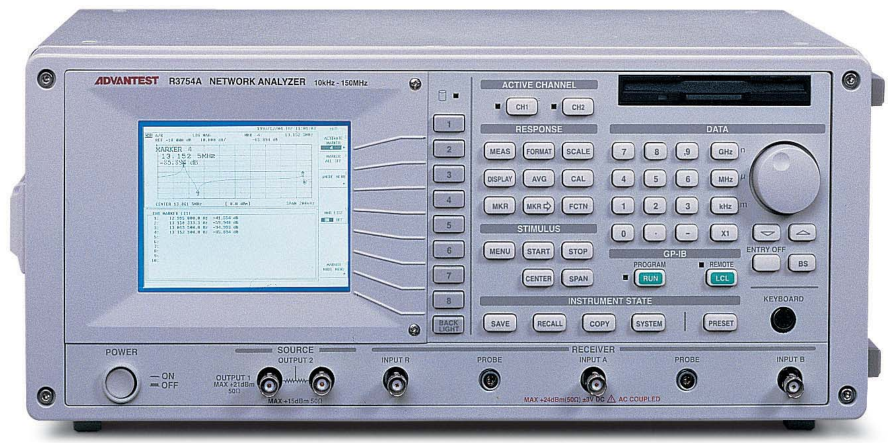
7) On request.

8) Other variants available, e.g. N male.

Vector Network Analyzer R3754

10 kHz to 150 (200) MHz

High-performance vector network analyzer for use in applications with high throughput and wide dynamic range



Brief description

The Vector Network Analyzer R3754 up to 150 MHz (Advantest) is designed as a fast measuring instrument predominantly for use in applications with high throughput and wide dynamic range, e.g. for measurements on crystal oscillators and filters.

The analyzer is available as a single-channel, 2-channel or 3-channel model, with monochrome or colour display. A 15 kHz resolution filter allows sweep speeds down to 50 µs per point. The measurement uncertainty in the warmup phase of the instrument as well as the effect of the average noise level on the measurement accuracy were substantially reduced.

Main features

- Monochrome or TFT colour LCD
- High sweep speed of 50 µs/point with 15 kHz resolution
- 1 or 2 measurement channels, 1 reference channel
- 130 dB dynamic range
- Built-in process controller

Design features

Model R3754A features a high contrast monochrome LC display, whereas model R3754B has a TFT colour display but otherwise the same performance features. All models of the R3754 Series are fitted with a built-in BASIC controller as standard. Detailed user prompts can be displayed on the screen in addition to the measurement results. Test routines and instrument settings can be stored on floppy disk.

Options

The basic model comes with one measurement channel, a reference channel and a second measurement channel being available as an option. Further options include a programmable parallel interface, time range measurement as well as a measurement function for determining the dependence of the measurement parameters on the drive level of the device under test (DLD = drive level dependence), 3-port resonator measurement, frequency extension up to 200 MHz, and a precision reference with an aging of 2 x 10^{-8}/day.

Specifications in brief

Receiver section (23°C ±5°C)	
Frequency range	10 kHz to 150 MHz (optional 200 MHz)
Impedance	50 Ω
Return loss (ATT 0 dB)	≥20 dB
Max. input level	
ATT 25 dB, AMP 0 dB	+8 dBm
ATT 0 dB, AMP 0 dB	–20 dBm
ATT 0 dB, AMP 16 dB	–36 dBm
Input destruction level	+24 dBm, +3 V DC
Input crosstalk	
10 kHz to 500 kHz	105 dB
Displayed average noise level	
RBW 10 kHz	200 kHz to 500 kHz: –102 dBm 500 kHz to 150 MHz: –112 dBm
RBW 300 Hz	10 kHz to 500 kHz: –117 dBm 500 kHz to 150 MHz: –127 dBm

Measurement format	
Input channel	1 channel, 2 channels (option 10), 3 channels (option 11)
Measurement channel	2 channels (4-trace display)
Measurement parameters	R A/R R A (option 10) A/R B/R, A/B, R, A, B (option 11)
AC/DC display	logarithmic/linear amplitude, phase, group delay, real and imaginary parts of complex number parameters Z, R, X (impedance conversion meas.) Y, G, B (admittance conversion meas.) phase extension display
Smith chart	logarithmic/linear amplitude and phase for marker reading, real and imaginary, R+jX, G+jB

Vector Network Analyzer R3754

Polar coordinates display	logarithmic/linear amplitude and phase for marker reading, real and imaginary parts
Signal source (23°C ±5° C)	
Frequency	
Range	10 kHz to 150 MHz (optional 200 MHz)
Resolution	0.1 Hz
Accuracy	+5 ppm typ.
Output	
Level range	+21 dBm to –43 dBm
Resolution	0.1 dB
Accuracy	+0.5 dB (0 dBm, 10 MHz)
Linearity (50 MHz)	
+21 dBm to –35 dBm	+0.5 dB
–35 dBm to –43 dBm	+1.5 dB
Flatness (at 0 dBm)	
10 kHz to 300 kHz	+ 2.0 dB
300 kHz to 150 MHz	+ 1.5 dB
Impedance (output port 1)	50 Ω
Return loss (at 0 dBm)	≥13 dB typ.
Signal purity	
Harmonic distortion	<–15 dBc
Nonharmonic spurious	<–20 dBc or –60 dBm, whichever is greater
Phase noise	<–95 dBc (1 Hz) (10 kHz offset)
Sweep characteristics	
Sweep parameter	frequency, signal level
Range	same as frequency sweep range
Range setting	start/stop or center/span
Sweep type	linear/logarithmic frequency sweep, level sweep, sweep of a user-defined segment
Sweep time	max. 0.05 ms/point (RBW 15 kHz)
Measurement point	3, 6, 11, 21, 51, 101, 201, 301, 401, 501, 601, or 1201 points
Sweep trigger	continuous, single, external
Sweep mode	dual sweep (2-channel sweep in the same frequency range)

Marker functions

- 10 individual markers can be set for each channel
- Any of the10 markers can be specified as the reference marker enabling delta value measurements between markers
- Markers of each channel can be set in coupled or independent form
- Marker search possible for a section specified by the delta marker
- MAX search, MIN search, NEXT search
- Search is performed for each sweep
- It is possible to calculate the bandwidth, center frequency, Q at the X dB down point. It is also possible to search the phase 0° frequency value and the ±X° frequency width
- Limit line function, direct analysis function, resonator analysis, etc

Save register	allows storing of set conditions and CAL data in battery-backed internal memory
Data save/recall	allows storing/loading data to/from FDD programming functions
BASIC control function	standard control function allows control of the main unit as well as other measurement equipment with GPIB interface
Error correction functions	
Normalization	corrects frequency response (amplitude, phase)
1-port calibration	corrects bridge directivity, frequency response and source matching error; error correction requires short, open and load
Data averaging	averages data 2 to 999
Transfer full calibration	high-accuracy measurement possible using transfer normalization in transfer measurement; error correction requires short and load
Interfaces	
External display signal output	15-pin D-sub connector (VGA)
GPIB data output and remote control	conforming to IEEE 486
Printer port	25-pin D-sub
Serial port	based on RS-232
Keyboard	IBM PC/AT-compatible
External reference frequency input	
Parallel I/O interface	TTL level, 8-bit output (2 ports), 4-bit I/O (2 ports) (option 01)
Probe power	(option 10, option 11)
External trigger signal input	BNC connector (female)
Display	
R3754A	5" STN monochrome LCD
R3754B	6.5" TFT colour LCD, 640 x 640 pixel
Backlighting	ON/OFF, no adjustment for R3754A
Contrast	contrast control provided for R3754A
General data	
With FDD	
Operating temperature range	+5°C to +40°C
Humidity	80% max. (no condensation)
Without FDD	
Operating temperature range	0°C to +50°C
Storage temperature range	–20°C to +60°C
Humidity	80% or less (no condensation)
Power supply	100 V to 120 V AC, 220 V to 240 V AC, 48 Hz to 66 Hz, autosetting to AC supply
Power consumption	200 VA max.
Dimensions (W x H x D)	424 mm x 177 mm x 300 mm
Weight	12 kg or less

Ordering information

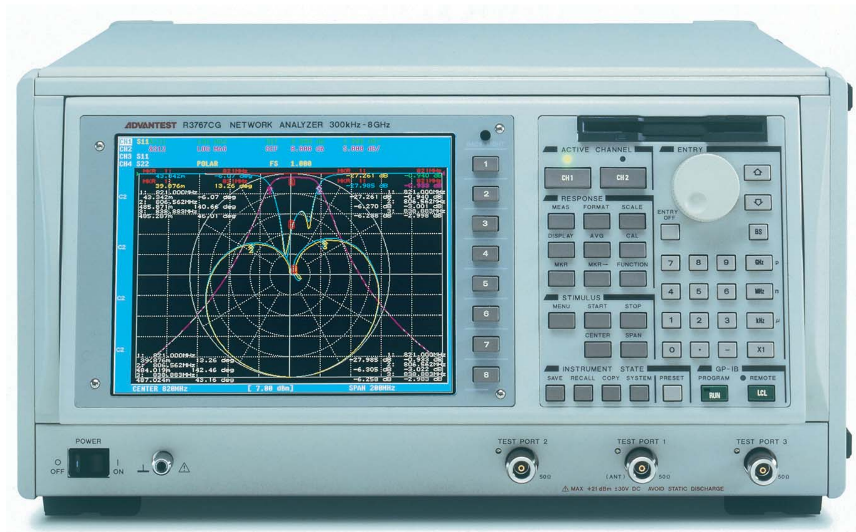
Vector Network Analyzer	R3754
Options	
Parallel I/O Interface	01
2-Channel Option (A, R)	10
3-Channel Option (A, B, R)	11
Frequency Range Extension 200 MHz	15
Timebase 2 x 10^{-8}/day	20
Time Range Measurement	70
DLD Function	71
3-Port Resonator Measurement	72
Extras	
Transit Case	R16080M
Carrier Bag	R16280M
19" Rack Adapter	A02468

Vector Network Analyzers R3765, R3767G

300 kHz to 3.8 (8) GHz

Vector network analyzers with

2-, 3- and 4-port test set



Model R3767 CG (photo 43469-2)

Brief description

Network Analyzers R3765 and R3767 (Advantest) measure amplitude, phase and group delay. Thanks to signal processing, the analyzers can perform measurements at a high rate of 0.15 ms per testpoint. Models have a TFT colour LCD allowing simultaneous display of up to four diagrams and eight traces. A programmable sweep function is provided in all models and allows to define the resolution bandwidth, power level and measurement time for each individual testpoint. An electronic attenuator (option)supports high-speed measurement of the performance characteristics of crystals or compression points of amplifiers.

Overview of models

- The **A models** have a built-in power splitter and two test inputs so that two DUTs can be measured simultaneously or for instance a three-port multiplexer in a single sweep
- The **B models** have a built-in SWR bridge for simultaneous measurement of reflection and transmission
- The **C models** incorporate a full-featured S-parameter test set, thus allowing simultaneous measurement of the forward and reflected characteristics of any DUTs

Main features

- Measurement speed: 0.15 ms/ testpoint
- 1 Hz steps
- Dynamic range up to 100 dB
- Built-in process controller
- internal 3- or 4-port test set (optional)

Operation

The analyzers of this Series are provided with a built-in BASIC controller. Frequently recurring test routines can easily be executed thanks to programmable menu-guided control; an external controller is usually not required. Detailed user prompts can be displayed on the screen in addition to the test results. Limit lines facilitate evaluation of the test results. The required programs and instrument settings can be saved on floppy disk. All models are fitted with an IEC/IEEE bus for external control, the command language is SCPI-compatible. A serial interface (RS-232) for the connection of a barcode reader and a printer interface is available in addition; a user-definable parallel interface allows direct connection of component feeders.

Extras

- **Option 10:** output attenuator up to 60 dB
- **Option 70:** time domain analysis (TDR)

Frequency range	Model		
300 kHz to 3.8 GHz	R3765AG	R3765BG	R3765CG
300 kHz to 8 GHz	R3767AG	R3767BG	R3767CG
Display	TFT colour LC display (640 x 480 dots), 8.4“		
Output level	+17 to –3 dBm	+7 to –13 dBm	+10 to –10 dBm
S parameter	A/R, B/R	S_{11}, S_{21}	S_{11}, S_{21}, S_{12}, S_{22}

Vector Network Analyzers R3765, R3767G

- **Option 12:** 75-Ω version
- **Option 11:** 3-port test set
- **Option 14:** internal 4-port test set
- **Option 70/71:** software fixtures

Software Fixtures (Option 71/72)
Versatile simulation tool, that provides impedance transformation, matching circuits (embedding, deembedding), measurement of symmetrically components (option 71 only) and differential S parameters (option 71 only).

Software for various applications is available for automatic test routines, e.g. for duplexers, filters, TDR measurements on coaxial cables for finding faults and for the use of customer-specific calibration sets.

Specifications in brief

Measurement functions	
Number of measurement channels	models A/B: 2 channels/4 traces model C: 4 channels/8 traces
Measurement settings	
AH models	A/R, B/R, A/B, A, B
BH models	transmission, reflection
CH models	S11, S12, S21, S22, S11&S21, S22&S12
Display formats	log/lin amplitude, phase, group delay, real and imaginary part, |Z|, R,X, |Y|, G, B
Smith chart	marker display for log/lin amplitude, phase, real and imaginary part, R + jX, G + jB,
Polar coordinates	marker display for log/lin amplitude, phase, real and imaginary part
Signal characteristics	
Frequency range, resolution	300 kHz to 3.8 (8) GHz, 1 Hz
Measurement uncertainty (25 ±5°C)	±10 ppm
Output level	see overview of models
Resolution	0.01 dB
Accuracy (50 MHz, 25 ±5° C)	0.5 dB
Frequency response (25 ±5°C)	2 dB (V_{pp})
Impedance	50 Ω
Signal purity	
Harmonic distortion	<–20 dB
Nonharmonic distortion	<–30 dB
Phase noise (10 kHz offset, 1 kHz RBW)	(–85 dBc +20 log (f/40 MHz)) dBc
Sweep characteristics	
Parameters	frequency, level
Range	full frequency range or full level range depending on model
Sweep mode	lin/log frequency or level sweep; user-defined
Sweep time	0.15 ms/testpoint with 2-port calibration
Testpoints	3, 6, 11, 21, 51, 101, 201, 301, 601, 801, 1201
Trigger	continuous, single, external
Receiver characteristics	
Input	N connector, 50 Ω
Maximum input level	0 dBm (models A/B) +12 dBm (model C)
Noise level	with maximum input signal –90 dBc at RBW=3 kHz –100 dBc at RBW=10 kHz
Resolution bandwidth	10 Hz to 20 kHz in 1, 2, 3, 4, 5, 7 steps
Input crosstalk	
R3765 (<3.8 GHz)	–90 dB
Model C (2.6 to 3.8 GHz)	–85 dB
R3767 (<3,8 GHz)	–90 dB
R3767 (<8 GHz)	–70 dB
Directivity	
<2.6 GHz	–30 dB
<3.8 GHz	–26 dB
<8 GHz	–22 dB
Amplitude measurement	
Resolution	0.001 dB
Accuracy	
–10 dBm, 50 MHz, 25 ±5°C	±0.2 dB
Amplitude response	max. input level –10 dB
–10 to –60 dBm	±0.05 dB
Phase measurement	±180°
Resolution	0.01°
Frequency response	±2°
–10 to –50 dB	±0.3°
Group-delay measurement	1 ps to 250 s
Resolution	1 ps
Display	see overview of models
Markers	up to 10 independent markers + delta marker with the option of showing all markers in a list
Automatic search function	min, max, bandwidth, etc. SWR, filter parameters
Data transfer	
Built-in BASIC controller	provided as standard, high-speed evaluation functions for essential trace points through direct data access; control of external devices via IEC/IEEE bus
Disk drive	3.5", 720 Kbyte (DD), 1.44 Mbyte (HD)
External interfaces	15-pin VGA, Centronics IEC bus (IEEE 488.2, SCPI) RS-232-C (for BASIC controller only)
Parallel interface	24 bit, 2 x TTL 8-bit output, 2 x 4-bit input/output for BASIC applications; PS2 connector for US keyboard
External reference frequency	1, 2, 5, 10 MHz, >0 dBm
General data	
Power supply, AC	100 to 240 V, 48 to 66 Hz, max. 300 VA
Dimensions (W x H x D)	424 mm x 220 mm x 400 mm
Weight	18 kg

Ordering information

Vector Network Analyzers	R3765, R3767G

Vector Network and Component Analyzer R 3860

300 kHz to 8 GHz

High-speed, modular vector network and component analyzer with built-in 2-port, 3-port or 4-port test set

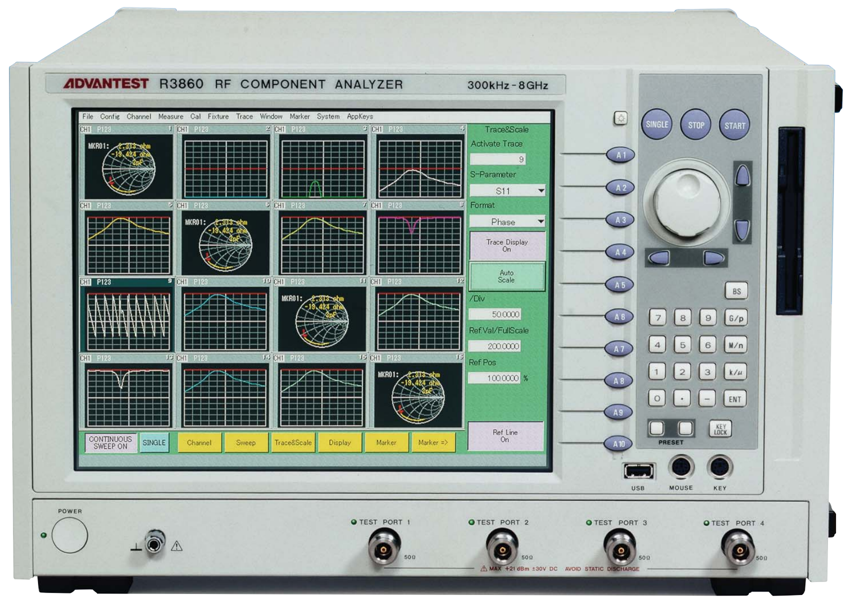


Photo 43869-1

New

Brief description

The R 3860 is a 2-port vector network analyzer of modular design, which can optionally be equipped with a 3-port or 4-port test set. The R 3860 is suitable for measurements on passive components, mixers and amplifiers.

The analyzer can be enhanced by additional modules, e.g. a power supply module for testing multiport components and modules. Comprehensive analysis of the components is thus possible with a single measuring instrument.

Integrated software simulations enable measurements on balanced components as increasingly used in mobile radio industry.

The R 3860 is based on a Windows NT platform and has a 12.1" LCD colour display (touch screen).

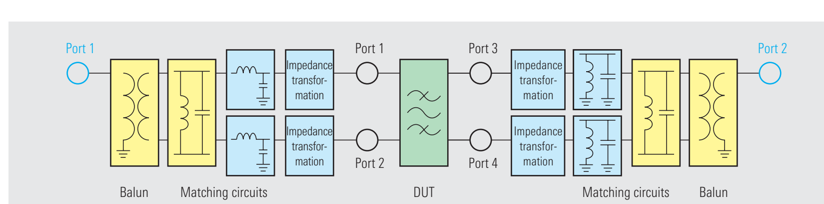
Main features

- Modular design for easy expandability
- Built-in 2-port , 3-port or 4-port test set
- Can be expanded to 9 or 12 ports with external test set
- Suitable for passive and active components
- Extremely high measurement speed (10 µs/point)
- High IEC/IEEE bus speeds allow efficient use in production environments
- Large 12.1" screen for display of up to 16 split windows and 8 channels
- Software simulation for measurement of balanced components
- Impedance transformation
- Simulation of matching circuits
- Baluns
- Measurement of differential S-parameters and symmetry
- Time domain analysis (TDR)

Calibration

In addition to conventional calibration standards, two automatic calibration kits can also be used. The automatic calibration kit is available for 2 ports or 4 ports.

Complete and fast 2-port, 3-port or 4-port calibration can thus be performed without having to change the calibration standards and without calibration errors.



Combination of software simulations for 4-port measurement

Vector Network and Component Analyzer R3860

Models and configurations

Configuration of ports	Basic unit + option
2-port basic unit incl. software simulations and TDR	R3860 + option 12
3-port basic unit incl. software simulations and TDR	R3860 + option 13
4-port basic unit incl. software simulations and TDR	R3860 + option 14

Multiport Test Adapter R3968

The external Test Adapter R3968 can be used for analyzing multiport components and modules, for example in mobile radio industry. It can be configured as a 9-port or 12-port adapter and is controlled by the R3860.

Multiport Test Adapter R3968 (photo 43881)

Specifications in brief

Measurement functions

Measurement channels	8
Display windows	16
Tracing	16 traces/channels (up to 16 traces can be displayed simultaneously)
Measurement parameters	
OPT12	S_{11}, S_{21}, S_{12}, S_{22}
OPT13	S_{11}, S_{22}, S_{33}, S_{21}, S_{12}, S_{31}, S_{13}, S_{23}, S_{32}
OPT14	S_{11}, S_{22}, S_{33}, S_{44}, S_{21}, S_{31}, S_{41}, S_{12}, S_{32}, S_{42}, S_{13}, S_{23}, S_{43}, S_{14}, S_{24}, S_{34} can be converted to impedances (Z) or admittances (Y) by the parameter conversion function, if required
Measurement format	
Orthogonal coordinates display	amplitude (linear/logarithmic), phase, group delay, VSWR, complex number (real/imaginary)
Smith chart	marker reading values are linear/logarithmic amplitude, phase, complex number (real/imaginary) R + jX, G + jB
Polar coordinates display	marker reading values are linear/logarithmic amplitude, phase, complex number (real/imaginary)
Error correction	normalize, 1-port, 2-port, 3-port (OPT13/14 only), 4-port (OPT14 only), averaging, smoothing, electric length, phase offset
Marker	16 multimarkers, delta marker, search function, marker --> function

Signal source characteristics

Frequency	
Range	300 kHz to 8 GHz
Setting resolution	1 Hz
Measurement resolution	±0.01 ppm
Accuracy	±10 ppm
Temperature stability	±15 ppm (5°C to 40°C, typ.)
Aging	±3 ppm/year, typ.
Output power	
Range	
OPT12/13	+7 dBm to –13 dBm
OPT12/14	+5 dBm to –13 dBm
Resolution	0.01 dB
Accuracy	±0.5 dB (50 MHz, 0 dB) specified at TEST PORT 1
Flatness	2 dB (pp) specified at TEST PORT 1
Linearity	
OPT12/13	
300 kHz to 15 MHz	±0.4 dB (–8 dBm +2 dBm, ref. to 0 dBm) ±0.8 dB (–13 dBm +7 dBm, ref. to 0 dBm)
15 MHz to 8 GHz	±0.2 dB (–8 dBm +2 dBm, ref. to 0 dBm) ±0.4 dB (–13 dBm +7 dBm, ref. to 0 dBm)
OPT14	
300 kHz to 15 MHz	±0.4 dB (–8 dBm +2 dBm, ref. to 0 dBm) ±0.8 dB (–13 dBm +5 dBm, ref. to 0 dBm)
15 MHz to 8 GHz	±0.2 dB (–8 dBm +2 dBm, ref. to 0 dBm) ±0.4 dB (–13 dBm +5 dBm, ref. to 0 dBm)
Signal purity	
Harmonics	–20 dBc (max. output level)
Nonharmonics	–30 dBc (max. output level)
Phase noise (10 kHz offset)	
300 kHz to 990 MHz	–106 dBc (Hz)
990 kHz to 1.98 GHz	–100 dBc (Hz)
1.98 GHz to 3.96 GHz	–94 dBc (Hz)
3.96 GHz to 8 GHz	–88 dBc (Hz)
Sweep	linear, log, program, power
Time	10 µs/point (RBW 400 kHz)
Number of points	3 to 1601
Trigger	continuous, single, hold, external

Vector Network and Component Analyzer R 3860

Receiving section characteristics

Resolution bandwidth	400 kHz, 200 kHz, 150 kHz, 100 kHz, 100 kHz to 10 Hz (in steps of 1, 1.5, 2, 3, 4, 5, 7)
Stability	
Trace noise	
300 kHz to 15 MHz	0.005 dB (rms) (RBW 10 kHz, typ.)
15 MHz to 990 MHz	0.005 dB (rms) (RBW 100 kHz, typ.)
990 MHz to 1.98 GHz	0.01 dB (rms) (RBW 100 kHz, typ.)
1.98 GHz to 3.96 GHz	0.02 dB (rms) (RBW 100 kHz, typ.)
3.96 GHz to 8 GHz	0.04 dB (rms) (RBW 100 kHz, typ.)
Temperature	
300 kHz to 2.6 GHz	0.01 dB/°C typ.
2.6 GHz to 8 GHz	0.02 dB/°C typ.
Aging	0.005 dB/week, typ.
Amplitude characteristics	
Resolution	0.001 dB
Frequency characteristics	±1 dB
Dynamic accuracy	referred to an input range from the maximum input level to –20 dB
0 to –10 dB	±0.2 dB (300 kHz to 3.8 GHz)
0 to –10 dB	±0.4 dB (3.8 GHz to 8 GHz)
–10 to –50 dB	±0.05 dB
–50 to –60 dB	±0.1 dB
–60 to –70 dB	±0.4 dB
–70 to –90 dB	±1.0 dB
Phase characteristics	
Resolution	0.01°
Dynamic accuracy	referred to an input range from the maximum input level to –20 dB
0 to –10 dB	±0.2° (300 kHz to 3.8 GHz)
0 to –10 dB	±0.4° (3.8 GHz to 8 GHz)
–10 to –50 dB	±0.3°
–50 to –60 dB	±0.4°
–60 to –70 dB	±1.5°
–70 to –80 dB	±4.0°
–80 to –90 dB	±8.0°

Test port characteristics

Load matching	–16 dB (300 kHz to 40 MHz)
	–20 dB (40 MHz to 2.6 GHz)
	–16 dB (2.6 GHz to 3.8 GHz)
	–14 dB (3.8 GHz to 8.0 GHz)
Source matching	–14 dB (300 kHz to 40 MHz)
	–18 dB (40 MHz to 2.6 GHz)
	–15 dB (2.6 GHz to 3.8 GHz)
	–12 dB (3.8 GHz to 8.0 GHz)
Polarity	–28 dB (300 kHz to 40 MHz)
	–30 dB (40 MHz to 2.6 GHz)
	–26 dB (2.6 GHz to 3.8 GHz)
	–22 dB (3.8 GHz to 8.0 GHz)
Crosstalk	–90 dB (300 kHz to 40 MHz)
	–100 dB (40 MHz to 2.6 GHz)
	–90 dB (2.6 GHz to 3.8 GHz)
	–80 dB (3.8 GHz to 5.0 GHz)
	–70 dB (5.0 GHz to 8.0 GHz)
Max. input level	+5 dBm
Noise level (at max. input level, RBW =10 kHz)	
300 kHz to 15 MHz	–82 dB
15 MHz to 100 MHz	–77 dB
100 MHz to 2.6 GHz	–85 dB
2.6 GHz to 8 GHz	–75 dB
Input damage level	+21 dBm, 30 V (DC)

Interfaces

Test port	N, female
External monitor	15-pin, D-Sub, VGA
Remote control	IEEE 488.2
Parallel output	TTL, 8 bits x 2 ports
Parallel input/output	TTL, 4 bits x 2 ports
Serial	accessory serial I/O
Printer	IEEE-1284-1994
LAN	10Base-T
Keyboard	PS/2, 101/106 keys
Mouse	PS/2
Ext. reference frequency input	1 MHz, 2 MHz, 5 MHz, 10 MHz (±10 ppm), 0 dBm, 50 Ω or more
Probe power	±15 V, ±0.5 V, 300 mA

General data

Display	12.1" SVGA, TFT, colour, touch screen, backlighting
Operating temperature range	+5°C to +40°C
Storage environment	hard disk 20 GB, floppy disk (–20°C to +60°C)
Power source	100 to 120 V (AC), 50/60 Hz 220 V to 240 V (AC), 50/60 Hz automatic switching between 100/220 V (AC)
Power consumption	max. 500 VA
Dimensions (W x H x D)	424 mm x 266 mm x 530 mm
Weight	max. 36 kg

Ordering information

Vector Network and Component Analyzer

Basic Unit incl. software solutions

2-PORT	R 3860 + OPT12
3-PORT	R 3860 + OPT13
4-PORT	R 3860 + OPT14

Accessories supplied instruction manual, power cable, pen for touch screen

Options

Multiport Test Adapter	R 3968
2-Port Automatic Calibration Kit	R17050
4-Port Automatic Calibration Kit	R17051

Further options are in preparation.

Harmonic Mixers R&S FS-Z60/-Z75/-Z90/-Z110

Frequency range extension to 110 GHz for Spectrum Analyzers R&S FSEM and R&S FSEK, Signal Analyzers R&S FSIQ26 and EMI Test Receivers R&S ESIB26 and R&S ESIB40

Photo 43662-5

Brief description

Harmonic Mixers R&S FS-Z60/-Z75/-Z90/-Z110 extend the frequency range of Spectrum Analyzers R&S FSEM and R&S FSEK, EMI Test Receivers ESIB26 and ESIB40 and Signal Analyzers R&S FSIQ26.

The mixers are available with standard waveguide flanges to cover the following bands:

- R&S FS-Z60: 40 GHz to 60 GHz (V band)
- R&S FS-Z75: 50 GHz to 75 GHz (V band)
- R&S FS-Z90: 60 GHz to 90 GHz (E band)
- R&S FS-Z110: 75 GHz to 110 GHz (W band)

Main features

No additional biasing required
Due to their double diode design these mixers feature flat frequency response and require no additional biasing which makes them especially suitable for automated measurements. High accuracy requirements are met when operating the mixers with R&S FSEM/K, R&S FSIQ26, ESI26 or ESI40. Therefore the harmonic mixers are suitable for EMC measurement applications.

Individual conversion loss table supplied
For each mixer an individual conversion loss table with 50 frequency points is supplied as a hardcopy and as a file on floppy disk. The data file can be transferred to the hard disk of the measuring instruments mentioned above. Once the file is activated, all additionally required parameters for mixer operation will be set automatically. This makes for extreme ease of operation. For quick reference each mixer is labelled with a look-up table with reduced number of data points.

High sensitivity
The low conversion loss and the high LO frequency range enable the user to measure even very low level signals.

High large-signal immunity
With a typical 1 dB compression point of +6 dBm and low conversion loss the mixers feature a very high dynamic range. Measurements of low level signals are possible even in the presence of high level signals, which considerably facilitates practical use.

Transparent spectrum display
Due to the high LO frequency (up to 15.2 GHz) and the resultant low order of harmonics used the number of unwanted responses is low. This yields a highly transparent spectrum display. Additionally the unwanted components can be automatically identified and suppressed by R&S FSE/R&S FSIQ/ESIB.

Wide image-free frequency range
When operated with the R&S FSE/R&S FSIQ/ESIB the high intermediate frequency of 741.4 MHz results in a wide frequency range without the display of image frequency responses. With low level input signals an image-free frequency range of 1482.8 MHz is obtained.

Harmonic Mixers R&S FS-Z60/-Z75/-Z90/-Z110

Specifications

Frequency range/level	**R&S FS-Z60**	**R&S FS-Z75**	**R&S FS-Z90**	**R&S FS-Z110**
Frequency range	40 GHz to 60 GHz	50 GHz to 75 GHz	60 GHz to 90 GHz	75 Ghz to 110 GHz
Maximum input level (LO level <19 dBm)				
CW RF	+16 dBm			
CW RF (+40°C to +60°)C	+13 dBm			
1 dB compression	+6 dBm nominal			
Odd-order suppression	20 dB typ.			
Conversion loss (when used with R&S FSE/FSIQ/ESIB)	≤25 dB, 18 dB typ.	≤34 dB, 25 dB typ.	≤37.5 dB, 34 dB typ.	≤40 dB, 32 dB typ.
Frequency response within any 5 GHz band	<3 dB	<3 dB	<5 dB	<6 dB
Displayed average noise level				
when used with R&S FSE/R&S FSIQ/ESIB (RBW 1 kHz, VBW 100 Hz, 20 averages, trace average)	≤–107dBm –114 dBm typ.	≤–98 dBm –107 dBm typ.	≤–94 dBm –98 dBm typ.	≤–92 dBm –100 dBm typ.
Measurement uncertainty				
Level uncertainty (95% confidence level, when used with R&S FSE/R&S FSIQ/ESIB)LO level +12,5 to +18,5 dBm)	<3.0 dB (+25°C) <4.5 dB (+5°C to +40°C)			
Temperature drift (max.)				
+5°C to +40°C	<1.5 dB			
–20°C to +60°C	<2.5 dB			
RF input	WR 19, UG-383/ U-M flange (modified)	WR 15, UG-385/ U flange	WR 12, UG-387/ U flange	WR 10, UG-387/ U-M flange (modified)
VSWR	<3.5:1, 2.2:1 typ.	<3.5:1, 2.2:1 typ.	<3.6:1, 2.5:1 typ.	<3:1, 2.3:1 typ.
LO input/IF output				
Connector	SMA-connector			
LO signal				
Frequency range	9.81 GHz to 15.19 GHz	8.21 GHz to 12.62 GHz	8.21 GHz to 12.62 GHz	9.4 GHz to 14 GHz
Harmonic number	4	6	6	8
Optimum LO level	+15.5 dBm	+15.5 dBm	+15.5 dBm	+14 dBm
Maximum LO level	+19 dBm			
IF signal				
IF (nom.)	741.4 MHz	741.4 MHz	741.4 MHz	–
General data				
Nominal temperature range	+5°C to +40°C			
Limit temperature range	–20°C to +60°C			
Dimensions in mm (W x H x D)	28.6 x 33.8 x 63.5	20 x 29.5 x 60	20 x 29.5 x 60	28.6 x 33.8 x 63.5
Weight	170 g	150 g	150 g	150 g

Ordering information

Harmonic Mixer		
40 GHz to 60 GHz	R&S FS-Z60	1089.0799.02
50 GHz to 75 GHz	R&S FS-Z75	1089.0847.02
60 GHz to 90 GHz	R&S FS-Z90	1089.0899.02
75 GHz to 110 GHz	R&S FS-Z110	1089.0947.02
Required option for external mixing (for R&S FSEK/M ESIB26/40, R&S FSIQ26)	R&S FSE-B21	1084.7243.02
Accessories supplied [1)]		
Operating manual, disk with conversion loss data, chart with conversion loss data, carrying case		

1) Connection cable is supplied with option R&S FSE-B21.

SWR Bridges R&S ZRA, R&S ZRB2, R&S ZRC, R&S VCA-Z1

Measurement of reflection coefficient of RF circuits and components

R&S ZRA	**40 kHz to 150 MHz**
R&S ZRB2	**5 MHz to 3 GHz**
R&S ZRC	**40 kHz to 4 GHz**
R&S VCA-Z1	**5 MHz to 850 MHz**

SWR Bridge R&S ZRC with calibration standards (photo 40527)

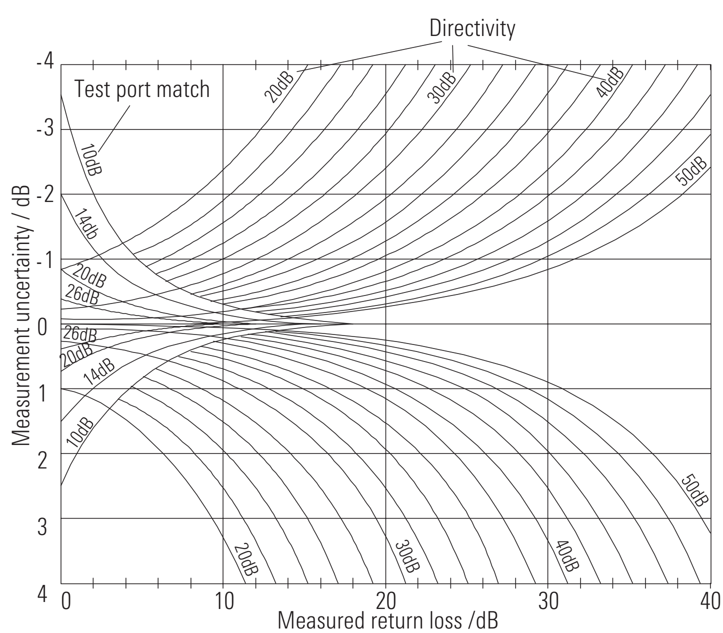
Brief description

SWR bridges are used for measuring the reflection coefficient of RF circuits and components. The output signal from the signal generator, e.g. the tracking generator of Spectrum Analyzer FSE or one Network Analyzer ZVx is applied to the device under test via the SWR bridge. Depending on the reflection coefficient of the device under test, part of the signal is reflected to the bridge and then routed to the receiver, e.g. to the test input of FSE or in the case of external test sets to the additional test input "Input b2" or "Input b1", where it is detected and displayed.

Measurement accuracy

The accuracy of the bridge is limited by its directivity as well as by the SWR of the bridge at the test port. The measurement of small reflection coefficients is affected by the finite directivity. Reflection coefficients that are smaller than the directivity cannot be measured directly. In measurements of large reflection coefficients, the accuracy depends primarily on the matching at the test port.

The diagram shown allows a quantitative evaluation of the measurement accuracy.



Measurement uncertainties as a function of directivity and test port matching of the bridge

SWR Bridges R&S ZRA, R&S ZRB2, R&S ZRC, R&S VCA-Z1

Specifications in brief, ordering information

Designation	**R&S ZRA**	**R&S ZRB2**	**R&S ZRB2 (precision)**	**R&S ZRB2**
Impedance	50 Ω	50 Ω	50 Ω	75 Ω
Frequency range	40 kHz to150 MHz	5 MHz to 2.5 GHz	5 MHz to 3 GHz	5 MHz to 2 GHz
Directivity	≥45 dB (up to 1 MHz) ≥40 dB (up to 150 MHz)	≥40 dB	≥46 dB (up to 2 GHz) ≥40 dB (up to 2.5 GHz) ≥34 dB (up to 3 GHz)	≥40 dB
Test port matching	≥20 dB (up to 200 kHz) ≥30 dB (0.2 to 50 MHz) ≥20 dB (up to 150 MHz)	≥23 dB	≥26 dB (up to 2.5 GHz) ≥22dB (up to3 GHz)	≥20 dB (up to1.5 GHz)
Insertion loss[1]	7.5 dB + 6 dB	7 dB + 6 dB	7 dB + 6 dB	8 dB + 6 dB
Power-handling capacity	0.5 W	0.5 W	0.5 W	0.5 W
Test port connector	N female	N female N male	N female N male	N female
Accessories supplied	----	----	----	----
Rated temperature range	0 to +50°C	0 to +50°C	0 to +50°C	0 to +50°C
Storage temperature range	–40 to +70°C	–40 to +70°C	–40 to +70°C	–40 to +70°C
Connectors[2]	N female	N female	N female	N female
Weight	240 g	240 g	240 g	250 g
Dimensions[3]	72 x 57 x 33	72 x 57 x 20	72 x 57 x 20	72 x 57 x 22
Order numbers	1052.3607.52	373.9017.53 373.9017.56	373.9017.52 373.9017.55	802.1018.73

Designation	**R&S ZRC**	**R&S ZRC**	**R&S VCA-Z1**
Impedance	50 Ω	75 Ω	75 Ω
Frequency range	40 kHz to 4 GHz	40 kHz to 2.5 GHz	5 MHz to 850 MHz
Directivity	≥40 dB (up to 3 GHz)	≥40 dB	≥40 dB (up to 300 MHz) ≥34 dB (up to 850 MHz)
Test port matching	≥12 dB + 11dB log (f/40 kHz) (up to 400 kHz) ≥23 dB (up to 3 GHz) ≥20 dB (3 GHz to 4 GHz)	≥8 dB + 12 dB log (f/40 kHz) (up to 400 kHz) ≥20 dB (400 kHz to 2.5 GHz)	≥20 dB
Insertion loss[1]	7 dB + 6 dB	7 dB + 6 dB	8 dB + 5 dB
Power-handling capacity	0.5 W	0.5 W	0.5 W
Test port connector	N female N male	N female N male	BNC male
Accessories supplied	short/open, termination, connector adapter	short/open, termination, connector adapter	–
Rated temperature range	0 to +50°C	0 to +50°C	0 to +50°C
Storage temperature range	–40 to +70°C	–40 to +70°C	–40 to +70°C
Connectors[2]	N female	N female	BNC female
Weight	340 g	340 g	250 g
Dimensions[3]	72 x 77 x 24	72 x 77 x 24	72 x 57 x 22
Order numbers	1039.9492.52 1039.9492.55	1039.9492.72 1039.9492.75	1052.5900.02

1) Input attenuation ----> test port + test port ---> output.

2) input, output.

3) in mm without connectors.

New approaches in generation of complex I/Q Signals with Vector Signal Generator R&S AMIQ and Signal Generator R&S SMIQ (photo 43304-5)

Contents of Chapter 5

Signal Generator R&S SMT

R&S SMT02: 5 kHz to 1.5 GHz

R&S SMT03: 5 kHz to 3 GHz

R&S SMT06: 5 kHz to 6 GHz

For receiver and EMS measurements

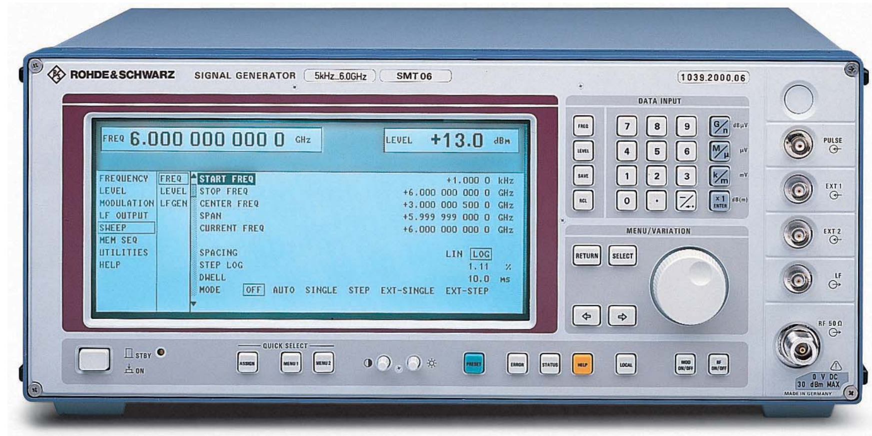


Photo 42353

Brief description

Signal Generator R&S SMT covers the complete range of conventional analog receiver measurements. It provides an exceptionally high signal quality for a generator in this price category, as well as outstanding level accuracy, a wide variety of modulation and signal generation modes, customized configuration, and great ease of operation. Features such as programmable RF, LF and level sweeps as well as the correction of external frequency response make the R&S SMT an ideal source for EMS measurements.

Main features

- Ideal EMS signal source with specified frequency range from 5 kHz
- AM, FM, φM, pulse modulation
- FM DC with high carrier frequency accuracy
- Broadband FM from DC to 8 MHz, broadband φM from DC to 2 MHz
- Convenient RF/LF/level sweep
- Programmable level correction (compensation of external frequency response)
- VOR/ILS generator (option SM-B6)
  – phase resolution 0.01°
  – DDM resolution 0.0001
- Stereo generator (option R&S SM-B6) for measurements on FM sound broadcast transmitters and receivers
- Large, backlit LCD for clear display of all relevant settings
- Minimum RF leakage due to special shielding measures
- Calibration interval of three years

Overview of options

Designation, functions		Option
Reference Oscillator OCXO: aging <1 x 10^{-9}/day		R&S SM-B1
LF Generator: supplies sinewave, noise 0.1 Hz to 500 kHz, triangular, squarewave 0.1 Hz to 50 kHz signals		R&S SM-B2
Pulse Modulator: on/off ratio >80 dB, rise/fall time <10 ns	R&S SMT02:	R&S SM-B3
	R&S SMT03:	R&S SM-B8
	R&S SMT06:	R&S SM-B9
Pulse Generator: only in conjunction with R&S SM-B3/R&S SM-B8/R&S SM-B9; provides single, delayed and double pulses		R&S SM-B4
Multifunction Generator: produces stereo multiplex and VOR/ILS signals as well as sinewave, noise 0.1 Hz to 1 MHz, triangular, sawtooth, squarewave 0.1 Hz to 50 kHz signals		R&S SM-B6
Rear Connectors for RF and LF: to replace front-panel connectors		R&S SMT-B19

Specifications in brief

Frequency			
Range	R&S SMT02	5 kHz to 1.5 GHz	
	R&S SMT03	5 kHz to 3 GHz	
	R&S SMT06	5 kHz to 6 GHz	
Resolution		0.1 Hz	
Phase offset		adjustable in 1° steps	
Reference frequency		standard	option SM-B1
Aging (after 30 days of operation)		1 x 10^{-6}/year	<1 x 10^{-9}/day
Temperature effect (0 to 55 °C)		2 x 10^{-6}	<5 x 10^{-8}

Spectral purity	
Spurious signals	
Harmonics	<–30 dBc, with SM-B8/-B9: <–26 dBc
Nonharmonics	
f <1.5 GHz	<–80 dBc
f >1.5 GHz	<–74 dBc
f >3 GHz	<–68 dBc
SSB phase noise at 20 kHz from carrier, 1 Hz bandwidth	
<67.5 MHz/125 MHz	<–120 dBc/<–134 dBc
250 MHz/500 MHz	<–128 dBc/<–122 dBc
1000 MHz/2000 MHz	<–116 dBc/<–110 dBc
3000 MHz/6000 MHz	<–109 dBc/<–103 dBc

Signal Generator R&S SMT

Residual FM, rms (f = 1 GHz)	
0.3 kHz to 3 kHz (CCITT)	<8 Hz
0.03 kHz to 20 kHz	<20 Hz
Level	–144 to +13 dBm
Resolution	0.1 dB
Accuracy for levels >–127dBm	
f <1.5 GHz	±1 dB
f >1.5 GHz	±1.5 dB
f >3 GHz	±2 dB
Level frequency response at 0 dBm	1 dB, 0.3 dB typ.
Overload protection	protects the unit from externally applied RF power (50 Ω source) and DC voltages, R&S SMT02 and 03: ≤50 W/35 V, R&S SMT06: ≤1 W/0 V
Simultaneous modulation	any combination of AM, FM (φM) and pulse modulation
Amplitude modulation	internal, external AC/DC
Modulation depth/resolution	0 to 100%/0.1%
Setting error at 1 kHz (m <80%)	<4% of reading ±1%
AM distortion at 1 kHz	
m = 30%	<1%
m = 80%	<2%
Modulation frequency range	DC to 100 kHz
Frequency modulation	internal, external AC/DC, two-tone with two separate channels FM1 and FM2
Maximum deviation	depending on carrier frequency: 5 MHz (at f_c <130 MHz) to 40 MHz (at f_c 6 GHz)
Setting error at AF = 1 kHz (FM AC)	<(3% of reading + 20 Hz)
FM distortion at AF = 1 kHz and 50% of max. deviation	<0.2%, 0.1% typ.
Modulation frequency response	
FM1/2: 20 Hz (DC) to 100 kHz	0.5 dB
FM2: 20 Hz (DC) to 8 MHz	3 dB
Stereo modulation	
Crosstalk attenuation	>50 dB
Unweighted S/N ratio	>76 dB
Carrier frequency offset (FM DC)	<0.1% of deviation
Phase modulation	internal, external AC/DC, two-tone with two separate channels broadband φM or narrowband φM (broadband φM only possible with φM2)
Maximum deviation	depending on carrier frequency
φM range 1: DC to 100 kHz	12.5 rad to 400 rad
φM range 2: DC to 2 MHz	0.625 rad to 20 rad
Pulse modulation	with option R&S SM-B3, R&S SM-B8, R&S SM-B9
Operating modes	external; internal with optional Pulse Generator R&S SM-B4
On/off ratio	>80 dB
Rise/fall time (10/90%)	<10 ns
Internal modulation generator	0.4/1/3/15 kHz ±3%
Level (EMF) at LF socket	1 V ±1% (R_{out} = 10 Ω, R_L >200 Ω)
LF generator	option R&S SM-B2
Sinewave, noise	0.1 Hz to 500 kHz
Triangular, squarewave	0.1 Hz to 50 kHz
Distortion (20 Hz to 100 kHz)	<0.1% (level >0.5 V)
Level (EMF) at LF socket	1 mV to 4 V (R_{out} = 10 Ω, R_L >200 Ω)

Multifunction generator	option R&S SM-B6
Modulation signals	sinewave, triangular, sawtooth, squarewave, noise, stereo MPX, VOR/ILS
Sinewave, noise	0.1 Hz to 1 MHz
Triangular, sawtooth, squarewave	0.1 Hz to 50 kHz
Distortion (20 Hz to 100 kHz)	<0.1% (level >0.5 V)
Level (EMF) at LF socket	1 mV to 4 V (R_{out} = 10 Ω, R_L >200 Ω)
Stereo multiplex signal	with option R&S SM-B6
Stereo operating modes	R, L, R = L, R = –L, ARI (pilot tone or MPX signal can be connected to LF socket)
Frequency range of L, R signal	0.1 Hz to 15 kHz
Preemphasis	50 µs, 75 µs
Pilot-tone frequency	19 kHz ±1 Hz
Pilot phase/resolution	0 to 360°/0.1°
VOR modulation signal	with option R&S SM-B6
Settings	30 Hz (VAR, REF)/ 9.96 kHz FM carrier, FM deviation, COM/ID tone
Phase/phase resolution	0 to 360°/0.01°
Bearing error (RF output, 108 to 118 MHz)	<0.05°
ILS modulation signal	with option R&S SM-B6
Settings	90 Hz, 150 Hz tone, COM/ID tone, marker beacon
DDM setting range/resolution	0 to ±0.8/0.0001
DDM error (RF output)	
Localizer (108 MHz to 112 MHz)	<0.0004 + 1% of DDM reading
Glideslope (329 MHz to 335 MHz)	<0.0008 + 1% of DDM reading
Pulse generator	option R&S SM-B4
Operating modes	single, delayed and double pulse
Pulse repetition period	100 ns to 85 s
Pulse width	20 ns to 1 s
Pulse delay	40 ns to 1 s
Double pulse	60 ns to 1 s
Sweep	digital sweep in discrete steps for RF, level and LF LF sweep with option R&S SM-B2 or R&S SM-B6
Remote control	IEC 625 (IEEE 488)
Command set	SCPI 1993.0
General data	
Power supply	90 V to 132 V/180 V to 265 V, 47 Hz to 440 Hz (300 VA)
Dimensions (W x H x D)	435 mm x 192 mm x 350 mm
Weight	20 kg for fully equipped unit

Ordering information

Signal Generator	R&S SMT02	1039.2000.02
	R&S SMT03	1039.2000.03
	R&S SMT06	1039.2000.06
Options		
Reference Oscillator OCXO	R&S SM-B1	1036.7599.02
LF Generator	R&S SM-B2	1036.7947.02
Pulse Modulator		
for R&S SMT02	R&S SM-B3	1036.6340.02
for R&S SMT03	R&S SM-B8	1036.6805.02
for R&S SMT06	R&S SM-B9	1039.5100.02
Pulse Generator (only in combination with R&S SM-B3, -B8 or -B9)	R&S SM-B4	1036.9310.02
Multifunction Generator	R&S SM-B6	1036.7760.02
Rear Connectors for RF and LF	R&S SMT-B19	1039.4003.02

Signal Generator SML01

SML01: 9 kHz to 1.1 GHz

SML02: 9 kHz to 2.2 GHz

SML03: 9 kHz to 3.3 GHz

Economy at its best

Photo 43412-2

New

Brief description

SML offers all features required of a state-of-the-art general-purpose signal generator: wide frequency range, large variety of modulation functions and high reliability – at an extremely attractive price. The fields of application of SML are virtually unlimited in development, servicing or production where it is used as a flexible signal source in automatic test systems. SML benefits both from our long-standing experience in the field of signal generators and the latest technology. Its uses are as versatile as its functionalities.

Main features

Frequency
- 9 kHz to 1.1 GHz/2.2 GHz/3.3 GHz
- 0.1 Hz frequency resolution

Level
- –140 dBm to +13 dBm (+19 dBm overrange)
- High level accuracy (deviation <0.5 dB)
- Level setting without overshoots
- Electronic attenuator
- Non-interrupting level setting

Spectral purity
- SSB phase noise <–122 dBc (1 Hz), <–128 dBc (1 Hz) typ. (at carrier offset 20 kHz)
- Broadband noise <–140 dBc (1 Hz), –150 dBc (1 Hz) typ. (f = 1 GHz, carrier offset >2 MHz)

Speed
- Setting times <10 ms for frequency and level

Modulation
- AM/FM/φM as standard
- Simultaneous operation of AM, FM/φM and pulse modulation
- Optional pulse modulator with integrated pulse generator (SML-B3)

Low cost of ownership
- 3-year calibration cycle
- Low purchase price
- High reliability through electronic attenuator (wear-free)
- Service-friendly (continuous selftest, access to internal test points via LCD)
- Options OCXO (SML-B1) and pulse modulator (SML-B3) retrofittable

Size
- Compact size: 427 mm x 88 mm x 450 mm
- Low weight: <8 kg

Applications

The use of a signal generator in the laboratory requires
- Wide frequency range
- High spectral purity
- High and accurate output level
- Very good modulation characteristics

These features are particularly important in servicing
- High mobility
- Flexible control
- Protection against overvoltage

In production these factors play a vital role
- Accuracy for high yield
- Speed for high throughput
- Reliability for undisturbed operation

EMS measurements require
- Non-interrupting level setting
- Level setting without overshoots
- Wide frequency range

Stereo/RDS Coder SML-B5 (option)

Fitted with the new option, the signal generators of the tried and tested SML and SMV families generate stereo-modulated RF signals to standard for use in production, development and service. At the core of this option is a digital signal processor (DSP) that generates stereo, RDS and ARI signals of outstanding quality, which is fully sustained owing to the excellent FM modulators in the generators.

User-friendly operation

- One-hand operation with EasyWheel
- All settings simple and self-explanatory
- High-contrast LC display
- User-assignable menu keys
- Online help including IEC/IEEE bus commands

Specifications in brief

Specifications are valid under the following conditions:
15 minutes warm-up time at ambient temperature, specified environmental conditions met, calibration cycle adhered to, and total calibration performed.
Data without tolerances: typical values only.
Data designated with "nominal" apply to design parameters and are not tested.
Data designated "overrange" are not warranted.

Frequency

Range	9 kHz to 1.1 GHz
SML01	9 kHz to 1.1 GHz
SML02	9 kHz to 2.2 GHz
SML03	9 kHz to 3.3 GHz
Resolution	0.1 Hz
Setting time (for an offset of $<1\times10^{-7}$ or <90 Hz for f ≤76 MHz)	<10 ms

Reference frequency

	Standard	Option SML-B1
Aging (after 30 days of operation)	$<1\times10^{-6}$/year	$<1\times10^{-7}$/year or $<5\times10^{-10}$/day
Temperature drift (0°C to 55°C)	$<1\times10^{-6}$	$<2\times10^{-8}$

Spectral purity

Spurious signals	
Harmonics [1]	
SML01	<–30 dBc at levels ≤+10 dBm
SML02/SML03	
f ≤20 kHz	<–25 dBc at levels ≤+8 dBm
f >20 kHz	<–30 dBc at levels ≤+8 dBm
Subharmonics	
f ≤1.1 GHz	none
f >1.1 GHz	<–50 dBc
Nonharmonics	<–70 dBc
(carrier offset >10 kHz)	
f ≤1,1 GHz	<–70 dBc
f >1.1 GHz to 2.2 GHz	<–64 dBc
f >2.2 GHz to 3.3 GHz	<–58 dBc
Broadband noise [2] (f = 1GHz, carrier offset >2 MHz, 1 Hz bandwidth)	<–140 dBc, –150 dBc typ.
SSB noise (f = 1 GHz, 20 kHz carrier offset, 1 Hz bandwidth)	<–122 dBc, –128 dBc typ.
Spurious FM, rms (f = 1 GHz)	
0.3 kHz to 3 kHz	<4 Hz, 1 Hz typ.
0.03 kHz to 20 kHz	<10 Hz, 3 Hz typ.
Spurious AM, rms (0.03 kHz to 20 kHz)	<0.02%

Level

Range	–140 dBm to +13 dBm[3] (Overrange +19 dBm)
Resolution	0.1 dB
Total level deviation[3] Output>–120 dBm	
SML01	<0.5 dB
SML02/SML03	
100 kHz to ≤ 2 GHz	<0.5 dB
f >2 GHz	<0.9 dB
Frequency response at 0 dBm[3]	
SML01	<0.5 dB, 0.3 dB typ.
SML02/SML03	
100 kHz to ≤ 2 GHz	<0.7 dB
f >2 GHz	<1,0 dB
Characteristic impedance	50 Ω
VSWR SML01	<1,5
VSWR SML02/03	
100kHz to 1.5 Ghz	1.6
f >1.5 GHz	2.3
Setting time (IEC/IEEE bus), f >100 kHz	<10 ms, 5 ms typ.
Non-interrupting level setting[4]	20 dB, overrange 30 dB

Overvoltage protection	safeguards unit against externally applied RF power and DC voltage (50 Ω source)
Max. permissible RF power f ≤2.2 GHz	50 W
Max. permissible RF power f >2.2 GHz	25 W
Max. permissible DC voltage	35 V

Internal modulation generator

Frequency range; Resolution	0.1 Hz to 1 MHz; 0.1 Hz
Frequency accuracy	as for reference frequency + 2.4×10^{-3} Hz
Frequency response (up to 500 kHz, level >100 mV)	<0.5 dB
THD (up to 100 kHz, level 4 V, R_L = 600 Ω)	<0.1%
Open-circuit voltage V_p (LF connector)	1 mV to 4 V
Resolution	1 mV
Setting accuracy (at 1 kHz)	1% of V_P+ 1 mV
Output impedance	approx. 10 Ω
Frequency setting time	<10 ms

Simultaneous modulation	AM, FM/φM and pulse modulation

Amplitude modulation[5]

Operating modes	internal, external AC/DC, internal/external two-tone
Modulation depth; Resolution	0% to 100%; 0.1%
Setting accuracy at 1 kHz (m <80%)[6]	<4% of reading +1%
AM distortion at 1 kHz	
m = 30%	<1%
m = 80%	<2%
Modulation frequency range (3 dB), f >100 kHz	DC/10 Hz to 50 kHz
Incidental φM at AM (30%), AF = 1 kHz	<0.2 rad

Frequency modulation

Operating modes	internal, external AC/DC, internal/external two-tone
Frequency deviation	
9 kHz to 76 MHz	0 Hz to 1 MHz
>76 MHz to 151.3125 MHz	0 Hz to 125 kHz
>151.3125 MHz to 302.625 MHz	0 Hz to 250 kHz
>302.625 MHz to 605.25 MHz	0 Hz to 500 kHz
>605,25 MHz to 1,2105 GHz	0 Hz to 1 MHz
>1,2105 GHz to 1,818 GHz	0 Hz to 2 MHz
>1,818 GHz to 2,655 GHz	0 Hz to 3 MHz
>2,655 GHz to 3,300 GHz	0 Hz to 4 MHz

Signal Generator SML

Resolution	<1% of set deviation, minimum 10 Hz
Setting accuracy (at AF = 1 kHz)	<4% of reading + 20 Hz
FM distortion (at AF = 1 kHz and 50% of max. deviation)	<0.2%, 0.1 % typ.
Modulation frequency range (–3 dB), standard/wide	DC/10 Hz to 100 kHz/500 kHz
Incidental AM (at AF = 1 kHz, f >10 MHz, 40 kHz deviation)	<0.1%
Stereo modulation at 40 kHz useful deviation, AF = 1 kHz, RF = 87 MHz to 108 MHz	
Crosstalk	>50 dB
S/N ratio unweighted, rms	>70 dB
S/N ratio weighted, rms	>70 dB
Distortion	<0.2%, 0.1% typ.
Carrier frequency offset at FM DC	0.1% typ. of set deviation

Phase modulation

Operating modes	internal, external AC/DC, internal/external two-tone
Phase deviation[7)]	
9 kHz to 76 MHz	0 rad to 10 (2) rad
>76 MHz to 151.3125 MHz	0 rad to 1.25 (0.25) rad
>151.3125 MHz to 302.625 MHz	0 rad to 2.5 (0.5) rad
>302.625 MHz to 605.25 MHz	0 rad to 5 (1) rad
>605.25 MHz to 1.2105 GHz	0 rad to 10 (2) rad
>1.2105 GHz to 1.818 GHz	0 rad to 20 (4) rad
>1.818 GHz to 2.655 GHz	0 rad to 30 (6) rad
>2.655 GHz to 3.300 GHz	0 rad to 40 (8) rad
Resolution	<1%, min. 0.001 rad
Setting accuracy at AF = 1 kHz	<4% of reading + 0.02 rad
Phase distortion (at AF = 1 kHz and 50% of maximum deviation)	<0.2%, 0.1% typ.
Modulation frequency range (–3 dB), standard/wide	DC/10 Hz to 100 kHz/500 kHz

Pulse modulation (with option SML-B3)

Operating modes	internal, external
On/off ratio	>80 dB
Rise/fall time (10%/90%)	<20 ns, 10 ns typ.
Pulse repetition frequency	0 MHz to 2.5 MHz
Pulse delay	50 ns typ.
Video crosstalk (V_p)	<30 mV

Pulse generator (with option SML-B3)

Operating modes	automatic, externally triggered, external gate mode, single pulse, double pulse, delayed pulse (externally triggered)
Active trigger edge	positive or negative
Pulse period	100 ns to 85 s
Resolution	5 digits, min. 20 ns
Accuracy	$<1 \times 10^{-4}$
Pulse width	20 ns to 1 s
Resolution	4 digits, min. 20 ns
Accuracy	$<(1 \times 10^{-4} + 3$ ns)
Pulse delay	20 ns to 1 s
Resolution	4 digits, min. 20 ns
Accuracy	$<(1 \times 10^{-4} + 3$ ns)
Double-pulse spacing	20 ns to 1 s
Resolution	4 digits, min. 20 ns
Accuracy	$<(1 \times 10^{-4} + 3$ ns)
Trigger delay	50 ns typ.
Jitter	<10 ns

Sweep	digital in discrete steps
RF sweep, AF sweep	
Operating modes	automatic, single shot, manually or externally triggered, linear or logarithmic
Sweep range	user-selectable
Step width (lin)	user-selectable
Step width (log)	0.01% to 100%
Level sweep	
Operating modes	automatic, single-shot, manually or externally triggered, logarithmic
Sweep range	user-selectable
Step width (log)	user-selectable
Step time	10 ms to 1 s
Resolution	0.1 ms

General data

Memory for device settings	100 storable settings
Remote control	IEC 625 (IEEE 488) and RS-232
Temperature resistance	
Nominal temperature range	0°C and 55°C; meets IEC68-2-1 and IEC68-2-2
Storage temperature range	–40°C to +70°C
Power supply	100 V to 120 V (AC), 50 Hz to 60 Hz, 200 V to 240 V (AC), 50 Hz to 60 Hz, autoranging, max. 150 VA
Dimensions (W x H x D)	427 mm x 88 mm x 450 mm
Weight	<8 kg when fully equipped

Ordering information

Signal Generator	SML01	1090.3000.11
	SML02	1090.3000.12
	SML03	1090.3000.13
Accessories supplied	power cable, user manual	
Options		
Reference Oscillator OCXO	SML-B1	1090.5790.02
Pulse Modulator	SML-B3	1090.5403.02[8)]
Stereo/RDS Coder	SML-B5	1147.8805.02
Rear Connectors for AF, RF	SML-B19	1090.5303.02[8)]
Extras		
Service Kit	SML-Z2	1090.5203.02
19" rack adapter	ZZA-211	1096.3260.00
Transport Bag	ZZT-214	1109.5119.00
Service Manual Modules		1090.3123.24

1) With option SML-B3 only for f > 20 MHz.

2) With Attenuator Mode Auto.

3) SML02, SML03: +11 dBm at f ≤5MHz, f>3GHz.

4) With Attenuator Mode Fixed.

5) With Attenuator Mode Auto, f≥100 kHz.

6) With option SML-B3 only for f > 10 MHz.

7) Values in brackets apply to wide modulation bandwidth.

8) Factory-fitted only.

Microwave Signal Generator SMP

SMP02, 22: 0.01/2 GHz to 20 GHz

SMP03: 0.01/2 GHz to 27 GHz

SMP04: 0.01/2 GHz to 40 GHz

Excellent signal characteristics and high output power up to 40 GHz

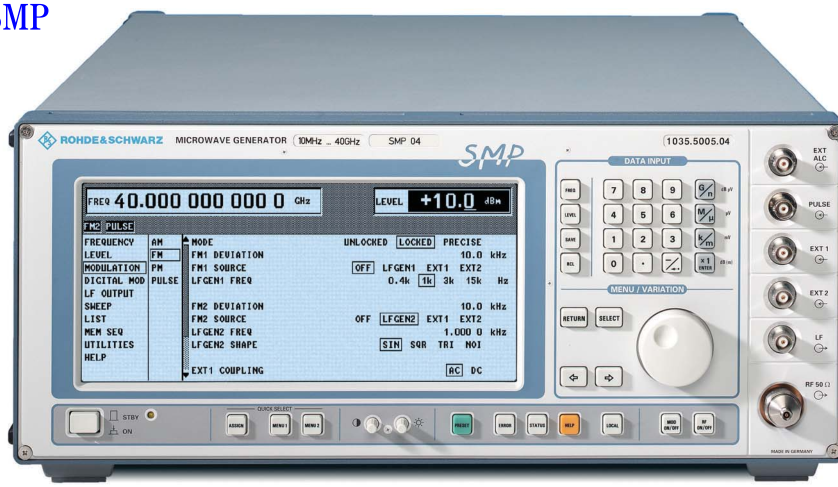


Photo 41 154

Brief description

SMP is a reliable, high-precision signal source featuring high output power, high spectral purity and excellent pulse modulation. It is able to supply signals for any measurements on radar and communications receivers. A wide range of extensions ensures universal use in R&D, production, EMC and environmental measurements as well as in material testing.

Main features

- High spectral purity
- Stable output frequency
- High output level:

SMP02	SMP22	SMP03	SMP04
>11.5	>20	>13	>10 dBm
at 20	20	27	40 GHz

- Fast settling after a frequency change
- AM, FM, φM, pulse modulation
- Scan modulation
- RF, AF and level sweep
- Large choice of options for user-specific configuration
- Great ease of operation through modern menu concept

Overview of options

Designation, functions	Option
Reference Oscillator OCXO: aging <1 x 10^{-9}/day	SM-B1
LF Generator: supplies sinewave, noise 0.1 Hz to 500 kHz, triangular, squarewave 0.1 Hz to 50 kHz signals	SM-B2
FM/φM Modulator: FM DC to 1 MHz, φM DC to 100 kHz, precision FM DC	SM-B5
Frequency Extension 0.01 GHz to 2 GHz[1)]: extends the lower frequency limit to 10 MHz	SMP-B11
Pulse Modulator 2 GHz to 20 GHz[1)]: on/off ratio >80 dB, rise/fall time <10 ns; for SMP02 and SMP22 only	SMP-B12, model 02
Pulse Modulator 2 GHz to 27 GHz[1)]: on/off ratio >80 dB, rise/fall time <10 ns; for SMP03 only	SMP-B12, model 03
Pulse Modulator 2 GHz to 40 GHz[1)]: on/off ratio >80 dB, rise/fall time <10 ns; for SMP04 only	SMP-B12, model 04
Pulse Modulator 0.01 GHz to 2 GHz[1)]: on/off ratio >80 dB, rise/fall time <10 ns	SMP-B13
Pulse Generator: provides single, delayed and double pulses	SMP-B14
RF Attenuator 27 GHz[1)]: allows level setting down to –130 dBm; for SMP02, SMP22 and SMP03 only	SMP-B15
RF Attenuator 40 GHz[1)]: allows level setting down to –130 dBm; for SMP04 only	SMP-B17
Auxiliary Interface: V/GHz output, Z output for scalar network analyzers	SMP-B18
Rear Connectors for RF and AF[1)]: to replace front-panel connectors; for SMP02, SMP22 and SMP03 only	SMP-B19
Rear Connectors for RF and AF[1)]: to replace front-panel connectors; for SMP04 only	SMP-B20

1) Factory-fitted option.

Microwave Signal Generator SMP

Specifications in brief

Frequency		
Range	standard	with option SMP-B11
SMP02, SMP22	2 to 20 GHz	10 MHz to 20 GHz
SMP03	2 to 27 GHz	10 MHz to 27 GHz
SMP04	2 to 40 GHz	10 MHz to 40 GHz
Resolution	0.1 Hz	
Setting time (to within <1 x 10^{-6}) after IEC/IEEE bus delimiter	<(11 ms + 5 ms/GHz)	

Reference frequency	**standard**	**option SM-B1**
Aging (after 30 days of operation)	1 x 10^{-6}/year	<1 x 10^{-9}/day
Temperature effect (0 to 55°C)	2 x 10^{-6}	<5 x 10^{-8}

Spectral purity				
Spurious signals	**SMP02**	**SMP22**	**SMP03**	**SMP04**
Harmonics:				
f <1.8 GHz	<–30 dBc (<+8 dBm)	<–25 dBc (<+8 dBm)	<–30 dBc (<+3 dBm)	<–30 dBc (<±0 dBm)
f ≥1.8 GHz	<–40 dBc (<+10 dBm)	<–25 dBc (<+15 dBm)	<–40 dBc (<+3 dBm)	<–40 dBc (<±0 dBm
Harmonics with options SMP-B12, -B13 (pulse modulation on):				
f <1.8 GHz	<–25 dBc (<+8 dBm)	<–25 dBc (<+8 dBm)	<–25 dBc (<+3 dBm)	<–25 dBc (<±0 dBm)
f ≥1.8 GHz	<–25 dBc (<+11 dBm)	<–25 dBc (<+11 dBm)	<–25 dBc (<+3 dBm)	<–25 dBc (<±0 dBm)
Subharmonics				
f ≤20 GHz	none	none	none	none
f >20 GHz	–	–	<–40 dBc	<–30 dBc
Nonharmonics at >10 kHz from carrier:				
f <2 GHz	typ. <–60 dBc	typ. <–60 dBc	typ. <–60 dBc	typ. <–60 dBc
2 to 20 GHz	<–60 dBc	<–60 dBc	<–60 dBc	<–60 dBc
f >20 GHz	–	–	<–54 dBc	<–54 dBc
SSB phase noise, 1 Hz bandwidth, FM off:		offset from carrier		
Frequency range	100 Hz	1 kHz	10 kHz	100 kHz
10 MHz to <2 GHz	<–64 dBc	<–92 dBc	<–98 dBc	<–101 dBc
2 to 10 GHz	<–64 dBc	<–92 dBc	<–98 dBc	<–101 dBc
>10 to 20 GHz	<–58 dBc	<–86 dBc	<–92 dBc	<–95 dBc
>20 to 27/40 GHz	<–54 dBc	<–80 dBc	<–86 dBc	<–92 dBc

Level				
Maximum level SMP02, SMP22				
Frequency range	SMP02, option SMP-B15		SMP22, option SMP-B15	
	without	with	without	with
10 MHz to <2 GHz	>+17 dBm	>+17 dBm	>+17 dBm	>+17 dBm
2 to 20 GHz	>+11.5 dBm	>+10 dBm	>+20 dBm	>+18.5 dBm
Maximum level SMP03, SMP04:				
Frequency range	SMP03, option SMP-B15		SMP04, option SMP-B17	
	without	with	without	with
10 MHz to <2 GHz	>+12 dBm	>+12 dBm	>+12 dBm	>+12 dBm
2 to <18 GHz	>+10 dBm	>+8.5 dBm	>+10 dBm	>+8.5 dBm
18 to 20 GHz	>+6 dBm	>+4.5 dBm	>+6 dBm	>+4.5 dBm
>20 to 27/33 GHz	>+13 dBm	>+11 dBm	>+12 dBm	>+10 dBm
>33 to 40 GHz	–	–	>+10 dBm	>+8 dBm

Modulation — any combination of AM scan, FM (φM) and pulse modulation

Amplitude modulation	**internal, external AC/DC**
Modulation depth/resolution	0 to 90%/0.1%
AM distortion at AF = 1 kHz (m = 60%), f >50 MHz	<1%, <0.5% typ.
Modulation frequency range	DC to 100 kHz

Frequency modulation	int., ext. AC/DC, locked/unlocked, two-tone with two separate channels FM1 and FM2
Standard frequency modulation	without option SM-B5
Maximum deviation	f ≤20 GHz: 10 MHz f >20 GHz: 20 MHz
FM distortion at AF = 50 kHz and 500 kHz deviation	<0.5%, 0.05% typ.
Modulation frequency range	
Locked mode	10 kHz to 5 MHz
Unlocked mode	DC to 5 MHz
FM with option SM-B5	standard FM available
Maximum deviation/resolution	
f ≤20 GHz	1 MHz/<1%, min. 10 Hz
f >20 GHz	2 MHz/<1%, min. 20 Hz
	FM distortion at AF = 1 kHz
and 500 kHz deviation	<0.5%, 0.05% typ.
Modulation frequency range	DC to 1 MHz

Phase modulation	with option SM-B5; int., ext. AC/DC, two-tone with two separate channels φM1 and φM2
Maximum deviation/resolution	
f ≤20 GHz	10 rad/<1%, min. 0.001 rad
f >20 GHz	20 rad/<1%, min. 0.002 rad
φM distortion at AF = 1 kHz and 5 rad deviation	<1%
Modulation frequency range	DC to 100 kHz

ASK modulation	external
Max. modulation depth	90%
Resolution	0.1%
Data rate	0 to 200 kHz

FSK modulation		external	
Maximum shift	standard FM	with option SM-B5	Resolution
f ≤20 GHz	10 MHz	1 MHz	<1%, min. 10 Hz
f >20 GHz	20 MHz	2 MHz	<1%, min. 20 Hz
Data rate (standard FM)			
Locked mode		20 kHz to 2 MHz	
Unlocked mode		0 to 2 MHz	
Data rate with option SM-B5		0 to 2 MHz	

Pulse modulation	ext., int. with option SMP-B14	
	w/o option SMP--B12, -B13	with option SMP--B12, -B13
Frequency range	≥2 GHz	-B13:10 MHz to 2 GHz -B12: ≥2 GHz
On/off ratio	>50 dB (level >0 dBm)	>80 dB
Rise/fall time (10/90%)	<500 ns	<10 ns
Minimum pulse width	1 µs	20 ns
Pulse repetition frequency	0 to 500 kHz	0 to 10 MHz
Pulse delay	100 ns typ.	50 ns typ.
Video feedthrough	<15 mV (peak value)	<15 mV (peak value)

Internal modulation generator	0.4/1/3/15 kHz ±3%
Level (EMF) at LF socket	1 V ±1% (R_{out} = 10 Ω, R_L >200 Ω)

Microwave Signal Generator SMP

LF generator	option SM-B2
Sinewave, noise	0.1 Hz to 500 kHz
Triangular, squarewave	0.1 Hz to 50 kHz
Distortion (20 Hz to 100 kHz)	<0.1% (level >0.5 V)
Level (EMF) at LF socket	1 mV to 4 V (R_{out} = 10 Ω, R_L >200 Ω)
Pulse generator	option SM-B4
Operating modes	single, delayed and double pulse
Pulse repetition period	100 ns to 85 s
Pulse width	20 ns to 1 s
Pulse delay	40 ns to 1 s
Double pulse	60 ns to 1 s
Sweep	digital sweep in discrete steps for RF, level and LF LF sweep with option SM-B2 or SM-B6
Interfaces	
2nd RF output	2 GHz to 20 GHz, 0 dBm
Auxiliary interface	with option SMP-B18
V/GHz output	output voltage proportional to frequency, 0.5 or 1 V/GHz selectable
Remote control	IEC 625 (IEEE 488)
Command set	SCPI 1993.0
General data	
Power supply	90 V to 132 V/180 V to 265 V, 47 Hz to 440 Hz, max. 400 VA
Dimensions (W x H x D)	435 mm x 192 mm x 570 mm
Weight	27 kg for fully equipped unit

Ordering information

Signal Generator	SMP02	1035.5005.02
	SMP22	1035.5005.22
	SMP03	1035.5005.03
	SMP04	1035.5005.04
Options		
Frequency Extension 10 MHz to 2 GHz[1)]	SMP-B11	1036.6240.02
Pulse Modulator [1)]		
2 GHz to 20 GHz (SMP02, SMP22)	SMP-B12	1036.5750.02
2 GHz to 27 GHz (SMP03)	SMP-B12	1036.5750.03
2 GHz to 40 GHz (SMP04)	SMP-B12	1036.5750.04
Pulse Modulator 10 MHz to 2 GHz[1)]	SMP-B13	1036.7147.02
Pulse Generator	SMP-B14	1036.7347.02
RF Attenuator 27 GHz[1)]	SMP-B15	1036.5250.02
40 GHz[1)]	SMP-B17	1036.5550.02
Auxiliary Interface	SMP-B18	1036.8920.02
Rear Connectors for AF, RF[1)]		
up to 27 GHz	SMP-B19	1039.4303.02
up to 40 GHz	SMP-B20	1039.4503.02
Reference Oscillator OCXO	SM-B1	1036.7599.02
LF Generator	SM-B2	1036.7947.02
FM/φM Modulator	SM-B5	1036.8489.02

1) Factory-fitted option.

Microwave Signal Generator R&S SMR

R&S SMR 20/27/30/40:

10 MHz to 20/27/30/40 GHz

High-performance,

cost-effective and

reliable up to 40 GHz

R&S SMR40 (photo 43264-5)

Brief description

The R&S SMR family comprises four basic models designed as CW generators with pulse modulation capability. Offering an excellent price/performance ratio, each of the four basic models is ideal for the user wishing to enter the field of microwave testing at an affordable price. Should measurements become more demanding - no problem with R&S SMR: all basic models can be upgraded fast and easily by means of options to give a signal generator with AM/FM modulation capability or a synthesized sweep generator featuring fast, fully synthesized analog ramp sweep.

Main features

Wide frequency range

- R&S SMR20: 1 GHz to 20 GHz
- R&S SMR27: 1 GHz to 27 GHz
- R&S SMR30: 1 GHz to 30 GHz
- R&S SMR40: 1 GHz to 40 GHz
- Optional extension of lower frequency limit to 10 MHz (R&S SMR-B11)
- Frequency resolution 1 kHz, optional 0.1 Hz (R&S SMR-B3)

High, levelled output power

- R&S SMR20 >+10 dBm (at 20 GHz)
- R&S SMR27 >+11 dBm (at 27 GHz)
- R&S SMR30/40 >+9 dBm (at 30/40 GHz)

High precisision output level

- High precision, frequency-response-compensated level control
- The setting range can be extended to –130 dBm with the optional RF attenuator (option R&S SMR-B15/B17)

Sweep capabilities

- Digital RF and level sweep (standard version)
- Analog ramp sweep (RF sweep, option R&S SMR-B4)
- Max. sweep rate for ramp sweeps min. 600 MHz/ms (frequency >2 GHz)
- Digital sweep of LF generator (with option R&S SMR-B5)
- 10 freely selectable frequency markers for RF sweep
- Operating modes: automatic, single-shot, manual, externally triggered

Maximum ease of operation

- High-contrast LC display
- Online help including IEC/IEEE bus commands
- All settings simple and self-explanatory
- User-assignable keys
- One-hand operation with EasyWheel

Memory

- Space for 50 complete instrument setups
- Convenient memory sequence modes

Optional pulse generator SMR-B14

- Operating modes: single pulse, double pulse, externally triggered, gate mode
- Pulse repetition 100 ns to 85 s
- Pulse width 20 ns to 1 s

Optional IF input (R&S SMR-B23/R&S SMR-B24/R&S SMR-B25)

- Built-in upconverter for digitally modulated IF signals from DC to 700 MHz or from 40 MHz to 6 GHz (R&S SMR-B25)
- Ideal for use with Vector Signal Generator R&S SMIQ and I/Q Modulation Generator AMIQ

Advantages at a glance

- CW generator with pulse modulation and digital frequency sweep, easily upgradeable to AM-FM signal generator and synthesized sweeper with analog ramp sweep thanks to flexible options concept
- Excellent spectral purity, high-precision output level and stable output frequency
- Simultaneous modulation modes for generation of complex modulation signals for modern communication and location systems
- Compact, lightweight, user-friendly: ideal in the lab and for field applications
- 3-year calibration cycle
- Excellent price/performance ratio

Microwave Signal Generator R&S SMR

Specifications in brief

Specifications are valid under the following conditions:
15 minutes warm-up time at ambient temperature, specified environmental conditions met, calibration cycle adhered to, and total calibration performed.
Data without tolerances: typical values only.
Data designated with "nominal" apply to design parameters and are not tested.
Data designated "overrange" are not guaranteed.

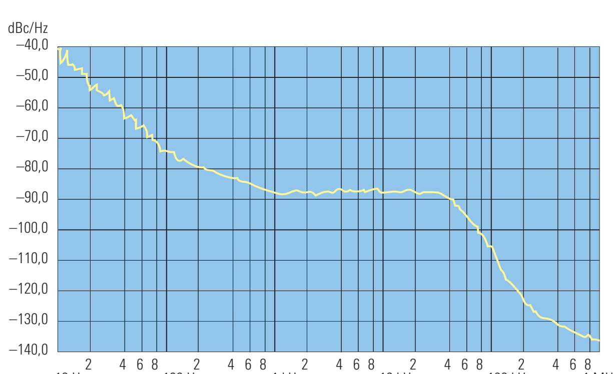
Frequency

Range	w/o option SMR-B11	with option SMR-B11
R&S SMR 20	1 GHz to 20 GHz	10 MHz to 20 GHz
R&S SMR 27	1 GHz to 27 GHz	10 MHz to 27 GHz
R&S SMR 30	1 GHz to 30 GHz	10 MHz to 30 GHz
R&S SMR 40	1GHz to 40 GHz	10 MHz to 40 GHz
Resolution	without option R&S SMR-B3	with option R&S SMR-B3
	1 kHz	0.1 Hz
Setting time (to within $<1\cdot10^{-6}$)	<10 ms + 1 ms/GHz	

Reference frequency	**Standard**	**Option R&S SMR-B1**
Aging (after 30 days of operation)	$1\cdot10^{-6}$/Year	$<1\cdot10^{-7}$/Year
Temperature effect (0°C to 55°C)	$2\cdot10^{-6}$	$<1\cdot10^{-10}$/°C

Spectral purity

Spurious signals	
Harmonics	
f ≤20 GHz	<–55 dBc
f >20 GHz	<–40 dBc
Subharmonics	
f ≤20 GHz	<–65 dBc
f >20 GHz	<–30 dBc
Nonharmonics (>50 kHz from carrier)	
f <20 GHz	<–60 dBc
f >20 GHz	<–54 dBc
SSB phase noise (f = 10 GHz, 10 kHz from carrier, 1 Hz bandwidth, CW, FM OFF)	<–83 dBc
Residual FM, rms (f = 10 GHz, FM OFF)	
0.3 kHz to 3 kHz	<20 Hz
0.03 kHz to 20 kHz	<200 Hz



SSB phase noise at 10 GHz

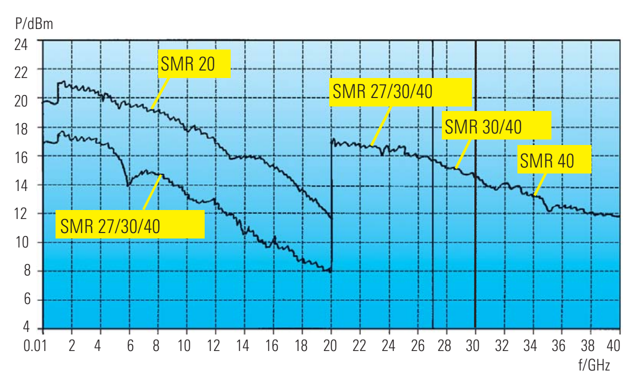
Level

Maximum level without option R&S SMR-B23/-B24/-B25

Frequency range	R&S SMR 20 without R&S SMR-B15	R&S SMR 20 with option SMR-B15	R&S SMR 27/SMR 30/SMR 40 without option SMR-B15/-B17	R&S SMR 27/SMR 30/SMR 40 with option SMR-B15/-B17
0.01 GHz to <1 GHz	>+13 dBm		>+13 dBm	
1 GHz to <18 GHz	>+11 dBm	>+10 dBm	>+8 dBm	>+7 dBm
18 GHz to 20 GHz	>+10 dBm	>+8 dBm	>+7 dBm	>+5 dBm
>20 GHz to 27 GHz	--	--	>+11 dBm	>+9 dBm
>27 GHz to 30 GHz	--	--	>+9 dBm	>+7 dBm
>30 GHz to 40 GHz	--	--	>+9 dBm	>+7 dBm

Maximum level with option R&S SMR-B23/-B24/-B25, normal mode (IF input OFF)

Frequency range	R&S SMR 20 without SMR-B15	R&S SMR 20 with option SMR-B15	R&S SMR 27/SMR 30/SMR 40 without option SMR-B15/-B17	R&S SMR 27/SMR 30/SMR 40 with option SMR-B15/-B17
0.01 GHz to <1 GHz	>+13 dBm		>+12 dBm	
1 GHz to <18 GHz	>+10 dBm	>+9 dBm	>+7 dBm	>+6 dBm
18 GHz to 20 GHz	>+8 dBm	>+6 dBm	>+5 dBm	>+3 dBm
>20. GHz to 27 GHz	--	--	>+8 dBm	>+6 dBm
>20 GHz to 30 GHz			>+6 dBm	>+4 dBm
>30 GHz to 40 GHz	--	--	>+6 dBm	>+4 dBm



Typical maximum output level over frequency (with option SMR-B15/-B17)

Linear amplitude modulation (option R&S SMR-B5)

Operating modes	internal, external AC/DC
Modulation depth	0% to 100%
AM distortion (f>50 MHz, AF = 1 kHz, m = 60%)	<1%
Modulation frequency range	DC to 100 kHz

Logarithmic amplitude modulation (option R&S SMR-B5 (SCAN AM))

Operating modes	internal, external
Dynamic range	–30 dB, overrange >30 dB
Sensitivity	–0.1 dB/V to –10 dB/V

Microwave Signal Generator R&S SMR

Frequency modulation (option R&S SMR-B5)

Operating modes	internal, external AC/DC
Maximum deviation	
≤15.625 MHz	39.0625 kHz
>15.625 MHz to 31.25 MHz	78.125 kHz
>31.25 MHz to 62.5 MHz	156.25 kHz
>62.5 MHz to 125 MHz	312.5 kHz
>125 MHz to 250 MHz	625 kHz
>250 MHz to 500 MHz	1.25 MHz
>500 MHz to <1 GHz	2.5 MHz
1 GHz to 2 GHz	5 MHz
>2 GHz to 10 GHz	10 MHz
>10 GHz to 20 GHz	20 MHz
f >20 GHz	40 MHz
FM distortion (NF = 1 kHz, half maximum deviation)	<0.5%
Modulation frequency range	DC to 5 MHz

ASK modulation (option R&S SMR-B5)

Operating modes	internal, external
Maximum modulation depth	90%
Resolution	0.1%
Data rate	0 Hz to 200 kHz

FSK modulation (option R&S SMR-B5)

Operating modes	internal, external
Maximum deviation	
≤15.625 MHz	39.0625 kHz
>15.625 MHz to 31.25 MHz	78.125 kHz
>31.25 MHz to 62.5 MHz	156.25 kHz
>62.5 MHz to 125 MHz	312.5 kHz
>125 MHz to 250 MHz	625 kHz
>250 MHz to 500 MHz	1.25 MHz
>500 MHz to <1 GHz	2.5 MHz
1 GHz to 2 GHz	5 MHz
>2 GHz to 10 GHz	10 MHz
>10 GHz to 20 GHz	20 MHz
f >20 GHz	40 MHz
Resolution	<1 %, minimum 10 Hz
Data rate	0 Hz to 2 MHz

Pulse modulation

Operating modes	external, internal with option SMR-B14
On/off ratio	>80 dB
Raise-/fall time (10/90%)	
62.5 MHz to 125 MHz	<50 ns
>125 MHz to 450 MHz	<20 ns
>450 MHz	<12 ns
Minimum pulse width	
ALC OFF (level control)	20 ns
ALC ON	500 ns
Maximum pulse pause	
ALC OFF	40 ns
ALC ON	free
Minimum pulse/pause ratio	
ALC OFF	1/100
ALC ON	free
Maximum pulse repeat frequency	
62.5 MHz to 125 MHz	1 MHz
>125 MHz to 450 MHz	2 MHz
>450 MHz	10 MHz
Video cross talk (V_{pp})	<20 mV

IF input (option R&S SMR-B23/-B24/-B25)

	R&S SMR-B23	R&S SMR-B24	R&S SMR-B25
IF input			
Frequency range	DC to 700 MHz	DC to 700 MHz	40 MHz to 6 GHz
level	<0 dBm	<0 dBm	<0 dBm
Frequency resp.	<5 dB	<7 dB	<7 dB
RF output			
Frequency range	1 GHz to 20 GHz	2 GHz to 27/30/40 GHz	1 GHz to 20 GHz
LO level	<–6 dBm	<–3 dBm	<–0 dBm
SWR	<2	<2	<2
Conversion loss (IF input/RF output)			
with option SMR-B15/-B17*)	6 dB to 15 dB	6 dB to 20 dB	6 dB to 15 dB
without option SMR-B15/-B17	6 dB to 13 dB	6 dB to 16 dB	6 dB to 13 dB

*) Option R&S SMR-B15/-B17 in zero position. The conversion loss can be increased with option R&S SMR-B15/-B17 by 10 dB to 110 dB in 10-dB steps. With option R&S SMR-B19/-B20 conversion loss increases up to 0.1 dB/GHz.

LF generator (option R&S SMR-B5)

Frequency range	0.1 Hz to 10 MHz
Resolution	0.1 Hz
Waveforms	sinewave, squarewave
Frequency error	$<1 \cdot 10^{-4}$

Pulse generator (option R&S SMR-B14)

Operating modes	single or double pulse (automatic or externally triggered), delayed pulse (externally triggered), gate mode (external)
Pulse periode	100 ns to 85 s
Pulse width	20 ns to 1 s
Pulse delay	20 ns to 1 s
Double pulse distance	60 ns to 1 s
Resolution	4 digit, min. 20 ns

Digital sweep, sweep in discrete steps

RF sweep, AF sweep	
Operating modes	automatic, single-shot, manual or externally triggered, linear or logarithmic
	freely selectable
Sweep range	freely selectable
Step width (lin)	0.01% to 100%
Step width (log)	
Level sweep	
Operating modes	automatic, single-shot, manual or externally triggered, logarithmic
Sweep range	0 to 20 dB
Step time	1 ms to 1 s
Markers	10, free selectable

Ramp sweep (option R&S SMR-B4)

RF sweep, AF sweep	
Operating modes	automatic, single-shot, manual or externally triggered, start/stop, center frequency, center span, marker
Sweep range	free selectable
Accuracy	(0.005% of deviation)/(sweep time/s) + reference error
Sweep time	10 ms to 100 s (≤30 ms switchover time at 1/2/10 and 20 GHz)

Microwave Signal Generator R&S SMR

Maximum sweep speed	
≤15.625 MHz	2.34375 MHz/ms
>15.625 MHz to 31.25 MHz	4.6875 MHz/ms
>31.25 MHz to 62.5 MHz	9.375 MHz/ms
>62.5 MHz to 125 MHz	18.75 MHz/ms
>125 MHz to 250 MHz	37.5 MHz/ms
>250 MHz to 500 MHz	75 MHz/ms
>500 MHz to <1 GHz	150 MHz/ms
1 GHz to 2 GHz	300 MHz/ms
>2 GHz to 10 GHz	600 MHz/ms
>10 GHz to 20 GHz	1200 MHz/ms
f >20 GHz	2400 MHz/ms
MARKER output signal	TTL level, polarity selectable
X output	0 V to 10 V
BLANK output signal	TTL level, polarity selectable
List mode	Frequency and level values can be stored in a list and will be set very fast.
Permissible level variation	20 dB
Operating modes	automatic, single-shot, manual or externally triggered
Step time	1 ms to 1 s
Remote control	
System	IEC 625 (IEEE 488)
Command set	SCPI 1995.0

General data

Power supply	100 V to 120 V (AC), 50 Hz to 400 Hz, 200 V to 240 V (AC), 50 Hz to 60 Hz, autosetting to AC voltage, max. 200 VA
Dimensions (W x H x D)	426.7 mm x 87.6 mm x 450 mm
Weight	<12 kg when fully equipped

Ordering information

Signal generator	R&S SMR20	1104.0002.20
	R&S SMR27	1104.0002.27
	R&S SMR30	1104.0002.30
	R&S SMR40	1104.0002.40
Accessories supplied	Power cable, operating manual, adapter 3.5 mm female (R&S SMR20), adapter 2.9 mm female (SMR27/30/40)	
Options		
Reference Oscillator OCXO	R&S SMR-B1	1104.5485.02
Frequency Resolution 0.1 Hz	R&S SMR-B3	1104.5585.02
Ramp Sweep	R&S SMR-B4	1104.5685.02
AM/FM/Scan Modulator	R&S SMR-B5	1104.3501.02
Frequency Extension 0.01 GHz to 1 GHz[1]	R&S SMR-B11	1104.4250.02
Pulse Generator	R&S SMR-B14	1104.3982.02
RF Attenuator 20 GHz (R&S SMR 20/R&S SMR 27)[1]	R&S SMR-B15	1104.4989.02
RF Attenuator 40 GHz (R&S SMR30/R&S SMR40)[1]	R&S SMR-B17	1104.5233.02
Rear Connectors for RF, AF (R&S SMR20/R&S SMR27)[1]	R&S SMR-B19	1104.6281.02
Rear Connectors for RF, AF (R&S SMR30/R&S SMR40)[1]	R&S SMR-B20	1104.6381.02
IF Input 20 GHz (R&S SMR20)[1]	R&S SMR-B23	1104.5804.02
IF Input 40 GHz (R&S SMR27/R&S SMR30/R&S SMR40)[1]	R&S SMR-B24	1104.6100.02
IF Input 0.04 GHz to 6 GHz (R&S SMR20)[1]	R&S SMR-B25	1135.1998.02
Extras		
Service Kit	R&S SMR-Z1	1103.9506.02
19" Rack Adapter	R&S ZZA-211	1096.3260.00
Adapter (R&S SMR20)		
3.5 mm female		1021.0512.00
3.5 mm male		1021.0529.00
N female		1021.0535.00
N male		1021.0541.00
Adapter (R&S SMR27/30/40)		
2.9 mm female		1036.4790.00
2.9 mm male		1036.4802.00
N female		1036.4777.00
N male		1036.4783.00

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[1] Option factory-fitted only.

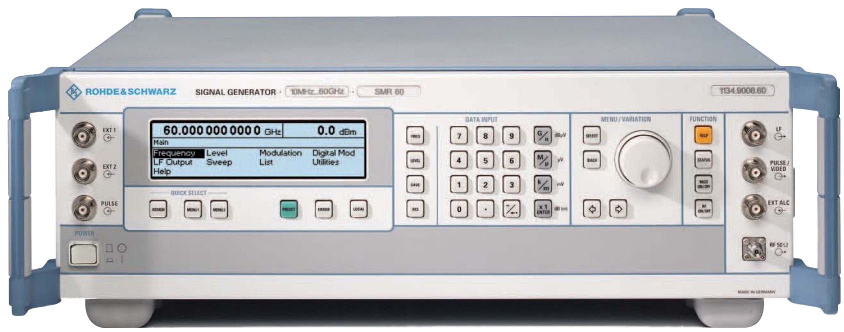
Microwave Signal Generators R&S SMR50/60

New

R&S SMR50: 10 MHz to 50 GHz

R&S SMR60: 10 MHz to 60 GHz

High-performance, cost-effective and reliable up to 60 GHz



R&S SMR60 (photo 43842-1)

Brief description

The R&S SMR50/60 are designed as CW generators with pulse modulation capability. Offering an excellent price/performance ratio, each of the models is ideal for economical measuring setups in the field of microwave testing up to 60 GHz at an affordable price. Should the measurement tasks become more demanding, both models can be upgraded any time by means of options to give an AM/FM signal generator or a synthesized sweep generator featuring fast, fully synthesized, analog ramp sweep.

Excellent spectral purity

The R&S SMR50/60 stands out from other generators for its excellent spectral purity. Advanced frequency synthesis makes for low SSB phase noise and high spurious suppression, both of which are for example prerequisites for reliable receiver measurements. Modern microwave filters in the output path of the instrument ensure excellent harmonics suppression. This is necessary to obtain conclusive results in scalar network analysis measurements.

High-precision output level

Microwave signal generators are frequently used for calibrating test receivers. This task calls for a highly accurate and stable output level settable with high resolution. This is ensured by a high-precision, frequency-response-compensated level control for levels higher than –20 dBm. This range can be extended to –110 dB with the optional RF Attenuator R&S SMR-B18.

Main features

Ease of operation

- High-contrast LC display
- Online help including IEC/IEEE-bus commands
- Simple and self-explanatory settings
- Storage of menu layers
- One-hand operation with EasyWheel

Wide frequency range

- 1 GHz to 50 GHz (R&S SMR50)
- 1 GHz to 60 GHz (R&S SMR60)
- Extension of lower frequency limit to 10 MHz (option R&S SMR-B11)
- Frequency resolution 1 kHz, 0.1 Hz (option R&S SMR-B3)

High output power

- without option R&S SMR-B18
  – R&S SMR50 >+3 dBm (at 50 GHz)
  – R&S SMR60 >0 dBm (at 60 GHz)
- with option R&S SMR-B18
  – R&S SMR50 >0 dBm (at 50 GHz)
  – R&S SMR60 >–4 dBm (at 60 GHz)

High-precision level control

- High-precision, frequency-response-compensated level control
- Setting range extendible to –110 dBm (option R&S SMR-B18)

Three instruments in one

- CW generator with pulse modulation capability (standard version)
- Signal generator with AM/FM SCAN and LF generator (option R&S SMR-B5)
- Synthesized sweep generator with analog ramp sweep (option R&S SMR-B4)

Optional pulse generator (R&S SMR-B14)

- Operating modes: single pulse, double pulse (automatically or externally triggered), delayed pulse (externally triggered), gate mode (external)
- Pulse repetition 100 ns to 85 s
- Pulse width 20 ns...1 s

Sweep capabilities

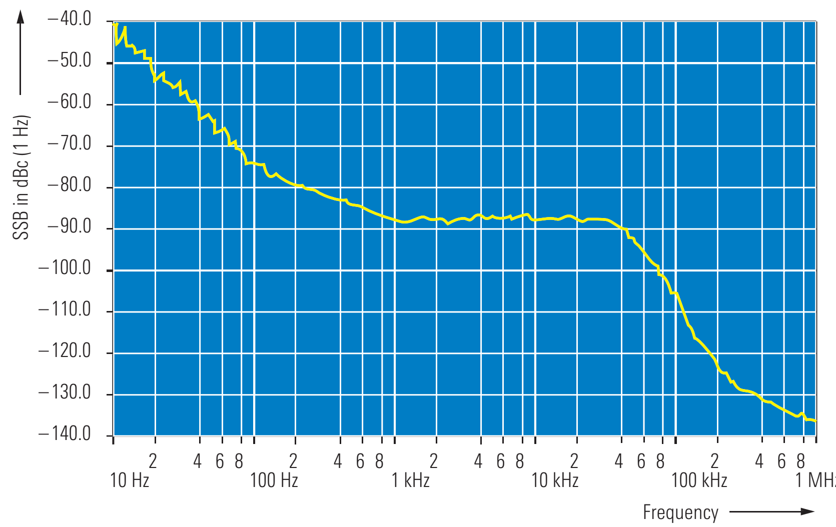
- Digital RF and level sweep (standard version)
- Analog ramp sweep (RF sweep, option R&S SMR-B4)
- Maximum sweep rate for ramp sweeps min. 600 MHz/ms (f >2 GHz)
- Digital sweep of LF generator (with option R&S SMR-B5)

Microwave Signal Generators R&S SMR 50/60

- 10 freely selectable frequency markers for RF sweep
- Operating modes: automatic, single-shot, manual, externally triggered, linear or logarithmic

Further features

- Space for 50 complete instrument setups
- Compact, lightweight, user-friendly: ideal in the lab and for field applications
- 3-year calibration cycle



SSB phase noise at 10 GHz

Specifications in brief

The specifications are valid under the following conditions:
warmup time 30 minutes, specified environmental conditions met, calibration cycle adhered to and total calibration performed.
Data designated "typ.", "overrange" or "underrange" are not warranted.

Frequency	
R&S SMR 50	
Without option R&S SMR-B11	1 GHz to 50 GHz
With option R&S SMR-B11	10 MHz to 50 GHz
R&S SMR 60	
Without option R&S SMR-B11	1 GHz to 60 GHz
With option R&S SMR-B11	10 MHz to 60 GHz
Resolution without/with **option R&S SMR-B3**	1 kHz/0.1 Hz

Reference frequency	**Standard/Option R&S SMR-B1**
Aging (after 30 days of operation)	1 x 10^{-6}/year/<1 x 10–7/year
Temperature effect (0°C to 55 °C)	2 x 10^{-6}/<1 x 10–10/°C
Warmup time	–/15 min
Output for internal reference	10 MHz, 1 V (V_{rms}), 50 Ω
Input for external reference	10 MHz, 0.1 V to 2 V, 50 Ω
Permissible frequency drift	3 x 10^{-6}

Spectral purity	
Harmonics[1]	
10 MHz ≤ f ≤30 MHz	<–50 dBc
30 MHz < f ≤20 GHz	<–55 dBc
f >20 GHz[2]	<–40 dBc
Subharmonics	
f ≤20 GHz	<–65 dBc
f >20 GHz	<–30 dBc
Subharmonics (carrier offset >50 kHz)	
f ≤20 GHz	<–60 dBc
20 GHz < f ≤40 GHz	<–54 dBc
f >40 GHz	<–52 dBc
SSB phase noise (f = 10 GHz, 10 kHz from carrier, 1 Hz bandwidth, CW, FM off)	<–83 dBc
Residual FM, rms (f = 10 GHz, FM off)	
0.3 kHz to 3 kHz	<20 Hz
0.02 kHz to 23 kHz	<200 Hz

Level	
Maximum level[3]	
Frequency range	without/with option R&S SMR-B18
0.01 GHz ≤ f <1GHz	
1 GHz ≤ f <18 GHz	>+11 dBm
18 GHz ≤ f ≤20 GHz	>+8 dBm/>+7 dBm
20 GHz < f ≤27 GHz	>+7 dBm/>+5 dBm
27 GHz < f ≤30 GHz	>+11 dBm/>+9 dBm
30 GHz < f ≤40 GHz	>+9 dBm/>+7 dBm
40 GHz < f ≤50 GHz	>+7 dBm/>+5 dBm
50 GHz < f ≤60 GHz	>+3 dBm/>+0 dBm
	>0 dBm/>–4 dBm
Minimum level of all models	
Without option R&S SMR-B18	–20 dBm
With option R&S SMR-B18	–110 dBm
Total deviation (level = –4 dBm)	
f ≤20 GHz	<1 dB
20 GHz < f ≤40 GHz	<1.4 dB
f >40 GHz	<1.8 dB
Frequency response (level = –4 dBm)	
f ≤20 GHz[4]	<0.5 dB, <±0.3 dB typ.
20 GHz < f ≤40 GHz	<0.7 dB, <±0.4 dB typ.
f >40 GHz	<0.9 dB, <±0.5 dB typ.
Impedance, SWR	50 Ω, <2
Setting time after IEC/IEEE-bus delimiter	<10 ms
With option SMR-B18, with switching in attenuator	<25 ms
Range for non-interrupting level setting	>16 dB

Microwave Signal Generators R&S SMR50/60

Linear amplitude modulation	**option R&S SMR-B5**
Operating modes	intern, extern AC/DC
Modulation depth[5]	0% to 100%
Setting accuracy (AF = 1 kHz, m <80%)[6]	<4% of reading +1%
AM distortion (AF = 1 kHz, m = 60%)[6]	
f <1 GHz	<3%
f ≥1 GHz	<1%
Modulation frequency response (m = 60%)[6]	
f <1 GHz, DC to 50 kHz	<3 dB
f ≥1 GHz	
20 Hz to 20 kHz	<1 dB
DC to 100 kHz	<3 dB
Incidental φM with AM, peak value (AF = 1 kHz, m = 30%)	<0.4 rad
EXT1, EXT2 modulation input	1 V (high/low indication for inaccuracy >3%)
Input impedance	50 Ω/600 Ω[7] or 100 kΩ

Logarithmic amplitude modulation	**option SMR-B5 (SCAN AM)**
Operating modes	internal, external
Dynamic range	>20 dB
Sensitivity	±0.1 dB/V to ±10 dB/V
Rise/fall time (10%/90%)	<10 µs
EXT1, EXT2 modulation input	–6 V to +6 V
Input impedance	50 Ω/600 Ω[7] or 100 kΩ

Frequency modulation	**option R&S SMR-B5**
Operating modes	internal, external AC/DC
Maximum deviation	
f ≤15.625 MHz	39.0625 kHz
15.625 MHz < f ≤31.25 MHz	78.125 kHz
31.25 MHz < f ≤62.5 MHz	156.25 kHz
62.5 MHz < f ≤125 MHz	312.5 kHz
125 MHz < f ≤250 MHz	625 kHz
250 MHz < f ≤500 MHz	1.25 MHz
500 MHz < f <1 GHz	2.5 MHz
1 GHz ≤ f ≤2 GHz	5 MHz
2 GHz < f ≤10 GHz	10 MHz
10 GHz < f ≤20 GHz	20 MHz
20 GHz < f ≤40 GHz	40 MHz
f >40 GHz	80 MHz
FM distortion (AF = 1 kHz, half max. deviation)	<0.5%
Modulation frequency range	DC to 5 MHz
Modulation frequency response	<3 dB
EXT1, EXT2 modulation input	
Input impedance	50 Ω/600 Ω[7] or 100 kΩ
Input voltage V_p for selected deviation	1 V (high/low indication for inaccuracy >3%)

ASK modulation	external, **option R&S SMR-B5**
Maximum modulation depth	90%
Data rate	
f <1 GHz	0 Hz to 100 kHz
f ≥1 GHz	0 Hz to 200 kHz
Rise/fall time (10%/90%)	
f <1 GHz	<10 µs
f ≥1 GHz	<5 µs
EXT1 modulation input	TTL/HCT, 50 Ω/600 Ω[7] or 100 kΩ

FSK modulation	external, **option R&S SMR-B5**
Maximum deviation	
f ≤15.625 MHz	39.0625 kHz
15.625 MHz < f ≤31.25 MHz	78.125 kHz
31.25 MHz < f ≤62.5 MHz	156.25 kHz
62.5 MHz < f ≤125 MHz	312.5 kHz
125 MHz < f ≤250 MHz	625 kHz
250 MHz < f ≤500 MHz	1.25 MHz
500 MHz < f <1 GHz	2.5 MHz
1 GHz ≤ f ≤2 GHz	5 MHz
2 GHz < f ≤10 GHz	10 MHz
10 GHz < f ≤20 GHz	20 MHz
20 GHz < f ≤40 GHz	40 MHz
f >40 GHz	80 MHz
Data rate	0 Hz to 2 MHz
Rise/fall time (10%/90%)	<500 ns
EXT1 modulation input	TTL/HCT, 50 Ω/600 Ω[7] or 100 kΩ

Pulse modulation	external, internal **option R&S SMR-B14**
On/off ratio	>80 dB
On/off ratio (10%/90%)	
62.5 MHz ≤ f ≤125 MHz	<50 ns[8]
125 MHz < f ≤450 MHz	< 20 ns[8]
f >450 MHz	<12 ns[8]
Minimum pulse width	
With level control on (ALC ON)	500 ns
With level control off (ALC OFF)	25 ns
Maximum pulse pause	
With level control on (ALC ON)	40 ms
With level control off (ALC OFF)	any
Minimum pulse/pause ratio	
With level control on (ALC ON)	1/100
With level control off (ALC OFF)	any
Maximum pulse repetition frequency	
62.5 MHz ≤ f ≤125 MHz	1 MHz
125 MHz < f ≤450 MHz	2 MHz
f >450 MHz	10 MHz
Pulse delay	50 ns typ.
Video feedthrough V_{pp}	<20 mV
PULSE modulation input	TTL/HCT signal or selectable switching thresholds at +0.5 V or –2.5 V
Input impedance	50 Ω (max. 2 W, overload protection) or 10 kΩ

Simultaneous modulation
FM (FSK) is independent of AM (SCAN AM, ASK) and pulse modulation. Reduced AM bandwidth for simultaneous AM (SCAN AM, ASK) and pulse modulation.

LF generator	**option R&S SMR-B5**
Frequency range	0.1 Hz to 10 MHz
Waveforms	sinewave, squarewave
Frequency response (up to 500 kHz)	<0.5 dB
Distortion (up to 100 kHz)	<0.5% (R_L >200 Ω, level = 0.5 V)
Open-circuit voltage V_p (LF connector)	40 mV to 3.5 V, 10 Ω

Pulse generator	**option R&S SMR-B14**
Operating modes	single or double pulse (automatically or externally triggered), delayed pulse (externally triggered), gate mode (external)
Active trigger edge	positive or negative
Pulse repetition period	100 ns to 85 s
Pulse width	20 ns to 1 s

Microwave Signal Generators R&S SMR 50/60

Pulse delay	20 ns to 1 s
Double pulse	60 ns to 1 s
Trigger delay	50 ns typ.
Jitter	<10 ns
PULSE modulation input	TTL/HCT signal or selectable switching thresholds
SYNC output	TTL/ACT signal ($R_L \geq 50\ \Omega$), 40 ns pulse width
PULSE/VIDEO output	TTL/ACT signal ($R_L \geq 50\ \Omega$)

Digital sweep, sweep in discrete steps

RF sweep, AF sweep	
Operating modes	automatic, single-shot, manual or externally triggered, logarithmic
Sweep range	freely selectable
Step width (lin)	freely selectable
Step width (log)	0.01% to 100%
Step time	10 ms to 5 s
Level sweep	
Operating modes	automatic, single-shot, manual or externally triggered, logarithmic
Sweep range	0 dB to ≥16 dB
Step width	0.01 dB to 20 dB
Step time	1 ms to 5 s
Markers	10, freely selectable
MARKER output signal	TTL level, selectable polarity
output	0 V to 10 V
BLANK output signal	TTL level, selectable polarity

Ramp sweep	**option R&S SMR-B4**
RF sweep	automatic, single-shot, manual or externally triggered
Operating modes	Start/Stop, center frequency/span
Sweep range	freely selectable, increasing
Sweep time[9]	10 ms to 100 s
Max. sweep rate	
f ≤15.625 MHz	2.34375 MHz/ms
15.625 MHz < f ≤31.25 MHz	4.6875 MHz/ms
31.25 MHz < f ≤62.5 MHz	9.375 MHz/ms
62.5 MHz < f ≤125 MHz	18.75 MHz/ms
125 MHz < f ≤250 MHz	37.5 MHz/ms
250 MHz < f ≤500 MHz	75 MHz/ms
500 MHz < f <1 GHz	150 MHz/ms
1 GHz ≤ f ≤2 GHz	300 MHz/ms
2 GHz < f ≤10 GHz	600 MHz/ms
10 GHz < f ≤20 GHz	1200 MHz/ms
20 GHz < f ≤40 GHz	2400 MHz/ms
f >40 GHz	4800 MHz/ms
Markers	10, freely selectable
MARKER output signal	TTL level, selectable polarity
X output	0 V to 10 V
BLANK output signal	TTL level, selectable polarity

List mode

Frequency and level values can be stored in a list.

Permissible level variation	max. 20 dB
Operating modes	auto, single-shot, manual or external trigger
Maximum number of frequency/level entries	2003
Maximum number of lists	up to 10
Step time	1 ms to 5 s

General data

Storable instrument setups	50
Remote control	IEC 625-1 (IEEE 488.1)
Setting time (after IEC/IEEE-bus delimiter)	<10 ms
Rated temperature range	0°C to +55°C
Storage temperature range	–40°C to +70°C
Power supply	100 to120 V (AC), 50 Hz to 400 Hz, 200 V to 240 V (AC), 50 Hz to 60 Hz, autoranging, max. 300 VA
Dimensions (W x H x D)	426.7 mm x 131.4 mm x 450 mm
Weight	<13.5 kg when fully equipped

1) SMR50: level <0 dBm. SMR60: level <0 dBm for f ≤50 GHz or <–4 dBm for f >50 GHz.

2) Specifications for harmonics above 50 GHz (R&S SMR50) and 60 GHz (R&S SMR60) only typical.

3) Maximum level is reduced by up to 2 dB in the temperature range 35°C to 55°C.

4) From 10 MHz to 50 MHz, the specified total deviation is only valid in the temperature range 15°C to 35°C. The deviation outside this temperature range is likely to be higher by max. 0.7 dB.

5) The modulation depth adjustable within the AM specifications continuously decreases from 6 dB below the maximum level up to the maximum level.

6) This specification does not apply
a) to non-interrupting level setting (ATTENUATOR MODE FIXED) if option R&S SMR-B18 is used,
b) to levels below –8 dBm without option R&S SMR-B18,
c) to external level control mode (EXT ALC).

7) 50 Ω or 600 Ω selectable by means of internal jumpers.

8) Only valid if level control set to OFF (ALC OFF.

9) ≤30 ms switching time at 1 GHz, 2 GHz, 10 GHz, 20 GHz and 40 GHz.

Ordering information

Microwave Signal Generator	R&S SMR50	1134.9008.50
	R&S SMR60	1134.9008.60
Accessories supplied	Power cable, operating manual	
Options		
OCXO Reference Oscillator	R&S SMR-B1	1104.5485.02
Frequency Resolution 0.1 Hz	R&S SMR-B3	1104.5585.02
Ramp Sweep	R&S SMR-B4	1104.5685.02
AM/FM/Scan Modulator	R&S SMR-B5	1104.3501.03
Frequency Extension 0.01 GHz to 1 GHz[1]	R&S SMR-B11	1104.4250.60
Pulse Generator	R&S SMR-B14	1104.3982.02
RF Attenuator 60 GHz[1]	R&S SMR-B18	1135.2907.02
Rear Connectors for AF	R&S SMR-B21	1135.2407.02
Extras		
Service Kit	R&S SMR-Z1	1103.9506.02
Interface Cable	R&S SMR-Z3	1134.9772.02
19" Rack Adapter	R&S ZZA-311	1096.3277.00

1) Factory-fitted option.

Vector Signal Generator R&S SMIQ

R&S SMIQ02B/03B/04B/06B:

300 kHz to 2.2/3.3/4.4/6.4 GHz

Digital signals of your choice

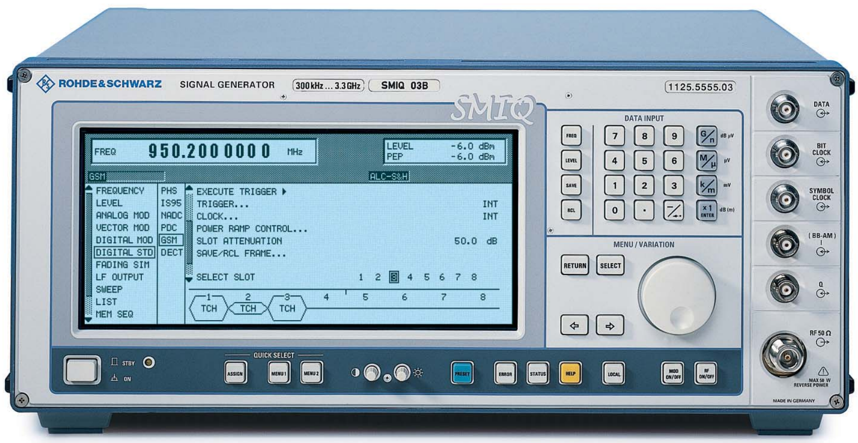


Photo 43304-3

Brief description

The B series of Signal Generator Family R&S SMIQ for analog and digital modulation from Rohde&Schwarz is offering solutions for today and tomorrow. This series particularly takes into account future developments in the field of 3rd-generation digital mobile radio.

The R&S SMIQ family comprises four models which differ in their upper frequency limits. These feature a hitherto unrivalled versatility regarding signal generation and signal quality and are therefore ideal for use in development and type-approval testing.

With their outstanding price/performance ratio, these signal generators are also economically attractive for applications in production. The wide frequency range from 300 kHz to 6.4 GHz covers all main radio bands including their IF ranges.

The high-grade I/Q modulator fitted as standard ensures minimum error vector magnitude and high intermodulation suppression. Using modern digital signal processor (DSP) technology, the versatile concept allows the generation of high-precision digital modulation signals with high bit rates without any limitations on modulation modes or standards.

In addition to digital modulation, the signal generators provide the full range of analog modulation modes as well as simultaneous modulation capability.

Main features

- Frequency range 300 kHz to 2.2 GHz/ 3.3 GHz/4.4 GHz/6.4 GHz
- Analog and digital modulation
- Versatile and broadband generation of digitally modulated signals up to 18 Msymbol/s
- Generation of TDMA, CDMA, WCDMA and CDMA2000 standard signals to all main mobile radio standards
- Broadband I/Q modulator with outstanding vector accuracy
- Optional internal fading simulator to test specifications of mobile radio standards
- Optional internal noise generator and distortion simulator
- Optional BER measurement
- Optional arbitrary waveform generator
- Low ACP for IS-95 CDMA and WCDMA (option)
- Low cost of ownership due to three-year calibration intervals
- Future-oriented platform concept
- Unrivalled price/performance ratio

Characteristics

Digital modulation

Any digital modulation modes (with option R&S SMIQB20)

- Free choice of modulation mode from ASK through to 256QAM
- Any kind of baseband filtering with variable filter parameters
- Symbol rate adjustable up to 18 Msymbol/s
- Realtime coding of internal and external data
- Internal PRBS generators

Convenient burst generation for TDMA standards (with option R&S SMIQB20/ R&S SMIQB11)

- TDMA mobile radio standards provided as standard GSM, GSM-EDGE, DECT, NADC (IS-54C/IS-136), PDC, PHS
- Versatile external synchronization capabilities
- Realtime processing of external and internal data
- Generation of TDMA frames with versatile timeslot configuration
- Continuous PRBS sequences
- Optimization of burst shaping to reduce spectra due to switching
- Realtime processing with external data for BER tests
- Fast Slot-by-slot modulation change at GSM/EDGE

SMIQ: Overview of options

Application[1]	R&S SM-B1 Reference Oscillator OCXO	R&S SM-B5 FM/φM Modulator	R&S SMIQB11[2] Data Generator (15 Mbit RAM)	R&S SMIQB12 Memory Extension, 32 Mbit	R&S SMIQB14 Fading Simulator (6 paths)	R&S SMIQB15 2nd Fading Simulator (6 paths)	R&S SMIQB17 Noise Generator and Distortion Simulator	R&S SMIQB20 Digital Modulation Coder	R&S SMIQB21 BER measurement	R&S SMIQB42[3] Digital Standard IS-95 CDMA	R&S SMIQB43[3] Digital Standard WCDMA (NTT DoCoMo 1.0, ARIB 0.0)	R&S SMIQB45[3] Digital Standard WCDMA according to 3GPP (FDD)	R&S SMIQB47 Low ACP for IS-95 CDMA and WCDMA	R&S SMIQB48 Extended Functions for WCDMA 3GPP	R&S SMIQB60 Arbitrary Waveform Generator	R&S SMIQK11 Digital Standard IS-95 CDMA (with ARB R&S SMIQB60)	R&S SMIQK12 Digital Standard CDMA2000 (with ARB R&S SMIQB60)
TDMA																	
To standard	❍		●	❍	❍			●									
Non-standard	❍	❍	●	❍	❍		❍	●	❍								
CDMA IS-95																	
To standard	❍	❍	●	❍	❍		❍	●		●					❍	❍	
WCDMA																	
To standard	❍	❍	●	❍	❍		❍	●			●	●	●	❍	❍		
CDMA2000																	
To standard	❍	❍	●	❍	❍		❍	●							●		●
Fading																	
					●	❍											
Vector modulation																	
	❍	❍	❍	❍	❍	❍	❍	❍		❍	❍	❍	❍				
Analog modulation (AM, FM, φM)																	
	❍	●															
Fast setting time																	
	❍	❍	❍	❍	❍	❍	❍	❍		❍	❍	❍					

1) R&S SMIQ02B/03B (R&S SMIQ04B/06B) can be equipped with up to three (two) of the following options: R&S SM-B5, R&S SMIQB14, R&S SMIQB15 or R&S SMIQB17

2) Option R&S SMIQB20 required

3) Options R&S SMIQB20 and R&S SMIQB11 required

● = required

❍ = optional

Analog modulation

- Broadband AM with up to 30 MHz modulation frequency
- I/Q modulation with 30 MHz modulation bandwidth (3 dB), 60 MHz RF bandwidth
- Unprecedented vector accuracy and high intermodulation suppression
- Amplitude modulation
- Pulse modulation
- Optional frequency and phase modulation (R&S SM-B5)

RF characteristics

- Wide output frequency range from 300 kHz to 6.4 GHz
- High (up to 16 dBm) and precise output level (<0.5 dB)
- Fast setting time for frequency (<3 ms) and level (<2.5 ms)[1]
- Frequency hopping (500 µs)
- High spectral purity (–130 dBc (1 Hz) typ. at 1 GHz and 20 kHz carrier offset)
- Calibrated RF level in range from –140 dBm to –5 dBm
- RF, AF and level sweep (user-programmable)

1) Without switching the mechanical attenuators.

Special options

Fading simulation (options R&S SMIQB14 and R&S SMIQB15)

- Fading of internal or external I/Q signals conforming to mobile radio standards
- 6-path simulation can be enhanced to 12-path simulation (2-channel fading also possible with second vector signal generator)
- Rayleigh, Rice and lognormal fading profiles independently for each path selectable
- Selectable path attenuation and delay
- Simulation of high speeds
- Preprogrammed fading profiles for mobile radio standards GSM, NADC, IS-95 CDMA and TETRA
- Frequency range of basic unit can be fully utilized

Noise generator and distortion simulator (option R&S SMIQB17)

- Simulation of amplitude and phase distortion (AM/AM and AM/φM characteristics)
- Distortion characteristics programmable from up to 30 input values
- Superimposed noise signals (AWGN)
- C/N ratio variable with high resolution over a wide range
- Broad noise bandwidth (10 kHz to 10 MHz)

Bit error rate measurements (option R&S SMIQB21)

- Up to 30 MHz clock rate

Vector Signal Generator R&S SMIQ

WCDMA for 3GPP/FDD (option R&S SMIQB45)
Software option R&S SMIQB45 supports the generation of downlink and uplink signals in line with the 3GPP standard (FDD mode). As the standardization process is not yet completed, the functionality of this option will continuously be adapted to the relevant standard modifications and expansions (for functionality see specifications).

Low ACP for IS-95 CDMA and W-CDMA (option R&S SMIQB47)
- Specially designed for 1.2288 Mcps, 4.096 Mcps and 8.192 Mcps as well as 3.840 Mcps according to 3GPP
- Can be used with internal (option R&S SMIQB42/43/45/48) or external CDMA/WCDMA signals
- Typical WCDMA adjacent-channel power ratio (5 MHz offset, 3.84 Mcps): –67 dBc (1 DPCH)
- Typical IS-95 CDMA adjacent-channel power ratio (885 kHz offset): –78 dBc (9 code channels)

Enhanced functions for WCDMA 3GPP (FDD) digital standard (option R&S SMIQB48)
This option expands the functionality of option R&S SMIQB45 WCDMA 3GPP. It allows the generation of up to four enhanced channels that can be combined with the standard channels.

- Very long signal sequences and continuous PRBS sequences (e.g. PN9) often required for BER measurements can be implemented for the channel under test
- Use of externally precoded data or the generation of long power control profiles for the DUT
- Testing the closed-loop power control function of a mobile station
- Receiver and performance tests to TS 25.101, TS 25.104, TS25.14. and TS25.944
- Realistic simulation of W-CDMA scenarios
- Creation and insertion of bit errors into the data of enhanced channels
- Insertion of block errors (BLERs) into the channel-coded data
- Generation of W-CDMA signals of up to 2 minutes repetition rate

Enhanced fading functions for W-CDMA 3GPP (option SMIQB49)
Option R&S SMIQB49 extends the functionality of fading options R&S SMIQB14/ B15 to include WCDMA 3GPP channel simulation. It adds three new modes to the fading simulator so that all scenarios defined in 3GPP Release 99 can be simulated:

- In fine delay mode, fading simulator resolution is increased to 1 ns with up to four paths being available
- In moving delay mode, two paths are simulated: for one path the delay remains constant, whereas for the other path the delay varies continuously
- In birth-death mode, there are two paths changing delay in steps in accordance with the 3GPP channel model

Digital standard IS-95 (options R&S SMIQK11 and R&S SMIQB60 (ARB))
In addition to generating IS-95 signals with option R&S SMIQB42, R&S SMIQ in conjunction with R&S SMIQB60 simulates CDMA signals to the North-American standard IS-95A. Option R&S SMIQK11 enables IS-95 functionality under WinIQSIM™.

- Up to eight complete base stations comprising 64 code channels each are available in forward link and up to 16 mobile stations in reverse link
- Channel power can be set independently for all code channels
- Adjacent-channel power can be calculated for 1. and 2. adjacent channel and output as a spectral display
- CCDF trace can be displayed

Digital standard cdma2000 (options R&S SMIQK12 and R&S SMIQB60 (ARB))
CDMA signals to the North-American standard IS-2000 can be simulated by means of software option R&S SMIQK12 in conjunction with Arbitrary Waveform Generator R&S SMIQB60. Option R&S SMIQK12 enables cdma2000 functionality under WinIQSIM™.

The modes 1X direct spread, 3X direct spread and 3X multicarrier (forward link only) are available. In forward link four base stations of max. 91 code channels can be set, in reverse link four mobile stations of max. 13 code channels each.

Arbitrary Waveform Generator R&S SMIQB60
To further enhance the versatility of the modulation coder, a dual-channel arbitrary waveform generator (ARB) with a maximum clock rate of 40 MHz is available as an option. It can store up to 512 ksamples of externally computed I/Q values.

The supplied WinIQSIM™ software allows the calculation of arbitrary modulation signals, for example COFDM, multicarrier and noise, and downloading them into R&S SMIQ. Together with a convenient data editor, WinIQSIM™ can calcu-

Vector Signal Generator R&S SMIQ

late any kind of TDMA frame configuration, simulate impairments by superimposed interference signals, etc.

Applications

- Type-approval testing of digital base and mobile stations
- Base-station transmitter test
- Sensitivity measurements on digital receivers
- Selectivity measurements on digital receivers
- Testing of equalizers
- Tolerance tests on digital systems
- Components tests
- Development of new digital communication systems

Specifications in brief

Frequency

Range	R&S SMIQ02B	300 kHz to 2.2 GHz	
	R&S SMIQ03B	300 kHz to 3.3 GHz	
	R&S SMIQ04B	300 kHz to 4.4 GHz	
	R&S SMIQ06B	300 kHz to 6.4 GHz	
Resolution		0.1 Hz	
Reference frequency		Standard	Option R&S SM-B1
Aging (after 30 days operation)		1×10^{-6}/year	$<1 \times 10^{-9}$/day
Temperature effect (0°C to 50°C)		2×10^{-6}	$<5 \times 10^{-8}$

Level

Range	R&S SMIQ02B/03B	–144 dBm to +13 dBm (PEP)[1]	
	R&S SMIQ04B/06B	–144 dBm to +10 dBm (PEP)[1]	
Overranging without warranty of specs		up to16 dBm	
Resolution		0.1 dB or 0.01 dB	
Total level uncertainty >–127 dBm[2,3]			
f ≤2 GHz		<±1 dB	(<±0.5 dB typ.)
f >2 GHz to 4 GHz		<±1.5 dB	(<±0.9 dB typ.)
f >4 GHz to 6 GHz		<±2 dB	(<±1.2 dB typ.)
f >6 GHz		<±2.5 dB	
Frequency response at 0 dBm[2,3]			
f ≤3.3 GHz		<1 dB	(<0.3 dB typ.)
f >3.3 GHz		<±1.5 dB	(<±0.5 dB typ.)

Spectral purity[2]

Spurious		
Harmonics at levels ≤10 dBm (R&S SMIQ02B/03B)	<–30 dBc	
Harmonics at levels ≤7 dBm (R&S SMIQ04B/06B)	<–30 dBc	
Broadband noise, carrier offset >5 MHz	CW	
f >20 MHz to 450 MHz	<–136 dBc	(–142 dBc typ.)
f >450 MHz to 3040 MHz	<–138 dBc	(–144 dBc typ.)
f >3040 MHz to 3300 MHz	<–136 dBc	(–142 dBc typ.)
f >3300 MHz to 6400 MHz	<–132 dBc	(–138 dBc typ.)
Broadband noise, vector modulation, (f >20 MHz) carrier offset >5 MHz	<–131 dBc	(–137 dBc typ.)
SSB phase noise, carrier offset 20 MHz, 1 Hz bandwidth	CW	Vector modulation (dig. Mod.)
f = 20 MHz to 450 MHz	<–116 dBc	<–119 dBc
f = 1 GHz	<–126 dBc	<–123 dBc
f = 2 GHz	<–120 dBc	<–120 dBc
f = 3 GHz	<–116 dBc	<–116 dBc
f = 6 GHz	<–110 dBc	<–110 dBc

Sweep

RF sweep, AF sweep	digital sweep in discrete steps
Modes	automatic, single shot, manual or external trigger, linear or logarithmic

Modulation

Internal modulation generator	
Frequency range	0.1 Hz to 1 MHz
Frequency error	$<1 \times 10^{-4}$ + 0.012 Hz
Open-circuit voltage at LF socket	1 mV to 4 V peak
Vector modulation	
Level accuracy with vector modulation, additional error with ALC OFF, relative to CW	<0.3 dB
Modulation inputs I and Q Input voltage for full-scale input	$\sqrt{I^2+Q^2}$ = 0.5 V (1 V EMK with 50-Ω Source)
Envelope control	RF level can be controlled with an analog voltage of 0 V to 1 V via the POWER RAMP input
Amplitude modulation[2]	internal, external AC/DC
Modulation depth	0% to 100%
Broadband amplitude modulation	external DC
Input voltage for 100% AM	0.25 V peak
Pulse modulation	external
On/off ratio	>80 dB
Rise/fall time(10/90%)	30 ns typ.
Pulse repetition frequency	0 Hz to 1 MHz
Frequency modulation	**Option R&S SM-B5**
	int., external AC/DC, two-tone with two modulation channels FM1 and FM2
Max. deviation	0.5/1/2/4 MHz depending on frequency
Phase modulation	**Option R&S SM-B5**
	int., external AC/DC, two-tone with two modulation channels φM1 and φM2
Max. deviation	5/10/20/40 rad depend. on frequency
Digital modulation	**Option R&S SMIQB20**
	internal, external, serial, ext. parallel

Predefined modulation settings

APCO C4FM, APCO CQPSK, CDPD, CT2, DECT, GSM, IRIDIUM, NADC, PDC, PHS, TETRA, TFTS, PWT, ICO BPSK, ICO GMSK, ICO QPSK, GSM EDGE, CDMA IS-95, WCDMA, QPSK

Internal PRBS	selectable lengths: 2^9–1, 2^{15}–1, 2^{16}–1, 2^{20}–1, 2^{21}–1 and 2^{23}–1
Envelope control	internal or external
Range of function	1 ksymbol/s to 2.5 Msymbol/s
Modulation modes	ASK, FSK, GMSK, PSK, QAM
ASK, symbol rate	100 symbol/s to 18 Msymbol/s[1]
FSK, modulation modes	2FSK, 4FSK, 4FSK APCO, GFSK
GMSK, bit rate	100 bit/s to 7.5 Mbit/s[1]
PSK, modulation modes	BPSK, QPSK, OQPSK, QPSK (IS-95), OQPSK (IS-95), QPSK (ICO), QPSK (INMARSAT), π/4DQPSK, π/4QPSK, 8PSK, 8PSK EDGE
QAM, modulation modes	16QAM, 32QAM, 64QAM, 256QAM

Vector Signal Generator R&S SMIQ

Data generator **Option R&S SMIQB11**
Programmable data memory for modulation data, envelope-control and trigger signals. The data generator can be operated only in conjunction with the optional modulation coder

Max. symbol rate	8.5 Msymbol/s
Operating modes	automatically repeating, single shot, manually or externally triggered

Memory extension **Option R&S SMIQB12**
The data generator memory can be extended to max. 79 Mbit by fitting up to two options R&S SMIQB12.

Memory capacity	32 Mbit

Digital standards **Options R&S SMIQB20, SMIQB11**

GSM / EDGE	according GSM standard
Frequency	880 to 960 MHz/1710 to 2000 MHz
Modulation	GMSK or 8PSK EDGE (8PSK with 3π/8 Rotation)
DECT	according ETS300175-2 and ETS300176-1
Frequency	1880 MHz to 1900 MHz
Modulation	GFSK (Standard), π/4 DQPSK
NADC	according IS-54 and IS-136
Frequency	824 to 894 MHz/1850 to 2000 MHz
Modulation	π/4 DQPSK
PDC	according RCR STD-27
Frequency	810 to 826 MHz/940 to 956MHz 1429 to 1453 MHz/1477 to 1501 MHz
Modulation	π/4 DQPSK
PHS	according RCR STD-28
Frequency	1895.0 MHz to 1918.1 MHz
Modulation	π/4 DQPSK

Digital standard IS-95 CDMA **Option R&S SMIQB42**
According TIA standard IS-95A and J-STD-008

Frequency	824 to 894 MHz/1850 to 2000 MHz
Modulation	QPSK, OQPSK

Digital standard WCDMA **Option R&S SMIQB43 2)**

Frequency	1800 MHz to 2200 MHz
Modulation	QPSK, OQPSK

Digital standard WCDMA 3GPP (FDD) **Option R&S SMIQB45 3)**
according 3GPP standard 3.4.0 (FDD)

3GPP (FDD) Version	optional 3.4.0, according technical specifications 3GPP TS25.211 and TS25.213
Frequency	1800 MHz to 2200 MHz

Simultaneous modulation
Any combination is possible with the following exceptions:
– Simultaneous FM and φM
– Simultaneous digital modulation and vector modulation
Pulse modulation cannot be used together with level attenuation function LEV ATT (option R&S SMIQB20)

Options for special applications

Fading simulation **Options R&S SMIQB14, SMIQB15**

paths and channels	
with option R&S SMIQB14	6 paths, 1 channel
with options R&S SMIQB14 and -B15	12 paths, 1 channel or 6 + 6 paths, 2 channels with second R&S SMIQ through simple retrofit
Path attenuation	0 dB to 50 dB
Path delay	0 μs to 1600 μs
Doppler shift	0.1 Hz to 1600 Hz

Speed range

$$v_{min} = \frac{0,03 \times 10^9 \frac{m}{s^2}}{f_{RF}} \qquad v_{max} = \frac{479 \times 10^9 \frac{m}{s^2}}{f_{RF}}$$

Rayleigh fading, pseudo noise interval	>372 h
Rice fading	
Power ratio 4)	–30 dB to +30 dB
Frequency ratio	–1 to +1
Lognormal fading, Suzuki fading	
Standard deviation	0 dB to 12 dB
Correlation	paths 1 to 6 with paths 7 to 12

Enhanced fading functions for WCDMA 3GPP **Option R&S SMIQB49**
The following data deviate from the specifications for R&S SMIQB14/R&S SMIQB15

Fine delay mode	
Number of paths	2 (with R&S SMIQB14), 4 (with R&S SMIQB14 + R&S SMIQB15)
Profiles	Rayleigh, pure Doppler
Delay, resolution	25 ns to 1637 μs, 1 ns
Moving delay mode	
Number of paths	2
Delay, path 1	0 to 1000 μs (in 50 ns steps)
Delay, path 2	delay path 1 + delay variation (peak-peak) x sin (2pt /variation period)
Delay variation (peak-peak)	150 ns to 50 μs
Variation period	10 s to 500 s
Delay step size	<1 ns
Birth-death mode	
Number of paths	2
Profiles	pure Doppler
Delay	5 μs to 1000 μs
Delay range	5 μs to +5 μs (not variable)
Delay grid	1 μs (not variable)
Hopping dwell	100 ms to 5 s

Noise and distortion simulation **Option R&S SMIQB17**

Distortion simulator	AM/AM and AM/φM distortion of modulation signal
Distortion characteristic	each characteristic programmable by entering up to 30 input values via IEC/IEEE bus or by entering up to five polynomial coefficients
Noise generator (AWGN)	
Distribution density	Gaussian, statistically indep. for I and Q
Crest-Factor	14 dB
C/N	–30 dB to 30 dB

Bit error rate measurement **Option R&S SMIQB21**

Pseudo-random bit sequences (PRBS)	2^9-1, 2^{11}-1, 2^{15}-1, 2^{16}-1, 2^{20}-1, 2^{21}-1, 2^{23}-1
Measurement time	selectable through maximum number of data bits or bit errors (max. 2^{31} bits each), continuous measurement
Measurement result	BER in ppm, % or decade values (if selected number of data bits or bit errors is attained) status displays: not synchronized, no clock, no data

Improved adjacent-channel power ratio for WCDMA and CDMA IS-95 **Option R&S SMIQB47**
Selectable baseband filters to improve ACP values (values see at Digital Standards CDMA/WCDMA)

1) PEP = peak envelope power.

2) Data apply to RF ≥5 MHz unless specified otherwise and for ATTENUATOR MODE NORMAL function.

3) Additional error with ALC OFF <0.3 dB.

Vector Signal Generator R&S SMIQ

Enhanced functions for digital standard WCDMA 3GPP (FDD)	**Option R&S SMIQB48**
3GPP (FDD) version	3.4.0 to 3GPP technical specifications TS25.101, TS25.104, TS25.141, TS25.211 and TS25.213

Enhanced Channels
Channels of W-CDMA system in R&S SMIQ that offer enhanced functionality compared with standard channels of option R&S SMIQB45.
Can be used in downlink for max. four DPCHs and in uplink for one DPCCH and max. three DPDCHs. All DPCHs or DPDCHs have the same symbol rate.

Enhanced functions at a glance:
- Sequences of up to 1042 frames
- Data lists for data fields and TPC field
- External power control
- Channel coding
- Bit error insertion
- Block error insertion
- Simulation of realistic noise scenarios
- Orthogonal channel noise simulation (OCNS)
- Additional mobile stations

Arbitrary waveform generator	**Option R&S SMIQB60**
Waveform memory, interpolation	
Output memory	
Length of waveform	1 to 524216 in steps of one sample
Resolution	12 bit
Downloading time for 512k I/Q samples	4 s
Nonvolatile memory	
Number of blocks	22 (one waveform occupies at least one block)
Block size	24 from firmware version 5.30
Interpolation	65527
Interpolation bandwidth (-0.1dB)	0.375 x clock rate
Repetitive spectra suppression through analog filter	>70 dB
Clock generation	
Clock rate	1 kHz to 40 MHz
Resolution	0.1 Hz
Clock mode	internal or external
Signal output, channels	2 (I and Q)
Output level (EMF, peak)	
Normal mode	$SQRT(I^2 + Q^2) = 1$ V, 50 Ω
Manual mode	–6 dB to 0 dB referred to 1 V, setting range up to +3 dB
Level difference between channels	<0.2% at 1 kHz [1)]
DC offset	<–54 dB in normal mode [1)]
Frequency response	
Magnitude up to 12 MHz/10 MHz	<1 dB/0.1 dB typ.
Group delay up to 10 MHz	1 ns typ.
I/Q imbalance	
Magnitude up to 10 MHz	0.05 dB typ.
Group delay up to 10 MHz	0.5 ns typ.
SFDR (sinewave 1 MHz, clock 4 MHz, measurement range up to 12 MHz)	>60 dB
Trigger modes	auto, retrig, armed auto, armed retrig
Trigger source	internal or external
Trigger outputs	2
Delay	0 to 524216 samples
On time	1 to 524215 samples
Off time	1 to 524215 samples
Level	TTL

General data

Memory for instrument settings	50 storable settings
List Mode	

Frequency and level values can be stored in a list and set in an extremely short time; permissible level variation: 90 dB

Max. number of channels	2000
Remote control	IEC 625 (IEEE 488)
Command set	SCPI 1993.0
Power supply	90 V to 265 V (AC), 50 Hz to 400 Hz, autosetting to AC supply, max. 300 VA
Dimensions (W x H x D)	435 mm x 192 mm x 460 mm
Weight	25 kg when fully equipped

Ordering information

Vector Signal Generator		
300 kHz to 2.2 GHz	R&S SMIQ02B	1125.5555.02
300 kHz to 3.3 GHz	R&S SMIQ03B	1125.5555.03
300 kHz to 4.4 GHz	R&S SMIQ04B	1125.5555.04
300 kHz to 6.4 GHz	R&S SMIQ06B	1125.5555.06
Accessories supplied	power cable, operating manual	

Options

Reference Oscillator OCXO	R&S SM-B1	1036.7599.02
FM/φM Modulator	R&S SM-B5	1036.8489.02
Data Generator	R&S SMIQB11	1085.4502.04
Memory Extension, 32 Mbit	R&S SMIQB12	1085.2800.04
Fading Simulator, 6 paths	R&S SMIQB14	1085.4002.02
Second Fading Simulator for 12 paths or 2 channels	R&S SMIQB15	1085.4402.02
Noise Generator and Distortion Simulator	R&S SMIQB17	1104.9000.02
RF and AF Rear Connectors	R&S SMIQB19	1085.2997.02
Modulation Coder	R&S SMIQB20	1125.5190.02
BER Measurement	R&S SMIQB21	1125.5490.02
Digital Standard IS-95 CDMA	R&S SMIQB42	1104.7936.02
Digital Standard WCDMA acc. to NTT DoCoMo 1.0, ARIB 0.0 standard	R&S SMIQB43	1104.8032.02
Digital Standard WCDMA according to 3GPP (FDD)	R&S SMIQB45	1104.8232.02
Low ACP for IS-95 CDMA and W-CDMA	R&S SMIQB47	1125.5090.02
Extended Functions for WCDMA (3GPP)	R&S SMIQB48	1105.0587.02
Extended Fading Functions for WCDMA (3GPP)	R&S SMIQB49	1105.1083.02
Digital Standard GPS	R&S SMIQB51	1105.1683.02
Arbitrary Waveform Generator incl. R&S WinIQSIM™	R&S SMIQB60	1136.4390.02
TETRA T1 Simulator	R&S SMIQ-K8	1136.4290.02
Digital Standard IS-95 CDMA (software for R&S SMIQB60)	R&S SMIQK11	1105.0287.02
Digital Standard CDMA2000 (software for R&S SMIQB60)	R&S SMIQK12	1105.0435.02
Dig. Standard WCDMATDD mode (3GPP) (for option R&S SMIQB60)	R&S SMIQK13	1105.1231.02
Digital Standard TD-SCDMA (software for R&S SMIQB60)	R&S SMIQK14	1105.1338.02
OFDM Signal Generation, HIPER LAN/2	R&S SMIQK15	1105.1531.02
Digital Standard IEEE 802.11b	R&S SMIQK16	1154.7700.02
Digital Standard 1xEV-DO	R&S SMIQK17	1154.7800.02
Digital Standard IEEE 802.11a	R&S SMIQK18	1154.7952.02

Additional hint: R&S SMIQ02B/03B (R&S SMIQ04B/06B) can be equipped with up to three (two) of the following options: R&S SM-B5, R&S SMIQB14, R&S SMIQB15, R&S SMIQB17

Application software

Generation of data and control lists	R&S SMIQ-K1	*)
Bluetooth signals for R&S SMIQ	R&S SMIQ-K5	*)
User mappings and user filters for R&S SMIQ	User Mod	*)

1) Spectral components exceeding max. IQ bandwidth will be suppressed.

2) Cannot be fitted together with Digital Standard WCDMA 3GPP (option R&S SMIQB45).

3) Cannot be fitted together with Digital Standard WCDMA NTT DoCoMo (option R&S SMIQB43).

4) Ratio of discrete and distributed component.

5) Contrast of LCD lower at higher temperature.

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Vector Signal Generator R&S SMIQ03HD

2110 MHz to 2170 MHz

Dedicated to 3GPP, special model of Vector Signal Generator R&S SMIQ

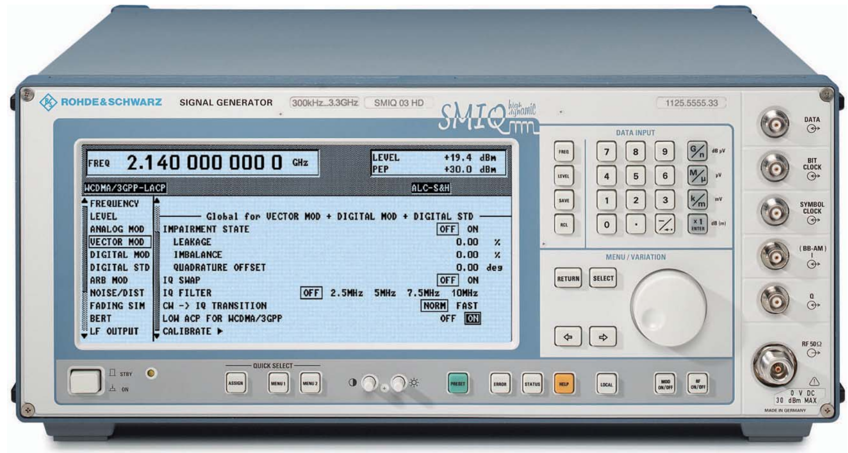

Photo 43481-1

Brief description

The third-generation mobile radio standards use broadband transmission methods to allow the configuration of communication networks with high data rates. WCDMA with its bandwidth of 3.84 MHz and the underlying CDMA method places particularly stringent requirements on the total transmission chain.

The signal statistics of a WCDMA signal reveal high crest factors (peak-to-average power ratios). Therefore, amplifiers with a wide linear range are required to ensure distortion-free transmission not only of average transmit power but also of high power peaks.

The requirements on base station power amplifiers become even more stringent since the amplifiers also transmit multicarrier signals within the 60 MHz downlink band. In addition to single-carrier power amplifiers (SCPAs), multicarrier power amplifiers (MCPAs) are increasingly used. Signal sources featuring wide dynamic range and high accuracy, such as the R&S SMIQ03HD, are required for the development and production testing of the amplifiers. WCDMA specifications allow base stations only a very low adjacent-channel power (ACP). The R&S SMIQ03HD supplies a test signal whose adjacent-channel leakage ratio (ACLR) is much better than the one required for base stations so that measurements can be carried out on amplifiers with sufficient dynamic range.

Main features

- Wide dynamic range: ACLR 70 dB typ. for 3GPP test model 1/64
- Short frequency and level setting time
- Single-carrier scenarios: further improvement of ACLR (77 dB typ.) with option R&S SMIQB57. Band-specific solution (3GPP downlink) combined with high output power (up to +30 dBm PEP)
- Multicarrier scenarios: integrated baseband filters to improve ACLR for 1 to 4 W-CDMA carriers
- Optional fading simulator (R&S SMIQB14/B15) and noise generator/distortion simulator (R&S SMIQB17)

SCPA	Description	Type	Order No.
Internal baseband generation	Vector Signal Generator	R&S SMIQ03HD	1125.5555.33
	Modulation Coder	R&S SMIQB20	1125.5190.02
	Data Generator	R&S SMIQB11	1805.4502.04
	Digital Standard WCDMA 3GPP (FDD)	R&S SMIQB45	1104.8232.02
	High ACLR for WCDMA 3GPP (2110 MHz to 2170 MHz)	R&S SMIQB57	1105.1831.02
Ext. baseband generation (e.g. using AMIQ)	Vector Signal Generator	R&S SMIQ03HD	1125.5555.33
	High ACLR for WCDMA 3GPP (2110 MHz to 2170 MHz)	R&S SMIQB57	1105.1831.02
	I/Q Modulation Generator, incl. WinIQSIM™	AMIQ	1110.2003.03 1110.2003.04

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Vector Signal Generator R&S SMIQ03HD

Specifications

Specifications apply under the following conditions: 30 minutes warmup time at ambient temperature, specified environmental conditions met, calibration cycle adhered to, and total calibration performed. Data designated "overrange" are not warranted. For general data please refer to the R&S SMIQ standard data sheet (PD 0757.2438). The following data differs from the standard data or pertains to additional features.

Digital Standard WCDMA 3GPP (FDD) (option R&S SMIQB45)

Single-carrier measurements

ACLR	
(frequency 1850 MHz to 2200 MHz, level ≤8 dBm (PEP))	
1 DPCH (crest factor 5.4 dB, I/Q filter 2.5 MHz)	
Offset 5 MHz, low-distortion output mode	>67 dB, 71 dB typ.
Offset 10 MHz, low-noise output mode	>73 dB, 76 dB typ.
Test model 1, 64 DPCH (crest factor 10.6 dB, I/Q filter 2.5 MHz)	
Offset 5 MHz, low-distortion output mode	>66 dB, 70 dB typ.
Offset 10 MHz, low-noise output mode	>70 dB, 73 dB typ.
ACLR	
1 DPCH (crest factor 5.4 dB, average power ≤10 dBm)	
Offset 5 MHz, low-distortion output mode	>75 dB, 78 dB typ.
Offset 10 MHz, low-noise output mode	>81 dB, 84 dB typ.
Test model 1, 64 DPCH (crest factor 10.6 dB, average power ≤10 dBm)	
Offset 5 MHz, low-distortion output mode	>74 dB, 77 dB typ.
Offset 10 MHz, low-noise output mode	>79 dB, 82 dB typ.

Multicarrier measurements

ACLR	
(frequency 2110 MHz to 2170 MHz, level ≤8 dBm (PEP); multicarrier signals generated with the internal Arbitrary Waveform Generator R&S SMIQB60)	
2 carriers, test model 1, 64 DPCH (crest factor 11 dB, I/Q filter 5 MHz)	
Offset 5 MHz, low-distortion output mode	>60 dB, 64 dB typ.
Offset 10 MHz, low-noise output mode	>65 dB, 68 dB typ.
3 carriers, test model 1, 64 DPCH (crest factor 11.3 dB, I/Q filter 7.5 MHz)	
Offset 5 MHz, low-distortion output mode	>59 dB, 63 dB typ.
Offset 10 MHz, low-noise output mode	>62 dB, 65 dB typ.
4 carriers, test model 1, 64 DPCH (crest factor 11.8 dB, I/Q filter 10 MHz)	
Offset 5 MHz, low-distortion output mode	>58 dB, 62 dB typ.
Offset 10 MHz, low-noise output mode	>61 dB, 64 dB typ.

High ACLR[1] for WCDMA 2110 MHz to 2170 MHz (option R&S SMIQB57)

Frequency

Frequency range	2110 MHz to 2170 MHz
3GPP channel bandwidth	3.84 MHz

Level

Output level (PEP), normal output mode	–130 dBm to 27 dBm
Overrange	30 dBm
Uninterrupted level setting	
Attenuator mode fixed	>30 dB
Repeatability	
ALC STATE ON (CW mode)	0.05 dB typ.
ALC STATE OFF (time interval 5 minutes, temperature interval 5 °C)	<0.15 dB
Linearity error (in displayed level range, attenuator mode fixed)	<0.2 dB in specified temperature range[2], 0.1 dB typ.
Total level uncertainty[2]	
Attenuator mode auto (–120 dBm to 25 dBm (PEP))	
CW	<0.5 dB
Digital modulation	<0.7 dB
VSWR, output impedance	
Level >15 dBm (PEP)	<1.8
Level ≤15 dBm (PEP)	<1.5
Max. permissible RF reverse power	1 W

Spectral purity

Harmonics	
Level <25 dBm (PEP)	<–30 dBc, –40 dBc typ.
Level <15 dBm (PEP)	<–40 dBc, –50 dBc typ.
Nonharmonics, carrier offset >10 kHz	<–86 dBc
Subharmonics	none
Error vector magnitude (W-CDMA, 3.84 Mcps), rms	4% typ.

1) ACLR definition according to 3GPP TS 25.141: ACLR (adjacent-channel leakage ratio) is the ratio of the average power centered on the assigned channel frequency to the average power centered on an adjacent channel frequency. In both cases the average power is measured with a filter that has root raised cosine (RRC) filter response with a roll-off factor α = 0.22 and a bandwidth equal to the chip rate.

2) The specifications only apply to temperatures from +10 °C to +40 °C.

Restrictions on other data when using option R&S SMIQB57

General: Modulation bandwidth is reduced to 3GPP channel bandwidth. Due to steep bandpass filtering, additional amplitude and group delay distortions occur.

Function/option concerned	Remark
– Broadband amplitude modulation	–
– Digital modulation	Increased EVM at higher symbol rates
– Digital Standard IS-95 CDMA SMIQB42	850 kHz IQ filter not provided
– Digital Standard WCDMA R&S SMIQB43, Digital Standard WCDMA 3GPP (FDD) R&S SMIQB45, Enhanced Functions for Digital Standard WCDMA 3GPP (FDD) R&S SMIQB48	Increased EVM
– Arbitrary Waveform Generator SMIQB60	–
– Fading Simulators R&S SMIQB14/15	–
– Noise Generator/Distortion Simulator R&S SMIQB17	–
– Amplitude modulation	Not possible with option R&S SMIQB57
– Level setting, attenuator mode electronic	Not possible with option R&S SMIQB57
– Level setting, ALC OFF, MODE TABLE	Not possible with option R&S SMIQB57

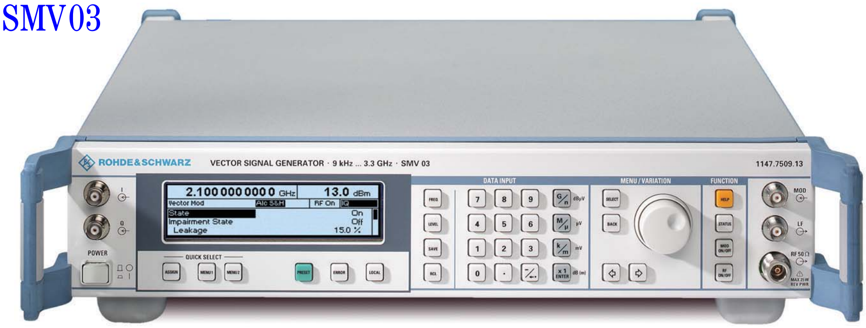
Ordering information

Vector Signal Generator	R&S SMIQ03HD	1125.5555.33
Accessories supplied	power cable, operating manual	
Options		
High ACLR for WCDMA 3GPP (2110 MHz to 2170 MHz)	R&S SMIQB57[1]	1105.1831.02

1) Factory installation only.

For all other options/recommended extras/application software please refer to the R&S SMIQ data sheet (PD 0757.2438).

Vector Signal Generator R&S SMV03



Vector modulation in the analog class

Photo 43792-1

Brief description

The Vector Signal Generator R&S SMV03 is based on the successful analog Signal Generator R&S SML03 and so features the same excellent technical characteristics. It comprises an additional broadband I/Q modulator which is able to generate any digital signal in conjunction with an external I/Q source. The R&S SMV03 is, therefore, a way of entering the wide field of automatic test systems as well as gaining access to applications like R&D and service. When used together with AMIQ and WinIQSIM™, the R&S SMV03 can generate digital signals that meet any requirement.

Main features

RF characteristics

- Frequency range from 9 kHz to 3.3 GHz with 0.1 Hz resolution
- High output level of +13 dBm with a deviation <0.5 dB
- Interruption-free level setting by electronic attenuator
- High spectral purity (<–122 dBc (1 Hz) at f = 1 GHz with 20 kHz carrier offset)
- Frequency and level setting time <10 ms

Vector modulation

- Wide I/Q bandwidth of >50 MHz (3 dB), 100 MHz RF bandwidth for f >500 MHz to 3 GHz
- High vector accuracy

Analog modulation

- AM/FM/φM as standard
- Simultaneous AM, FM/φM, pulse and vector modulation
- Optional pulse modulator with integrated pulse generator (R&S SML-B3)

Size

- Compact size 427 mm x 88 mm x 450 mm
- Low weight <9.5 kg

User friendly

- One-hand operation with EasyWheel
- All settings simple and self-explanatory
- High-contrast LCD
- User-assignable menu keys
- Online help including IEC/IEEE-bus commands

Low Cost of Ownership

- 3-year calibration cycle
- Electronic attenuator for wear-free operation
- Service-friendly (continuous selftest, access to internal test points)

Production: fast, accurate, reliable

Versatility

The R&S SMV03 generates all kinds of I/Q-modulated signals using the integrated vector modulator. Thanks to its wide bandwidth of 50 MHz, the R&S SMV03 is also optimally suited for applications using high data rates such as WLAN standards. Signals to digital standards can be easily generated in conjunction with an external I/Q source like the Modulation Generator R&S AMIQ (PD 0757.3970) and the associated R&S WinIQSIM™ (PD 0757.6940) simulation software.

Dimensions

The compact size (only 2 HU) makes the R&S SMV03 ideal for use in production where space is often limited.

Speed

Speed is essential – especially in production. And this is exactly where the R&S SMV03 shows what it can do with a frequency and level setting time of <10 ms.

Accuracy

Any measurement uncertainty has two components: the uncertainty due to the measuring instrument and that due to the rest of the test setup. The lower the level uncertainty of the vector signal generator, the greater the test setup tolerance that may be allowed. If greater tolerances can be allowed for the DUT because of the small level error of the R&S SMV03, production rejects can be markedly reduced - an advantage that pays off immediately.

Vector Signal Generator R&S SMV03

Reliability
A signal generator used in production must feature high reliability. The R&S SMV03 meets this requirement for example through the use of a completely wear-free electronic attenuator.

Output level
In production test systems, the signal is routed to the DUT via switches and cables which introduce losses. This can be compensated for by the high output power of the R&S SMV03.

Lab and R&D: versatile

Versatile modulation modes
Particularly in research, a great variety of digital signals are used in the development of new systems, which are not always covered by a standard. Thanks to its very wideband I/Q modulator, the R&S SMV03 can handle universal tasks of this kind.

Also, the vector signal generator, in conjunction with the optional Pulse Modulator R&S SML-B3, can handle all types of analog modulation. AM, FM/φM and pulse modulation can be used simultaneously as can vector modulation, FM/φM and pulse modulation.

High spectral purity
Thanks to its low phase noise R&S SMV03 is ideally suited to replace LOs.

High and accurate output level
The high level accuracy of the Vector Signal Generator R&S SMV03 is a prerequisite for highly accurate measurements on sensitive analog and digital receivers. Its high output level makes the R&S SMV03 an ideal source for driving high-level mixers.

Servicing: robust, compact, lightweight

Mobility
SMV03 is lightweight (<9.5 kg) and compact and therefore very easy to transport.

Flexible control
In service environments, an IEC/IEEE interface is not always available to control the generator. This is not a problem as the R&S SMV03 can also be controlled via a standard RS-232-C interface.

Protection against overvoltage
The integrated overvoltage protection of the RF output protects the SML against very high external voltages such as may occur during transceiver measurements.

EMS measurements

Interruption-free level setting without overshoots
EMS measurements require interruption-free level setting which should also be overshoot-free. The R&S SMV03 does not produce any overshoots – even at setting times <10 ms. Furthermore, it has a wide dynamic range of typ. 30 dB over which level adjustment is interruption-free.

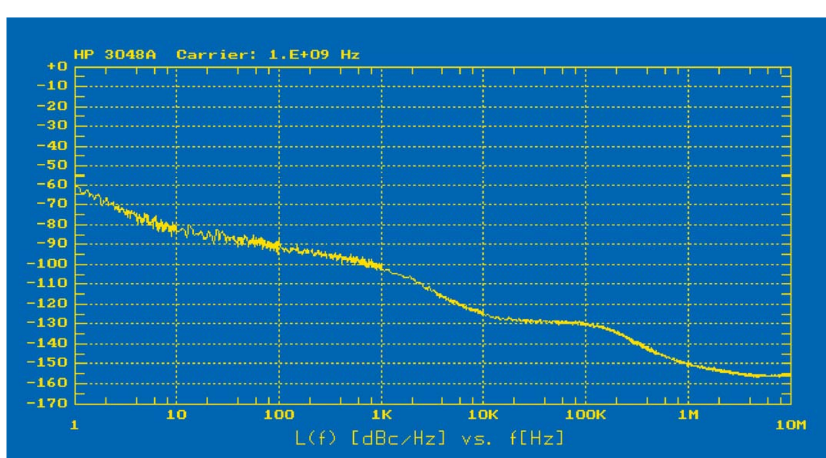
Wide frequency range
R&S SMV03 features a lower frequency limit of 9 kHz as standard and so fully covers the frequency range required for EMC measurements.

Reference source

R&S SMV03 allows selection of the mode of frequency generation. In the Extended Divider Range mode, the RF signal is generated by frequency division. The excellent values obtained in this mode for SSB phase noise are comparable to those from the high-grade crystal oscillators normally used as reference sources from 10 MHz to 30 MHz.

Stereo/RDS Coder R&S SML-B5 (option)

Fitted with the new option, the signal generators of the tried and tested R&S SML and R&S SMV families generate stereo-modulated RF signals to standard for use in production, development and service. At the core of this option is a digital signal processor (DSP) that generates stereo, RDS and ARI signals of outstanding quality, which is fully sustained owing to the excellent FM modulators in the generators.



Typical SSB phase noise at 1 GHz (with OCXO option R&S SML-B1)

Vector Signal Generator R&S SMV03

Specifications in brief

Frequency

I/Q modulation off	9 kHz to 3.3 GHz	
I/Q modulation on	5 MHz to 3.3 GHz	
Resolution	0.1 Hz	
Reference frequency	**Standard**	**Option R&S SML-B1**
Aging (after 30 days of operation)	$<1\cdot10^{-6}$/year	$<1\cdot10^{-7}$/year
Temperature effect (0°C to 55°C)	$<1\cdot10^{-6}$	$<2\cdot10^{-8}$
Output for internal reference	10 MHz	
Input for external reference	10 MHz	
Permissible frequency drift	$5\cdot10^{-6}$	

Spectral purity

Harmonics spurious signals [1]	
f ≤20 kHz	<–25 dBc at levels ≤+8 dBm
f >20 kHz	<–30 dBc at levels ≤+8 dBm
Subharmonics spurious signals	
f ≤1.1 GHz	–
f >1.1 GHz	<–50 dBc
Nonharmonics spurious signals (carrier offset >10 kHz)	
f ≤1.1 GHz	<–70 dBc
f >1.1 GHz to 2.2 GHz	<–64 dBc
f >2.2 GHz to 3.3 GHz	<–58 dBc
Broadband noise[2] (f = 1 GHz, carrier offset >2 MHz, 1 Hz bandwidth)	<–140 dBc, –150 dBc typ.
SSB phase noise (f = 1 GHz, 20 kHz carrier offset, 1 Hz bandwidth)	<–122 dBc, –128 dBc typ.
Spurious FM, rms (f = 1 GHz)	
0.3 kHz to 3 kHz	<4 Hz, 1 Hz typ.
0.03 kHz to 20 kHz	<10 Hz, 3 Hz typ.
Spurious AM, rms	
0.03 kHz to 20 kHz	<0.02%

Level

Range	–140 dBm to +13 dBm[2] (overrange +19 dBm)
Resolution	0.1 dB
Level accuracy [2] [3] (level >–120 dBm)	
100 kHz to ≤2 GHz	<0.5 dB
f >2 GHz	<0.9 dB
Frequency response at 0 dBm [2] [3]	
100 kHz to ≤2 GHz	<0.7 dB
f >2 GHz	<1.0 dB
SWR	
100 kHz to 1.5 GHz	1.6
f >1.5 GHz	2.3
Setting time (IEC/IEEE bus), f >100 kHz	<10 ms, 5 ms typ.
Interruption-free level setting[4]	
I/Q modulation off	20 dB, overrange 30 dB
I/Q modulation on	15 dB, overrange 20 dB

Overvoltage protection	safeguards unit against externally applied RF power and DC voltage (50 Ω source)
Max. permissible RF power	
f ≤2.2 GHz	50 W
f >2.2 GHz	25 W
Max. permissible DC voltage	35 V

Vector Modulation	external DC
Additional level inaccuracy in case of vector modulation (ALC OFF), referred to CW mode	<0.3 dB
I and Q modulation inputs	
SWR (DC to 30 MHz)	<1.2
Input voltage for full-scale level	$\sqrt{I^2+Q^2} = 0.5$ V (1 V into 50 Ω)
Static error vector[5], Level <+8 dBm	
Rms value	<0.5%
Peak value	<1%
Modulation frequency response	
f >500 MHz to 3 GHz	
DC to 5 MHz	<0.4 dB
DC to 50 MHz	<3 dB
f <500 MHz and f >3 GHz [6]	
DC to 5 MHz	<0.4 dB
DC to 30 MHz	<3 dB
Residual carrier at 0 V input voltage referred to max. input voltage	<–45 dBc
I/Q imbalance	
Carrier leakage (Setting range)	0% to 50%
I≠Q (Setting range)	–12% to +12%
Quadrature offset (Setting range)	–10° to +10°
Adjacent-channel power WCDMA 3GPP FDD (f = 2.14 GHz) Test model 1 (64 DPCHs)	
Offset 5 MHz	<–60 dBc, –62 dBc typ.
Offset 10 MHz	<–64 dBc, –66 dBc typ.

Internal modulation generator

Frequency range; resolution	0.1 Hz to 1 MHz; 0.1 Hz
Frequency response (up to 500 kHz, level >100 mV)	<0.5 dB
THD (up to 100 kHz, level 4 V, R_L = 600 Ω)	<0.1%
Open-circuit voltage V_p (LF connector)	1 mV to 4 V
Frequency setting time (after reception of last IEC/IEEE-bus character)	<10 ms

Simultaneous modulation	AM, FM/φM and pulse modulation or vector modulation, FM/φM and pulse modulation
Amplitude modulation [7]	internal, external AC/DC, internal/external two-tone
Modulation depth	0% to 100%

settable modulation depth continuously decreasing between +7 dBm and +13 dBm[8] while adhering to AM specifications; a status message is output when the modulation depth is too high

Setting accuracy at 1 kHz (m <80%) [9]	<4% of reading +1%
AM distortion at 1 kHz	
m = 30%	<1%
m = 80%	<2%
Modulation frequency range (<3 dB)	DC/10 Hz to 50 kHz
Incidental φM at AM (30%), AF=1 kHz	<0.2 rad
Modulation input EXT	1 V

Vector Signal Generator R&S SMV03

Frequency modulation	internal, external AC/DC, internal/external two-tone
Frequency deviation	
9 kHz to 76 MHz	0 Hz to 1 MHz
>76 MHz to 151.3125 MHz	0 Hz to 125 kHz
>151.3125 MHz to 302.625 MHz	0 Hz to 250 kHz
>302.625 MHz to 605.25 MHz	0 Hz to 500 kHz
>605.25 MHz to 1.2105 GHz	0 Hz to 1 MHz
>1.2105 GHz to 1.818 GHz	0 Hz to 2 MHz
>1.818 GHz to 2.655 GHz	0 Hz to 3 MHz
>2.655 GHz to 3.300 GHz	0 Hz to 4 MHz
FM distortion (at AF = 1 kHz and 50% of max. deviation)	<0.2%, 0.1% typ.
Modulation frequency range (<3 dB)	
standard	DC to 100 kHz
wide	10 Hz to 500 kHz
Incidental AM (at AF = 1 kHz, f >10 MHz, 40 kHz deviation)	<0.1%
Stereo modulation at 40 kHz useful deviation, AF = 1 kHz, RF = 87 MHz to 108 MHz	
Crosstalk	>50 dB
S/N ratio unweighted, rms	>70 dB
S/N ratio weighted, rms	>70 dB
Distortion	<0.2%, 0.1% typ.
Carrier frequency offset at FM DC	0.1% typ. of set deviation
Modulation input EXT	1 V
Phase modulation	internal, external AC/DC, internal/external two-tone
Phase deviation [10]	
9 kHz to 76 MHz	0 rad to10 (2) rad
>76 MHz to 151.3125 MHz	0 rad to 1.25 (0.25) rad
>151.3125 MHz to 302.625 MHz	0 rad to 2.5 (0.5) rad
>302.625 MHz to 605.25 MHz	0 rad to 5 (1) rad
>605.25 MHz to 1.2105 GHz	0 rad to 10 (2) rad
>1.2105 GHz to 1.818 GHz	0 rad to 20 (4) rad
>1.818 GHz to 2.655 GHz	0 rad to 30 (6) rad
>2.655 GHz to 3.300 GHz	0 rad to 40 (8) rad
Phase distortion (at AF = 1 kHz and 50% of maximum deviation)	<0.2%, 0.1% typ.
Modulation frequency range (–3 dB)	
standard	DC to 100 kHz
wide	10 Hz to 500 kHz
Modulation inputs EXT	1 V
Pulse modulation (option SML-B3)	internal, external
On/off ratio	>80 dB
Rise/fall time (10%/90%)	<20 ns, 10 ns typ.
Pulse repetition frequency	0 Hz to 2.5 MHz
Pulse delay	50 ns typ.
Video crosstalk (V_p)	<30 mV
Modulation input PULSE	TTL level (HCT)
Pulse generator (option SML-B3)	automatic, externally triggered, external gate mode, single pulse, double pulse, delayed pulse (externally triggered)
Active trigger edge	positive or negative
Pulse period/resolution/accuracy	100 ns to 85 s/5 digits/<1 x 10^{-4}
Pulse width/resolution/accuracy	20 ns to 1 s/4 digits/<1 x 10^{-4} + 3 ns
Pulse delay/resolution/accuracy	20 ns to 1 s/4 digits/<1 x 10^{-4} + 3 ns
Double-pulse spacing/resol./accuracy	20 ns to 1 s/4 digits/<1 x 10^{-4} + 3 ns
Trigger delay	50 ns typ.
Jitter	<10 ns
PULSE/VIDEO output	TTL signal (R_L ≥50 Ω)
Sweep	digital in discrete steps
RF sweep, AF sweep	automatic, single-shot, manually or externally triggered, linear or logarithmic
Sweep range	user-selectable
Step width (lin)	user-selectable
Step width (log)	0.01% to 100%
Level sweep	automatic, single-shot, manually or externally triggered, logarithmic
Sweep range	user-selectable
Step width (log)	user-selectable
Step time/resolution	10 ms to 1 s/0.1 ms
Trigger input/impedance	TTL (HCT)/10 kΩ (pull-up)

General data

Memory for device settings	100 storable settings
Remote control	IEC625 (IEEE 488) and RS-232-C
Rated temperature range	0 °C to 55 °C;
Storage temperature range	–40°C to +70°C
Power supply	100 V to 120 V (AC), 50 Hz to 400 Hz, 200 V to 240 V (AC), 50 Hz to 60 Hz, autoranging, max. 250 VA
Dimensions (W x H x D)	427 mm x 88 mm x 450 mm
Weight	9.5 kg when fully equipped

1) With option R&S SML-B3 only for f > 20 MHz.
2) With Attenuator Mode Auto.
3) Temperature range 20°C to 30°C.
4) With Attenuator Mode Fixed.
5) After 1 hour warm-up and recalibration within 4 hours of operation after temperature variations <5°C.
6) The modulation BW continuously decreases upon approaching 5 MHz or 3.3 GHz.
7) With Attenuator Mode Auto, f ≥100 kHz.
8) R&S SML02, R&S SML03: +5 dBm to 11 dBm at f ≤5 MHz, f >3 GHz.
9) With option R&S SML-B3 only for f >10 MHz.
10) Values in brackets apply to wide modulation bandwidth.

Ordering information

Vector Signal Generator	R&S SMV03	1147.7509.13
Accessories supplied	power cable, user manual	
Options		
Reference Oscillator OCXO	R&S SML-B1	1090.5790.02
Pulse Modulator	R&S SML-B3	1090.5403.02[1]
Stereo /RDS Coder	R&S SML-B5	1147.8805.02
Rear Connectors for AF, RF	R&S SML-B19	1090.5303.02[1]
Extras		
Service Kit	R&S SML-Z2	1090.5203.02
19" Rack Adapter	R&S ZZA-211	1096.3260.00
Transport Bag	R&S ZZT-214	1109.5119.00
Service Manual, Modules		1090.3123.24

1) Factory-fitted only.

I/Q Modulation Generator R&S AMIQ03, AMIQ04, Simulation Software R&S WinIQSIM™

R&S AMIQ03: 4 M samples,
R&S AMIQ04: 16 M samples
New approaches in the generation of complex I/Q signals

Photo 43419-3

Brief description

I/Q Modulation Generators R&S AMIQ03, R&S AMIQ04 and Simulation Software R&S WinIQSIM™ open up new dimensions for the generation of I/Q signals. R&S AMIQ is a dual-channel modulation generator that has consequently been designed for use as an I/Q source. It is programmed and set with Software R&S WinIQSIM™. Alternatively, R&S AMIQ can be operated from a Vector Signal Generator SMIQ.

Each channel can store 4000000 (R&S AMIQ03) or 16000000 samples (R&S AMIQ04) respectively. Even at high symbol rates sequences of sufficient length can thus be generated. With clock frequencies of up to 100 Msample/s and a high amplitude resolution of 14 (up to 16 bits via digital I/Q output) bits, R&S AMIQ is the ideal source for any signal in the world of digital modulation.

An automatic amplitude/offset alignment as well as fine adjustment of the skew provide excellent symmetry of the two channels which previously was extremely difficult to attain with dual-channel ARB generators. The error vector can thus be minimized.

A typical application of R&S AMIQ and R&S WinIQSIM™ is not only to drive the I/Q inputs of a vector signal generator. This combination is also ideal for direct applications in the baseband, e.g. for testing I/Q modulators/demodulators.

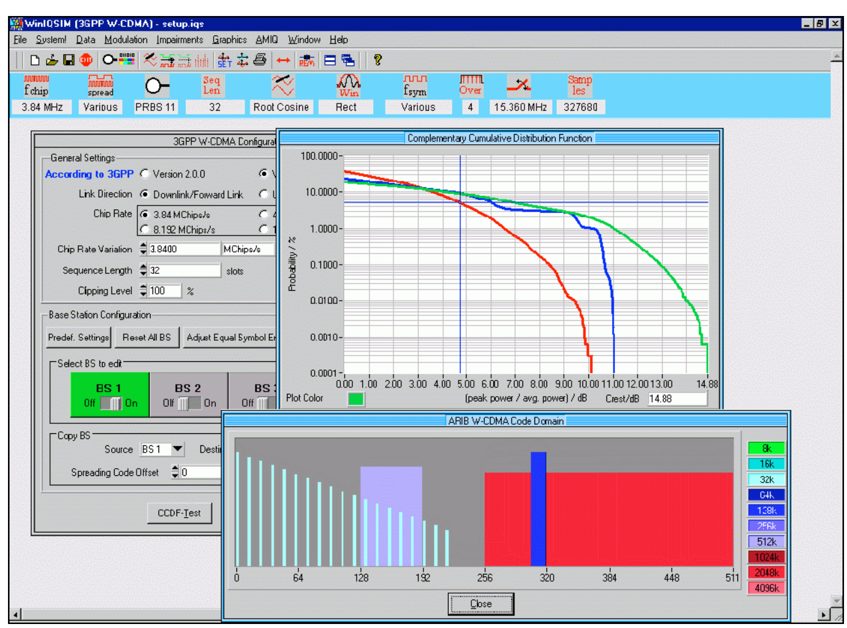
Main features

R&S AMIQ

- 14-bit resolution (up to 16 bits via digital I/Q output) or 16000000 samples (R&S AMIQ04) respectively
- 4000000 samples memory depth (R&S AMIQ03)
- 100 MHz sample rate
- Integrated hard disk and floppy disk drive
- Optional BER measurement
- Optional differential I/Q outputs
- Optional digital I/Q output

R&S WinIQSIM™

- Calculation of digitally modulated I/Q and IF signals
- Single-carrier, multicarrier and CDMA and WCDMA 3GPP signals
- Import of I/Q signals via DDE interface
- Versatile data editor
- Superposition/simulation of impairments
- Graphic display



I/Q Modulation Generator R&S AMIQ 03, AMIQ 04, Simulation Software R&S WinIQSIM™

I/Q simulation software

Modulation methods like GMSK or π/4 DQPSK are used in mobile communication systems such as GSM (Global System for Mobile Communications) or NADC (North American Digital Cellular). These complex modulation modes are usually generated with the aid of an I/Q or vector modulator. The calculation and generation of the required baseband signals is of course quite complex.

R&S WinIQSIM™ is a Windows software allowing calculation of I and Q baseband signals. Its capabilities range from single-carrier modulation, generation of multi-carrier, CDMA and WCDMA signals through to TDMA frame configurations with the help of a convenient data editor. All modulation parameters and impairments can be simulated for single-carrier and multi-carrier as well as for CDMA signals. To put it in a nutshell: R&S WinIQSIM™ is an indispensable tool for anyone engaged in modern digital modulation.

Specifications in brief

R&S AMIQ

Output memory	
Waveform length (data and markers)	
Clock rate mode 1 (10 Hz to 4 MHz)	24 to 4 000 000 samples in steps of one
Clock rate mode 2 (2 MHz to100 MHz)	24 to 4 000 000 samples in steps of four
Amplitude resolution	14 bits (up to 16 bits via digital I/Q output)
Marker channels	usable as marker or trigger
Marker outputs	4
Clock	
Clock rate	internal/external 10 Hz to 100 MHz
Setting range (internal)	10 Hz to 105 MHz 1)
Resolution (internal)	1 x 10^{-7}
Reference frequency	
Internal reference output	
Frequency	10 MHz
Aging (after 30 days of operation)	1 x 10^{-5}/year
Temperature effect (0°C to 45°C)	<2 x 10^{-6}/°C
Signal output	
Number of outputs	2 (I and Q), 4 in conjunction with R&S AMIQ-B2 (I and Q additional)
Output impedance	50 Ω
Output voltage (V_p into 50 Ω)	
Fix mode	0.5 V, same for both channels
Variable mode	0 mV to 1 V, separately adjustable for each channel
Skew between I and Q channel (filter off, clock rate 10 MHz, fix mode)	
Fine variation	±1 ns typ.
Resolution	<10 ps
Effective bits (sinewave 5 MHz, clock frequency 50 MHz, fix mode)	11 typ.
Filters	
Operating modes	off (no filter), internal or external
Internal filters	
25 MHz, elliptic, 7th order + delay equalizer	
Freq. response Amplitude	0.15 dB typ. up to 25 MHz
Group delay	500 ps typ. up to 20 MHz
2.5 MHz, elliptic, 7th order + delay equalizer	
Freq. response Amplitude	0.15 dB typ. up to 2.5 MHz
Group delay	5 ns typ. up to 2 MHz
Trigger	
CONT mode	repetitive output of loaded waveform after occurrence of trigger
SINGLE mode	single output of loaded waveform after occurrence of trigger
GATED mode	start of (repetitive) waveform output after occurrence of trigger until end of trigger event
Trigger signal	via remote control or trigger input
Trigger input	BNC connector, selectable polarity
Input level	TTL
Marker outputs	4, BNC connectors
Level	TTL, terminatable with 50 Ω, high > 2 V

BER (option R&S AMIQ-B1)
Data supplied by the DUT can be compared with a nominal random bit sequence; the results are transferred to the host computer (via the currently used remote control)

Pseudo random bit sequences	2^9–1, 2^{11}–1, 2^{15}–1, 2^{16}–1, 2^{20}–1, 2^{21}–1, 2^{23}–1

I/Q Modulation Generator R&S AMIQ 03, AMIQ 04, Simulation Software R&S WinIQSIM™

Differential Outputs (Option R&S AMIQ-B2)
Supports additional inverted signals to I and Q and allows simultaneous overlapping of output signals with a DC level.

Digital I/Q Output (Option R&S AMIQ-B3)
Supports digital data for both channels I and Q (either 8 or 16 bits resolution)

Remote control and memory	IEC 625-2 (IEEE 488) and RS-232-C
Command set	SCPI 1996.0 with extensions
Mass memory	floppy disk drive (3.5", 1.44 MB), hard disk >3 GB
General data	
Rated temperature range	0 °C to +45 °C; to IEC68-2-1 and IEC68-2-2
Storage temperature range	−40 °C to +70 °C
Power supply	90 V to 132 V (AC), 47 Hz to 63 Hz, 180 V to 264 V (AC), 47 Hz to 63 Hz, autoranging of AC supply, 150 VA
Dimensions (W x H x D)	427 mm x 88 mm x 450 mm
Weight	8.4 kg

R&S WinIQSIM™

User interface	Windows interface with context-sensitive help
Systems	single-carrier, IF signals up to 25 MHz, multicarrier, multicarrier mixed signal, up to 512 carriers with or without modulation, with variable power, WCDMA, IS-95
Modulation modes	
PSK	BPSK, QPSK, offset QPSK, π/4 DQPSK, 8 PSK, 8PSK-EDGE; parameter: reference level, PSK rotation
QAM	16/32/64/256 QAM; parameter: reference level
FSK	MSK, 2 FSK, 4 FSK, GTFM; parameter: modulation index 0.1 to 12 GTFM, b = 0 to 1
User-specific modulation	
Data editor	definition of TDMA data structures with power-time templates
Sequence length	1 to max. 4 M symbols/16 M symbols
Simulation of impairments and transfer characteristics	I/Q impairments, phase noise, bandpass, amplifier models, power ramping, multipath propagation, offset, additive interferers, receiver filters, quantization, smoothing
Graphic output	user-selectable scaling, zoom function, delta marker; display modes: i(t), q(t), r(t), phi(t), r(t), f(t), eye I, eye Q, eye F, vector diagram, constellation diagram, magnitude/phase/group delay spectrum, additional CCDF and ACP; display of code domain at WCDMA 3 GPP
Remote control of R&S AMIQ	download and starting of waveforms, hardware configuration, alignment and fine adjustment, file management

Digital standard IS-95 and CDMA 2000

See also „Supplements to R&S SMIQ, R&S AMIQ and R&S WinIQSIM™, Digital standards IS-95 and CDMA 2000“, PD 0757.5908
Simulation CDMA signals to North American standard IS-95 A and CDMA 2000, available as software option R&S AMIQK11 of R&S AMIQ or software option SMIQK11 in conjunction with option SMIQB60 (arbitrary waveform generator of SMIQ)

IS-95	
Chip rate	
Standard	1.2288 Mcps
Range	R&S AMIQ: 10 cps to 100 Mcps SMIQB60: 1 kcps to 40 Mcps
cdma2000	
Chip rate	
Standard	1.2288 Mcps (1X), 3.6864 Mcps (3X)
Range	R&S AMIQ: 10 cps to 100 Mcps SMIQB60: 1 kcps to 40 Mcps
WCDMA TDD mode (3GPP)	Option R&S AMIQK13 see www.rohde-schwarz.com
Carrier spacing	
Standard	1.25 MHz
Variable	R&S AMIQ: 0 to 10 MHz SMIQB60: 0 to 2 MHz

Ordering information

I/Q Modulation Generator		
4 M samples	R&S AMIQ	1110.2003.03
16 M samples	R&S AMIQ	1110.2003.04
Accessories supplied	R&S WinIQSIM™, version for Windows 3.x and Windows 95/98/NT on CD; manual, power cable, operating manual	
Options		
BER Measurement	R&S AMIQ-B1	1110.3500.02
Differential I/Q Outputs	R&S AMIQ-B2	1110.3700.03
Digital I/Q output	R&S AMIQ-B3	1122.2103.02
Rear I/Q Outputs	R&S AMIQB19 2)	1110.3400.02
IS-95 CDMA	R&S AMIQK11 3)	1122.2003.02
Digital Standard CDMA 2000	R&S AMIQK12 3)	1122.2503.02
Digital Standard WCDMA TDD mode (3GPP)	R&S AMIQK13 3)	1122.2603.02
Digital Standard TD-SCDMA	R&S AMIQK14 3)	1122.2703.02
OFDM Signal Generation HIPERLAN/2	R&S AMIQK15 3)	1122.2803.02
Digital Standard IEEE 802.11B	R&S AMIQK16 3)	1122.2903.02
Digital Standard 1XEV-DO	R&S AMIQK17 3)	1122.3000.02
Extra		
19" Rack Adapter	R&S ZZA-211	1096.3260.00

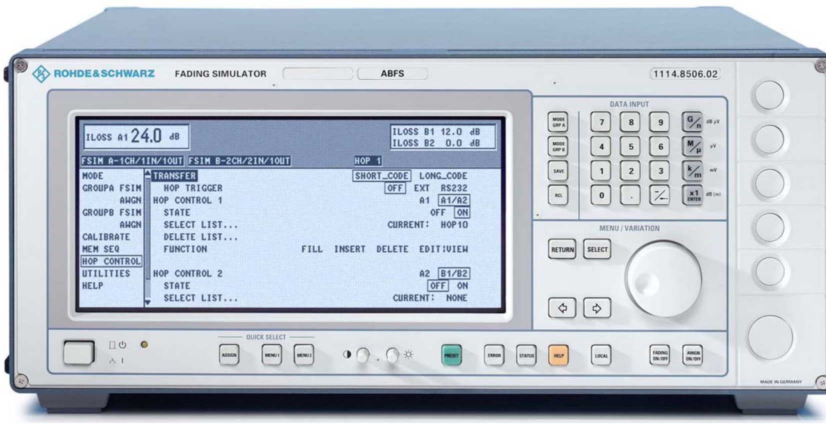
1) Data at clock >100 MHz are not warranted, max. environment temperature 35 °C.

2) Marker outputs 3 and 4 not provided if this option is fitted, R&S AMIQ-B19 not suitable in conjunction with R&S AMIQ-B2.

3) WINIQSIM™ required.

Baseband Fading Simulator R&S ABFS

Saving costs through real-world fading tests



R&S ABFS (photo 43435-3)

Brief description

The characteristics of a radio channel may strongly impair signal transmission between a transmitter and in particular a moving receiver.

Baseband Fading Simulator R&S ABFS generates signals which simulate real receive conditions in mobile applications. Thus, the response of receivers under real-world conditions can be checked already during development and QM acceptance testing. The simulation of fading signals at baseband level reduces costs.

Baseband Fading Simulator R&S ABFS is suitable for universal mobile radio applications in research, development and production. It comprises all scenarios and statistical models for simulating sporadic fading as specified in the test regulations of mobile radio standards (e.g. GSM, IS-54/IS-136 or IS-95 CDMA).

The open concept of R&S ABFS allows the simulation of radio channels of existing and future communication systems (e.g. mobile radio, broadcasting, flight telephone, WLL, or WLAN systems). R&S ABFS can also simulate frequency hopping systems. The basic model of R&S ABFS comes with two independent channels for 6-path fading. The two channels can be interconnected as follows:

- Distribution of an input to two outputs (e.g. with different fading profiles). This feature makes it possible to simulate several antennas with different characteristics or frequency diversity methods
- Simulation of two inputs with individual profiles and addition at output. Cell change or superposition of interferers can be tested with this configuration
- Coupling of two channels so that a channel with 12 propagation paths is obtained.

Main features

- 2 fading channels (4 with option R&S ABFS-B2)
- 12 propagation paths (24 with option R&S ABFS-B2)
- Max. 12 propagation paths per channel
- Universal use in research, development and production
- Simulation of present and future communication systems thanks to open concept
- Receiver tests at I/Q level together with a baseband source
- Ease of operation
- High reliability

Options

Noise Generator R&S ABFS-B1 adds a noise source to the output of the first channel so that noise can be simulated in the frequency band used. The noise generator can be switched on or off irrespective of the operating modes of the basic version.

Second Fading Simulator R&S ABFS-B2 offers two extra channels with the same characteristics in addition to the two channels of the basic model.

Second Noise Generator R&S ABFS-B3 represents an additional noise source for a further output. This second noise generator is either assigned to the second channel of the basic R&S ABFS (with first noise generator R&S ABFS-B1 for the first channel) or to the first channel of the second fading simulator R&S ABFS-B2. Fading profiles of the Rayleigh, Rician, Pure Doppler, lognormal or Suzuki method can be assigned to each of the propagation paths irrespective of the selected circuit. In addition to the fading profiles mentioned, the following parameters can be defined for each propagation path:

Baseband Fading Simulator R&S ABFS

- Path attenuation
- Delay time
- Doppler frequency or speed between transmitter and receiver
- Coupling to another channel

Many fading models (e.g. GSM Rural Urban, Typical Urban) have already been programmed in R&S ABFS. The user can quickly recall these default settings and also modify the parameters.

Specifications

I/Q inputs and outputs	
Input voltage for full-scale level	$\sqrt{I^2+Q^2} = 0{,}5$ V
Residual DC voltage at output	<2 mV, fine tuning by software
Insertion loss of basic unit	0.3 dB
Fading simulation	
Number of propagation paths and fading channels	1 channel with 12 paths or 2 channels with 6 paths each
Basic model with option R&S ABFS-B2	2 channels with 12 paths each or 4 channels with 6 paths each
Insertion loss between input and output at 0 dB path attenuation	min. 9 dB
Frequency response up to 5 MHz offset from carrier frequency (corresponding to 10 MHz system bandwidth)	+0.1 dB to –0.6 dB
Path attenuation	0 dB to 50 dB
Path delay	0 µs to 1600 µs
Doppler shift	
Frequency range	0.1 Hz to 1600 Hz
Speed range	$v_{min} = \frac{0.03 \cdot 10^9 m/s^2}{f_{RF}}$ $v_{max} = \frac{479 \cdot 10^9 m/s^2}{f_{RF}}$
For example at f_{RF} = 1 GHz	v_{min} = 0.1 km/h, v_{max} = 1724 km/h
Rayleigh fading	
Pseudo noise interval	>372 h
Rice fading	
Power ratio[1]	–30 dB to +30 dB
Frequency ratio	–1 to +1
Lognormal fading, Suzuki fading	
Standard deviation, range	0 dB to 12 dB
Local constant	l_{min} to 200 m, $l_{min} = \frac{12 \cdot 10^9 m/s}{f_{RF}}$
Correlation	paths 1 to 6 with paths 7 to 12 of a channel (A or B)
Range for magnitude	0% to 100%
Range for phase	0° to 360°
RF setting	setting of the RF results in an automatic calculation and display of the Doppler frequency according to the set motion speed[2]
Range (for each fading channel)	5 MHz to 8.5 GHz
Frequency hopping mode	RF can be stored in a list and quickly set via a serial interface
Interface	RS-232-C, 1 byte with start and stop bit
Addressing of frequency list	8 or 16 bit as address for each fading channel
Setting time after frequency change during Rayleigh fading	<3.5 ms
Noise generator with options R&S ABFS-B1 or R&S ABFS-B3	
Amplitude distribution	Gaussian, statistically independent for I and Q
Crest factor	14 dB
Noise power level in relation to full-scale level, range	–17 dBfs to –50 dBfs
Output level at full-scale level (AC)	$\sqrt{I^2+Q^2} = 0.5$ V (= 4 dBm)
Insertion loss between input and output	0 dB, 6 dB, 12 dB to 42 dB
Output spectrum	white noise
Bandwidth	depending on set system bandwidth
Frequency response	
up to 0.7 x system bandwidth (max. 5 MHz)	<0.5 dB
RF system bandwidth[3]	bandwidth determining noise power
Setting range	10 kHz to 10 MHz
General data	
Memory for device settings	50
Remote control	IEC 625 (IEEE 488)
Power supply	90 V to 132 V (AC), 47 Hz to 440 Hz, 180 V to 265 V (AC), 47 Hz to 440 Hz, autoranging, max. 300 VA
Operating temperature range	0°C to 45°C
Storage temperature range	–40°C to +70°C
Dimensions (W x H x D)	435 mm x 192 mm x 460 mm
Weight	20 kg when unit is fully equipped

Ordering information

Baseband Fading Simulator	R&S ABFS	1114.8506.02
Accessories supplied	power cable, operating manual	
Options		
Noise Generator	R&S ABFS-B1	1115.0009.02
Second Fading Simulator	R&S ABFS-B2	1115.0309.02
Second Noise Generator	R&S ABFS-B3	1115.0609.02
Fading for 3GPP	R&S ABFS-B49	1115.0909.02
Extras		
19'' Rack Adapter	R&S ZZA-94	0396.4905.00
Service Kit	R&S SM-Z3	1085.2500.02
Trolley	R&S ZZK-1	1014.0510.00
Transit Case	R&S ZZK-944	1013.9366.00
Service Manual	R&S ABFS	1114.8564.94

1) Ratio between discrete and distributed component.

2) The phase differences between paths caused by different settings of path delay are taken into account when the RF is modified. This applies to frequency hopping mode only.

3) 0.5 x system bandwidth is used for baseband.

Receiver Test Source R3562

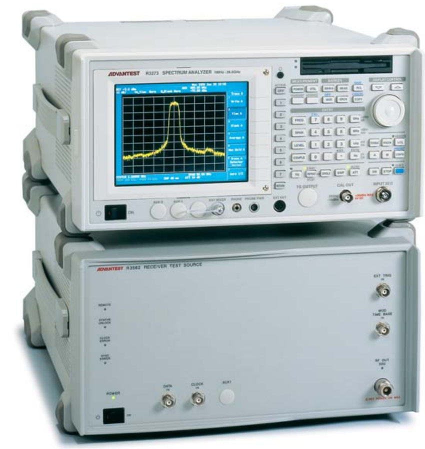
Receiver Test Source for WCDMA/3GPP and cdma2000

Advantest

Brief description

Receiver Test Source R3562 from Advantest generates WCDMA (3GPP) and cdma2000 (3GPP2) radio frames. Equipped with various clock output functions, the R3562 can easily synchronize with mobile and base stations to carry out the receiver sensitivity test with the built in Bit Error Rate (BER) counter.

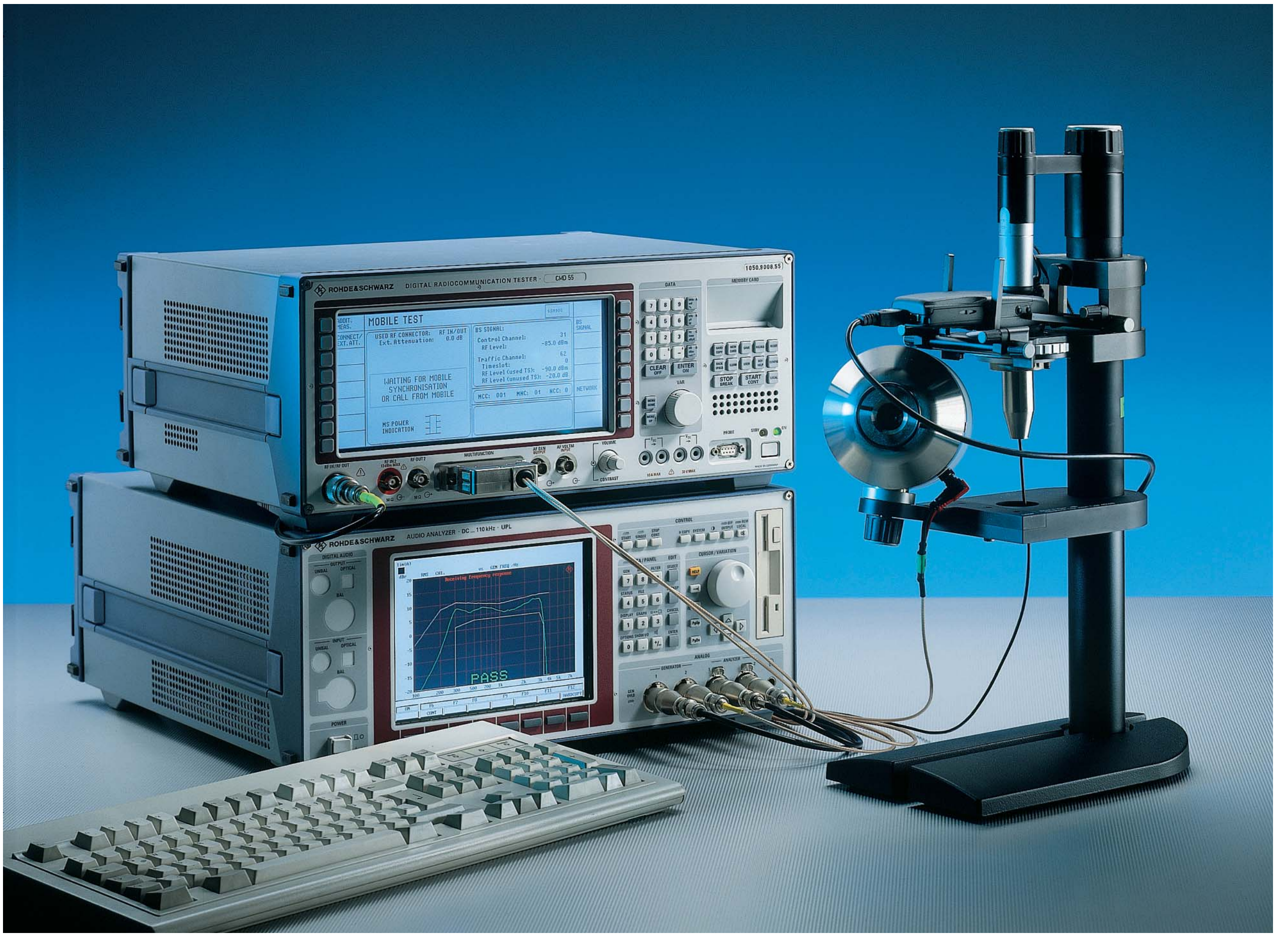
Since the R3562 is capable of adding the transmission power control signal (TPC) in 3GPP mode, it is able to confirm the power control steps in combination with the Spectrum Analyzers R3267 and R3273.



R3562 (lower unit, photo 43440-2)

Specifications in brief

Output frequency	
Range; Resolution	800 to 2300 MHz; 100 Hz
Measurement accuracy	accuracy of frequency standard
Reference frequency	
Internal frequency standard	10 MHz
Measurement accuracy	3×10^{-8}/day, 5×10^{-7}/year (after 24 hours) 3×10^{-7} (25°C) after 2 minutes warm up
Output level, impedance	>0 dBm, 50 Ω
External frequency standard	
Input frequency	1/2/5/10/15 MHz
Input level; impedance	>0 dBm; 50 Ω
Time base for modulation	
Input frequency; Input level	3.48 MHz x n (n=1, 2, 4); TTL
External trigger	
Input level; Variable offset widths	TTL; 20 to 200 chips
Clock/timing outputs; Level	chip clock/radio frame timing/ slot timing/TPC repeat timing/TPC insert timing; TTL
Output level	
Range; Resolution	–125 dBm to 0 dBm; 0.1 dB
Measurement accuracy (25°C ± 10°C)	
Frequency ≤1000 MHz	<±1.5 dB (–120.0 dBm to 0 dBm) <±2.5 dB (–125.0 dBm to –120.1 dBm)
Frequency >1000 MHz	<±1.5 dB (–110.0 dBm to 0 dBm) <±2.5 dB (–125.0 dBm to –110.1 dBm)
Output impedance; Max reverse-input	50 Ω; 2 W
Signal purity	
Harmonics	<–30 dBc
Nonharmonics	<–60 dBc (offset frequency > 10 kHz)
ACP	<–45 dBc (5 kHz offset) <–55 dBc (10 kHz offset)
SSB phase noise	<–107 dBc (1 Hz) (50 kHz offset, at 1 GHz)
Modulation	
Modulation modes; System	QPSK (DL)/ HPSK (UL); 3GPP (FDD)
Chip rate; Base-band filter	3.84 Mcps; root Nyquist type (α = 0.22)
Data source; Error vector	PN9, PN15. ALLO, ALL1; <6% rms
Uplink	
Output channel	DPCCH, DPCCH x 1 channel
Channel bit rates	30/60/120/240/480/960 kbps (DPDCH)
Information bit rates	12.2/64/144/384 kbps (DTCH)
Long scrambling codes	0 to 16,777.215
Channelization codes	SF/4 (DPDCH)
Channel power rate	Gain filter βc, βd = 0 to 15
TFCI bits	0 to 3FF [hexadecimal] 0 to 3FFFFFFF [hexadecimal]
TPC information	Up or down or repeat the specified slot lengths (Max. 75 slot)
Downlink	
Output channel	primary CPICH, primary SCH, secondary SCH, P_CCPCH, DPCH x 1 channel
Channel bit rates	60/120/240/480/960 kbps (DPDCH)
Information bit rates	12.2/64/144/384 kbps (DTCH)
Primary scrambling codes	0 to 8.191
Channelization codes	2 to 127 (DPCH)
Channel power rate	–20 to 0/0.1 dB steps
TFCI bits	0 to 3FF [hexadecimal]
TPC information	up or down or repeat the specified slot lengths (max. 75 slots)
Channel timing	τ_{DPCH} = 0 chip
I/Q input/output	
Input frequency range	1 kHz to 2.5 MHz, frequency characteristics <2 dB p-p
input level	$\sqrt{I^2 + Q^2}$ = 0.5 V rms, 50 Ω, max.3 V V_{pp}
Interval I/Q output level	1 V p-p, 50 Ω
BER counter	
Measurement rates	1 kbps to 5 Mbps
Measurement patterns	PN9, PN15
Measurement bit lengths	1,000 to 10,000,000 bits
Clock/data polarities	selectable, positive, negative
Input signal	clock, data (TTL level)
Local output	
Frequency; Level	5.0314 GHz to 6.5314 GHz; >0 dBm
External interface	
Remote control; Serial I/Q	IEEE-488; interface only for R3267/3273
General data	
Operating temperature range	0°C to +50°C
Storage temperature range	–20°C to +60°C
AC power supply	100 V to 120V, 50/60 Hz 220 V to 240 V, 50/60 Hz autosetting
Power consumption; Frequency	<300 VA; 50/60 Hz
Dimensions (W x H x D)	approx. 420 mm x 355 mm x 178 mm
Weight	<16 kg



Audio Analyzer R&S UPL16 for acoustic measurements on mobile phones to 3GPP TS 51.010 (photo 43158-3)

Contents of Chapter 6

Audio Analyzer R&S UPL

DC to 110 kHz

Compact instrument for audio measurements at analog and digital interfaces

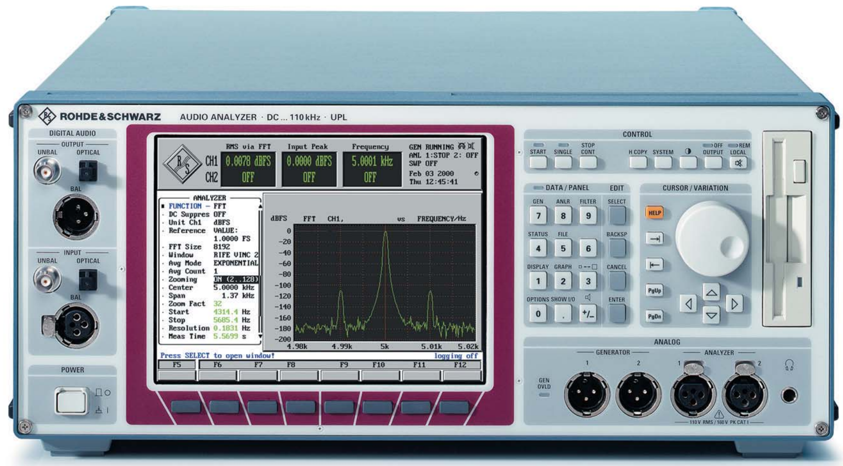


Photo 42992-2

Brief description

Audio Analyzer R&S UPL comprises analyzers and generators for dual-channel measurements and generation of a wide variety of analog and digital audio signals. Its measurement functions and signals are available at all interfaces so that all input-output combinations (AA, AD, DA, DD) are possible. An option allows comprehensive tests of the physical parameters of the audio interfaces, including jitter amplitude and spectrum, pulse amplitude, difference and delay with respect to a reference input.

R&S UPL is thus suitable for all types of audio measurement. Particular emphasis was placed on high measurement speed, which is a must in automatic testing in production.

Main features

- Compact instrument with integrated PC and colour or monochrome LC display
- Wide variety of test functions and numerous test signals for performing virtually all measurement tasks

Overview of options

Designation, functions	Option
Low Distortion Generator: analog sinewave generator offering lower inherent distortion and wider frequency range than built-in standard generator	R&S UPL-B1
Digital Audio I/O: contains the balanced, unbalanced and optical digital audio interfaces with clock rate up to 48 kHz	R&S UPL-B2
Digital Audio I/O: same as R&S UPL-B2, but clock rate up to 96 kHz	R&S UPL-B29
Extended Analysis Functions: coherence and transfer functions, rub & buzz measurement, third-octave analysis	R&S UPL-B6
Digital Audio Protocol: with Digital Audio I/O fitted, this option allows the generation and analysis of additional digital data such as channel status and user data, validity bits and the evaluation of parity bits	R&S UPL-B21
Jitter and Interface Test: with Digital Audio I/O fitted, this option enables the physical parameters of digital audio interfaces to be examined	R&S UPL-B22
Remote Control: enables remote control via the RS-232-C interface or the IEC/IEEE bus interface (IEC 625/IEEE 488)	R&S UPL-B4
Audio Monitor: adds a headphones output and a built-in loudspeaker to R&S UPL	R&S UPL-B5
Hearing Aids Test Accessories	R&S UPL-B7
Mobile Phone Test Set: measures the acoustic characteristics of mobile phones	R&S UPL-B7
3G Mobile Phone Tests: acoustic measurements on mobile phones to 3GPP Standards	R&S UPL-B9
Universal Sequence Controller: enables measurement sequences to be generated and executed with the aid of a built-in program generator	R&S UPL-B10
LAN Interface: connects the R&S UPL to Novell networks for data transfer	R&S UPL-B11
Automatic Audio Line Measurement: enables measurement of broadcast links according to ITU-T 0.33 recommendations (R&S UPL-B10 required)	R&S UPL-B33

Audio Analyzer R&S UPL

- Versatile analysis thanks to internal FFT analyzer of wide dynamic range and high frequency resolution
- Future-proof: new test functions can be loaded from diskette
- Any number of digital filters, also for analog measurements
- Maximum dynamic range for the analysis of high-grade components
- Intelligent operator guidance and context-sensitive help system (German and English)
- Mnemonic analysis and generation of channel status data of digital audio interfaces
- Measurement/generation of protocol errors at digital interfaces
- Variety of sweep functions
- More than 10 weighting filters
  – highpass, lowpass, bandpass filters

Specifications in brief

All inherent distortion values refer to the frequency range 20 Hz to 22 kHz.

Analyzers

Analog inputs	
Balanced, floating	2 channels, 300 Ω/600 Ω/200 kΩ
Voltage measurement range	0.1 µV to 110 V rms
Common-mode rejection	>100 dB (50 Hz)
Frequency range	DC to 110 kHz
Frequency response	±0.03 dB, 20 Hz to 22 kHz
Digital inputs	
Digital Audio I/O option	
Balanced input	XLR connector, 110 Ω
Unbalanced input	BNC connector, 75 Ω
Optical input	Toslink system
Clock rate	35 to 55 kHz (R&S UPL-B2) 35 to 106 kHz (R&S UPL-B29)
Frequency range	10 Hz to 45.7% of clock rate

Measurement functions of analog analyzers; digital analyzers in italics (option R&S UPL-B2 or R&S UPL-B29)

AF level	
Noise (600 Ω)	1.6 µV (CCIR unweight.); *-180 dBFS*
Weighting	RMS, peak [2], quasi-peak (CCIR 468) [2]
Accuracy	±0.05 dB (V_{rms}, 1 kHz)
Filters	weighting filter; HP, LP, BP; user-configurable in terms of cutoff frequency/attenuation; max. 3 filters can be combined
Selective level	
Center frequency	selectable/swept/coR&S UPLed to generator or input frequency
Bandwidth (0.1 dB)	1%/3%/third octave/$^1/_{12}$ octave/ selectable
Total harmonic distortion (THD)	
Fundamental	10 Hz to 22 kHz
Inherent distortion (Σ 2nd to 9th order)	–120 dB [1]; *–130 dB* [1]
SINAD and THD+N	
Fundamental	20 Hz to 22 kHz
Inherent distortion	–110 dB [1]; *–126 dB* [1]
Filters	HP, LP + weighting filter
Modulation distortion	2nd plus 3rd order
Measurement method	selective to DIN IEC 268-3
Inherent distortion	–100 dB; *–123 dB* [1]
Difference-frequency distortion	2nd or 3rd order
Measurement method	selective to DIN IEC 268-3
Inherent distortion d2	–120 dB; *–130 dB* [1]
d3	–100 dB [1]; *–130 dB* [1]
Wow and flutter [2], meas. method	DIN IEC/NAB/JIS/2-sigma
Frequency	10 Hz to 110 kHz, 20 Hz to 20 kHz
Accuracy (S/N >80 dB)	±0.005%
Phase, group delay	20 Hz to 20 kHz
Accuracy (phase)	±0.5°
Polarity test	
DC voltage	0 to ±110 V; *0 to ±FS*
Waveform (2-channel)	memory depth 7424 points

FFT analyzer	
Frequency range	DC to 110 kHz; *DC to 45.7% of clock rate*
FFT size/resolution	16 k points/0.023 Hz
Window functions	rectangular/Hann/Blackman-Harris/Rife-Vincent 1 to 3/Hamming/flat-top/Kaiser
Averaging	max. 256-fold, exp. + linear
Noise floor	–140 dB; *–160 dB*

Filter

For all analog and digital analyzers. Up to 3 filters can be combined as required. All filters are digital filters with a coefficient accuracy of 32 bit floating point (exception: analog notch filter).

Weighting filters

A weighting; C message; CCITT; CCIR weighted, unweighted; CCIR ARM; deemphasis 50/15, 50, 75, J.17; rumble weighted, unweighted; DC noise highpass; IEC tuner; jitter weighted

User-definable filters

8th order elliptical, type C (for highpass and lowpass filters also 4th order), passband ripple +0/–0.1 dB, stopband att. approx. 20 to 120 dB selectable in steps of approx. 10 dB (highpass and lowpass filters: stopband attenuation 40 to 120 dB).

Analog notch filter

For measurements on signals with high S/N ratio, this filter improves the dynamic range of the analyzer by up to 30 dB to 140 dB for analyzer 22 kHz, or 120 dB for analyzer 110 kHz (typical noise floor of FFT). The filter is also used for measuring THD, THD+N and MOD DIST with dynamic mode precision.

Generators

Analog outputs	
Balanced, floating	2 channels, 10 Ω/200 Ω/600 Ω
Output voltage	0.1 mV to 20 V rms (no load)
Unbalanced, floating	2 channels, 5 Ω
Output voltage	0.1 mV to 10 V rms (no load)
Frequency range	2 Hz to 21.75 kHz, sine up to 110 kHz [3]
Frequency response	±0.05 dB, 20 Hz to 20 kHz
Inherent distortion [3]	–120 dB
Digital outputs	same as digital inputs

Audio Analyzer R&S UPL

Generator functions of analog generators; digital generators in italics (option R&S UPL-B2 or R&S UPL-B29)

Sinewave	
Inherent THD	–120 dB [3]; *–130 dB*
Inherent THD+N	–110 dB [1]; *–126 dB* [1]
Signal for modulation distortion analysis, selectable	signal/interf. freq., amplitude ratio
Inherent distortion	–100 dB; *–123 dB* [1]
Difference-frequency signal, select.	center frequency and frequency offset
Inherent distortion d2	–120 dB; *–130 dB* [1]
d3	–100 dB [1]; *–130 dB* [1]
Multisine, selectable	amplitude/frequency; max. 17 freq.
Sine-burst, sine^2 burst	level ratio and duty cycle selectable
Noise	flat/Gaussian/triangular distribution
Multifrequency noise	band-limited/white/pink/user-defined
Arbitrary waveform	any waveform from file
Max. number of points	16 k
Polarity test signal	Sine^2 burst
Sweeps	frequency, amplitude, burst interval, burst duration, time

Sweep

Generator sweep

Parameters	frequency, level, with bursts also interval + duration, one- or two-dimensional
Sweep	linear, logarithmic, tabular, single, continuous, manual
Stepping	automatic after end of measurement time delay (fixed or loaded table)

Analyzer sweep

Parameters	frequency or level of input signal
Sweep	single, continuous

Digital audio protocol (option R&S UPL-B21)

Generator

Validity bit	NONE, L, R, L+R
Channel status data	mnemonic entry with user-defin. masks, predefined masks for professional and consumer format to AES3 or IEC-958
User data	loaded from file (max. 384 bits) or set to zero

Analyzer

Display	validity bit L and R
Error indication	block errors, sequence errors, clock rate errors, preamble errors
Clock rate measurement	50 ppm
Channel status display	user-defin. mnemonic display of data fields, predefined settings for professional and consumer format to AES3 or IEC-958, binary and hexadecimal format
User bit display	user-definable mnemonic display, block-synchronized

Jitter and interface test (option R&S UPL-B22)

Generator

Jitter injection	0 to 5 UI, 10 Hz to 21.75 kHz
Common mode signal	0 to 20 V V_{pp}, 20 Hz to 21.75 kHz
Phase (output to reference)	0 to ±64 UI, selectable
Cable simulator	100 m audio cable

Analyzer

Input signal	amplitude, sampling rate
Jitter measurement	amplitude, frequency, spectrum, reclocking
Common mode test	amplitude, frequency, spectrum
Phase (input to reference)	0 to ±64 UI
Delay (input to output)	100 µs to 500 ms

Extended analysis functions (option R&S UPL-B6)

Coherence and transfer functions	can be displayed simultaneously
Averaging	2 to 2048
FFT length	256, 512, 1k, 2k, 4k, 8k points
Rub & buzz measurement	simultaneous measurement of frequency response, rub & buzz and polarity
Tracking highpass filter	2 to 20 times fundamental
Lower/upper frequency limit	selectable
Measurement time (200 Hz to 20 kHz, 200 points log.)	2 s
Multisine generator function	extended functions
Mode 1	crest factor or phase of each component selectable
Mode 2	crest factor selectable
Third octave analysis	for analyzer ANLG 22 kHz and digital 48 kHz
Number of third octaves	32
Stereo sine	in digital generator only
Other functions	under development

Hearing aids test accessories (option R&S UPL-B7)

Consisting of acoustic test chamber, acoustic 2 cm³ coR&S UPLer, various battery adapters, connecting cables, software for measurements to IEC60118 and ANSI S3.22

Additional requirements	options R&S UPL-B5 and R&S UPL-B10

LAN Interface for R&S UPL06/66 (option R&S UPL-B11)

Connector (rear panel)	RJ45
Supported standards	10Base-T, 100Base-Tx
LAN client	Novell Netware
Supported protocols	IPX, TCP/IP

Audio Analyzer R&S UPL

General data

Graphical display of results	Monitor (not R&S UPL66) 8.4" LCD, colour display, display of any sweep trace, display of trace groups bargraph display with min./max. values spectrum, also as waterfall display list of results bar charts for THD and intermodulation measurements
Display functions	Autoscale axis zoom full-screen and part-screen mode 2 vertical,1 horizontal cursor line search function for max. values marker for harmonics (spectrum) user-labelling for graphs change of unit and scale also possible for loaded traces
Test reports	Screen copy to printer, plotter or file (PCX, HPGL, Postscript) lists of results; sweep lists tolerance curves list of out-of-tolerance values equalizer traces
Storage functions	Instrument settings, optionally with measured values and curves spectra sweep results sweep lists tolerance curves equalizer traces
Interface	RS-232-C, Centronics
Remote control	IEC 625-2 (option R&S UPL-B4)
Operating temperature range	0°C to +45°C
Storage temperature range	–20°C to +60°C
Power supply	100/120/220/230 V ±10%, 50 Hz to 60 Hz, 160 VA
Dimensions (W x H x D); Weight	435 mm x 192 mm x 475 mm; 12.6 kg

Ordering information

Audio Analyzer		
with colour LCD	R&S UPL06	1078.2008.06
without display and keyboard	R&S UPL66	1078.2008.66
GSM model	R&S UPL16	1078.2008.16
Options		
Low Distortion Generator	R&S UPL-B1	1078.4400.02
Digital Audio I/O 48 kHz	R&S UPL-B2	1078.4000.02
Digital Audio I/O 96 kHz	R&S UPL-B29	1078.5107.02
Remote Control	R&S UPL-B4	1078.3804.02
Audio Monitor	R&S UPL-B5	1078.4600.03
Extended Analysis Functions	R&S UPL-B6	1078.4500.02
Hearing Aids Test Accessories	R&S UPL-B7	1090.2704.02
Mobile Phone Test Set	R&S UPL-B8	1117.3505.02
3G Mobile Phone Tests (software, transformer, adaptor)	R&S UPL-B9 [4)]	1154.7500.02
Universal Sequence Controller	R&S UPL-B10	1078.3904.02
LAN Interface for R&S UPL06/66	R&S UPL-B11	1154.7600.02
Digital Audio Protocol	R&S UPL-B21	1078.3856.02
Jitter and Interface Test	R&S UPL-B22	1078.3956.02
Coded Audio Signal Generation	R&S UPL-B23 [5)]	1078.5188.02
Automatic Audio Line Measurement	R&S UPL-B33	1078.4852.02
150 Ω Modification	R&S UPL-U3	1078.4900.02
R&S UPL16 Upgrade Mobile Phone Tests (GSM-Release 99 with CMU)	R&S UPL-U81	1154.7900.02
XLR/BNC Adapter Set	R&S UPL-Z1	1078.3704.02
Extras		
19" Rack Adapter	R&S ZZA-94	0396.4905.00
Service manual		1078.2089.24

1) Total inherent distortion of generator and analyzer.

2) Not in whole frequency range.

3) Only with built-in Low Distortion Generator R&S UPL-B1.

4) Option R&S UPL-B6 and R&S UPL-B10 required.

5) Option R&S UPL-B2 or R&S UPL-B29 required.

Test System for Hearing Aids R&S UPL + R&S UPL-B7

Measurements on hearing aids

to EN 60118 or ANSI S3.22

Test setup with acoustic test chamber (photo 43159)

Brief description

Audio Analyzer R&S UPL (see data sheet 0757.2238) in conjunction with option R&S UPL-B7 is a complete test system for all standard measurements on hearing aids. To carry out such measurements, R&S UPL only requires the options Audio Monitoring (R&S UPL- B5) and Universal Sequence Controller (R&S UPL-B10).

The test system meets all the requirements relevant in the production, quality management and service of hearing aids. The HEARPRO software supplied with the system allows the user to generate test routines tailored to the specific characteristics of the device under test.The type and sequence of measurements are freely selectable. All test parameters can be accurately defined.

Option R&S UPL-B7 includes

- a compact acoustic test chamber
- a complete set of cables
- a 2 cm^3 coupler with built-in microphone and calibration adapter
- a set of battery adapters for all commercial battery sizes for DUT power supply

Calibration of the complete test setup requires a sound level calibrator and a test microphone which are not part of the equipment supplied.

For all relevant measurements

The convenient HEARPRO test software supplied with the system can handle measurements according to standards EN 60118 or ANSI S3.22-1996. All standard measurements can be carried out:

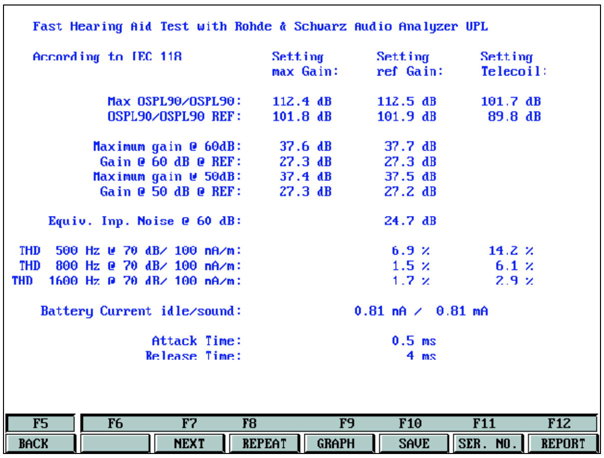
- SSPL curves
- adjustment to reference gain
- OSPL curves
- equivalent inherent noise
- THD at selectable frequencies
- battery current drain
- output sound pressure as a function of input sound pressure
- attack and release times of units using AGC
- groups of curves, e.g. for displaying the effect of frequency response setting at selectable sound pressure levels
- settings for telecoil measurements on hearing aid
- OSPL curve with telecoil
- THD with telecoil

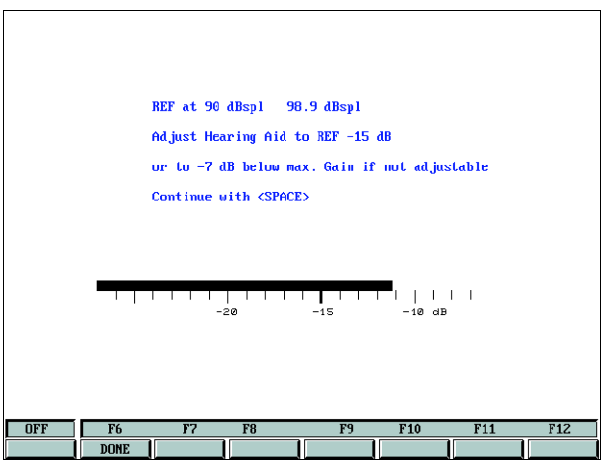
Powerful in production

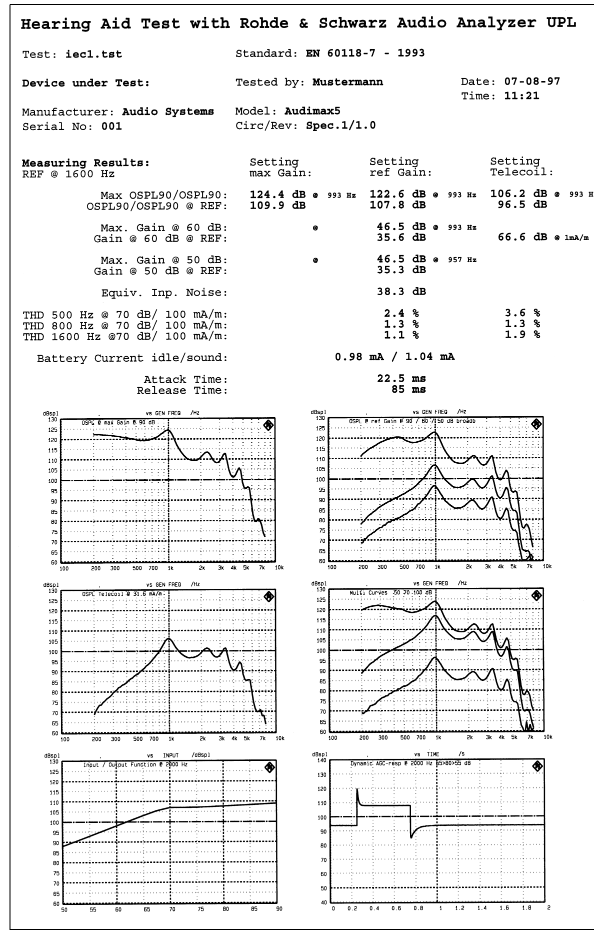
The high measurement speed of the system makes for high throughput in production applications. This can be further optimized by adapting the measurement speed to the DUT response.

Frequency response measurements and test results can be subjected to automatic tolerance checks. The results of these checks are documented and stored as PASS or FAIL results together with all test curves. This ensures consistent production quality. The clear-cut logging of all measurements facilitates evaluation of relevant parameters.

Test System for Hearing Aids R&S UPL + R&S UPL-B7







Hearing Aid Test with Rohde & Schwarz Audio Analyzer UPL

Test: **iec1.tst** Standard: **EN 60118-7 - 1993**

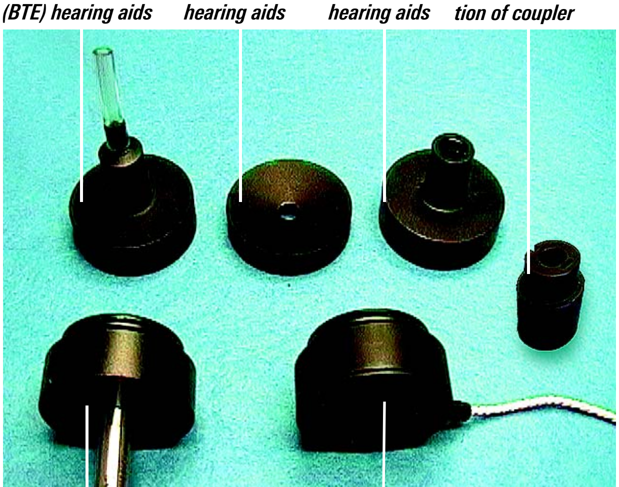
Device under Test: Tested by: **Mustermann** Date: **07-08-97** Time: **11:21**

Manufacturer: **Audio Systems** Model: **Audimax5**
Serial No: **001** Circ/Rev: **Spec.1/1.0**

Measuring Results: REF @ 1600 Hz	Setting max Gain:	Setting ref Gain:	Setting Telecoil:
Max OSPL90/OSPL90:	124.4 dB @ 993 Hz	122.6 dB @ 993 Hz	106.2 dB @ 993 Hz
OSPL90/OSPL90 @ REF:	109.9 dB	107.8 dB	96.5 dB
Max. Gain @ 60 dB:	@	46.5 dB @ 993 Hz	
Gain @ 60 dB @ REF:		35.6 dB	66.6 dB @ 1mA/m
Max. Gain @ 50 dB:	@	46.5 dB @ 957 Hz	
Gain @ 50 dB @ REF:		35.3 dB	
Equiv. Inp. Noise:		38.3 dB	
THD 500 Hz @ 70 dB/ 100 mA/m:		2.4 %	3.6 %
THD 800 Hz @ 70 dB/ 100 mA/m:		1.3 %	1.3 %
THD 1600 Hz @70 dB/ 100 mA/m:		1.1 %	1.9 %
Battery Current idle/sound:		0.98 mA / 1.04 mA	
Attack Time:		22.5 ms	
Release Time:		85 ms	

Screen display of results (left top), setting aid for acoustic gain of hearing aid (left bottom) and log printout (right)

Adapter for behind-the-ear (BTE) hearing aids *Adapter for in-the-ear (ITE) hearing aids* *Adapter for body-worn hearing aids* *Adapter for calibration of coupler*



Coupler for ¼" microphone (microphone not supplied) *Coupler with built-in microphone*

Specifications for R&S UPL with R&S UPL-B7

Max. sound pressure	>100 dB SPL, 110 dB SPL typ.
THD	<0.3% for 90 dB SPL
Ambient noise attenuation	>40 dB (20 Hz to 1500 Hz) >45 dB (>1500 Hz)
Frequency response of acoustic chamber without correction	±2 dB (100 Hz to 8000 Hz)
Feedthroughs for	– microphone connector for coupler with built-in microphone – battery adapter – 2 x 5-contact Mini-DIN for Hi-Pro programmer and ¼" microphone preamplifier (GRAS 26 AC-R can be used)
Dimensions of acoustic chamber (W x H x D)	365 mm x 260 mm x 400 mm
Weight	22 kg

Coded Audio Signal Generation R&S UPL-B23, Audio Switcher R&S UPZ

Multichannel audio measurements on surround sound decoders

New

Brief description

Previous method

Up to now, measuring surround decoders necessarily involved defining and storing coded test sequences on a DVD or the PC hard disk. The DVD player/PC was connected to the DUT, where the test signals were decoded and finally measured by an audio analyzer at the analog outputs. Since the test files and the measurements ran on different instruments, synchronization was difficult, leading to extended measurement times.

Modern solution: Audio Analyzer R&S UPL plus R&S UPL-B23

The R&S UPL-B23 option enables the Audio Analyzer R&S UPL to generate AC-3-coded test signals directly with the built-in generator. The measurements are synchronized automatically between the generator and the analyzer.

This has the following advantages:

- The internal synchronization considerably speeds up measurements
- Test sequences can be combined much more flexibly, since the number of channels, frequency or level sweep, start and stop frequency/level as well as the number of sweep points can be set directly; settings are made in a similar way to those for a standard analog sweep
- The test signals are no longer recorded on DVD/PC, thus saving time previously spent on combining and coding the test signals
- Additional hardware, such as a PC or DVD player, is not required

Main features

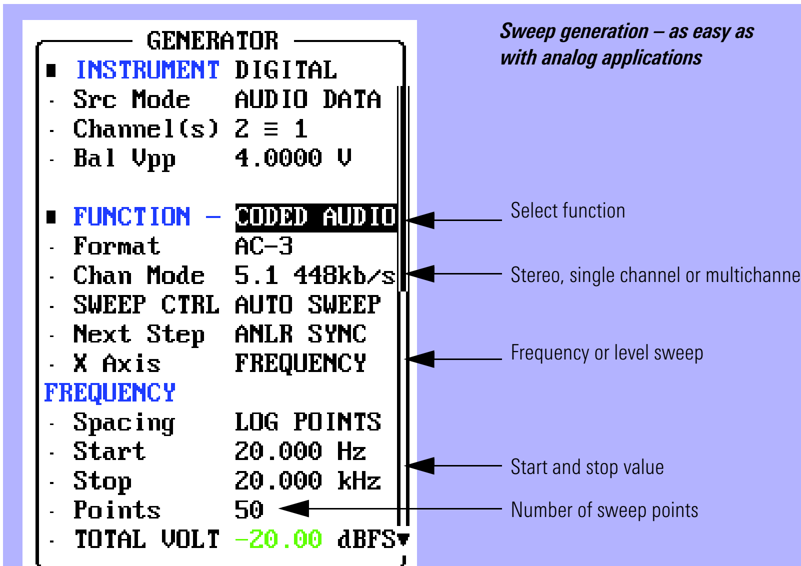
Option R&S UPL-B23

- Generation of coded test signals in AC-3 format (Dolby Digital)
- User-selectable sweep parameters

Audio Switcher R&S UPZ

- Available as input and output switcher
- Cascading of up to 128 channels
- Direct operation via the Audio Analyzer R&S UPL
- Control via RS-232-C for universal applications

Sweep generation – as easy as with analog applications



Coded Audio Signal Generation R&S UPL-B23, Audio Switcher R&S UPZ

Test files available
The AC-3 format (Dolby Digital) is currently supported, and other data formats are in preparation. At present, the test files are:

- Stereo signals (coded with 192 kbit/s) and 5.1-channel signals (448 kbit/s), for frequency and level sweeps; these signals allow the measurement of frequency response, linearity, S/N ratio and harmonic distortion
- Test signals for the individual channels (448 kbit/s) to determine crosstalk attenuation

Measuring surround decoders
Surround applications for use in the home generally have six channels. In order to test 5.1 decoders, the six channels are connected to the Audio Analyzer R&S UPL via the Audio Switcher R&S UPZ. The R&S UPZ is controlled directly from the R&S UPL panel via an RS-232-C interface.

For professional surround applications, the Audio Switcher R&S UPZ comprises 8 channels, with two output channels to allow the two R&S UPL measurement channels to be used simultaneously.

Input/output model
Like the Audio Analyzer R&S UPL, the Audio Switcher R&S UPZ has XLR connectors. Since there is a difference between male and female connectors in the XLR system, the R&S UPZ is available both as an input and an output model.

It is possible to cascade up to 16 input switchers plus 16 output switchers, allowing up to 128 input and output channels to be switched.

Extended range of applications
The Audio Switcher R&S UPZ can be operated not only via the R&S UPL. Through its RS-232-C interface, it can also be controlled directly from other units or a controller. This opens up new possibilities; for instance, in broadcasting stations, where studio operations require the switching of several audio channels. The R&S UPZ may also be used in production; for instance, when car radios are tested, measurements can be performed at all four loudspeaker outputs.

With the Audio Switcher R&S UPZ, up to 128 input and 128 output channels can be cascaded

Specifications in brief

Coded Audio Signal Generation R&S UPL-B23

Format	AC-3 (IEC 61937)
Coding	
Stereo signals	192 kbit/s
5.1-multichannel	448 kbit/s
Single channels	448 kbit/s
Frequency range	5.2083 Hz to 20 kHz
Level range	0 dBFS to –120 dBFS
Sweep parameters	frequency, level

Audio Switcher UPZ

Electrical data

Signal amplitude [1]	30 V (RMS)/2 A (42 V (peak))
Crosstalk (balanced 600 Ω load) [2]	
20 kHz	–140 dB typ.
100 kHz	–126 dB typ.
Series resistance	<0.3 Ω typ. (per signal pin)
Shunt capacitance	<90 pF typ. (each signal pin to ground)

General data

Operating temperature range	0 °C to +50 °C
Storage temperature range	–40 °C to +70 °C
Power supply	100 V to 120 V (AC) (±10%) 220 V to 240 V (AC) (±10%) 50 Hz to 60 Hz (±5%)
Power consumption	
Input switcher	5 VA typ., 10 VA max.
Output switcher	5 VA typ., 12 VA typ. (all channels active) 15 VA max.
Remote control	via RS-232-C
Dimensions (W x H x D)	427 mm x 43 mm x 350 mm
Weight	3.7 kg

Ordering information

Coded Audio Signal Generation	R&S UPL-B23	1078.5188.02
Audio Switcher (Input, female)	R&S UPZ	1120.8004.02
Audio Switcher (Output, male)	R&S UPZ	1120.8004.03
Accessories supplied (UPZ)	power cable, operating manual, service manual, RS-232-C extension cable	
Extras (UPZ)		
19" Rack Adapter	R&S ZZA-111	1096.3254.00

1) For maximum relay life: 5 W or 0.2 A max.

2) Between any two channels into 600 Ω.

VOR/ILS Receiver/Analyzer R&S EVS200

Monitoring terrestrial radionavigation equipment at airports and field stations

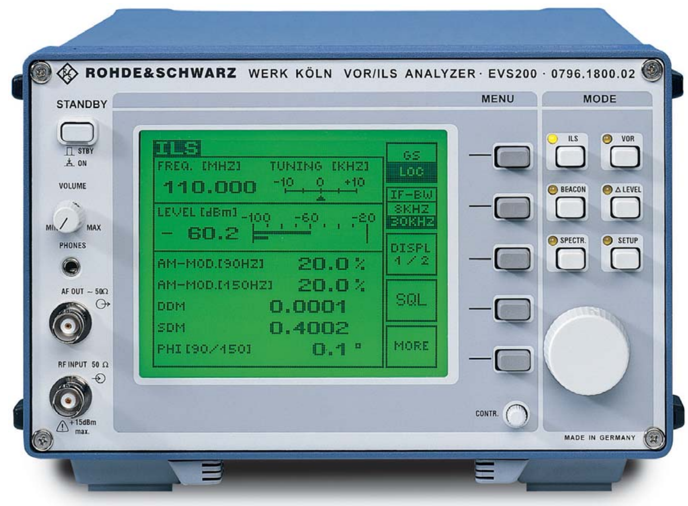


Photo 43151-1

Brief description

VOR/ILS Analyzer R&S EVS200 is a portable combinational measuring instrument for monitoring terrestrial radionavigation equipment at airports and field stations. It provides high-precision signal analysis of ILS localizers and glidepath transmitters as well as of VOR systems including marker beacon.

Thanks to its high measurement accuracy and fast data output, R&S EVS200 is ideal for dynamic, computer-aided measurement of runway characteristics. The wide input level range and optimal shielding of the modules allow measurements to be carried out close to antennas.

Measurement applications

- Dynamic runway measurements
- Measurement of DDM/SDM on antenna array and runway
- Clearance & glidepath (joint analysis of parameters without switching off transmitter system)
- Qualification of test signals at field testpoints and checking of bearing indication of VOR/DVOR transmitters
- Difference level measurement with dynamic range up to 110 dB
- Measurement of marker beacon signal parameters
- Point-by-point far-field measurement
- Measurement of transmitting antenna characteristic using delta level mode
- Functional monitoring of VOR/ILS transmitter systems in the field including remote data transmission
- Use in flight inspection systems
- Further analysis of received signals via multifunctional output (DSP OUT) and audio output
- Analysis of external audio signals via audio input

Main features

- VOR/ILS signal analysis with digital signal processor (DSP)
- High measurement accuracy and wide dynamic range
- High long-term stability
- High measurement speed, 90 measurements/s in ILS mode
- Minimum susceptibility to interference through special shielding, operational even at high levels up to +15 dBm
- 120 memory channels for DDM/SDM values
- Built-in test equipment (BITE)
- RF spectrum display
- RS-232-C interface for remote control of all functions and result output
- Large, illuminated LCD with clear display of results
- Simultaneous indication of parameters on display
- AC-supply-independent operation with built-in battery
- Operation in vehicles from12 V onboard supply
- Operation from AC supply voltages 87 V to 265 V at 47 Hz to 63 Hz
- High mechanical resistance to MIL-810D and DIN-IEC 68

VOR/ILS Receiver/Analyzer R&S EVS200

Specifications

Receiver section

Frequency	
Range	74.7 MHz to 75.3 MHz, 107 MHz to 119 MHz, 319 MHz to 341 MHz
Deviation	≤2 ppm
Resolution	5 kHz
RF input	BNC (optional N)
Input voltage	15 dBm max. into 50 Ω
VSWR	<1.5
Sensitivity	–93 dBm ≥16 dB S/N (IF bandwidth 8 kHz)
IF bandwidth	
30 kHz	min. ±15 kHz (–3 dB), max. ±40 kHz (–60 dB)
8 kHz	min. ±4 kHz (–3 dB), max. ±12 kHz (–60 dB)
Demodulation	AM
Absolute level	
Display range	–90 dBm to +10 dBm
Accuracy	≤±2 dB
Difference level	
Bargraph (quasi-analog)	±12 dB (rel. to reference level)
Resolution	0.1 dB
Accuracy	≤±1 dB

ILS signal analysis

RF level	–70 dBm to –30 dBm
Frequency range	108 MHz to 118 MHz, 328 MHz to 336 MHz
Modulation depth (10% to 80%)	
90 Hz/150 Hz ±2%	accuracy 0.5%
300 Hz to 4 kHz (identifier)	≤1.2% of reading
Phase angle 90 Hz/150 Hz	
Measurement range	±60°
Measurement accuracy	≤0.2°
Resolution	0.1°
DDM measurement (≥30 kHz IF bandwidth)	
Localizer mode, measurement accuracy at 15% to 25% modulation (±0,1 DDM)	≤±0.0004 DDM, ±0.1% of reading
10% to 30% modulation (±0,2 DDM)	≥±0.0004 DDM, ±0.2% of reading
DDM measurement (≥30 kHz IF bandwidth)	
Glideslope mode, measurement accuracy at 30% to 50% modulation (±0,2 DDM)	≤±0.0008 DDM, ±0.1% of reading
Resolution (LOC/GS)	0.0001 DDM
Analog DDM output	
Localizer	0 to1 V in 4 subranges
Glideslope	0 to1 V in 4 subranges
SDM measurement	
SDM 10% to 80%	accuracy ±1% absolute
Resolution	0.0001 SDM

VOR signal analysis

Azimuth	
Accuracy	±0.1°
Resolution	0.05° / 0.01° (setup)
AM modulation depth 30 Hz and 9.96 kHz	
Accuracy	≤1%
Resolution	0.1%
FM deviation	
Accuracy	0.5%, ±0.1 Hz
Resolution	0.1 Hz

General data

RS-232-C interface	8N1
Selectable baud rate	1200, 2400, 4800, 9600, 19200
Operating temperature range	+5°C to +45°C
Storage temperature range	–20°C to +60°C
Power supply	
AC	87 to 265 V, 47 to 63 Hz (440 Hz optional), built-in battery charger
External DC	9 to 15 V DC (typ. 12 V DC, 1.4 A)
Battery	12V / 3.2 Ah
Charging	during AC-supply operation
Operating time	>90 min with average brightness of display
Mechanical resistance	shock-tested to MIL-810D
Vibration test	to DIN-IEC 68-2-36 and 68-2-6
EMC	
RF leakage	to EN 55011
RF pickup	to EN 61326-1
Dimensions (W x H x D)	219 mm x 147 mm x 350 mm
Weight	6.5 kg

Ordering information

VOR/ILS Analyzer	R&S EVS200	0796.1800.02
Options		
Weatherproof case with 2 straps	R&S EVS200-T	0798.4264.00
Antenna Set	R&S EVS200-A	3542.6081.00

Modulation Analyzers R&S FMA, FMAB, FMAV, FMB; Selective Modulation Analyzer FMAS

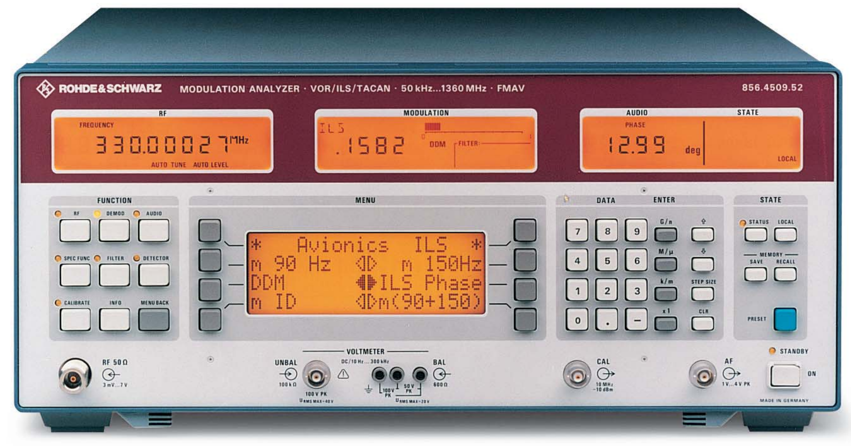
R&S FMA: 50 kHz to 1360 MHz

R&S FMAB: R&S FMA with built-in FM stereo decoder

R&S FMAS: R&S FMA with receiver and FM stereo decoder

R&S FMAV: analysis for air navigation systems

R&S FMB: extended frequency range up to 5.2 GHz



R&S FMAV (photo 40299-1)

Brief description

Modulation Analyzer R&S FMA

R&S FMA combines the functions of several measuring instruments all in one unit. It allows fast and accurate analysis of all parameters of modulated signals. Thanks to its versatility, it can also be used as an RF counter, power meter, voltmeter, psophometer, distortion meter and as an FM stereo decoder. R&S FMA is suitable for measurements in the field of broadcasting (e.g. on AM and FM transmitters) as well as radiotelephony and in the calibration of signal generators. It can be upgraded for many other measurement tasks.

Modulation Analyzer R&S FMAB

R&S FMAB has been especially designed for the analysis of FM stereo broadcast signals. Its measurement tasks include comprehensive analysis of VHF transmitters, channel transposers and VHF/baseband converters. The built-in stereo decoder with all its analysis functions can be separately used via the rear-panel input so that measurements on FM receivers and stereo coders are also possible.

Selective Modulation Analyzer R&S FMAS

R&S FMAS combines the characteristics of a universal modulation analyzer with those of an FM stereo/TV dual-sound receiver:

- RF/IF selection for 5 MHz to 1000 MHz can be switched on when required
- Selective audio analyzer

Modulation Analyzer R&S FMAV

R&S FMAV features the versatile measurement functions of the basic model and special functions for the needs of air-traffic control authorities, airport operators as well as manufacturers of air-navigation airborne and test systems.

It measures with utmost precision all modulation parameters relevant in VOR and ILS air navigation systems. With its extremely low measurement error achieved by means of digital signal processing, R&S FMAV meets the stringent requirements placed on measuring instruments for ILS systems of category III. Its high accuracy makes R&S FMAV also ideal for use as a calibrator for VOR and ILS signal generators.

Modulation Analyzer R&S FMB

R&S FMB enables modulation analysis right into the lower microwave range. Its fields of application are especially in outside broadcasting, radio relay links as well as testing and calibration of microwave generators. The outstanding characteristics of the basic model are fully maintained in the extended frequency range up to 5.2 GHz. The power meter function of R&S FMB differs from that of R&S FMA in that it is individually calibrated as a function of frequency and level.

Main features

- Fast, automatic frequency adjustment by direct frequency measurement
- Low-noise synthesizer with high frequency resolution
- Separate +PK and –PK detectors with extremely short response time
- True RMS detector

Modulation Analyzers R&S FMA, FMAB, FMAV, FMB; Selective Modulation Analyzer FMAS

- Extremely high accuracy
- High-precision power measurement (typ. error of R&S FMA <0.5 dB, even smaller for R&S FMB)

High measurement speed

- Two independent frequency counters for simultaneous RF and AF frequency measurements
- All measurement times can be adapted to the specific measurement problem, e.g. lowest measurement frequency or required counter resolution
- Measurement functions that are not required can be switched off
- FM demodulator with high bandwidth for analysis of digital modulators (e.g. mobile radio)

Additional features of R&S FMAS:

- Excellent static and dynamic selectivity and high sensitivity for direct measurements at the antenna
- Excellent transmission quality
- High overload capability to interfering signals
- Selective RF level measurement
- Low distortion due to phase-linear IF filters

Operation

- Menu-guided operation with softkeys
- Nonvolatile storage of up to 20 complete instrument setups
- Three displays for simultaneous readout of measurement results and indication of all important instrument settings
- Quasi-analog indication of high resolution with absolute or selective as well as MIN-MAX display
- IEC/IEEE bus remote control to IEEE 488.2

Overview of equipment and options

● Standard   R&S FMA-Bxx Option   – not available

Functions of individual models, options	R&S FMA	R&S FMAB	R&S FMAS	R&S FMAV	R&S FMB
AM/FM/φM	●	●	●	●	●
Weighting filters (CCITT, CCIR): lowpass filter 5 Hz, 4.2 kHz (high skirt selectivity), 30 kHz, 120 kHz (Bessel), special φM filter	R&S FMA-B1	●	●	R&S FMA-B1	R&S FMA-B1
DIST/SINAD Meter: 10 Hz to 100 kHz, distortion measurable down to <0.005% typ.	R&S FMA-B2	●	R&S FMA-B2	R&S FMA-B2	R&S FMA-B2
Stereo Decoder: precision instrument, built-in RDS demodulator with external evaluation facility	R&S FMA-B3	●	●	–	R&S FMA-B3
AM/FM Calibrator/AF Generator: high-precision level calibration, R&S FMA performance test, complete modulation test set for transmitters and transposers, VOR/ILS baseband signal generation/analysis	R&S FMA-B4	R&S FMA-B4	R&S FMA-B4	–	R&S FMA-B4
Same as before, but with **AF and VOR/ILS generator**	–	–	–	R&S FMA-B4	–
VOR/ILS measurements	–	–	–	●	–
ILS distortion meter	–	–	–	●	–
AF Analyzer/DSP Unit: selective AF analysis up to 45 kHz, digital AF analyzer, true THD measurement, measurement of intermodulation products	–	–	–	●	–
Selective AF analysis up to 150 kHz	R&S FMA-B8	R&S FMA-B8	●	–	R&S FMA-B8
RF/IF Selection: 5 to 1000 MHz, can be switched on when required; tracking 4-section preselection, selectable IF filters	R&S FMA-B9	R&S FMA-B9	●	–	–
Reference oscillator (1×10^{-7}/year)	R&S FMA-B10	R&S FMA-B10	R&S FMA-B10	●	R&S FMA-B10
5.2 GHz Frequency Extension: enhanced power measurement accuracy	R&S FMA-B12	R&S FMA-B12	–	–	●

Modulation Analyzers R&S FMA, FMAB, FMAV, FMB; Selective Modulation Analyzer FMAS

Specifications in brief

Frequency		
Frequency range		
R&S FMA, R&S FMAB, R&S FMAV	50 kHz to 1.36 GHz	
R&S FMAS	5 MHz to 1000 (1360) MHz	
R&S FMB as well as R&S FMA and R&S FMAB with option R&S FMA-B12	50 kHz to 5.2 GHz	
Frequency tuning	automatic or manual	
Display	10-digit readout	
Resolution	0.1/1/10/100 Hz selectable	
Reference oscillator	standard	option R&S FMA-B10
Aging	2×10^{-6}/year	1×10^{-7}/year
after 30 days of operation	–	1×10^{-9}/day
warm-up time	15 min	15 min
External reference input/output	manual or remote-controlled	

RF input	N connector, 50 Ω
Overload protection	up to 5 W (15 V rms)
Maximum peak voltage	25 V (including DC)
VSWR (f_{in} up to 1.36 GHz, att. ≥20 dB)	≤1.2

RF power measurement with calibration (R&S FMA models)	
Power measurement range	0.18 µW to 1 W (–37.5 to +30 dBm)
Accuracy (P ≥0.1 mW)	±1 dB (±0.5 dB typ.)

RF power measurement (R&S FMB)	
Measurement range	0.18 µW to 1 W (–37.5 to +30 dBm)
Accuracy (input level –10 to +5 dBm, f_{in}=50 kHz to 1.36 GHz)	±0.3 dB

Amplitude modulation measurement	
Modulation frequency range	10 Hz to 200 kHz
Resolution, Accuracy	0.1% of reading, ±1%
Residual AM, f_{in} up to 1.36 GHz, CCITT	≤0.01%
Incidental AM in FM mode	≤0.1%
AF distortion	≤0.2%

Frequency modulation measurement			
Modulation frequency range	10 Hz to 200 kHz		
Max. measurable deviation for f_{in}	50 to 300 kHz	0.3 to 10 MHz	≥10 MHz
	f_{in}/10	150 kHz	700 kHz
Accuracy	±1%		
Resolution	better than 0.1% of reading		
Residual FM for f_{in}, ≤1.36 GHz, CCITT, RMS	≤1 Hz		
Stereo S/N ratio, weighted	≥76 dB		
Stereo crosstalk attenuation	≥56 dB (f_{mod}=1 kHz)		
AF distortion, incidental FM	≤0.05%, ≤10 Hz		
Deemphasis	50/75/750 µs selectable		

Phase modulation measurement	
Modulation frequency range	200 Hz to 200 kHz
Max. measurable deviation	
300 kHz to 10 MHz	150 rad
≥10 MHz	700 rad
Accuracy	±2%
Residual φM, f_{in} up to 1.36 GHz, CCITT	≤0.004 rad
Resolution	<0.1% (minimum 0.0001 rad)
AF distortion	≤0.1%

AF voltmeter	
DC voltage measurement range	±10 µV to 20 V
Resolution, Accuracy	<0.1%, ±0.5%
AC voltage measurement range	30 µV to 20 V
Frequency range, resolution	10 Hz to 300 kHz, 0.1% of reading
Accuracy (RMS, 30 Hz to 20 kHz)	±1%

All AF measuring facilities such as detectors, filters, frequency counter and distortion meter can also be used in voltage measurements for weighting.

Inputs unbalanced	BNC, R_{in}=100 kΩ ∣∣ 80 pF
Inputs balanced	R_{in}= 600 Ω, 3-contact connectors, DIN 41628

AF detector	
Peak detector	positive or negative peak or their arithmetic mean
RMS detector	readout as RMS value or converted to peak for sinewave
Quasi-peak detector (with R&S FMA-B1)	detector to CCIR Rec. 468-4

Weighting filters	
Highpass filters (2nd/3rd/2nd order)	10/20/300 Hz
Lowpass filters	3/23 kHz (4th order), combined with 20 Hz highpass filter meets CCIR 468-4, unweighted; 100 kHz (4th order)
Filter option R&S FMA-B1	CCIR 468-4 (weighted), CCITT P53, 5 Hz lowpass, 30 kHz and 120 kHz Bessel lowpass of 4th order, 4.2 kHz Cauer lowpass, special φM filter

AF frequency display	5 digits
Frequency range, resolution	10 Hz to 300 kHz, 1 mHz to 10 Hz
Accuracy	±0.005% ±3 mHz ±1 digit

Distortion measurement (option R&S FMA-B2)	
Readout	in % or SINAD in dB
Automatic adjustment	for S/N ≥20 dB
Measurement range	10 Hz to 100 kHz
Display range THD/SINAD	0.005 to 50%/76 to 86 dB
Accuracy (20 Hz to 20 kHz)	±1 dB ±0.015% THD

Stereo decoder (option R&S FMA-B3)	
Crosstalk attenuation	≥60 dB (30 Hz to 15 kHz)
Frequency response	±0.1 dB (30 Hz to 15 kHz)
Level difference between L and R	≤0.1 dB
Nonlinear distortion	≤0.1% (THD, 30 Hz to 15 kHz)
Difference-frequency distortion (DIN 45403)	d_2 ≤0.05%, d_3 ≤0.1%
S/N ratio, CCIR, weighted, unweighted	≥80 dB
Deemphasis	50 or 75 µs, selectable
External decoder input	bal., 3-cont. connector (DIN 41628)
Common-mode rejection	≥50 dB (1 kHz < f ≤15 kHz)
Input level range	–12 to +12.5 dBm into 600 Ω, Z_{in} ≥40 kΩ
Resolution of level setting	≤0.2 dB
Stereo decoder outputs	
L, R, M	bal., 3-cont. connectors (DIN 41628), +6 dBm, Z_{out} ≤30 Ω, Z_L ≥300 Ω
S	unbalanced, BNC, Z_L ≥600 Ω
RDS decoder outputs	9-contact Cannon connector
Signals available	data, clock, quality signal, TP information, 57 kHz carrier (TTL)

Measurement time	1 s typ.
Fast modulation measurement	≤120 ms

Outputs	
IF output	max. 200 mV into 50 Ω
AM output	max. 1 V into 600 Ω (can be DC-coupled)
FM/φM output	+6 dBm (1.545 V) at 40 kHz deviation/40 rad into 600 Ω (DC-coupled)
Distortion measurement output (with option R&S FMA-B2)	max. 1 V into 600 Ω
AF output	1 to 4 V into 600 Ω

Remote control	IEC 625-1/625-2 (IEEE 488.1/.2)

Modulation Analyzers R&S FMA, FMAB, FMAV, FMB; Selective Modulation Analyzer FMAS

AM/FM Calibrator/AF Generator (option R&S FMA-B4)

The data are tested at 23 °C (73.4 °F) and warranted by design in the range 23 ±5 °C (73.4 ± 9° F).

AF (single-tone and two-tone signals)	10 Hz to 100 kHz
Resolution, Accuracy	1 mHz, 1 mHz + refer. frequency drift
Level	1 mV to 7 V (max. 10 V V_{pp})
Accuracy at 1 kHz	≤0.1% ±10 µV
Level resolution	0.02% (min. 10 µV)
Frequency response (at Z_{in} = 20 Ω, C_L ≤200 pF), 10 Hz to 50 kHz	≤±0.1%
THD + N (level ≤6 V), 10 Hz to 20 kHz	≤0.02%
Difference-frequency distortion (two-tone signals, peak voltage ≤8 V)	≥74 dB (10 Hz to 20 kHz)

Stereo MPX

Data determined by design, not tested individually. Generation of stereo multiplex signals L, R, R=L, R= –L including 19 kHz pilot tone (disconnectible) or 19 kHz pilot tone + 57 kHz subcarrier (without mutiplex signal)

Linear distortion	
Preemphasis	50/75 µs, selectable
Frequency response (10 Hz to 53 kHz)	≤0.1%
Crosstalk attenuation	≥65 dB (30 Hz to 15 kHz)
Non-linear distortion and difference-frequency distortion	≥70 dB
Unweighted and weighted S/N ratio to CCIR 468-4	≥80 dB
Pilot tone	
Nominal frequency	19 kHz ±1 mHz + refer. frequency drift
Phase versus carrier	≤0.1°
Setting range	±10°
57 kHz subcarrier (only possible with multiplex signal switched off)	
Nominal frequency	57 kHz ±1 mHz + refer. frequency drift
Phase versus pilot tone	≤0.1°
Setting range	±30°

VOR/ILS (R&S FMAV only)

Data determined by design, not tested individually.

VOR	
Deviation accuracy at 9.96 kHz subcarrier	≤±0.1% ±1 Hz
Setting range	0 to 700 Hz
Phase accuracy 30 Hz	≤±0.005°
ILS	
Frequency response 90 Hz/150 Hz	≤±0.02%
Additional gain difference error	≤0.1% x amplitude difference
Phase accuracy 90 Hz/150 Hz	≤±0.05°

Outputs	2 BNC female connectors on rear panel, unbalanced, same signal at both outputs (can be individually switched off) or 1 x balanced
Output impedance	20 Ω, 200 Ω, 600 Ω selectable
Tolerance	±1% ±2 Ω

AM

Carrier frequency	10 MHz
Level	–10 dBm
Modulation depth	adjustable from 0 to 99%
Accuracy at f_{mod}=1 kHz, 80% AM	≤0.1% of reading
Additional linearity error	≤0.1% (m=10 to 95%)
Modulation frequency response	≤0.1% (15 Hz to 10 kHz)
Modulation distortion (THD + N, m = 80%)	≤0.1% (10 Hz to 20 kHz)
Incidental φM, m ≤80%	≤0.01 rad
Residual AM	≤0.02% typ. (20 Hz to 23 kHz, RMS)

AM VOR/ILS (R&S FMAV only)

ILS	
DDM accuracy m=18 to 22%	≤±0.00005 DDM ±0.001 x (DDM)
DDM accuracy m=32 to 48%	≤±0.0001 DDM ±0.001 x (DDM)
Phase accuracy 90 Hz/150 Hz	≤0.1°
VOR	
Deviation accuracy at 9.96 kHz subcarrier	≤±0.1% ±1 Hz
Setting range	0 to 700 Hz
Phase accuracy 30 Hz	≤0.01°

FM

Carrier frequency	10 MHz
Level	–10 dBm
Deviation (f_{mod}=1 kHz, squarewave)	100 kHz
Accuracy	≤0.1%
Additional sinewave modulation	f_{mod}=10 Hz to 100 kHz, dev. =1 to 100 kHz
Residual FM (BW=23 kHz, RMS)	≤10 Hz
Accuracy for 100 kHz deviation, f_{mod}=1 kHz	≤0.2% + residual FM
Additional linearity error for f_{mod}=1 kHz, dev. =10 to 100 kHz	≤0.1%
Modulation frequency response	≤0.5% (10 Hz to 100 kHz)
Modulation distortion for 100 kHz deviation	≤0.1% (f_{mod}=10 Hz to 20 kHz)
Incidental AM for 50 kHz deviation	≤0.05% typ. (f_{mod} = 1 kHz, BW = 3 kHz)

Level

Carrier frequency	10 MHz
Accuracy	same as reference frequency
Level range	–50 to –4 dBm
Accuracy –10 dBm	≤0.1 dB at
Accuracy –40 dBm to –4 dBm	≤0.2 dB ±6 nW
Output	BNC female on front panel (CAL), can be internally switched to RF input
VSWR at 10 MHz	≤1.05

Specs in brief: R&S FMAS receive mode

Instead of the optional DIST/SINAD Meter R&S FMA-B2, the optional AF Analyzer/DSP Unit R&S FMA-B8 is fitted in the R&S FMAS.

RF/IF Selection (option R&S FMA-B9)

Frequency

Frequency range	5 to 1000 MHz	
	FM wide	FM narrow/TV 2-sound
IF bandwidth (–3 dB)	350 kHz	150 kHz
Shape factor (–3/–60 dB)	3.4	3.7

RF level

RF input level range	–87 to +30 dBm (10 µV to 7 V)
Overload protection	up to 5 W (15 V RMS), max. peak voltage 25 V
VSWR	≤2.7 (without attenuation) ≤1.4 (with ≥10 dB attenuation)
Selective level measurement	peak measurement
Measurement accuracy[1)]	
5 to 500 MHz	±2 dB ± 3 µV
500 to 1000 MHz	±3 dB ± 3 µV

Modulation Analyzers R&S FMA, FMAB, FMAV, FMB; Selective Modulation Analyzer FMAS

FM stereo

Selectivity

Ratio of wanted to unwanted signal for a weighted S/N ratio of ≥54 dB, referred to a wanted signal of Δf=40 kHz, f_{mod}=500 Hz.
Stereo measurements with 50 µs deemphasis in stereo decoder. Specifications apply to input levels ≥200 µV (–61 dBm) for mono, ≥2 mV (–41 dBm) for stereo.

Nearby selectivity, unwanted sig. modulated, f_{mod} = 500 Hz, Δf = 75 kHz

	stereo FM wide	mono FM narrow	FM wide	FM narrow
Frequency difference				
±100 kHz	≤64 dB	≤ 61 dB	≤ 7 dB	≤ 4 dB
±200 kHz	≤25 dB	≤ 11 dB	≤ 7 dB	≤ 0 dB
±300 kHz	≤ 5 dB	≤–15 dB	≤ 4 dB	≤–16 dB
±600 kHz	–	–	≤–26 dB	≤–46 dB

Far-off selectivity, unwanted signal modulated, f_{mod}=500 Hz, Δf=75 kHz,
Frequency difference ≥1.2 MHz (except for image frequency and 1st IF)

87.5 to 108 MHz	–	–	≤–54 dB	≤–54 dB
rest of range	–	–	≤–40 dB	≤–40 dB

Linear distortion

Amplitude-frequency response, measured at MPX signal output, Δf=40 kHz, reference frequency 500 Hz

	FM wide	FM narrow
40 Hz to 43 kHz	±0.1 dB	±0.1 dB
43 to 53 kHz	±0.1 dB	±0.3 dB
53 to 61 kHz	±0.2 dB	±1 dB
61 to 70 kHz	±0.5 dB	±3 dB
70 to 75 kHz	±1.5 dB	±5 dB
Stereo crosstalk L↔R, measured via stereo decoder, without deemphasis		
40 Hz to 5 kHz	–50 dB	–37 dB
5 to 15 kHz	–44 dB	–31 dB

Nonlinear distortion

THD measured at MPX signal output (mono)

	Δf=75 kHz wide	narrow	Δf=100 kHz wide	narrow
FM				
40 Hz to 5 kHz	–	≤0.5%	–	≤1%
40 Hz to 15 kHz	≤0.25%	–	≤0.5%	–

Measured via stereo decoder

	stereo wide	narrow	mono wide	narrow
FM				
40 Hz to 5 kHz				
Δf=75 kHz	≤0.3%	≤0.8%	≤0.25%	≤0.5%
Δf=100 kHz	≤0.6%	≤1.6%	≤0.5%	≤1%

S/N ratio

To CCIR 468-4, deemphasis 50 µs, referred to Δf=40 kHz, f_{mod}=500 Hz
S/N ratio (CCIR 468-4, weighted)
LOW NOISE[1]) mode

f_{in}/MHz:	5 to 130	stereo 130 to 470	470 to 1000	5 to 130	mono 130 to 470	470 to 1000
Input voltage						
≥200 µV	–	–	–	≥58 dB	≥58 dB	≥58 dB
≥2 mV	≥58 dB	≥58 dB	≥56 dB	≥76 dB	≥76 dB	≥74 dB
≥20 mV	≥70 dB	≥63 dB	≥60 dB	≥76 dB	≥76 dB	≥74 dB

TV dual sound

Input signal	TV dual-sound signal, standard B/G, at IF or in bands I, II and IV, V with and without modulated vision carrier

Deviation measurement accuracy		
30 Hz to 15 kHz, Δf ≤70 kHz	±1% + residual FM	
Difference accuracy with successive dev. measurement sound 1/sound 2, 30 Hz to 15 kHz	±0.3% + residual FM	
Nonlinear distortion	Δf=50 kHz	Δf=70 kHz
Distortion		
f_{mod}=30 Hz to 5 kHz	≤0.3%	0.5%
f_{mod}=5 to 15 kHz	≤0.5%	1%

S/N ratio
Quasi-peak measurement to CCIR 468-4,weighted and unweighted; deemphasis 50 µs, ref. to wanted signal of Δf=30 kHz and f_{mod}=500 Hz

Input level (selective)	unweighted	weighted
≥200 µV	≥53 dB	≥53 dB
≥2 mV	≥73 dB	≥73 dB

Channel crosstalk, referred to Δf=30 kHz, f_{mod}=500 Hz, selective measurements, deemphasis 50 µs, other sound carrier modulated with frequencies from 30 Hz to15 kHz, Δf=55 kHz.
Level (selective) ≥5 mV ≥80 dB

AF Analyzer/DSP Unit (R&S FMA-B8)

Selective distortion measurement

Readout	in % or dB
Display range	0.001 to 20%, –100 to –14 dB

Measurement of individual distortion d_i (i=2, 3, …10)

Meas. acc.	10 Hz ≤ f_1 ≤14 kHz, f_{di} ≤ 42 kHz ±5% of rdg ±0.02% absolute	f_1 ≤50 kHz f_{di} ≤150 kHz ±5% of rdg ±0,05% absolute

THD measurement
Measurement of harmonic i = n (n = 2 to 10 selectable)

Meas. acc.	10 Hz ≤ f_1 ≤14 kHz f_{dn} ≤42 kHz ±5% of rdg ±0.03% absolute	f_1 ≤50 kHz f_{dn} ≤150 kHz ±5% of rdg ±0.1% absolute

Intermodulation measurement

Difference frequency distortion d_2, d_3 to IEC 268-3

Readout	in % or dB
Display range	0.001 to 20%, –100 to –14 dB

Meas. acc. (f_2–f_1 ≥30 Hz)

2 x f_2–f_1 ≤42 kHz	42 kHz < 2 x f_2–f_1 ≤150 kHz
±5% of rdg ±0.02% absolute	±5% of rdg ±0.05% absolute

Selective modulation and voltage measurement

using special bandpass filter, in voltmeter, AM, FM and φM mode
Bandwidth (BW_{-3dB}) at center frequency f_c

f_c	10 Hz to ≤1 kHz	1 kHz to ≤20 kHz	20 kHz to ≤150 kHz
B_{-3dB}	2.3 Hz	6.8 Hz	68 Hz

Shape factor 3 dB/80 dB	<4
Far-off selectivity	80 dB
Display range	corresponding to display range of selected operating mode

Measurement uncertainty[2])
with meas. frequency deviation from center frequency <BW_{-3dB}/4

at center frequency f_c	10 Hz to 100 kHz ≤2%	100 kHz to 150 kHz ≤5%

Rear-panel outputs

Deflection for external oscilloscope

DSP1	Y deflection, 0 to 4 V, BNC female
DSP2	X deflection, 0 to 4 V, BNC female
Scale markers	
vertical	13 markers, 10 dB/div
horizontal	10 markers, scaling can be called up via the information menu

Modulation Analyzers R&S FMA, FMAB, FMAV, FMB; Selective Modulation Analyzer FMAS

Specs in brief: R&S FMAV, VOR/ILS measurement

VOR/ILS
Data are valid within the frequency ranges specified (f_{in}).
They are typical values for all frequencies ≥10 MHz.

VOR (f_{in} = 10 MHz; 108 to 120 MHz)	
Amplitude modulation measurement	accuracy for m = 10% to 90%:
f_{mod} = 30 Hz/9.96 kHz	±0.8% of reading
f_{mod} = 300 Hz to 4 kHz	±1.2% of reading
Frequency modulation measurement	9.96 kHz carrier
Max. measurable deviation	700 Hz
Accuracy (f_{mod} = 30 Hz ±1%)	±0.5% ±0.1 Hz
Phase difference measurement at 30 Hz	
Measurement range	0 to 360°
Measurement accuracy	±0.03°
Resolution	≤0.01°
ILS (f_{in} = 10 MHz; 108 to 120 MHz; 328 to 336 MHz)	
Amplitude modulation measurement	m = 10% to 90%
Measurement accuracy	
90/150 Hz ±2%	±0.5% of reading
300 Hz to 4 kHz (identifier)	±1.2% of reading
DDM measurement	
Measurement range	0 to ±0.2 DDM
f_{mod}	90/150 Hz ±1%
Measurement accuracy	
m = 18 to 22%	±0.0002 DDM ±0.1% of reading
m = 32 to 48%	±0.0005 DDM ±0.1% of reading
Resolution	≤0.0001 DDM
Measurement of phase angle between 90 Hz and 150 Hz signals	
Measurement range	±60°
Measurement accuracy	±0.2°
Resolution	≤0.01°

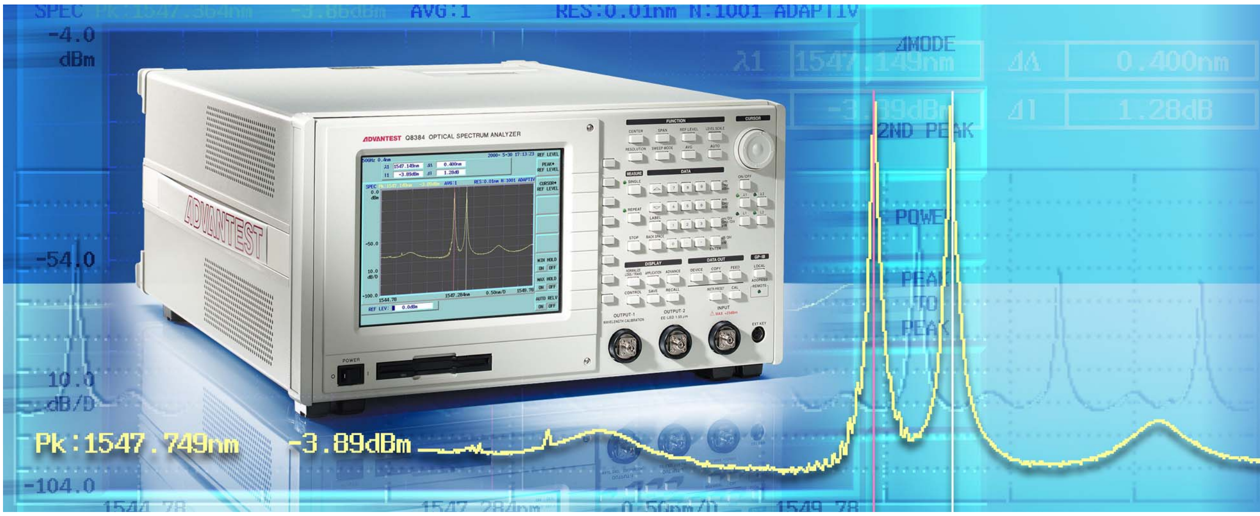
Ordering information

Modulation Analyzer	R&S FMA	0852.8500.52
	R&S FMAB	0856.4750.52
	R&S FMAV	0856.4509.52
	R&S FMB	0856.5005.52
Selective Modulation Analyzer	R&S FMAS	0856.6001.52
Options (possible configurations see pages 323)		
Filter	R&S FMA-B1	0855.2002.52
DIST/SINAD Meter	R&S FMA-B2	0855.0000.52
Stereo Decoder	R&S FMA-B3	0856.0003.52
AM/FM Calibrator/AF Generator	R&S FMA-B4	0855.6008.52
AF Analyzer/DSP Unit	R&S FMA-B8	0855.9007.55
RF/IF Selection 5 to 1000 MHz	R&S FMA-B9	0856.6501.52
Reference Oscillator	R&S FMA-B10	0856.3502.52
5.2 GHz Frequency Extension	R&S FMA-B12	0855.8500.52
Extras		
Service Kit	R&S FMA-Z1	0856.4009.52
For R&S FMAV:		
High-Power Attenuator 20 dB/50 W	R&S RDL 50	1035.1700.52

1) In temperature range 15°C to 35°C; error doubles outside this range.

2) Error of selective measurement in addition to error specified for selected voltmeter, AM, FM or φM mode.

Contents of Chapter 7



Optical Spectrum Analyzer Q8384 with highest resolution, low polarization dependence and wide dynamic range (photo 43439-4)

Contents of Chapter 7

Introduction to Optical Measurements

Ever since printing was invented by Gutenberg in the middle of the 15th century, the printed word has become the basis for passing on knowledge. The invention of the printing technology was however also the basis for the development of modern technologies on the way to the communications age. Today, computers play an important part in the generation, processing and filing of information and have replaced in many cases printing as a storage and transmission medium. Magnetic and semiconductor memories can save a gigantic quantity of data on a minimum of space. Computers are nowadays practically an indispensable tool in the generation of print and online media. High-speed worldwide data transmission is playing an important role as well.

Five centuries after the Gutenberg invention a new medium is having a revolutionary effect on the recording and imparting of human knowledge – the optical transmission. Semiconductors, laser and optical fibers are the main elements in this new transmission technology. Optoelectronic circuits and systems gain information from the light by analyzing its intensity, wavelength and polarization. This light in turn is also produced by optoelectronic devices and information added to it. Research, development and further refinement of such optoelectronic circuits makes an accurate measurement of the optical parameters necessary.

Optical power meters and light sources

Optical power meters are indispensable tools in the development of optical technologies. With their aid it is possible to determine basic parameters and thus increase the efficiency of a transmission system or components thereof. The measurement method is based either on a conversion of the light intensity into a proportional current or the light power is directly converted into thermal energy. While the latter method is frequently used for laboratory standards, the optoelectric conversion using semiconductor sensors is preferred for the industrial field. These sensors respond faster to intensity variations and nowadays also ensure stable measurement results.

A disadvantage however is the strong wavelength dependence of the semiconductor materials. To cover a range from 400 nm to 1750 nm, silicon sensors are generally used today up to about 1000 nm; for longer wavelengths, germanium or indium-gallium-arsenide (InGaAs) materials are suitable. With modern power meters, the wavelength dependence of the sensor material in its operating range is compensated with the aid of a correction table. The user merely needs to enter the wavelength of the light to be measured and the corrected result is displayed. To ensure correct measurement, the wavelength has to be precisely known. This is also important when using light sources, which in turn should be of tight tolerances within the wavelength spectrum.

The higher the power of a light source, the greater the dynamic range that is available. Since the power meter is calibrated to a light source e.g. for measurement of the transmission loss of an optical fiber, it is important that the power of the source remains stable. It is therefore imperative for the light sources to be power-regulated. For LEDs, current regulation with temperature signalling is sufficient, whereas for laser diodes (LDs) the power has to be directly measured via a monitor sensor.

Spectral analysis

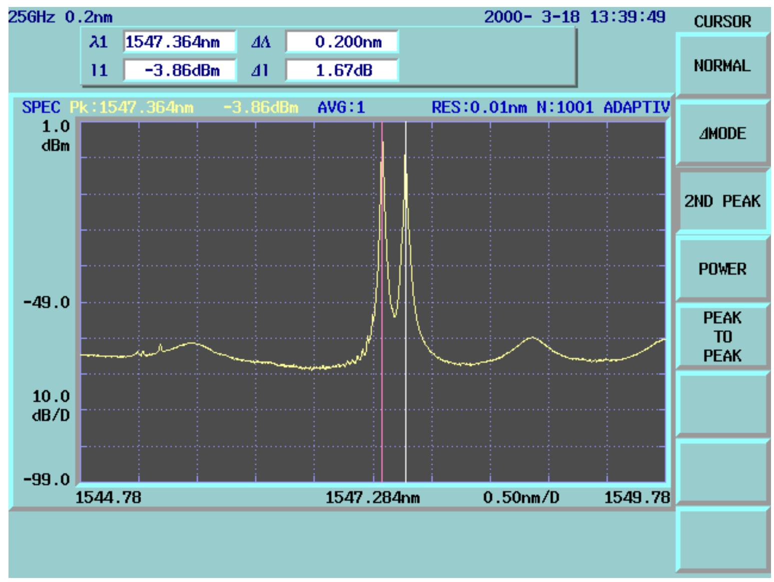
Spectral investigation of light began with the light of the sun. The human eye can perceive a wavelength range from about 400 nm to 800 nm. The short wavelength end of this range is the transition to the ultraviolet and appears to the eye in blue/violet; the long wavelengths produce deep red and are the transition to heat radiation (infrared). Within this range the different wavelengths appear as colours. Wavelengths from 850 nm to 1630 nm are used in optical communications. This "light" is invisible to the human eye so that a direct assessment is not possible. For scientific wavelength analysis, spectroscopes are used; in communications they are called optical spectrum analyzers. Methods for wavelength measurements are for instance:

- Diffraction of light using a diffraction grating (dispersive spectroscopy)
- Measurement of spatial intensity distribution
- Analysis of light e.g. with a Michelson interferometer (Fourier spectroscopy), using Fourier transform to retrieve a spectral signal from a temporal signal

Dispersive methods are used in the majority, since they allow a high measurement sensitivity. Interferometer methods are often superior in terms of measurement accuracy and resolution. Wavelength Meter Q8326 for instance achieves with this method a resolution of 1 pm with a measurement uncertainty of as low as 2 ppm. Other methods like Fabry-Perot or Macht-Zehnder interferometers are less frequently used in practice, but they also allow reliable wavelength analysis.

Measurement example

carried out with the Optical Spectrum Analyzer Q8384 (page 337).



High-resolution measurement of two optical sources with 0.2 nm resolution

About the following pages

This chapter on optical measurements describes important measuring instruments of the two types described above for use in R&D, industry and professional training. Our line of products is continuously updated to keep pace with the latest developments in this complex field of measurements. You can find out about our current range of products, especially about newly developed and special models, by contacting:

Rohde&Schwarz
Engineering and Sales GmbH

München, Germany
Telephone: +49 89 4129-13711
Telefax: +49 89 4129-13723

Optical Wavelength Meter Q8326

480 nm to 1650 nm

Optical wavelength meter of highest precision

Photo 43466-1

Brief description

Q8326 is an optical wavelength meter (Advantest) featuring high resolution of the central wavelength. It is suitable for laser diodes, LEDs and other narrowband light sources. Its high measurement accuracy and resolution are ensured over an extremely long period of time by the built-in HeNe reference laser. The light is coupled in by means of optical fiber. An analog level meter is provided to facilitate alignment of the optical axis, if the light has to be fed into the optical fiber first.

Thanks to its high accuracy, Q8326 can be used as a calibration standard for spectroscopes; it allows tuning of dye lasers. It can also be used for investigating the wavelength characteristics of semiconductor components. The high resolution allows for instance accurate measurement of the temperature and chirp response of laser diodes in case of WDM modulation. The instrument always displays the measured wavelength as a value in a vacuum, thus eliminating measurement errors due to the variable refraction index of the air. With 5 measurements per second, the instrument allows realtime observation of wavelength fluctuations. Intensity-modulated light can be accurately measured with a modulation frequency of 3 MHz or higher.

Main features

- Measurement uncertainty 2 ppm only
- Resolution 0.001 nm (averaged)
- Wavelength and frequency display
- 5 Measurements per sec

Operation

Q8326 can be switched to frequency display with a resolution of 100 MHz. The resolution is automatically set to the maximum value, the spectral width of the light source to be measured having a limiting effect and the attainable measurement accuracy being reduced by wideband sources. The display can be reset in the frequency and in the wavelength mode, so that only the frequency or wavelength variations will be displayed. This function is particularly useful for monitoring the long-term stability of sources. An optional 19" rack adapter is available for integration into systems. Beside standard FC input ST and SC connector types are to be adapted.

Specifications in brief

Wavelength ranges	480 nm to 1650 nm (181 to 625 THz)
Input sensitivity	–30 dBm (1200 nm to 1600 nm) –25 dBm (600 nm to 1650 nm)
Max. input level	+10 dBm
Display	10 digits, wavelength or frequency
Resolution	1/0.1/0.01/0.001+0.0001 nm or 100/10/1 GHz/100 MHz, automatic optimization
Measurement accuracy (25 ±5°C)	±(0.05 x half-value width of source) ±2 ppm ±resolution
Stability	±resolution for averaging
Averaging	moving average value (of last 10 measurements)
Measurement rate	5 measurements per second
Optical connector	FC/PC with internal 50/125 µm graded-index fiber, connector adapt-able
Analog output	D/A conversion from 0 to 1 V for last three digits of display
Remote control	IEC625 (IEEE488)
Operating temperature range	+10°C to +40°C
Power supply	100 V to 240 V, 50/60 Hz (60 VA)
Dimensions (W x H x D)	300 mm x 132 mm x 450 mm
Weight	10 kg

Ordering information

Optical Wavelength Meter	Q8326
Extras	
19" adaptor	A02450
SC adaptor	A08162
ST adaptor	A08163

Optical Multi-Wavelength Meter Q 8331

Optical Multi-Wavelength Meter for up to 300 channels with short measurement time

New

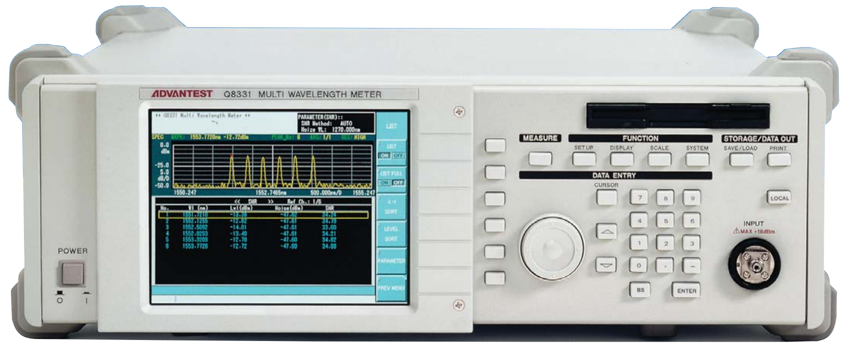


Photo 43871-1

Features and benefits

- Wavelength accuracy of ±1 ppm (±1.5 pm at 1550 nm)
- Resolution of up to 0.1 pm
- High Measurement Speed of 2 samples per second
- Distinguishes up to 300 optical channels
- Resolvable channel separation of 10 GHz
- Simultaneous spectrum and list display
- Analysis of deviations from Wavelength Reference Grid
- Pass/Fail monitoring and recording of measurement values over time

Applications

- Measure and verify DWDM Transmission Laser Wavelengths
- Tune DWDM Transmission Lasers
- Compare laser wavelengths to reference grid
- Monitor fluctuations of wavelengths and power levels over time

The Q8331 is a multi-wavelength meter for measuring wavelengths and power levels of DWDM optical signals. With high accuracy, resolution and speed, it measures modulated as well as unmodulated Continuous Wave (CW) optical signals. The instrument is based on a Michelson interferometer with internal He-Ne laser as wavelength reference. Use of a He-Ne laser as wavelength reference enables high accuracy measurements of up to ±1 ppm (±1.5 pm at 1550 nm). Since the He-Ne laser oscillates with very high stability, the measurement accuracy is guaranteed over a long time period without recalibration. In addition, the Q8331 includes temperature and atmospheric pressure sensors, that allow it to automatically adjust measurements to changes in temperature and atmospheric pressure.

Specifications

Wavelength range	1270 nm to 1680 nm
Wavelength accuracy	±1 ppm (1.5 pm at 1550 nm)
Display resolution	0.1 pm, channel separation 10 GHz
Power accuracy	±0.5 dB (1310 nm, 1550 nm)
Sensitivity	–40 dBm (1270 nm to 1600 nm)
Maximum input power	+10 dBm
Measurement time	0.5 s
Display	6.5" LCD
Dimensions (W x H x D)	424 mm x 132 mm x 500 mm
Weight	13 kg

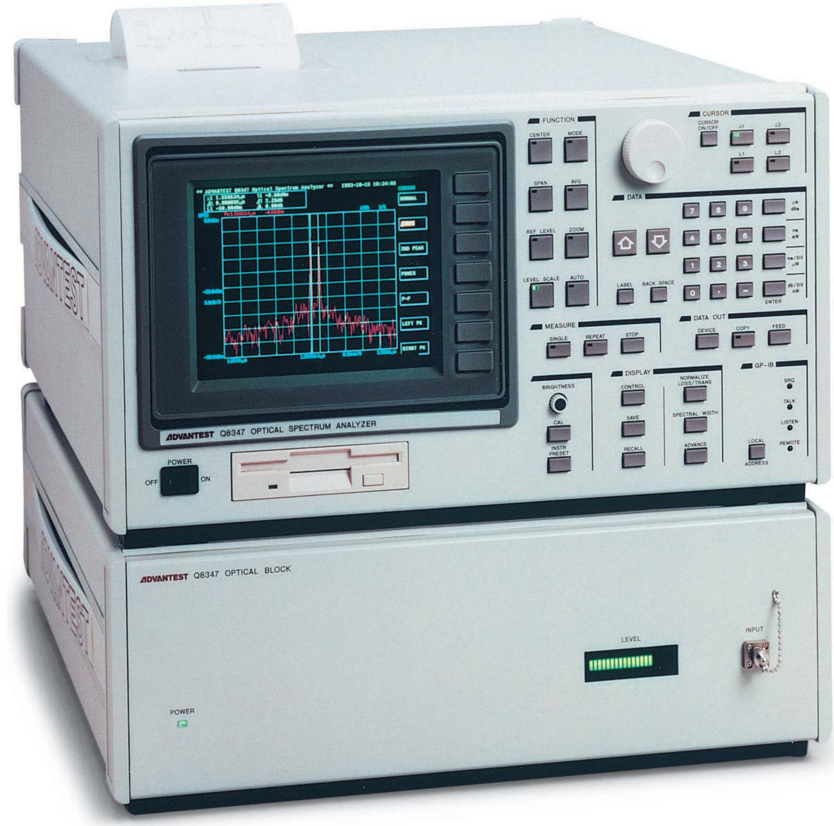
Ordering information

Optical Multi-Wavelength Meter	Q 8331
Accessories	
19" Rack Adapter	A 02708
SC Adapter	A 08162
ST Adapter	A 08163

Optical Spectrum Analyzer Q8347

350 nm to 1750 nm

Top-class, high-resolution optical analyzer



Brief description

Optical Spectrum Analyzer Q8347 (Advantest) uses a Michelson interferometer. The larger mechanical configuration of the interferometer allows max. resolutions of 1 pm or 1 GHz in the frequency mode. This resolution as well as a measurement accuracy of ±0.001 nm for interferometers of this size cannot be attained with monochromators. At 1550 nm the resolution is still as high as 0.007 nm, thus allowing accurate measurement of high-grade optical WDM components.

This resolution enables chirps from modulated LDs as well as from Soliton transmission to be analyzed. The highest resolution of 0.001 nm is attained at a wavelength of about 500 nm and is particularly useful for the analysis of blue laser diodes. The indicated wavelength is always the value in a vacuum.

In addition to the wavelength display mode, frequency display can also be selected, with deviations being read out in GHz. The use of the Fourier spectroscopy enables true measurement of the coherence length. Q8347 allows a value of up to 165 mm to be analyzed. The evaluation itself is made automatically at a keystroke.

In the spectral range a curve fitting function can be used. It directly shows the electroluminescence characteristic by fitting a Gaussian distribution into the emission spectrum – a valuable aid in the measurement of erbium-doped fiber amplifiers (EDFA), LDs and Soliton transmission systems.

Main features

- Max. resolution 0.001 nm (at 500 nm)
- Measurement accuracy 0.01 nm
- Coherence measurement

Operation

Alternatively to spectrum display, the instantaneous optical power can be directly read like on a power meter. The display shows the power versus time in graphical form. Versatile display modes such as

- Overlay display,
- Comparison with memory contents, display of two separate diagrams (split screen),

Optical Spectrum Analyzer Q8347

- Use of several markers,
- Normalization and direct readout of transmission loss as well as
- Automatic bandwidth analysis (e.g. half-value width measurement to RMS and envelope method),
- Curve fitting

and many other features facilitate operation of the analyzer and simplify analysis via IEC/IEEE bus.

The standard built-in 3 ½" disk drive is used as a storage medium. The stored binary data can be further processed under MS-Windows. The high-speed built-in thermal printer provides a hardcopy of the measurement results with all setting parameters within 8 seconds.

Specifications in brief

Spectral values	
Wavelength	350 nm to 1750 nm
Resolution (spacing between two testpoints)	0.001 nm at 500 nm 0.01 nm at 1550 nm
Measurement accuracy	±0.01 nm, the wavelength in a vacuum is indicated
Measurement principle	Michelson interferometer with HeNe reference laser
Span	0.1 nm to 1400 nm
Level	
Sensitivity	
700 to 1600 nm	–65 dBm
450 to 1700 nm	–52 dBm
350 to 1750 nm	–42 dBm
Max. input level	+10 dBm
Measurement accuracy	±2 dB
Polarization dependence	±0.8 dB
Linearity	±0.5 dB/10 dB ±1.0 dB/25 dB
Scale	0.2 to 10 dB/division, 1/2/5 steps, linear
Processing	
Measurement time	1 to 3.5 seconds per measurement depending on setting
Memory	16 curves, 10 instrument setups, 3 ½" disk drive
Analysis	coherence to 165 mm, X dB bandwidth, peak wavelength, curve fitting, etc
Interfaces	
Optical connector	FC/PC with internal 50/125 µm graded-index fiber, connector adaptable
Remote control	IEC625 (IEEE488)
Printer	built-in printer (standard) or output to plotter via IEC/IEEE bus
General data	
Power supply	220 to 240 V, 48/66 Hz, 260 VA
Dimensions (W x H x D)	424 mm x 335 mm*) x 500 mm *) total height of both parts
Weight	36 kg in total

Ordering information

Optical Spectrum Analyzer	**Q8347**
Extras	
5 rolls of printer paper	A09075
19" Rack Adapter (please order both numbers)	A02728 and A02732

Optical Spectrum Analyzer Q8384

600 nm to 1750 nm

Optical spectrum analyzer for DWDM applications

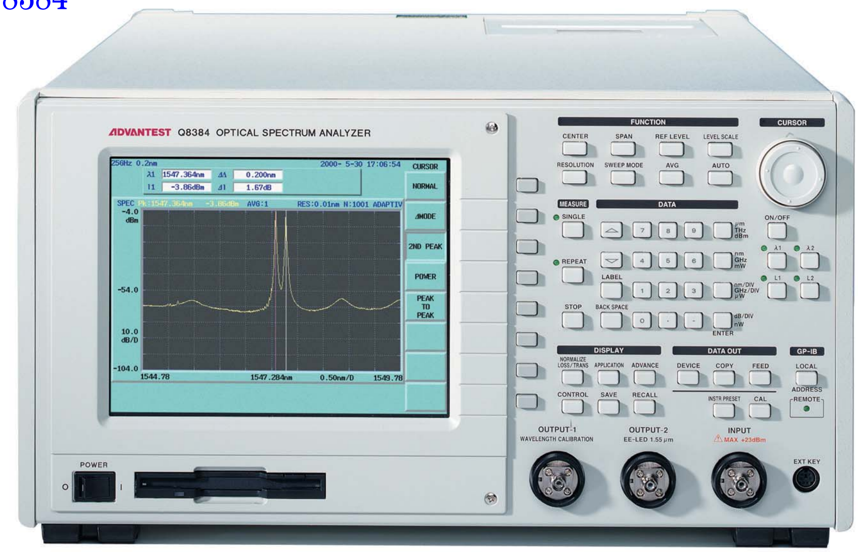


Photo 43439-5

Brief description

The Q8384 is a high-grade spectrum analyzer (Advantest) with a new kind of multi-path monochromator and extremely low polarization dependence. Thanks to a special method used, a value of ±0.05 dB can be ensured, the typical value is as low as 0.02 dB. Together with the narrow resolution bandwidth, the Q8384 can be used to perform accurate power measurements.

All these features, the resolution of wavelength measurement and the wide dynamic range make the Q8384 an ideal measuring instrument in the (D)WDM technology, i.e. for erbium-doped fiber amplifiers (EDFA). A special measurement function allows determination of noise figure, gain and spontaneous emission by simple comparison of the signal at the amplifier input with the signal at the amplifier output. All these features are of course also of great advantage for the measurement of laser diodes, LEDs and other light sources. A curve fitting function directly shows the electroluminescence characteristic by fitting a Gaussian distribution into the emission spectrum.

This is a valuable aid in the measurement of erbium- doped fiber amplifiers (EDFA) and LDs. Special functions for pulsed light allow measurements of fiber rings and Soliton transmission systems. Internal or external triggering is possible.

The measurement time is 0.5 second for a span of 10 nm and varies as a function of the span. The highest sensitivity is attained for wideband sources with a resolution of 5 nm, while narrowband sources (laser) can reliably be analyzed down to the noise level even with narrow resolution bandwidths. A normalization function in conjunction with a white light source or an optional internal EE-LED source enables direct measurement of the transmission and loss characteristics of optical filters and fibers.

Main features

- 10 pm resolution bandwidth
- Sensitivity –87 dBm
- Polarization dependence ±0.05 dB
- Accuracy of resolution bandwidth ±2%
- Power measurement
- Pulse light measurement
- Predefined test routines for filters and light sources

Operation

In addition to the amplifier analysis, the versatile display modes and many other features facilitate operation of the analyzer and simplify analysis via IEEE/IEC bus.

- Overlay display
- Comparison with memory contents
- Display of two separate diagrams (split screen)
- Power meter function
- Use of several markers
- Normalization and direct readout of transmission
- Automatic bandwidth analysis (e.g. half-value width measurement to RMS and envelope method)

Optical Spectrum Analyzer Q 8384

- Curve fitting
- Level and wavelength trend monitor
- Limit lines with PASS/FAIL comparator
- Predefined test routines for optical bandpass filters
- Predefined analysis of DFB-LD, FP-LD and LED
- Measurement of adjacent-channel power ratio (ACPR)
- ITU grid can be superimposed

The standard built-in disk drive is used as a storage medium. The stored data can be analyzed as text and bitmap format, copied into documents and printed. The high-speed built-in thermal printer provides a hardcopy of the measurement results with all setting parameters within 8 seconds.

Option

Optionally, an internal EE-LED light source for transmission and attenuation measurements in the 1550 nm window is available.

Specifications in brief

Spectral values	
Wavelength	600 nm to 1750 nm
Resolution (half-value width)	10 pm to 500 pm, 1/2/5 steps
Measurement accuracy	±0.2 nm ±0.02 nm (1530 nm to 1570 nm)
Measurement principle	polarization-compensated multi-path monochromator
Span	1 nm to 1200 nm, 0 nm
Level	
Sensitivity	
1250 nm to 1610 nm	–87 dBm
600 nm to 1750 nm	–55 dBm
Max. input level	+23 dBm
Measurement accuracy	±0.4 dB
Polarization dependence	±0.05 dB
Linearity	±0.05 dB/–10 dBm to –50 dBm
Dynamic range	50 dB at ±100 pm 67 dB at ±400 pm
Scale	0.1 to 10 dB/division, 1/2/5 steps, linear
Pulse light	in pulse mode or with external trigger, pulse >10 ns; Max Hold mode
Processing	
Measurement time	0.5 second for 10 nm span
Graphic pixels	max. 10,000
Memory	15 curves, instrument setups, 3 ½" disk drive
Analysis of amplifiers (EDFA)	noise figure, spontaneous emission, power, gain; X dB bandwidth, peak wavelength, WDM signal analysis for 256 channels, etc
Interfaces	
Optical connector	FC without contact in fiber
Remote control	IEC625 (IEEE488)
Printer	built-in printer (standard) or output via Centronics (bitmap)
Monitor, external	VGA

General data

Power supply	90 V to 250 V, 48/66 Hz, 200 VA
Dimensions (W x H x D); weight	424 mm x 221 mm x 500 mm; 29 kg

Ordering information

Optical Spectrum Analyzer	Q 8384
Option	
EE-LED Light Source	Option 25
Extras	
5 rolls of printer paper	A 09075
19" Rack Adapter	A 02722
SC Adapter	A 08162
ST Adapter	A 08163

Optical Chirpform Test Set Q7607

Instrument for easy and quick measurement of dynamic chirp of optical modulators and laser diodes up to a data rate of 50 Gbps

Photo 43870-1

Brief description

Information-carrying networks are changing rapidly due to enhanced technologies that increase transmission rates for optical communication systems. Especially for wavelength division multiplexing (WDM) transmission systems, R&D of components requires new instruments to meet increasing test needs such as testing for dynamic chirp. Therefore, Advantest developed the Q7607 Optical Chirpform Test Set. Together with Advantest's D3186 Pulse Pattern Generator, a digital sampling oscilloscope, and a personal computer, the Q7607 conveniently evaluates signal chirp of optical modulators and laser diodes up to a data rate of 50 Gbps in the time domain.

Main features

- Quick time-domain chirp measurement: 30 seconds or less
- High resolution of 20 MHz or better
- Wide measurement frequency bandwidth of about 100 GHz
- Automatic polarization adjustment
- Built-in optical amplifier (option 10)
- FSR (free spectral range) of 300 GHz

Characteristics

Automatic polarization adjustment
The Q7607 has an automatic polarization adjustment that facilitates fully automated high-speed and high-accuracy measurements.

Built-in optical amplifier (option 10)
Option 10 comes with a built-in optical amplifier that conditions the output signal for unamplified high-bandwidth O/E converters. This feature automatically controls the amplifier gain, which improves both measurement accuracy and S/N ratio measurements.

Quick time-domain chirp measurements
30 seconds or less – until now no simple and easy-to-use method existed to measure dynamic optical chirp. With the Q7607, Advantest makes dynamic chirp measurements a process by automatically separating the frequency modulation (FM) and intensity modulation (IM) components (conventional methods using spectral diffraction take 20 minutes or more for chirp measurement). Q7607 allows the user to measure dynamic chirp in 30 seconds or less.

High resolution
The Q7607 provides chirp data with approx. 20 MHz resolution or better.

Wide measurement frequency bandwidth
The measurement frequency bandwidth is approx. 100 GHz, the FSR (free spectral range) is approx. 300 GHz. This allows the Q7607 to measure transmission signals of more than 50 Gbit/s.

Simple operation
The user can measure and display chirp using almost any personal computer. The measurement data can also be downloaded to a spreadsheet, transmission waveform simulator, etc.

Optical Chirpform Test Set Q7607

Specifications

	Q7607	Q7607 + option 10
Wavelength range	1510 nm to 1610 nm	1530 nm to 1610 nm
Input optical power range	–10 dBm to +10 dBm	
Free spectral range		
10 G	150 GHz ±15 GHz	
50 G	300 GHz ±15 GHz	
Demodulation bandwidth		
10 G	100 Hz to 50 GHz	
50 G	100 Hz to 100 GHz	
Resolution of demodulation frequency	20 MHz peak-to-peak or less	
Insertion loss	13 dB or less	–
Optical output power (with option 10)	0 dBm or higher	
Optical input power	–10 dBm or higher	
Optical amplifier output (with option 10)	built-in optical amplifier with automatic gain adjustment	–
Input light polarization compensation	built-in automatic polarization compensator	

Input/output

Optical input/output	FC/PC connector
GPIB	in accordance with IEEE4738 1978

General data

Operating environment	
Ambient temperature	0°C to +40°C
Relative humidity	85% max. (no condensation)
Storage environment	
Ambient temperature	–20°C to +60°C
Relative humidity	90% max. (no condensation)
Power supply	100 V to 120 V AC, 220 V to 240 V AC, 50/60 Hz, 85 VA or less, automatic switching between 100 V and 200 V systems
Dimensions (W x H x D)	approx. 132 mm x 424 mm x 500 mm
Weight	13 kg or less (approx. 33 lb or less)

Ordering information

Optical Chirpform Test Set	Q7607
Option	
Optical Amplifier	10

Optical Network Analyzer Q7760

Performs high-speed measurement of transmission and reflection characteristics of optical components for DWDM at high optical frequency resolution

Photo 43683-1

Brief description

In recent years, progress in the research and development of ultra-high-speed optical transmission and high-density wavelength division multiplexing transmission (Dense WDM) has been enormous. These technologies are already in commercial use. The R&D requires the measurement of amplitude characteristics, dispersion, and group delay time of optical devices and optical subsystems at high optical frequency resolution.

Examples of devices for which such characteristics must be measured are AWG and Fibre Bragg Gratings filters, and dispersion compensator. Because dispersion characteristics in particular are an obstacle when optical transmission bit rate increases, dispersion values and the polarization mode dispersion (PMD) must be decreased or controlled.

The Q7760 optoscope is an optical network analyzer capable of measuring many characteristics of optical devices at high resolution and high speed in the optical carrier frequency domain. It can measure amplitude characteristics, dispersion and group delay time as phase-of-transmission characteristics and reflection characteristics. The Q7760 employs the phase-shift method of measurement to achieve both high optical frequency resolution and wide dynamic range.

Main features

- Comprehensive measurement of optical transfer characteristics in the optical carrier frequency domain
- Maximum optical frequency resolution: 50 MHz (wavelength of 0.4 pm)
- High-speed measurement: approx. 4 second (at 60 GHz sweep span)
- Measurement wavelength range: 1525 nm to 1635 nm

Measurement parameter	Reflection	Transmission
	Characteristics (S11)	Characteristics (S21)
Amplitude	Yes	Yes
Chromatic dispersion	Yes	Yes
Group delay time	Yes	Yes
PMD	No	Yes

Optical Network Analyzer Q7760

- Dynamic range of 40 dB
- Group delay measurement range with a maximum resolution of 0.1 ps, maximum measurement range is 25 ns
- Optical fiber length measurement

The Q7760 uses a tunable light source. By sweeping the wavelength (optical frequency), transmission and reflection characteristics (S21 and S11 in the S parameters) can be measured simultaneously in the optical carrier-frequency band. The Q7760 can measure the following parameters in a single sweep (see page 341).

Specifications

Measurement functions	
Sweep channels	2 channels (input reflection characteristics, forward transfer characteristics)
Reflection characteristics (S11)	Amplitude, group delay time, chromatic dispersion
Forward transfer characteristics (S22)	Amplitude, group delay time, chromatic dispersion
Optical signal source characteristics	
Measurement range	1525 nm to 1635 nm
Absolute wavelength accuracy	±0.025nm, ±2 ps with Q8326
Wavelength setting resolution	0.001nm
Sweep wavelength range	0.1 nm to 110 nm range (settable within the optical frequency range of 12.5 GHz to 8.75 THz)
Sweep frequency linearity	span X (±2.5%)
Sweep repeatability	span X (±0.3%) ±30 MHz or less
Sweep time	approx. 4 sec. (at setting wavelength span is less than 60 GHz)
Optical output power level	–14 dBm or more
Amplitude characteristics	
Scale	logarithmic table (0.2, 0.5, 1.0, 2.0, 5.0, 10.0 dB/div) and linear
Modulation frequency range	40 MHz to 3 GHz
Dynamic range	
Forward transfer characteristics	35 dB (40 dB typ.)
Input reflection characteristics	33 dB (38 dB typ.)
Linearity	
Relative level 0 to –25 dB	+0.10 dB
Relative level –25 to –30 dB	+0.25 dB
Polarization dependency	
Forward transfer characteristics	+0.05 dB (test port 2)
Input reflection characteristics	+0.10 dB (test port 1)
Repeatability at connector insertion	±0.1 dB
Group delay time characteristics	
Frequency modulation range (FM)	40 MHz to 3 GHz
Max. measurement range	
FM = 40 MHz	25 ns
FM = 3 GHz	333 ps
Group delay time resolution:	1.0 fs
Relative group delay time accuracy	Relative level (dB) / Accuracy: 0 dB to –15 dB: +0.2%/fm –15 dB to –20 dB: +0.4%/fm –20 dB to –25 dB: +1.0%/fm
Chromatic dispersion	
Measurement unit	wavelength range (ps/nm), optical frequency range (ps/GHz), displays in ps/nm x km, ps/GHz x km are also possible by entering the length of optical fiber under test
Polarization mode dispersion	
Measurement range	1 fs to 333 ps
Measurement resolution	1.0 fs
Fiber length measurement	0.2 m to 10,000 km
Processing functions	
Memory function	saves measurement data to memory and/or to a floppy disk
Display	optical frequency display, overlay, split screen, cursor function
Computing/analysis	averaging, smoothing, fitting functions
Optical input/output	
Optical connector type	FC type connector (standard), adapters to SC and ST type available as accessories
Interfaces	
Remote control	IEEE488-1978
Floppy disk drive	3½", MS-DOS format
Printer	D-SUB 25 pin ESC/P, ESC/P-R, PCL
Keyboard	conforms to IBM PC-AT
Monitor, external	D-SUB 15 pin (VGA)
General specifications	
Operating environment	
Ambient temperature	15°C to 35°C
Relative humidity	85% or less (no condensation)
Storage environment	
Ambient temperature	–10°C to 45°C
Relative humidity	90% or less (no condensation)
Power requirement	
Display unit	100 V to 120 V AC, 220 V to 240 V AC, 50/60 Hz, 300 VA or less
Optical network analyzer unit	100 V to 120 V AC, 220 V to 240 V AC, 50/60 Hz, 310 VA or less
Dimensions (W x H x D) approx.	
Display unit	424 mm x 220 mm x 400 mm
Optical network analyzer unit	424 mm x 220 mm x 500 mm
Weight	
Display unit	16 kg or less
Optical network analyzer unit	25 kg or less

Ordering information

Optical Network Analyzer	Q7760
Option	
PMD Measurement	15
Extra	
Optical/connector adapters	

Handheld Optical Power Meter TQ8210

400 nm to 1650 nm; versatile, handy optical power meter

Photo 43515

Brief description

TQ8210 (Advantest) is a versatile optical power meter. In conjunction with various optical sensors it covers a wavelength range from 400 nm to 1650 nm. Thanks to stringent calibration throughout, the power meter can be used in the entire wavelength range. Depending on the type of sensor, the optical power in optical fibers or in the light beam can be determined. An extremely flat sensor (Q82017A) facilitates measurements in tight spaces, e.g. of optical disks (CD, DVD).

The sensitivity is as good as –60 dBm even at 1550 nm. At low levels an averaging function with up to 20 average values ensures reliable measurement. The necessary zero adjustment is made automatically with the sensor darkened. A Max Hold function allows accurate power measurement even of test setups that are difficult to adjust and highly instable. An analog output is provided for recording the measurements.

Main features

- Continuous wavelength sensitivity compensation
- Backlit 4 ½-digit display
- Up to 13 hours of operation independent of AC power (built-in battery)
- Analog output

Operation

The instrument automatically identifies the sensor connected and recalls the appropriate correction values for the set wavelength, which remains indicated during the measurement. Backlighting of the display can be switched on for measurements in dark rooms.

Handheld Optical Power Meter Q8210

Specifications in brief

Basic unit	
Display	4 ½-digit LCD with selectable backlighting
Resolution	0.01 dB (measurement in dBm) 0.005 to 0.1 W (measurement in W)
Measurement rate	2 measurements/second
Measurement functions	power measurement, dBr (relative), Max Hold (for measurements in W)
Averaging	2 to 20 values, moving average value
Offset and zero adjustment	automatic upon keystroke
Analog output	0 to 2 V, impedance <10 Ω
Power supply	200 to 245 V (with AC adapter); built-in NiCd battery, max. 13 hours of operation (10 hours with LCD backlighting on)
Dimensions (W x H x D)	80 mm x 180 mm x 35 mm
Weight	400 g

Ordering information

Handheld Optical Power Meter		**Q8210**
Extras		
Optical Sensor		Q82014A TQ82015 Q82017A
Charging Adapter 200 to 245 V		A08019 (standard accessory)
Adapters for connectors		
Connector/Sensor	Q82014/15	Q82018A
FC/PC	A08012	A08081 (standard)
SC	A08090	A08082
ST	A08096	A08083
Biconical	A08025	—
D4	A08013	A08087
DIN	A08029	A08084
SMA (⅛")	A08028	—

Optical sensors

	Q82014A	TQ82015	Q82017A
Wavelength range	400 nm to 1100 nm	800 nm to 1600 nm	400 nm to 1100 nm
Field of application	measurement on optical fibers (adapter for connector to be ordered separately) or light beam	measurement on optical fibers (adapter for connector to be ordered separately) or light beam	light beam measurements also in very narrow spaces (e.g. in CD drives)
Sensor material	silicon	germanium	silicon
Power measurement range	–60 ±17 dBm, 1 nW to 50 mW	–40 ±10 dBm, 100 nW to 10 mW	–60 ±17 dBm, 1 nW to 50 mW
Photoreceptor area	approx. 8 mm dia.	approx. 5 mm dia.	approx. 10 mm x 10 mm square
Measurement ranges	8 ranges in 10 dB steps	5 ranges in 10 dB steps	8 ranges in 10 dB steps
Accuracy	±5% at 850 nm, –20 dBm	±5% at 1300 nm, –20 dBm	±5% at 850 nm, –20 dBm

Benchtop Optical Power Meter Q8221

400 nm to 1750 nm

Benchtop optical power meter of high measurement accuracy

Brief description

Optical Power Meter Q8221 (Advantest) provides two plug-in slots and can be fitted with five different optical sensors and one source. The optical sensors cover the wavelength range from 400 nm to 1750 nm and the power range from –93 dBm to +27 dBm. A continuous wavelength sensitivity compensation allows the sensors not only to be used at specific wavelengths, but throughout the specified range. Compensation is made automatically following selection of the wavelength by the user.

One LD is the source at 1550 nm. The high measurement accuracy and the extremely low polarization dependence make the Q8221 an ideal tool for demanding measurement tasks. A special adapter allows a return loss of at least 45 dB to be obtained even with PC polished FC connectors.

Thanks to its high speed of 20 measurements per second, Q8221 is suitable for a large variety of applications. Whether it is used as a two-channel power meter or as a combined power meter/source, its high measurement accuracy and source stability always ensure reliable measurement results.

Main features

- Two independent channels
- High measurement accuracy of 2.5% (with Q82208)
- Versatile measurement capabilities through various sensors and a plug-in light source
- Power Sensors Q82232/33 with extremely low polarization dependence

Specifications in brief (basic unit)

Basic unit	
Display	2 x 5 ½-digit
Resolution	0.001 dB (measurement in dBm)
Measurement rate	20 measurements/second
Measurement functions	power measurement in W and dBm, dBr (relative), etc
Averaging	2 to 256 values, moving average value
Offset and zero adjustment	automatic upon keystroke
Remote control	IEC 625 (IEEE 488)
Power supply	100 to 240 V, 48 to 66 Hz, 50 VA
Dimensions (W x H x D); weight	212 mm x 88 mm x 360 mm; 4 kg

Ordering information

Benchtop Optical Power Meter	Q8221

Benchtop Optical Power Meter Q8221

Optical sensors

Optical Sensor	**Q82214**	**Q82215**	**Q82216**	**Q82227**	**Q82208**	**Q82232**
Wavelength	400 to 1100 nm	800 to 1750 nm	800 to 1750 nm	800 to 1750 nm	800 to 1700 nm	900 to 1650 nm
Level	–80 to +17 dBm	–60 to +10 dBm	–77 to +10 dBm	–80 to +27 dBm	–94 to +10 dBm	–94 to +10 dBm
Sensor material	Si, 8 mm dia.	Ge, 8 mm dia.	Ge, 5 mm dia., cooled	InGaAs, cooled	InGaAs, cooled	InGaAs, cooled
Measurement accuracy (with pulsed light)	±3% (±4%) 780 nm, 0 dBm	±3% (±4%) 1300 nm, 0 dBm	±2.5% (±3.5%) 1300 nm, 0 dBm	±2.5% (±3.5%) 1550 nm, 0 dBm	±2.5% (±3.5%) 1300 nm, 0 dBm	±2.5% (±3.5%) 1550 nm, 0 dBm
Polarization	—	0.03 dB (pp) typ.	0.03 dB (pp) typ.	0.05 dB (pp) typ.	0.015 dB (pp) typ.	0.003 dB (pp)/ 0.005 dB (pp)
Adapter for connection of sensors (additionally required)	Q82202	Q82202	Q82202	Q82203	—	Q82203

Extra
19" Rack Adapter A02463

Adapters for connectors

	Q82202	**Q82202**	**Q82202**	**Q82203**	**–**	**Q82203**
FC	A08012	A08012	A08012	Standard	Standard	A08161
SC	A08090	A08090	A08090	—	—	A08161
ST	A08096	A08096	A08096	—	—	A08162
D4	A08013	A08013	A08013	—	—	A08163
SMA ⅛"	A08028	A08028	A08028	—	—	—
DIN	A08029	A08029	A08029	—	—	—
FC >45 dB ORL	—	—	—	A08328	A08328	—

Plug-in light source

Light source	**Q81212**
Type	FP-LD
Wavelength	1550 ±20 nm
Half-value width	10 nm
Level	0 ±1 dBm
Drift 1 h/8 h	0.05 dB/1 dB
Modulation	
Type of connector	FC

Optical Polarization Scrambler Q8163

High speed and precise polarization scrambler

Photo 43385-1

Brief description

A key performance factor in optical communication is the Polarization Dependant Loss (PDL) of the optical devices. The quality tends to deteriorate when PDL increases. The Q8163 is a high speed and precise polarization scrambler, which forms a measurement system together with an optical power meter that uses ultra-low PDL dependant power sensors.

The scrambler uses a polarization retaining fiber and a piezoelectric element instead of a conventional fiber loop method offering non-mechanically moving parts and therefore long durability as well as low influence of environment is warranted.

The so-called overall polarization measurement takes hundreds of different states of polarized light on the device, measures the optical power of the transmitted light and calculates the ratio between maximum and minimum values.

The power meter to recommend is the model Q8221 with the plug-in Q82203 and the power sensors Q82232 or Q82233.

When for example a PDL of 0.2 dBpp is measured a repeatable accuracy of 0.005 dBpp can be obtained for a measurement time of less than 1 sec.

Main features

- High-speed polarization variance
- Low insertion loss 3 dB and fluctuations ±0,005 dB
- High reliability

Specifications in brief

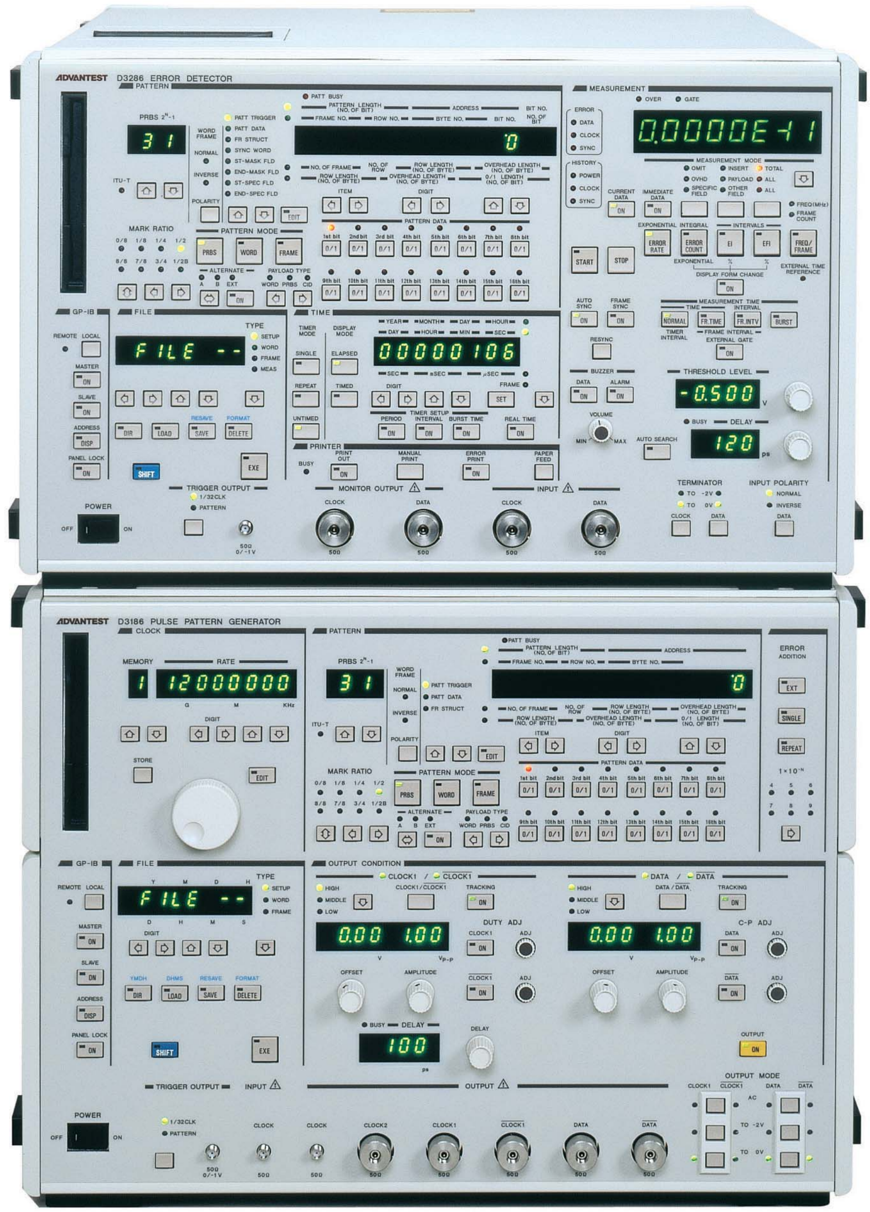
Wavelength range	1290 nm to 1580 nm
Insertion loss	< 3.0 dB
Insertion loss fluctuation	±0.005 dB
Return loss	<43 dB
Polarization variance speed	>500 rotations of the poincare sphere
Input/output connector	FC
Interface	GPIB

Ordering information

Optical Polarization Scrambler	Q8163
Extras	
Power meter	Q8221
Plug-in for Q8221	Q82203
Power sensors	Q82232 or Q82233

Bit Error Rate Tester D3186/D3286

Evaluation and analysis in high-speed digital communication and optical transmission network systems



Pattern Generator D3186 (bottom) and Error Rate Detector D3286 (top) (photo 43438-1)

Brief description

Pattern Generator D3186 and Error Rate Detector D3286 from Advantest are used for evaluation and analysis in high-speed digital communication and optical transmission network systems, e.g. SDH, SONET and ATM technology, as well as logic devices.

The system covers a broad frequency range of 150 Mbit/s to 12.5 Gbit/s with 1 kHz setting resolution, providing 9 types of pseudo random patterns, programmable word patterns and frame patterns. Complementary data outputs in binary code NRZ with a 10 mV setting resolution, minimal jitter and lowest rise and fall time waveform characteristics with phase delay settings of 1 ps step resolution are state-of-the-art features.

The clock source is either internal with a 0.15 GHz to 12.5 GHz generator optionally or external, using any microwave synthesizer. R&S signal generators SMP or SMR are available, controlled from the Pattern generator front panel.

The detector/receiver measures the bit error rate, error count, ES and EFS as well as frequency. Special attention was taken for the eye-opening and balance, measured with a sampling oscilloscope, due to retiming circuits, essential for the system quality, the equipment tolerances and the device phase margins. Auxiliary outputs for ¼ clock and data are available as standard.

Different modes like omit, insert, total and error addition give flexible evaluation tools. The instruments are equipped with an internal timer, GPIB, floppy disk drive and printer interface for error protocols.

Features

- Frequency range 150 Mbit/s /2 Gbit/s to 12.5 Gbit/s
- Generation of SDH/SONET frame pattern
- Pseudo random data as payload in the standard frame
- Excellent waveform quality and output impedance matching

Bit Error Rate Tester D3186/D3286

- Rise/fall time less than 30 ps, jitter less than 10 ps
- Burst data measurement effective in circulating loop tests
- Numerous outputs of clock and data signal
- 3 V output from the PPG for modulator testing
- Bit sequence masking
- Crosspoint and mark ratio adjustment
- Auto search function
- Monitor output for sampling scope
- Master/slave function, when using both instruments together and allowing pattern settings to be interlocked

Pulse Pattern Generator D3186

- Output impedance with good matching
- 3 V output for evaluation of modulators optionally
- Variable duty of the output waveform
- Generation of SDH/SONET frame pattern
- 8 Mbit word pattern, e.g. for generation of 6 STM-64 frames
- Multi-channel output: 2 data systems, 3 clock systems and 7 sub-rate systems
- Burst signal output
- Easy discovery of desirable patterns and error patterns
- Word pattern editor software

Bit Error Rate Detector D3286

- High input sensitivity
- SDH/SONET frame effective to evaluate the system synchronization
- Burst-data measurement effective to examine the circulating loop test is possible
- Masking function for bits
- Extra adjustment of the optimum timing and voltage at any mark ratio and even with word patterns
- Q factor measurement software

Applications

- Developing E/O and O/E modules:
  – Laser diodes, photo diodes, discrimination circuits, DC amplifiers, clock recovery circuits
- Optical devices
  – Laser diodes, photo diodes, connectors, fibers, fiber amplifiers
- High-speed logic IC
  – Multiplexers, demultiplexers, frequency dividers, logic boards
- Optical transmission systems
  – WDM and DWDM systems, repeaters, fiber amplifiers, FDDI, LANs, SDH/SONET transmission equipment

Specifications

Pulse Pattern Generator D3186

Frequency	
Internal clock (optional)	
Frequency range	150 MHz to 12 GHz (option 10) 2 GHz to 12 GHz (option 11) 150 MHz to 12.5 GHz (option 13)
Frequency setting resolution	1 kHz
Frequency stability	±10 ppm/year
Reference frequency output/input	10 MHz, 1.5 V V_{pp} min., AC-coupled, BNC
External Clock	
Frequency range	150 MHz to 12 GHz 150 MHz to 12.5 GHz (option 72)
Input level	0.7 V to 1.5 V V_{pp}
Patterns	
Pattern modes	selectable from the 3 choices below
Pseudo random pattern (PRBS)	option xx
Pattern length	2^N–1, N can be selected from among 7 choices: N=7, 9, 10, 11, 15, 23 or 31
Number of stages N and generating function	
Mark ratio	selectable from among 1/2, 1/4, 1/8, 0/8, 1/2B, 3/4, 7/8, or 8/8, patterns 1/2B, 3/4, 7/8 and 8/8 are logical inversions of patterns 1/2, 1/4, 1/8 and 0/8 respectively
Fully programmable pattern (WORD)	
Pattern length	1 to 8,388,608 (2^{23}) bits (ALTERNATE OFF) 1 to 4,194,304 (2^{22}) bits (ALTERNATE ON)
Logical inversion	possible
ALTERNATE mode	can be turned ON/OFF; when ON, switchable to either of 2 patterns, A or B
Switching control	internal, external switching possible
Frame pattern (FRAME)	option 70
Payload format	3 types below can be selected – fully programmable (WORD) – pseudo random (PRBS) – 0/1 continuous pattern + PRBS (CID)
Frame structure (when payload format is WORD or PRBS	
Number of frames	1 to 8,192 (ALTERNATE OFF) 1 to 4,096 (ALTERNATE ON), 1 frame steps
Number of lines in 1 frame	1 to 16 (1 line steps)
Number of bytes in 1 line	44 to 32,768
No. of overhead bytes in 1 line	4 to (number of bytes in 1 line –40 bytes), 4 byte steps
Error addition	
Error addition mode	repeat, single, external
Repeat	error ratio 1´10–N, N=4 to 9, bit error is added at a set interval
Single	1 bit error is added with every error addition command
External	1 bit error is added with every falling edge of an external error addition pulse input
Inputs	
External gate	inhibits data output, inhibits at LOW
Level	0 V/–1 V
Pulse width	at least 20 ns, or at least 64 x operating clock cycle, whichever is longer

Bit Error Rate Tester D 3186/D 3286

Connector, impedance	BNC, 50 Ω
External alternate	in ALTERNATE mode, switches between patterns A and B; pattern A at HIGH level, pattern B at LOW level
Level	0 V/–1 V
Connector, impedance	BNC, 50 Ω
External error addition	when pattern error addition is (EXT), 1 bit error is added for every falling edge of input pulse
Level	0 V/–1 V
Connector, impedance	BNC, 50 Ω
Outputs	
Data (DATA, $\overline{\text{DATA}}$)	2 patterns
Format, coupling	NRZ, DC
Amplitude range	
0.5 V to 2 V V_{pp}	10 mV steps (TO 0 V, AC)
0.6 V to 1 V V_{pp}	10 mV steps (TO –2 V)
0.5 V to 3 V V_{pp}	10 mV steps (TO 0 V), option 15
Offset range	
–2 V to +2 V	10 mV steps (TO 0 V)
–1 V to –0.6 V	10 mV steps (TO –2 V) (HIGH level reference)
Rise/fall time	30 ps max.
Load terminal conditions	selectable as either DC-coupled TO 0 V, TO –2 V or AC-coupled
Offset setting level	selectable HIGH, MIDDLE, LOW
Cross point variable	ON/OFF selectable
Connector, impedance	SMA (male), 50 Ω
Clock (CLOCK1, $\overline{\text{CLOCK1}}$)	2 patterns, complementary
Format, coupling	NRZ, DC
Amplitude range	
0.5 V to 2 V V_{pp}	10 mV steps (TO 0 V, AC)
0.6 V to 1 V V_{pp}	10 mV steps (TO –2 V)
Offset range	
–2 V to +2 V	10 mV steps (TO 0 V)
–1 V to –0.6 V	10 mV steps (TO –2 V) (HIGH level reference)
Rise/fall time	30 ps max.
Load terminal conditions	selectable as either DC-coupled TO 0 V, TO –2 V or AC-coupled
Offset setting level	selectable HIGH, MIDDLE, LOW
Crosspoint variable	ON/OFF selectable
Duty ratio variable	ON/OFF selectable
Variable delay range	±400 ps, 1 ps steps (CLOCK2 output reference)
Connector, impedance	SMA (male), 50 Ω
Clock (CLOCK2)	1 pattern
Format	NRZ
Coupling	AC (built-in DC blocking condenser)
Amplitude	approx. 1 V V_{pp} fixed
Offset	0 V ± 0.1 V fixed (MIDDLE level reference)
Waveform	rectangular
Rise/fall time	30 ps max
Connector, impedance	SMA (male), 50 Ω
Trigger signal	selectable as either clock synchronization or pattern synchronization
Clock synchronization (1/32 CLK)	clock frequency 1/32 divided output
Pattern synchronization (PATTERN)	varies output position to any position in 16 bit units
Level	HIGH 0 V ±0.2 V, LOW –1 V ±0.2 V
Connector, impedance	SMA (male), 50 Ω
1/2 clock	
Format, coupling	NRZ, DC
Level	HIGH 0 V ±0.2 V, LOW –1 V ±0.2 V
Connector, impedance	SMA (male), 50 Ω
1/4 rate output	
Bit rate	¼ operating clock frequency
Number of pattern outputs	4 patterns
Number of clock outputs	1 pattern
Skew	±150 ps max.
Level	HIGH 0 V ±0.25 V, LOW –1 V ±0.25 V
Connector, impedance	SMA (male), 50 Ω
System functions	
External clock generator control	when external clock generator (SG) is used, frequency and output level are controlled from D3186
Calendar/clock	selected as either year/month/day/hour or day/hour/minute/second
Storage	built-in floppy disk drive
Functions	Save, re-save, read in, erase, initialize
Data	Operating conditions, pattern settings

Error Rate Detector D3286

Frequency range	150 MHz to 12 GHz 150 MHz to 12,5 GHz (option 72)
Patterns	same as D3186 Pulse Pattern Generator
Reference measuring functions	simultaneous measurement of 6 functions, 1 function selectable for display Error rate measurement Error count measurement Error interval (EI) measurement Error-free interval (EFI) measurement Frequency measurement
Frame count measurement	can only be done when the pattern mode is FRAME, payload format is WORD or PRBS and measuring time mode is FRAME
TIME	FRAME TIME or FRAME
INTERVAL	FRAME INTERVAL
Error measurement mode	groups selectable, within each group 3 types of measurements can be done simultaneously, one type is displayed
Omission/insertion group	
OMISSION	logical data value at input is '0', when '1' is expected
INSERTION	logical data value at input is '1' when '0' is expected
TOTAL	sum of OMISSION and INSERTION type errors (all errors)
Overhead/payload group	only selectable when pattern mode is FRAME
OVERHEAD	errors in overhead part
PAYLOAD	errors in payload part
ALL	sum of errors in overhead part and payload part (all frame errors)
Inputs	
Data	
Format, coupling	NRZ, DC
Polarity	logical inversion possible
level	0.1 V to 2 V V_{pp}
Threshold level	
Setting range	setting resolution
–2.040 V to + 2.040 V	0.001 V steps (0 V terminal voltage)
–1.850 V to –0.750 V	0.001 V steps (–2 V terminal voltage)
Terminal voltage	–2 V/0 V (GND)
Connector, impedance	SMA (male), 50 Ω
Clock	sine or rectangular
Format	DC termination, AC coupling
Duty ratio	50% ±5%
Polarity	identified at rise edge
Variable delay	±400 ps 1 ps steps (at monitor output)
Level	0.5 V to 2 V V_{pp}
Terminal voltage	–2 V/0 V (GND)

Bit Error Rate Tester D 3186/D 3286

Connector, impedance	SMA (male), 50 Ω
Auto search function	automatically finds optimum values for data input threshold level and clock input delay
Trigger	selectable as either clock synchronization or pattern synchronization
Clock synchronization (1/32 CLK)	clock frequency 1/32 divided output
Pattern synchronization (PATTERN)	varies output position to any position in 16 bit units
Level	HIGH 0 V ±0.2 V, LOW –1 V ±0.2 V
Connector, impedance	SMA (male), 50 Ω
External gate	controls measurement start/stop
Level	0 V/–1 V
Connector, impedance	BNC (female), 50 Ω
External alternate	switches between patterns A and B in alternate mode; pattern A at HIGH level, pattern B at LOW level
Level	0 V/–1 V
Connector, impedance	BNC (female), 50 Ω

Outputs

Monitor	
Data monitor	data input through amplifier
Connector, impedance	SMA (male), 50 Ω
Clock	clock input through amplifier and variable delay line
Connector, impedance	SMA (male), 50 Ω
Error	
Rate	1/32 clock input
Signal form	32 phase logical sum
Code	RZ
Level	HIGH –0.0 ± 0.3 V, LOW –1.0 ± 0.3 V
Connector, impedance	SMA (female), 50 Ω
Stretched	
Level	TTL positive pulse
Pulse width	approx. 100 ns
Connector, impedance	SMA (female), 50 Ω

Measuring time modes

NORMAL	sets measurement interval in second units, measurement period in day/hour/minute/second units
FRAME TIME	only selectable when pattern mode is FRAME
Measuring interval	set in number of frame units
Measuring period	set in day/hour/minute/second units
FRAME INTERVAL	only selectable when pattern mode is FRAME
Measuring interval	set in number of frame units
Measuring period	set in number of measuring interval units
BURST	each time pattern synchronization is established during period from measuring start to measuring end, only area set by burst timer is measured

Synchronization

Mask function	can only be selected when pattern mode is WORD or FRAME; synchronization and measurement are done ignoring errors in the specified mask field
Pattern	
Auto synchronization	ON/OFF selectable, when ON, resynchronization is done automatically when error rate is equal to or greater than prescribed value
Frame	can be turned ON or OFF when pattern mode is FRAME or WORD; OFF during PRBS, when ON, specified hunting pattern is searched and high speed pattern synchronization is done
Re-synchronization	command via front panel keys or GPIB

Measurement conditions display lamps

GATE	during measurement.
OVER	measurement results overflow
Error alarm	
DATA error	1 or more bit error is detected, off when error is no longer detected
CLOCK error	input clock fails or frequency is too low, off when normal clock is input
SYNC error	pattern synchronization error, off when pattern synchronization is established

Timer/clock display

ELAPSED	elapsed time since start of measurement
TIMED	remaining time to end of measurement
PERIOD	displays or sets measuring period from start of measurement until end
INTERVAL	displays or sets measuring cycle
BURST TIME	displays or sets measuring time per signal burst when measuring time mode is BURST
REAL TIME	displays or sets real time as year/month/day/hour or day/hour/minute/second

System functions

Printer	measurement results, switchable between built-in and external
Interface	Centronics
Storage	measurement results as text format

General data

Master/slave	when used together with D3186 and D3286 respectively, allows pattern settings to be interlocked
Panel lock	possible
Remote control	GPIB (IEEE 488-1978)
Numerical value display	green 7-segment LED display
Set conditions memory	after power has been ON for 12 hours, retained at least 2 weeks (backed up by secondary battery)
Operating temperature range	0 °C to +40 °C
Storage temperature range	–20 °C to +70 °C
Power supply (D 3286)	AC 100 V to 120 V, AC 220 V to 240 V (automatic switchover) 48 to 63 Hz, sine wave, 550 (500) VA max.
Dimensions (W x H x D) (D 3286)	424 mm x 266 (310) mm x 550 mm
Weight	32 kg max.

Ordering information

Pulse Pattern Generator	D3186
Error Rate Detector	D3286

Options

Internal clock 150 MHz to 12 GHz	10
Internal clock 150 MHz to 12,5 GHz	13
3 V output	15
Frame format	70
12,5 Gbit/s extension	72

Transmission Analyzer D 3371

10 MHz to 3.6 GHz

Compact integration of a pulse pattern generator and bit error detector, a versatile tool for testing modern high-speed components

New

Photo 43899

Brief description

The versatile Transmission Analyzer D 3371 can be used from 10 MHz through 3.6 GHz, covering all data rates required for the SONET/SDH, Fiber Channel and Gigabit Ethernet technologies. The analyzer can also generate various pseudo random patterns and user-defined test patterns to allow a very realistic line traffic simulation. It thus covers an ample scope of flexible requirements from development to production and routine maintenance.

Main features

Outstanding quality of the output signal:

- Maximum 3 V (V_{pp}), wide amplitude output range from low-amplitude applications to direct laser diode modulation and EA modulators
- Generation of different test patterns
  - Pseudo random patterns
  - Programmable patterns
  - Zero substitution patterns
  - STM (SONET/SDH) frame patterns
  - Flexible patterns
- Significantly enhanced bit error measurement functions
  - Error rate measurement
  - Error count measurement
  - Error interval (EI) measurement
  - Error-free interval (EFI) measurement
  - Frequency measurement
  - Error performance measurement
- Generation of burst pattern signals
- Highly accurate internal synthesizer clock generator (10 MHz to 3.6 GHz)
- Automatic search function
- GPIB remote control
- 10Base-T Ethernet interface
- Interactive GUI with large colour display, touch panel
- Windows application software: software free of charge without warranty for various functions
  - 8B/10B Code Editor Software for Gigabit Ethernet pattern generation
  - Pattern Editor/Converter Software for easy data generation
  - Q-Factor measurement, Eye-Margin measurement and BER (bit error rate) diagram measurement software
- Module options
  - Option 10: Pulse Pattern Generator (2 V (V_{pp}) output)
  - Option 11: Pulse Pattern Generator (3 V (V_{pp}) output)
  - Option 12: Error Detector
  - Option 13: 3.6 GHz Synthesizer
- Optional measurement functions
  - Option 70: Jitter Tolerance
  - Option 71: Flexible Pattern
  - Option 72: Error Phase Analysis

Pulse Pattern Generator (Option 10: 2 V (V_{pp}) output, Option 11: 3 V (V_{pp}) output)

Pulse Pattern Generator: ideal for the analysis of device and module characteristics

The Pulse Pattern Generator is characterized by a high-quality waveform with flexible amplitude, offset and crosspoint for data and clock. User-defined patterns, pseudo random patterns (27-1 to 231-1, with adjustable mark-to-space ratio) and user-definable zero substitution patterns are provided for this purpose.

Transmission Analyzer D 3371

Wide amplitude output range
The Pulse Pattern Generator has a wide amplitude output range up to 3 V (V_{pp}) (Option 11), making it particularly suitable for applications from low to high input levels such as EA modulators.

Error Detector (OPTION 12)

BER function: automatic setting of the receiving device by means of the auto search function
The auto search function allows automatic setting of the pseudo random patterns, the input data threshold voltage and the input clock phase in order to achieve the values that are ideal for the measurement. The measurements can be performed at a high error rate (approx. 10-2) by optionally setting the synchronization threshold value. The use of patterns from the D 3371 pulse pattern generator allows bit error measurements with burst data that are required for the fiber-optic loop-back test. The measurement result logs can also be saved in the form of a text file.

3.6 GHz Synthesizer (OPTION 13)

The analyzer can be equipped with the synthesizer (10 MHz to 3.6 GHz) in order to internally achieve high-frequency resolution, high accuracy and reduced SSB phase noise of the clock generator.

Jitter Tolerance (OPTION 70)

Jitter tolerance measurement
By means of phase modulation on the test signal, the D 3371 can simulate jitter; different jitter frequencies and amplitudes are possible. Different test points referring to the defined clock frequency are recorded.

Graphics display of automatic jitter tolerance measurement
Once the measurement conditions are defined, jitter tolerance is measured automatically. The result is displayed graphically and in tabular form.

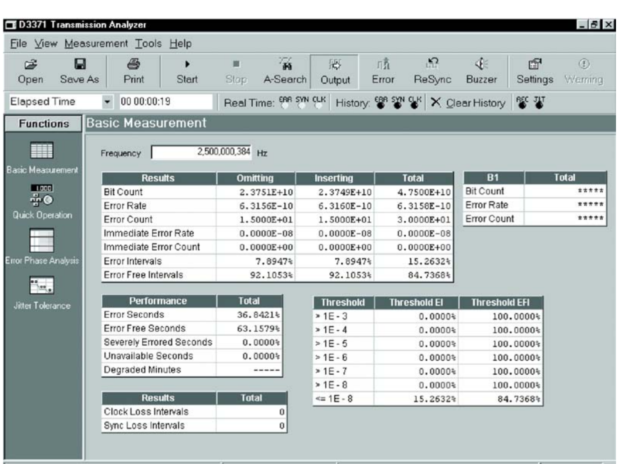
In the search mode, the analyzer automatically detects the jitter frequency/amplitude combinations where the initial bit errors occur. In some applications, a simple PASS/FAIL display is sufficient, which is output in the fast sweep mode.

Pattern Option (OPTION 71)

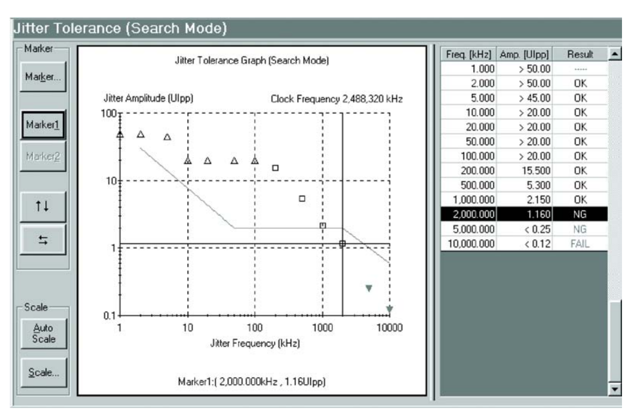
STM (SONET/SDH), flexible pattern function
The Pattern Option can generate typical SONET/SDH frame structures as well as user-definable pattern structures.

In the case of the STM (SONET/SDH) editor, the frame structure is in accordance with ITU-T G.707. Programmable or pseudo random patterns can be selected as a payload. B1 insertion and scrambling can also be set to ITU-T G.707.

The errors occurring in the overhead, payload and B1 byte can be evaluated separately.



Example display: basic measurement results



Example display: search mode measurement

Transmission Analyzer D3371

The FLEX editor is used to combine programmable and pseudo random patterns of different lengths with the aid of a pattern table. This function allows the simple simulation of packet-like header/payload structures with flexible pattern lengths, typical of IP. The Pattern Option is particularly useful in combination with the Error Phase Analysis (Option 72), which allows the location of bits in error.

Error Phase Analysis (OPTION 72)

Error Phase Analysis function
The Error Phase Analysis continuously records the bit errors during the bit error measurement and displays their locations. The reasons for the bit errors are thus easier to detect, and the error source can be effectively pinpointed.

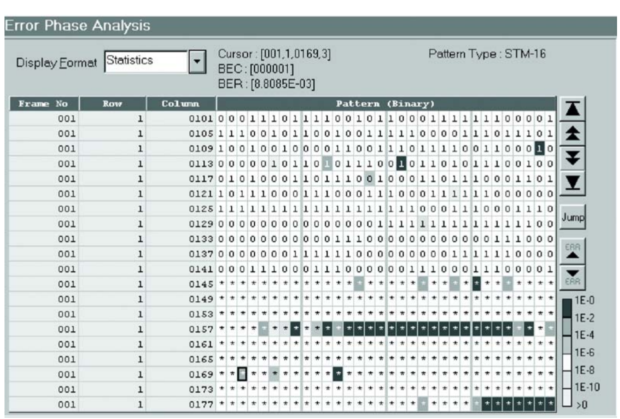
The result of an error phase analysis can be displayed as a time sequence or in statistical form.

Wide variety of Windows application software

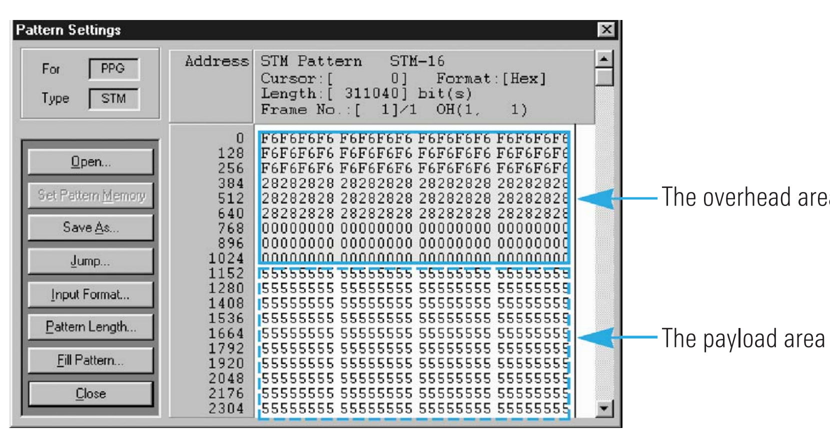
8B/10B Code Editor function for Gigabit Ethernet
By using the 8B/10B Code Editor function, user-defined 8-bit patterns can be converted automatically into 10-bit patterns. The 8-bit and 10-bit patterns generated can be used both with the pulse pattern generation and the error detector function. This simulation of the line coding simplifies the testing of devices, modules and communication systems for Gigabit Ethernet.

Pattern Editor Function
Although all patterns can be generated and edited directly in the D3371, it is easier and more convenient to use an external pattern editor software package on a separate PC.

Q-Factor measurement, Eye-Margin measurement and BER diagram measurement functions
If the D3371 is connected to a Windows PC via an IEC/IEEE bus, Q-Factor, Eye-Margin and BER diagram measurements can be performed. The software graphically displays different bit error rates as a function of parameters such as the phase and threshold voltage and calculates characteristic values such as Q-Factor. The results provide useful information such as phase or voltage reserves.



Example display: Error Phase Analysis (statistical display)



Example of STM (SONET/SDH) pattern generation

Transmission Analyzer D 3371

Specifications in brief

System function	
Operating software	Windows 98 Second Edition
Main memory	128 MB
Display	10.4" TFT colour display with keypad functions, 800 x 600 pixels, back-lit 3.5" disk drive in two operating modes (720 KB/1.44 MB)
Hard disk	3.5" (6 GB or more)
Operating	panel keys and keypad
Remote control	IEC/IEEE bus in accordance with IEEE 488.2
Accuracy of reference frequency	±10 ppm
Input/output	
Parallel interface	Sub-D, 25-pin
USB interface	type A, 2 channels for keyboard and mouse
Ethernet interface	10 Base-T
Remote control	IEC/IEEE-625 bus

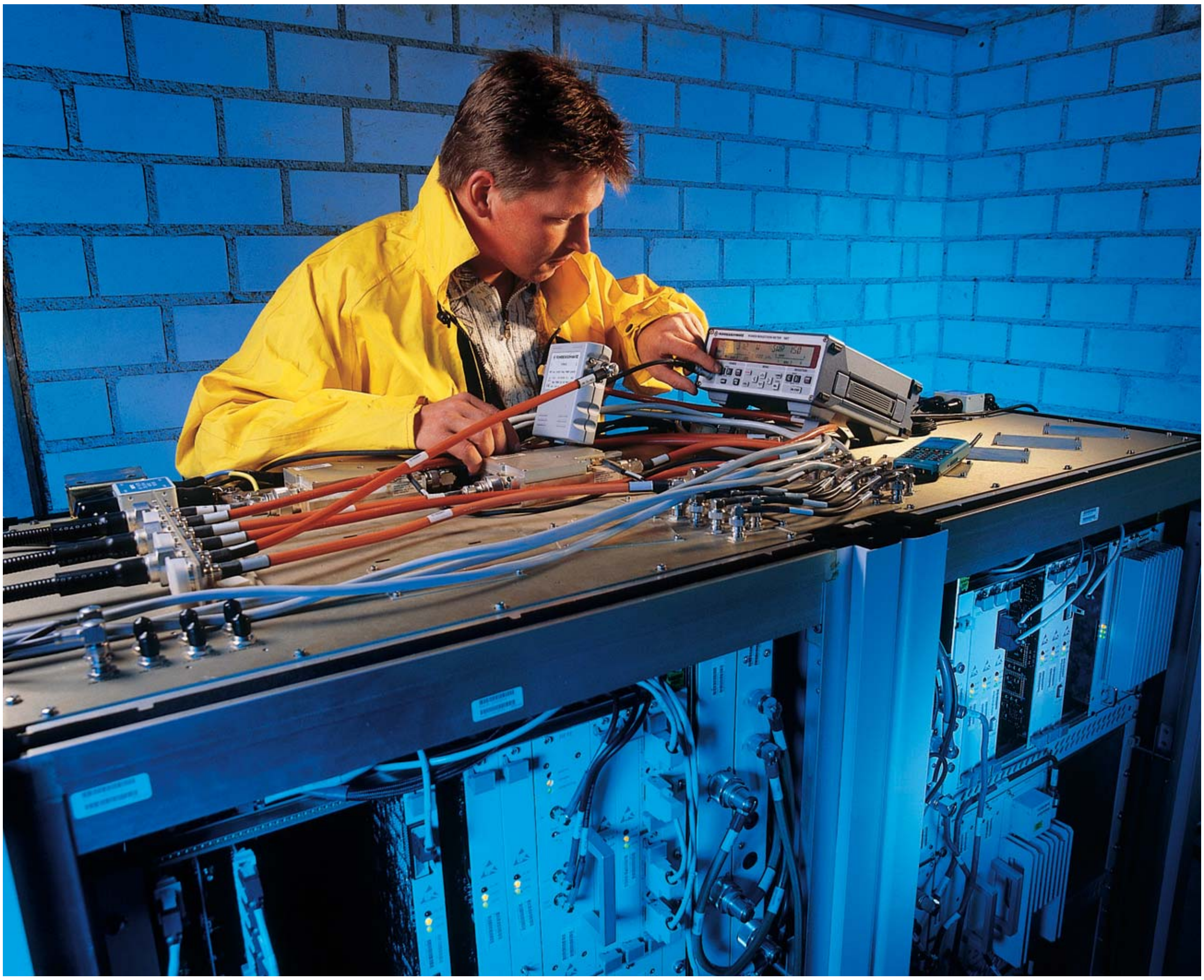
General data

Operating temperature range	+5 °C to +40 °C
Relative humidity	40% to 85% (without condensation)
Storage temperature range	–20 °C to +70 °C
AC input power source	100 V and 200 V AC systems are switched automatically 100 V AC system operation 200 V AC system operation; 50/60 Hz
Power supply (AC)	100 V to 120 V/220 V to 240 V, 50/60 Hz, max. 160 VA, automatic switchover of voltage ranges
Weight	max. 21 kg (module, accessories, etc, not included)
Dimension (W x H x D)	approx. 424 mm x 221 mm x 500 mm

Ordering information

Transmission Analyzer	D 3371

Contents of Chapter 8



Installing a mobile radio base station with R&S R&S NRT (photo 42667)

Contents of Chapter 8

Power Meter R&S NRP

With R&S *SMART SENSOR TECHNOLOGY*^{TM} – ready for a wide variety of applications

New

Photo 43877-6

Brief description

The microwave Power Meter R&S NRP is always the right choice: It is ideal for use in research and development, production, the lab or mobile service, not to mention when measuring CW signals or analyzing broadband modulation signals of third-generation mobile radio. The versatility of the R&S NRP power meter series is primarily due to the sensors. These sensors are intelligent standalone instruments that communicate with the basic unit or a PC via a digital interface.

Top measurement accuracy plus a dynamic range of 90 dB for broadband signals of any modulation are the most important characteristics of the Power Meter R&S NRP. The versatile sensors in R&S *SMART SENSOR TECHNOLOGY*^{TM} are a priceless investment if you wish to meet future requirements such as the broadband modulation types of third-generation mobile radio. In addition, the R&S NRP is also suitable of handling the RF bandwidths beyond 100 MHz that are already under discussion for wireless LAN.

Universal basic unit

The R&S NRP is small, lightweight and rugged, and the optional battery pack ensures several hours of operation without line power. Depending on requirements, it can be fitted with one, two or four measurement inputs. The IEEE/IEC bus connector is a standard feature as are the trigger input and the analog measurement output.

The user interface of the power meter takes its cue from the PC world: The basic unit is controlled via menu bars, menus and dialog boxes, and uses only three menu levels despite the large number of functions.

The high-resolution graphical display can show as many as four measurement results at the same time. The user can choose which results to display – either the data from the sensors (with a maximum of four connected simultaneously) or from different timeslots of a TDMA signal measured by means of one sensor. Even values obtained by calculation, such as SWR or return loss, can be displayed. For immediate clarity, each data window can be assigned a specific name.

Main features

- Innovative multipath sensor technology
- 90 dB dynamic range
- High measurement accuracy and speed
- One sensor for almost all applications
- Intelligent sensors – simply plug in and measure
- CW and broadband modulated signals
- Accurate measurement of average power regardless of bandwidth and modulation
- Multislot measurements for common time division systems (e.g. GSM/EDGE, DECT)
- Handling of external components through Γ and s-parameter correction
- Simultaneous operation of up to 4 sensors on basic unit
- Operation of sensor directly from PCs via USB interface
- 2-year calibration cycle

Power Meter R&S NRP

High system accuracy

Precise calibration

The accuracy of a microwave power measurement essentially depends on the characteristics of the sensor. The deviation of each manufactured sensor from the ideal characteristic is measured and then the value is stored in the sensor as a data record.

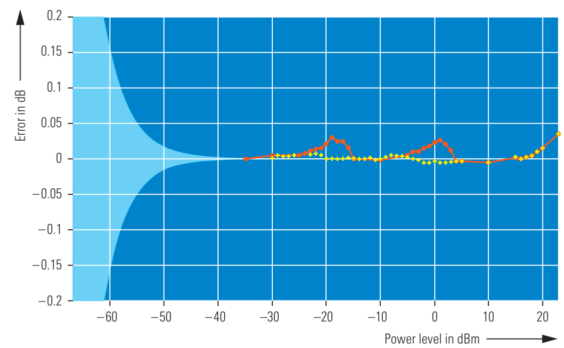
A power sensor can only be as good as the measuring instruments used to calibrate it. This is why the standards employed by Rohde & Schwarz are directly traceable to the power standards of the German Standards Laboratory (PTB).

High measurement accuracy – even with modulated signals

The concept of R&S *SMART SENSOR TECHNOLOGY*™ comprises an entire series of measures intended to make the sensors similar to thermal sensors in behaviour. This includes very accurate measurement of average power, regardless of modulation, as well as high immunity to incorrect weighting of harmonics, spurious and other interference signals.

Multiple-path and multiple-diode technology

The Power Sensors R&S NRP-Z11 and R&S NRP-Z21 fuse multiple-path architecture, multiple-diode technology and a simultaneously scanning multichannel measurement system into a unique high-performance concept. Multiple-path architecture is the combination of two or three diode detectors to obtain a large dynamic range for modulated signals. This is achieved by operating each detector exclusively in the square-law region and by using only the optimally driven detectors for the measurement.



Modulation-related errors of an R&S NRP-Z11 or R&S NRP-Z21 power sensor for a 3GPP test signal (test model 1-64) compared to a CW signal of the same magnitude. Red: default setting; yellow: transition area between measurement paths shifted by –6 dB; light blue: uncertainty caused by noise (modulation effect below –30 dBm negligible)

Γ correction

The most important source of error in power measurements on RF and microwave signals is the mismatch of source and sensor. To minimize the influence of mismatched sources, the standing wave ratio (SWR) at the sensor end was reduced to the extent technically feasible (1.13). A signal source with an SWR of 2, for example, only leads to an additional uncertainty of the measurement result of ±4% (0.17 dB), that will be further reduced by means of Γ correction. Then the complex reflection coefficient of the source is transmitted to the sensor via the USB data interface, and the sensor corrects the matching error by means of Γ correction, taking into consideration its own low impedance mismatch.

S-parameter correction

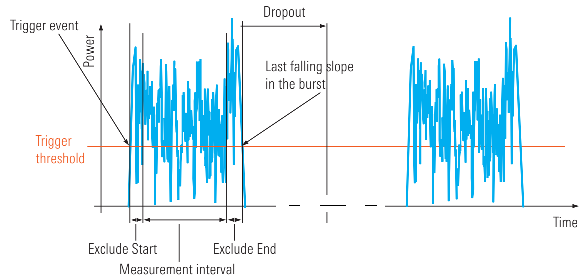
Especially in production facilities, the sensor is not direct connected with the source but via preceded attenuators or directional couplers.

With the help of a software tool, the complete s-parameter data set of the twoport connected ahead can be loaded into the sensor's memory via the USB data interface. The data format required (s2p/Touchstone) is provided by any vector network analyzer. After the source's complex reflection coefficient has been transmitted (optionally), a perfectly corrected reading is obtained

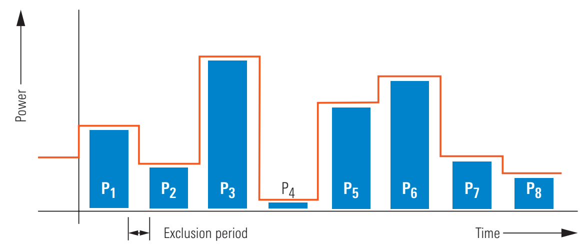
Dynamic ranges
(Bandwidth of test signal 100 MHz/5 MHz/0 (CW))

Technology	Mode/Signal type			
	Continuous	Timeslot 1 out of 8 (external trigger)	Burst duty cycle 1:8 (internal trigger)	Power versus Time 256 points (external trigger)
Thermoelectric sensor	50/50/50 dB	–	–	
Diode: Sensor in square-law region	43/43/50 dB	–	–	
CW sensor	43/43/90 dB	–	–	
Peak sensor	33/50/80 dB	–/50/57 dB	–/33/37 dB	–/50/57 dB
Multiple-path sensor	80/80/80 dB	–	–	
R&S *SMART SENSOR TECHNOLOGY*™	90/90/90 dB	85/85/85 dB	60/60/60 dB	70/70/70 dB

Power Meter R&S NRP



Modulated burst of an EDGE signal and corresponding settings for DROP OUT, HOLDOFF, EXCLUDE START and EXCLUDE END



Multislot measurement: for the most common time division methods (e.g. GSM/ EDGE, DECT), average power can be measured in all timeslots at the same time

High throughput in production

Autofilter function

As a rule, noise is superimposed on the signal to be measured. The relative noise content increases as power decreases. To obtain a low-noise display, a large averaging factor has to be selected for low signal levels, but such a factor increases the measurement time. Therefore a compromise must be made between sufficient signal/noise ratio and acceptable measurement time.

In addition to the Normal Mode of the auto filter, the Fixed Noise Mode is available. Therefore the relative noise content and the maximum measurement time can be defined, thus allowing the compromise between S/N ratio and measurement time to be optimized for the individual application. The user determines the limits, and the R&S NRP automatically selects the correct filter. Consequently, the instrument provides stable measurement results in the shortest possible time.

Fast measurement range selection

Multipath concepts for diode sensors often have the disadvantage of hard switching from path A to path B in the case of level changes, which also interrupts measurement data acquisition. This disadvantage has been eliminated in the R&S NRP diode sensors owing to parallel signal processing in the three paths and soft switching from one path to the other.

Measurement speed

All these requirements must be met before a power meter can make full use of its measurement speed. And the R&S NRP with its 1500 measurements per second (in buffered mode, measurement interval 2 x 100 µs) is a real champion.

Windowing

For measurements on very low-frequency-modulated signals typically large averaging factors must be used with other power meters to keep the display stable. This, however, extends the measurement time. The R&S NRP can be adapted to the signal period by means of windowing. The use of an integer multiple of the period yields a perfectly stabilized measurement result.

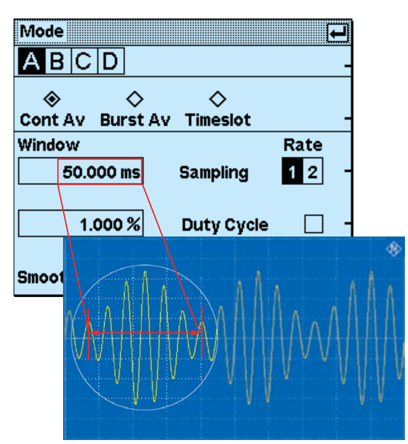
Signal-synchronized measurements

The R&S NRP-Z11 and R&S NRP-Z21 sensors can measure the average power not only in the classic manner, i.e. continuously without temporal reference to the signal content, but also synchronized with the signal over definable periods of time. A fundamental prerequisite is the availability of extensive trigger capabilities. The Power Meter R&S NRP can derive the trigger time from the test signal (internal triggering) and also perform measurements that are controlled by an external trigger signal. Further trigger parameters are available (trigger level, hold-off, drop-out).

Use on a PC

The sensors of the R&S NRP-Z series can be used as standalone measuring instruments even without the basic unit. In addition to the power sensor itself, they include a CPU that controls the sensor, processes the measurement results and operates the interface. All measurement data and settings are transmitted via a digital USB interface.

The main area of application is production, since production environments usually include a process controller.

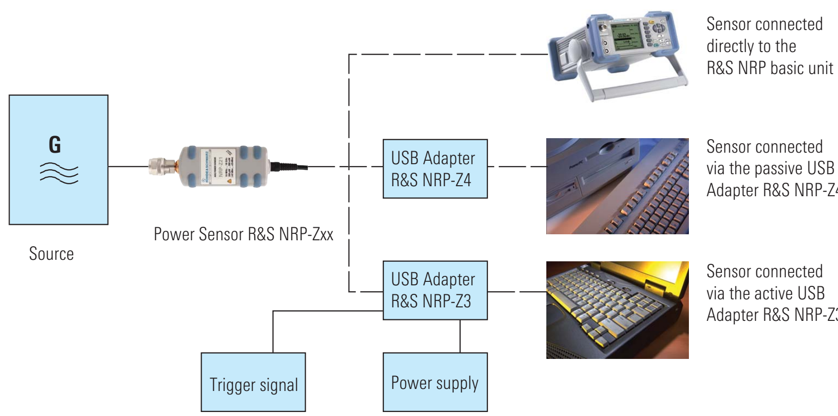


Windowing technique used on a low-frequency modulated AM signal

Power Meter R&S NRP

Service technicians will also appreciate this option since the power meter fits into a trouser pocket and can easily be operated from a laptop.

The software toolkit supplied as standard is required in order to control the R&S NRP power sensors via a PC. The software toolkit comes with both a DLL (dynamic link library), for individualized use of the entire sensor functionality under Windows, and the *Power Viewer*, a virtual power meter with basic measurement functions for the PC workstation.



Three ways of displaying results with an R&S NRP sensor

Two adapters are available for connection to the hardware

- The passive USB Adapter R&S NRP-Z4 provides all basic functions, as it handles the transmission of settings and measurement data as well as the power supply of the sensor.
- The active USB Adapter R&S NRP-Z3 has been developed for applications requiring external triggering of the power sensor. It also offers a separate power supply.

Specifications in brief

Specs are given only in a condensed form; for full and binding specs please refer to the NRP data sheet PD 0757.7023.21.

Power Sensors R&S NRP-Z11/-Z21 (specifications from 8 GHz to 18 GHz apply only to R&S NRP-Z21)

Sensor type	3-path diode sensor
Measurand	average power of incident wave or average power of source into 50 Ω (Γ correction activated)
Frequency range	10 MHz to 8 GHz (R&S NRP-Z11) 10 MHz to 18 GHz (R&S NRP-Z21)
Matching (SWR)	values in () for temperature range 15 °C to 35 °C
10 MHz to <30 MHz	<1.15 (1.13)
30 MHz to 2.4 GHz	<1.13 (1.11)
>2.4 GHz to 8.0 GHz	<1.20 (1.18)
>8.0 GHz to 18.0 GHz	<1.25 (1.23)
RF connector	N (male)
Power measurement range	
Continuous Average	200 pW to 200 mW (–67 to +23 dBm)
Burst Average	650 pW to 200 mW (–62 to +23 dBm)
Timeslot	650 pW to 200 mW (–62 to +23 dBm)
Scope (available as of December 2002)	10 nW to 200 mW (–50 to +23 dBm)
Max. power	
Average	0.4 W (+26 dBm) continuous
Peak envelope power	1.0 W (+30 dBm) for max. 10 μs
Measurement subranges	
Path 1	–67 dBm to –14 dBm
Path 2	–47 dBm to + 6 dBm
Path 3	–27 dBm to +23 dBm
Transition ranges	
With automatic path selection	(–19 ±1) dBm to (–13 ±1) dBm
User def'd crossover set to 0 dB	(+1 ±1) dBm to (+7 ±1) dBm
Measurement functions	
Stationary and periodically modulated signals	Continuous Average, Burst Average, Timeslot, Scope
Non-recurring waveforms	Scope
Continuous Average function	
Continuous measurement of average power	
Measurement window	2 x (10 μs to 300 ms)
Duty cycle correction	0.01% to 100.00%
Smoothing	see under Measurement window
Burst Average function	
Measurement of average burst power with automatic detection of burst (trigger settings required)	
Detectable burst width	20 μs to 100 ms
Dropout tolerance	
Excluding periods	(0 to 3) ms
Exclude from Start	(0 to 100) ms
Exclude from Stop	(0 to 3) ms
Measurement window	2 x (burst width – Excl. from Start – Excl. from Stop)

Power Meter R&S NRP

Timeslot function

Measurement of average power in one or more equidistant, successive timeslots

Duration (nominal width)	10 µs to 100 ms
Number of timeslots	1 to 128 (26 in case of operation from R&S NRP basic unit)
Excluding periods	
Exclude from Start	(0 to 100) ms
Exclude from Stop	(0 to 3) ms
Measurement window (per timeslot)	2 x (nom. width – Excl. from Start – Excl. from Stop)

Scope function

Measurement of power versus time	recurring and non-recurring waveforms
Measurement window Δ	
Recurring	2 x (100 µs to 300 ms)
Non-recurring	100 µs to 300 ms
Number of measurement points M	1 to 1024
Resolution Δ/M	≥10 µs
Beginning of measurement window (referenced to trigger)	–5 ms to 100 s

Dynamic behaviour of video path	values in (): 15°C to 35°C
Bandwidth	>50 kHz (100 kHz)
Rise time 10%/90%	<8 µs (4 µs)

Sampling frequencies

Frequency 1 (default)	133.358 kHz
Frequency 2	119.467 kHz

Display noise		values in []: 8 GHz to 18 GHz
15°C to 35°C	Path 1	<60 pW [64 pW] (40 pW typ.)
	Path 2	<5.6 nW [6.0 nW] (3.6 nW typ.)
	Path 3	<0.56 µW [0.60 µW] (0.36 µW typ.)

Display noise, relative

Measurement window 2 x 100 µs, without averaging	<0.160 dB (0.1 dB typ.)
Measurement window 2 x 20 ms, averaging factor 32 (measurement time approx. 1 s)	<0.002 dB (0.001 dB typ.)

Zero offset		values in []: 8 GHz to 18 GHz
15°C to 35°C	Path 1	<96 pW [102 pW] (64 pW typ.)
	Path 2	<9.0 nW [9.6 nW] (5.8 nW typ.)
	Path 3	<0.90 µW [0.96 µW] (0.58 µW typ.)

Zero drift	values in []: 8 GHz to 18 GHz
Path 1	<35 pW [37 pW]
Path 2	<3.0 nW [3.2 nW]
Path 3	<0.30 µW [0.32 µW]

Measurement error due to harmonics $n \times f_0$ of carrier frequency

Values in []: typ. standard uncertainty

n = 3, 5, 7, ...	–30 dBc	<0.003 dB [0.0015 dB]
	–20 dBc	<0.010 dB [0.005 dB]
	–10 dBc	<0.040 dB [0.015 dB]
n = 2, 4, 6, ...	–30 dBc	<0.001 dB [0.0003 dB]
	–20 dBc	<0.002 dB [0.001 dB]
	–10 dBc	<0.010 dB [0.003 dB]

Modulation influence	values in []: User def'd crossover <–6 dB

Measurement errors in subranges are proportional to power and depend on CCDF and modulation bandwidth of test signal

WCDMA (3-GPP Test Model 1-64)	
Worst case	–0.02 to +0.07 dB [–0.02 to +0.02 dB]
Typical	–0.01 to +0.03 dB [–0.01 to +0.01 dB]

Averaging filter

Modes	AUTO OFF (fixed averaging factor) AUTO ON (continuously auto-adapted) AUTO ONCE (automatically fixed once)
AUTO mode	
Normal mode	setting of filter depends on power to be measured and resolution
Resolution	1 dB, 0.1 dB, 0.01 dB, 0.001 dB
Fixed Noise mode	filter set to specified noise content
Noise content	0.0001 dB to 1 dB
Max. measurement time	0.01 s to 999 s
Averaging factor N	1 to 2^{16} (number of averaged measurement windows)
Result output	
Moving Average	continuous with every newly evaluated measurement window (e.g. in case of manual operation via NRP)
Repeat	only final result (e.g. in case of remote control of NRP)

Measurement window

Duration

as specified for the individual measurement functions

Shape

rectangular (integrating behaviour; available for all measurement functions) or Von Hann (smoothing filter, for efficient suppression of result variations due to modulation; only for Continuous Average function)

Measurement times

Continuous Average	N x (duration of measurement window + 0.2 ms) + t_z t_z: <1.6 ms (0.9 ms on average)
Burst Average, Timeslot, Scope	see NRP data sheet PD 0757.7023.21

Triggering

Source	Bus, External, Hold, Immediate, Internal
Slope (external, internal)	pos./neg.
Level (internal)	–35 dBm to +23 dBm

Attenuation correction

Function	correcting the measurement result by means of a fixed factor (dB offset)
Range	–100.000 dB to +100.000 dB

S-parameter correction

Function

taking into account a component connected ahead of the sensor by loading its s-parameter data set into the sensor

Number of frequencies	1 to 1000
Parameters	s_{11}, s_{21}, s_{12} and s_{22} (in s2p format)
Download	with NRP toolkit (supplied with sensor) via USB Adapter NRP-Z3 or NRP-Z4

Γ correction

Function	reducing the influence of mismatched sources
Parameters	magnitude and phase of reflection coefficient of source
Download	see under S-parameter correction

Frequency response correction

Function	taking into account the calibration factors relevant for the test frequency
Parameter	carrier frequency (center frequency)
Permissible deviation from actual value	50 MHz (0.05 x f below 1 GHz) for specified measurement uncertainty

Calibration uncertainty

10 MHz ... 8 GHz	0,047 dB to 0,083 dB
8 GHz ... 18 GHz	0,076 dB to 0,123 dB
Details	see NRP data sheet, PD 0757.7023.21

Power Meter R&S NRP

Uncertainty for absolute power measurements (15°C to 35°C, –40 dBm to +23 dBm)	
10 MHz to 8 GHz	0,069 dB to 0,097 dB
8 GHz to 18 GHz	0,096 dB to 0,142 dB
Details	see NRP data sheet PD 0757.7023.21
Uncertainty for relative power measurements (15°C to 35°C, –40 dBm to +23 dBm)	
10 MHz to 8 GHz	0,022 dB to 0,097 dB
8 GHz to 18 GHz	0,022 dB to 0,135 dB
Details	see NRP data sheet PD 0757.7023.21
Interface to host	
Power supply	+5 V/200 mA typ. (USB high-power device)
Remote control	as a USB device (function) in full-speed mode, compatible with USB 1.0/1.1/2.0 specifications
Trigger input	differential (0/+3.3 V)
Dimensions (W x H x L)	48 mm x 31 mm x 170 mm length incl. connecting cable: ~1.6 m
Weight	<0.3 kg

R&S NRP basic unit

Measurement functionality single-channel

See sensor specifications, plus:
relative measurement referenced to result or user-selectable reference value, storage of minima and maxima (Max, Min, Max-Min), limit monitoring

Display	
Absolute	in W, dBm and dBµV
Relative	in dB, as change in percent (Δ%) or as quotient

Measurement functionality multichannel

Simultaneous measurement in up to 4 channels; ratio, relative ratio or difference of results of 2 channels can be displayed (for all functions except Scope)

Display	
Difference	in W
Ratio	in dB, as change in percent (Δ%), as quotient or as one of the following matching parameters: SWR, return loss, reflection coefficient
Relative ratio	in dB, as change in percent (Δ%) or as quotient
Display	LC graphics screen ¼ VGA (320 x 240) pixel, monochrome, transflective
Backlighting	brightness adjustable

Measurement results
up to 4 results with additional information (Min, Max, Max-Min, frequency) can simultaneously be displayed in separate windows

Representation	digital, digital and analog
Resolution	
Digital values	selectable in 4 steps: 0.001 dB to 1 dB
Analog display	depending on user-definable scale end values
Manual operation	Windows-oriented menus with hotkeys for the most important functions
Remote control	IEC 60625.1 (IEEE488.1) and IEC 60625.2 (IEEE488.2)
Command set	SCPI-1999.0
Firmware download	with a Windows-compatible program from the R&S NRP toolkit via the rear-panel USB interface (type B)
Inputs/outputs (rear panel)	
OUT 1	
Analog	recorder output; user-definable linear relation to measurement result (display windows 1 to 4)
Pass/Fail	limit indicator with two user-selectable voltages for identifying the Pass and Fail states in the case of limit monitoring
Off	0 V
IN/OUT 2	
Analog Out	recorder output; user-definable linear relation to measurement result (display windows 1 to 4)
Trigger In	input for trigger signal to sensors
Power supply	
Voltage, frequency	220 V to 240 V, 50 Hz to 60 Hz 100 V to 120 V, 50 Hz to 400 Hz
Tolerance	±10% for voltage and frequency
Apparent power	<80 VA
Dimensions (W x H x D)	274 mm x 112 mm x 267 mm
Weight	<3.0 kg

General data

Temperature loading

Operating range and permissible range (in [] if different)	meet IEC 60068
R&S NRP with options	0°C [–5°C] to +50°C
R&S NRP-Z2, -Z11, -Z21	0°C [–10°C] to +50°C [+55°C]
R&S NRP-Z3	0°C to +40°C

Ordering information

Basic Unit		
Power Meter	R&S NRP	1143.8500.02
Power Sensors		
200 pW to 200 mW, 10 MHz to 8 GHz	R&S NRP-Z11	1138.3004.02
200 pW to 200 mW, 10 MHz to 18 GHz	R&S NRP-Z21	1137.6000.02
Options		
Sensor Check Source	R&S NRP-B1	1146.9008.02
Second Sensor Input (B)	R&S NRP-B2	1146.8801.02
3rd and 4th Sensor Inputs (C, D)	R&S NRP-B5	1146.9608.02
Rear-Panel Sensor Inputs A and B[1)]	R&S NRP-B6	1146.9908.02
Battery Supply	R&S NRP-B3	1146.8501.02
Extras		
Sensor Extension Cable to 5 m	R&S NRP-Z2	1146.6750.05
Sensor Extension Cable to 10 m	R&S NRP-Z2	1146.6750.10
USB Adapter (active)	R&S NRP-Z3	1146.7005.02
USB Adapter (passive)	R&S NRP-Z4	1146.8001.02
19" Rack Adapter (for 1 NRP + empty case)	R&S ZZA-T26	1109.4387.00
19" Rack Adapter (for 2 NRPs)	R&S ZZA-T27	1109.4393.00

1) Not in conjunction with the R&S NRP-B5.

Power Meter R&S NRVS

DC to 40 GHz

100 pW to 30 W

Power (average, pulse, PEP), level and DC voltage measurements

Photo 43225

Brief description

Power Meter R&S NRVS is an ideal instrument for a great variety of power measurement applications in labs and systems. Thanks to its intelligent sensors with calibration data memory and thermocouple sensors, which make adjustments by the user superfluous, R&S NRVS provides at all times high-precision measurements free of operator's errors.

Main features

- ◆ Fast power, level and voltage measurements
- ◆ Intelligent R&S NRV-Z probes and URV5-Z sensors: plug and play
- ◆ IEC/IEEE bus interface
- ◆ DC frequency input for tracking frequency-response correction
- ◆ Analog output
- ◆ Storage of 20 complete instrument setups
- ◆ 13 digital filters for noise suppression, automatic or manual filter selection
- ◆ Sensor check source (optional)

Characteristics

Display
Measurement results, units and various items of information are displayed on a large easy-to-read 4½-digit LC display in three selectable steps of resolution.

Pulse power
If pulse-modulated RF signals are measured, R&S NRVS calculates the pulse peak power from the measured average power and the entered pulse duty factor, and reads out the result directly. The use of Peak Power Sensors R&S NRV-Z31 and -Z33 for measuring the peak envelope power (PEP) is highly recommended.

Measurement rate
The attainable measurement rate not only depends on the type of sensor used but also on the setting of the averaging filter. R&S NRVS automatically makes the appropriate settings by determining the optimum averaging time required for a steady readout as a function of level and selected resolution. This automatic selection can be switched off.

Measuring heads

The range of measuring heads includes thermocouple power sensors as well as highly sensitive diode power sensors, peak power sensors (from page 368), probes and insertion units for voltage measurement (from page 381). R&S NRVS therefore covers a frequency range from DC to 40 GHz and a power span from 100 pW to 30 W.

The power sensors are not specifically designed for R&S NRVS and can therefore be freely used with any of the Rohde& Schwarz power meters and volt-

Power Meter R&S NRVS

Specifications in brief,

power sensors page 368, voltage probes page 381

Measurement functions	average power, pulse power, peak envelope power, AM, reflection, DC voltage (depending on sensor)
Frequency and level range	DC to 40 GHz, 100 pW to 30 W 9 kHz to 3 GHz, 200 mV to 1000 V (depending on sensor)
Probes and sensors	all R&S NRV sensors and URV5 probes
Display	LCD for digits, units, menu-guided operation and analog display, adjustable backlighting
Display of results	single-channel (with optional display of correction frequency) or dualchannel
Absolute readout	W, dBm, V, dBmV,
Relative readout	dB, %W or %V relative to a stored reference value
Analog display	automatic or with selectable scale
Digital display and resolution	max. 4½ digits, resolution selectable (0.1/0.01/0.001 dB)
Display filtering	averaging over 1 to 512 readings to reduce display noise; manual or automatic setting depending on measurement range and resolution
Display noise	see sensors from page 381/368
Measurement rate	see table below
Accuracy (without sensors)	
18°C to 28°C	0.4% +1 digit
10°C to 40°C	0.9% +1 digit
0°C to 50°C	1.4% +1 digit
Zero adjustment	manual or via IEC/IEEE bus, duration approx. 4 s
Frequency response correction	sensor-specific calibration data taken into account; numerical entry of test frequency (keyboard or via IEC/IEEE bus) or by frequency-proportional DC voltage
Attenuation compensation	external attenuation or gain taken into account; data entry via keyboard or IEC/IEEE bus, range ±200 dB
Entry of reference value	measured value on keystroke or numerical entry via keypad or IEC/IEEE bus
Reference impedance	for conversion between voltage and power, automatic readout of reference impedance from sensor data memory or numerical entry via keyboard or IEC/IEEE bus (for RF probe)
Remote control	IEC 625 (IEEE 488), control of all instrument functions
Interface functions	SH1, AH1, T6, L4, SR1, RL1, DC1, DT1, PP0
DC frequency input	
Connector	BNC
Input voltage range	±12 V, linear with selectable scale
DC output	
Connector	BNC, R_{out} = 1 kΩ, EMF proportional to analog display
Left-/right-hand full-scale value	corresponding to 0/+3 V
Accuracy	±5 mV
Channels	1, 2
Sensor check source	option R&S NRVS-B1
Output power	1 mW ±0.7%
Frequency	50 MHz
VSWR	1.05
RF connector	N female
General data	
Power supply	115 V +15/–22% (–15%), 47 Hz to 63 (440) Hz; 230 V +15/–22%, 47 Hz to 63 Hz, 13 VA
Dimensions (W x H x D)	219 mm x 103 mm x 350 mm
Weight	3.2 kg

Ordering information

Power Meter	R&S NRVS	1020.1809.02
Options		
Sensor Check Source	R&S NRVS-B1	1029.2908.02
Extras		
Rack adapter	R&S ZZA-97	0827.4527.00
Transit case	R&S UZ-24	1029.3379.02
Service Kit	R&S NRVS-S1	1029.2708.02

Dual-Channel Power Meter R&S NRVD

DC to 40 GHz

100 pW to 30 W

Power, level and voltage measurements; attenuation and reflection measurements: precise, versatile, convenient

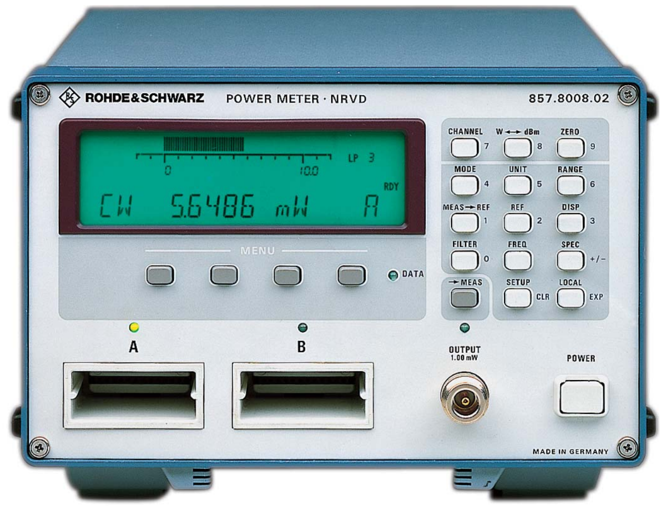


Photo 40095

Brief description

R&S NRVD functions like two independent R&S NRVS power meters in one enclosure performing simultaneous measurements and exchanging data with each other. The two channels can be set separately so that two completely different measurements can be carried out at the same time. The two measured values can also be related to each other for readout of reflection coefficient, SWR or return loss, for instance.

Main features

- Two independent channels performing simultaneous measurements
- LC display with variable backlighting
- IEC/IEEE bus interface (optionally SCPI or compatible with URV5)
- 13 digital filters for noise suppression, automatic or manual filter selection
- Considering frequency response of external components (attenuators or direction couplers inserted before sensor)
- Storage of 20 complete instrument setups
- Input/output option with DC frequency input, analog outputs, trigger input, ready output
- Large variety of intelligent sensors: plug and play
- Rear connectors for sensors
- Sensor check source

Characteristics

Display
Measurement results are displayed with selectable resolution on a five-digit LCD with adjustable backlighting. The values measured in the two channels or one measured value plus an additional item of information are displayed.

The R&S NRVD measures pulse-modulated RF signals like the R&S NRVS. Additionally, the modulation depth of amplitude-modulated signals can be determined from the power variation. After entering the source matching, the expected uncertainty for thermocouple power sensors can be displayed.

Measurement rate
See R&S NRVS, page 364.

Sensor check source
It supplies a highly accurate, low-distortion 50 MHz signal of 1 mW (0 dBm) power for checking the sensors.

Input/Output Option R&S NRVD-B2
Each measurement channel has an analog output with selectable scaling for connection of a recorder or for control purposes. Simple automatic test routines can be implemented with the aid of the trigger input and the ready output. Another input serves for taking up the frequency-proportional DC voltage from a sweep generator for tracking frequency-response correction.

Dual-Channel Power Meter R&S NRVD

Specifications in brief,

power sensors page 368, voltage probes page 381

Measurement functions	average power, pulse power, peak envelope power, AM, reflection, DC voltage (depending on sensor)
Frequency and level range	DC to 40 GHz, 100 pW to 30 W 9 kHz to 3 GHz, 200 mV to 1000 V (depending on sensor)
Probes and sensors	all R&S NRV sensors and URV5 probes
Display	LCD for digits, units, menu-guided operation and analog display, adjustable backlighting
Display of results	single-channel (with optional display of correction frequency) or dualchannel
Absolute readout	W, dBm, V, dBmV, dBV
Relative readout R&S NRVD	dB, difference, percent and ratio, relative to a stored reference value or to the second measurement channel; VSWR, reflection coefficient, return loss in dB, AM modulation depth
Analog display	automatic or with selectable scale
Digital display and resolution	max. 4½ digits, resolution selectable (0.1/0.01/0.001 dB)
Display filtering	averaging over 1 to 512 readings to reduce display noise; manual or automatic setting depending on measurement range and resolution
Display noise	see sensors from page 381/368
Measurement rate	see table below
Accuracy (without sensors)	
18°C to 28°C	0.3% +1 digit
10°C to 40°C	0.8% +1 digit
0°C to 50°C	1.3% +1 digit
Zero adjustment	manual or via IEC/IEEE bus, duration approx. 4 s
Frequency response correction	sensor-specific calibration data taken into account; numerical entry of test frequency (keyboard or via IEC/IEEE bus) or by frequency-proportional DC voltage
Attenuation compensation	external attenuation or gain taken into account; data entry via keyboard or IEC/IEEE bus, range ±200 dB
Entry of reference value	measured value on keystroke or numerical entry via keypad or IEC/IEEE bus
Reference impedance	for conversion between voltage and power, automatic readout of reference impedance from sensor data memory or numerical entry via keyboard or IEC/IEEE bus (for RF probe)
Remote control	IEC 625 (IEEE 488), SCPI, control of all instrument functions
Interface functions	SH1, AH1, T6, L4, SR1, RL1, DC1, DT1, PP0, PP1
DC frequency input	option R&S NRVD-B2
Connector	BNC
Input voltage range	±12 V, linear with selectable scale
DC output	option R&S NRVD-B2
Connector	BNC, R_{out} = 1 kΩ, EMF proportional to analog display
Left-/right-hand full-scale value	corresponding to 0/+3 V
Accuracy	±5 mV
Channels	1, 2
Input/Output Option R&S NRVD-B2	2 simultaneous DC voltage outputs, DC frequency input, trigger input (TTL, active low), ready output (TTL, active high)
Sensor check source	
Output power	1 mW ±0.7%
Frequency	50 MHz
VSWR	≤1.03
RF connector	N female
General data	
Power supply	100/120/220 V ±10%, 230 V –6/+15%; 47 Hz to 400 Hz (25 VA)
Dimensions (W x H x D)	219 mm x 147 mm x 350 mm
Weight	4.5 kg

Ordering information

Dual-Channel Power Meter	R&S NRVD	0857.8008.02
Option		
Input/Output Option	R&S NRVD-B2	0857.8908.02
Extras		
Rack adapter	R&S ZZA-98	827.4533.00
Transit case	R&S ZZK-983	1013.9172.00
Service Kit	R&S NRVD-S1	1029.2808.02

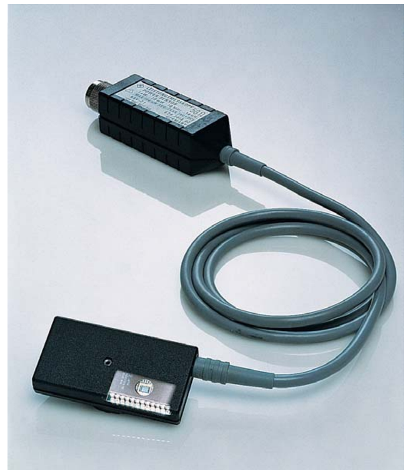
Power Sensors R&S NRV-Z

Brief description

For all power measurements with instruments from the R&S URV/R&S NRV families, 15 power sensors in all cover the frequency range from DC to 40 GHz. Three classes of sensitivity allow direct measurement of any power between 100 pW and 30 W. A 75-Ω sensor is available for TV and video applications.

The calibration data memory integrated in the sensor contains all the relevant information. With the sensor plugged in, a fully calibrated meter is ready for measurements. The calibration of all sensors can be traced to the relevant standards of the Federal German Bureau of Standards.

For calculating the total measurement uncertainty of the source power delivered to Z_0 load the following factors have to be taken into account: mismatch uncertainty, calibration uncertainty, linearity error, meter noise, zero offset, temperature effect, pulse measurement uncertainty (peak power sensors only) and measurement uncertainty of basic unit.



Calibration data for each sensor are stored in an EPROM in the sensor's connector (photo 37902)

Overview of models

High-Sensitivity Sensors
R&S NRV-Z1, -Z3, -Z4, -Z6, -Z15
These sensors measure the true RMS power from about 100 pW to 10 µW and can be used in this level range for signals with harmonic contents, noisy or modulated signals. For sinewave signals, the measurement range extends to 20 mW (13 mW into 75 Ω).

Medium-Sensitivity Sensors
R&S NRV-Z2, -Z5
Based on diode detectors with 20 dB attenuator, these sensors provide true RMS power measurement in the range from 10 nW to1 mW and up to 500 mW for sinewave signals. Compared to thermocouple sensors, shorter measurement times can be attained with these sensors.

Thermocouple Power Sensors
R&S NRV-Z51 to -Z55
They measure the average power irrespective of the waveform and therefore are also suitable for spread spectrum, IS-95 CDMA and WCDMA measurements, irrespective of the peak-to-average power ratio of the waveform concerned. Being individually calibrated, these sensors feature an unrivalled linearity over the entire dynamic range.

Peak Power Sensors
R&S NRV-Z31 to -Z33
These sensors measure the peak envelope power (PEP) of modulated or pulsed signals. The TDMA models 04 of the sensors allow fast and precise measurement of the transmitter power of mobile stations in GSM900/1800/1900 networks. Models 03 are suitable for measuring the sync pulse power of TV transmitters. Model 02 with a minimum pulse repetition frequency of 10 Hz is designed for general applications. Model 05 of R&S NRV-Z32 enables measurement of the power peak value of mobile stations to NADC and PDC standard.

Specifications in brief

Model	Frequency range Min. pulse width Min. PRF	Power range Max. power	Max. SWR (reflection coefficient)	Zero offset (±)	Meter noise	Linearity uncertainty in dB	Calibration uncertainty in dB
R&S NRV-Z1 N; 50 Ω	10 MHz to 18 GHz	200 pW to 20 mW 100 mW (AVG) 100 mW (PK)	0.01 to 1 GHz: 1.06 (0.03) >1 to 2 GHz: 1.13 (0.06) >2 to 4 GHz: 1.27 (0.12) >4 to 18 GHz: 1.41 (0.17)	100 pW	40 pW	0.03	0.07 0.07 0.08 0.08 to 0.15
R&S NRV-Z2 N; 50 Ω	10 MHz to 18 GHz	20 nW to 500 mW 2 W (AVG) 10 W (PK)	0.01 to 4 GHz: 1.05 (0.024) >4 to 8 GHz: 1.1 (0.048) >8 to 12.4 GHz: 1.15 (0.07) >12.4 to 18 GHz: 1.2 (0.09)	10 nW	4 nW	0.03	0.07 0.07 0.07 0.09 to 0.13

Power Sensors R&S NRV-Z

Specifications in brief

Model	Frequency range Min. pulse width Min. PRF	Power range Max. power	Max. SWR (reflection coefficient)	Zero offset (±)	Meter noise	Linearity uncertainty in dB	Calibration uncertainty in dB
R&S NRV-Z3 N; 75 Ω	1 MHz to 2.5 GHz	100 pW to 13 mW 70 mW (AVG) 70 mW (PK)	1 to 100 MHz: 1.11 (0.05) >0.1 to 1 GHz: 1.11 (0.05) >1 to 2.5 GHz: 1.2 (0.09)	40 pW	16 pW	0.03	0.06 0.07 0.07
R&S NRV-Z4 N; 50 Ω	100 kHz to 6 GHz	100 pW to 20 mW 100 mW (AVG) 100 mW (PK)	0.1 to 100 MHz: 1.05 (0.024) >0.1 to 2 GHz: 1.1 (0.048) >2 to 4 GHz: 1.2 (0.09) >4 to 6 GHz: 1.35 (0.15)	50 pW	20 pW	0.03	0.05 to 0.06 0.06 0.06 0.07
R&S NRV-Z5 N; 50 Ω	100 kHz to 6 GHz	10 nW to 500 mW 2 W (AVG), 10 W (PK)	100 kHz to 4 GHz: 1.05 (0.024) >4 to 6 GHz: 1.1 (0.048)	5 nW	2 nW	0.03	0.05 to 0.06 1.7 to 1.9
R&S NRV-Z6 PC 3.5; 50 Ω	50 MHz to 26.5 GHz	400 pW to 20 mW 100 mW (AVG) 100 mW (PK)	0.05 to 0.1 GHz: 1.3 (0.13) >0.1 to 18 GHz: 1.2 (0.09) >18 to 26.5 GHz: 1.4 (0.165)	200 pW	80 pW	0.04	0.06 0.06 to 0.13 0.09
R&S NRV-Z15 K; 50 Ω	50 MHz to 40 GHz	400 pW to 20 mW 100 mW (AVG) 100 mW (PK)	50 MHz to 4 GHz: 1.15 (0.7) >4 to 18 GHz: 1.37 (0.157) >18 to 40 GHz: 1.37 to 0.157)	200 pW	80 pW	0.04	0.05 to 0.06 0.07 to 0.15 0.08 to 0.1
R&S NRV-Z31 N; 50 Ω	30 MHz to 6 GHz 2 μs (mod. 02/03), 200 μs (mod. 04) 10 Hz (mod. 02), 100 Hz (mod. 03/04)	1 μW to 20 mW 100 mW (AVG) 100 mW (PK)	0.03 to 0.1 GHz: 1.05 (0.024) >0.1 to 2 GHz: 1.1 (0.048) >2 to 4 GHz: 1.2 (0.09) >4 to 6 GHz: 1.35 (0.15)	30 nW	3 nW	included in calibration uncertainty	0.06 0.07 0.11 to 0.15 0.12 to 0.16
R&S NRV-Z32 N; 50 Ω	30 MHz to 6 GHz 2 μs (mod. 02/03), 200 μs (mod. 04) 10 Hz (mod. 02), 100 Hz (mod. 03/04)	100 μW to 2 W 1 W (AVG) 8 W (PK, 1 μs)	0.03 to 2 GHz: 1.11 (0.052) >2 to 4 GHz: 1.11 (0.052) >4 to 6 GHz: 1.22 (0.099)	3 μW	0.3 μW	includ. in calibration uncertainty	0.08 to 0.10 0.13 to 0.25 0.18 to 0.27
R&S NRV-Z33 N; 50 Ω	30 MHz to 6 GHz 2 μs (mod. 03), 200 μs (mod. 04) 100 Hz (mod. 03/04)	1 mW to 20 W 12 W to 18 W (AVG) 80 W (PK)	0.03 to 2 GHz: 1.11 (0.052) >2 to 4 GHz: 1.22 (0.099) >4 to 6 GHz: 1.22 (0.099)	30 μW	3 μW	includ. in calibration uncertainty	0.08 to 0.10 0.15 to 0.18 0.18 to 0.20
R&S NRV-Z51 N; 50 Ω	DC to 18 GHz	1 μW to 100 mW 300 mW (AVG) 10 W (PK, 1 μs)	DC to 2 GHz: 1.1 (0.048) >2 to 12.4 GHz: 1.15 (0.07) >12.4 to 18 GHz: 1.2 (0.09)	60 nW	22 nW	0.02	0.05 0.05 to 0.07 0.09 to 0.12
R&S NRV-Z52 PC 3.5; 50 Ω	DC to 26.5 GHz	1 μW to 100 mW 300 mW (AVG) 10 W (PK, 1 μs)	DC to 2 GHz: 1.1 (0.048) >2 to 12.4 GHz: 1.15 (0.07) >12.4 to 18 GHz: 1.2 (0.09) >18 to 26.5 GHz: 1.25 (0.11)	60 nW	22 nW	0.02	0.05 to 0.06 0.06 to 0.08 0.10 to 0.13 0.08 to 0.09
R&S NRV-Z53 N; 50 Ω	DC to 18 GHz	100 μW to 10 W 12 W to 18 W (AVG) 1 kW (PK, 1 μs)	0.05 to 2 GHz: 1.11 (0.052) >2 to 8 GHz: 1.22 (0.099) >8 to 12.4 GHz: 1.27 (0.119) >12.4 to 18 GHz: 1.37 (0.157)	6 μW	2.2 μW	0.03 + 0.01 P/W	0.07 0.10 0.12 to 0.13 0.14 to 0.18
R&S NRV-Z54 N; 50 Ω	DC to 18 GHz	300 μW to 30 W 24 W to 36 W (AVG) 1 kW (PK, 3 μs)	0.05 to 2 GHz: 1.11 (0.052) >2 to 8 GHz: 1.22 (0.099) >8 to 12.4 GHz: 1.27 (0.119) >12.4 to 18 GHz: 1.37 (0.157)	20 μW	7 μW	0.03 + 0.007 P/W	0.08 0.10 to 0.11 0.12 to 0.13 0.14 to 0.18
R&S NRV-Z55 K; 50 Ω	DC to 40 GHz	1 μW to 100 mW 300 mW (AVG) 10 W (PK, 1 μs)	DC to 2 GHz: 1.1 (0.048) >2 to 12.4 GHz: 1.15 (0.07) >12.4 to 18 GHz: 1.2 (0.08) >18 to 26.5 GHz: 1.25 (0.11) >26.5 to 40 GHz: 1.30 (0.13)	60 nW	22 nW	0.02	0.05 0.06 to 0.08 0.10 to 0.13 0.08 to 0.09 0.10 to 0.11

Power Sensors R&S NRV-Z

Dimensions and weight

R&S NRV-Z1 to -Z15, -Z31, -Z51, -Z52	120 mm x 37 mm x 31 mm; 0.35 kg
R&S NRV-Z32	190 mm x 37 mm x 31 mm; 0.42 kg
R&S NRV-Z33, -Z53	240 mm x 54 mm x 60 mm; 0.53 kg
R&S NRV-Z54	298 mm x 54 mm x 60 mm; 0.68 kg
Length of connecting cable	approx. 1.3 m; other lengths on request

Ordering information

Peak Power Sensors

50 Ω, 6 GHz, 20 mW		
Standard model	R&S NRV-Z31	0857.9604.02
High-speed model	R&S NRV-Z31	0857.9604.03
TDMA model	R&S NRV-Z31	0857.9604.04
50 Ω, 6 GHz, 2 W		
TDMA model	R&S NRV-Z32	1031.6807.04
General-purpose model	R&S NRV-Z32	1031.6807.05
50 Ω, 6 GHz, 20 W		
High-speed model	R&S NRV-Z33	1031.6507.03
TDMA model	R&S NRV-Z33	1031.6507.04

Power Sensors

20 mW, 50 Ω, 18 GHz	R&S NRV-Z1	0828.3018.02
500 mW, 50 Ω, 18 GHz	R&S NRV-Z2	0828.3218.02
13 mW, 75 Ω, 2.5 GHz	R&S NRV-Z3	0828.3418.02
20 mW, 50 Ω, 6 GHz	R&S NRV-Z4	0828.3618.02
500 mW, 50 Ω, 6 GHz	R&S NRV-Z5	0828.3818.02
20 mW, 50 Ω, 26.5 GHz	R&S NRV-Z6	0828.5010.02
20 mW, 50 Ω, 40 GHz	R&S NRV-Z15	1081.2305.02
100 mW, 50 Ω, 18 GHz	R&S NRV-Z51	0857.9004.02
100 mW, 50 Ω, 26.5 GHz	R&S NRV-Z52	0857.9204.02
10 W, 50 Ω, 18 GHz	R&S NRV-Z53	0858.0500.02
30 W, 50 Ω, 18 GHz	R&S NRV-Z54	0858.0800.02
100 mW, 50 Ω, 40 GHz	R&S NRV-Z55	1081.2005.02

Power Reflection Meter R&S NRT

200 kHz to 4 GHz

0.3 mW to 2000 W

Power and reflection measurements under operational conditions

Photo 42661

Brief description

Directional power meters are used to measure power and reflection under operational conditions. Typical applications are in installation, maintenance and monitoring of transmitters, antennas and RF generators in industrial and medical fields. Power Reflection Meter R&S NRT is the right choice: rugged, accurate and compact. Due to the large variety of measurement functions and high accuracy it is suitable for classic applications in mobile use as well as for use in research, development, production and quality management.

Power Sensors R&S NRT-Z43 and -Z44 for use in radiocommunications
The wide frequency range from 200 (400) MHz to 4 GHz covers all relevant frequency bands, the measurement method is compatible with all common analog and in particular digital modulation standards: GSM 900/1800/1900, DECT, PHS, NADC, PDC, DAB, DVB, IS-95-CDMA, WCDMA and many more.

Power Sensors NAP-Z
The complete range of power sensors of the predecessor model NAP is available for the customary frequency ranges, e.g. shortwave, and can be connected via an option. The sensors cover all the main frequency bands, from the maritime radio frequencies in the range of 200 kHz through to the digital GSM900 network. The power measurement range extends from 0.3 mW to 2 kW. The NAP sensors are able to measure the average power irrespective of the modulation mode and some of them even the peak envelope power (PEP). All NAP sensors up to 1 GHz have a directivity of at least 30 dB and thus allow very precise reflection and power measurements.

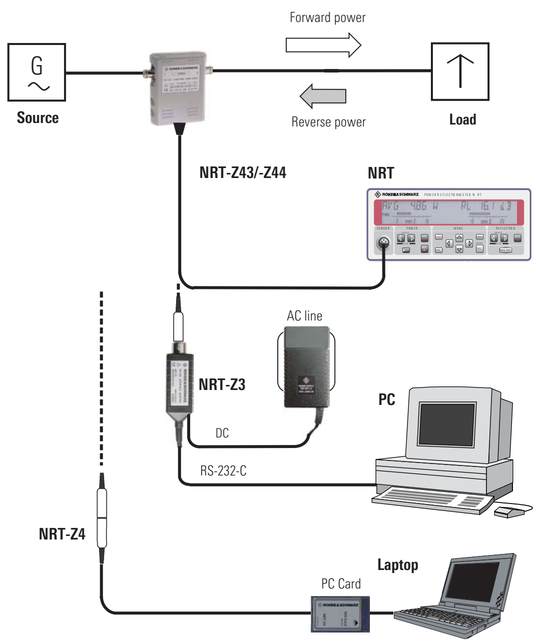
Measurement directly on PC
The sensors of the R&S NRT family are self-contained measuring instruments which are able to communicate with the basic unit or with a PC via a standard serial data interface. Interface Adapter R&S NRT-Z3 allows connection to the serial RS-232-C standard interface of PCs (COMx), PC Card Interface Adapter R&S NRT-Z4 operation at the PC card connector of laptops and notebooks. A program running under Windows (V-R&S NRT) is available for operation of the sensor and display of the measurement results.

Direct power monitoring on PC

Operation, measurement functions

Thanks to menu control, a manageable number of keys and a large display, operation of the R&S NRT is extremely easy. Switchover between the main functions is made at a keystroke:

- Choice between average power, average burst power, peak envelope power (PEP) and peak-to-average power ratio (crest factor)
- Switchover between forward power and absorbed power
- Measurement of power differences in dB or %
- Choice between return loss, SWR or reflection coefficient in reflection measurements
- Acoustic SWR monitoring
- Indication of maximum and minimum values
- Quasi-analog bargraph display
- Choice between measurement at the source or at the load



Power and reflection measurement with R&S NRT-Z43/-Z44: readout of results either on basic unit or directly on PC

Options

The R&S NRT basic unit comes with an IEC-bus (IEEE488) and RS-232-C interface, both to SCPI standard. Three options allow the R&S NRT to be adapted to different applications:

- Test input for connection of NAP sensors
- Two additional test inputs for R&S NRT sensors for simultaneous monitoring of up to three testpoints (R&S NRT-B2)
- Battery and built-in charger for mobile use (R&S NRT-B3)

Specifications in brief: power sensors

General data	**R&S NRT-Z43**	**R&S NRT-Z44**
Power measurement range[1)]	0.0007 to 30 W (average)/75 W (peak)	0.003 to 120 W (average)/300 W (peak)
Frequency range	400 MHz to 4 GHz	200 MHz to 4 GHz
SWR (referred to 50 Ω)	1.07 max. from 0.4 to 3 GHz 1.12 max. from 3 to 4 GHz	1.07 max. from 0.2 to 3 GHz 1.12 max. from 3 to 4 GHz
Insertion loss	0.06 dB max. from 0.4 to 1.5 GHz 0.09 dB max. from 1.5 to 4 GHz	0.06 dB max. from 0.2 to 1.5 GHz 0.09 dB max. from 1.5 to 4 GHz
Directivity	30 dB min. from 0.4 to 3 GHz 26 dB min. from 3 to 4 GHz	30 dB min. from 0.2 to 3 GHz 26 dB min. from 3 to 4 GHz
Average power measurement[2)]		
Definition	mean value of carrier power, averaged over several modulation cycles (thermal equivalent, true rms value in case of voltage measurement)	
Power measurement range CF: peak-to-average power ratio (crest factor)	0.007 [0.0007] to 75 W (CW, FM, jM, FSK, GMSK or equivalent) to 30 [3] W (CDMA, WCDMA, DAB, DVB) to 75 [7.5] W/CF (other modulation)	0.03 [0.003] to 300 W (CW, FM, jM, FSK, GMSK or equivalent)) to 120 [12] W (CDMA, WCDMA, DAB, DVB) to 300 [30] W/CF (other modulation)
Modulation	for all kinds of analog and digital modulation; lowest frequency component of signal envelope should exceed 7 Hz for steady indication	
Measurement uncertainty at 18 to 28°C	unmodulated RF (CW): 3.2% of rdg (0.14 dB)	unmodulated RF (CW): 3.2% of rdg (0.14 dB)
Burst average power measurement[2)]		
Definition	average on-power of periodic carrier bursts, based on the measurement of average power under consideration of burst width t and repetition rate 1/T: burst average power = average power x T/t	
Power measurement range	0.007 [0.0007] W x $\frac{T}{t}$	0.03 [0.003] W x $\frac{T}{t}$
	up to specified upper limit of average power measurement	up to specified upper limit of average power measurement
Burst width (t)	0.2 µs to 150 ms	0.2 µs to 150 ms
Repetition rate (1/T)	7/s min.	7/s min.
Measurement of peak-to-average power ratio (crest factor)		
Definition	ratio of peak envelope power to average power in dB (only with 1 ⟶ 2 forward direction)	
Power measurement range	see average power and peak envelope power specifications	
Measurement of peak envelope power (PEP)		
Definition	peak value of carrier power (only with 1 ⟶ 2 forward direction)	
Power measurement range Burst signals (repetition rate min. 20/s)	0.1(1)* to 75 W (* lower measurement limit depending on modulation)	0.4 (4)* to 300 W (* lower measurement limit depending on modulation)

Measurement of complementary cumulative distribution function (CCDF)	R&S NRT-Z43	R&S NRT-Z44
Definition	probability in % of forward power envelope exceeding a given threshold (only with 1 → 2 forward direction)	
Measurement range	0% to 100%	0% to 100%
Threshold level range	0.25 W to 75 W	1 W to 300 W
Reflection measurement [2] (values in {}: 3 to 4 GHz)		
Definition	measurement of load match in terms of SWR, return loss or reflection coefficient	
Reflection measurement range Return loss/SWR/reflection coefficient	0 dB to 23 {20} dB / 1.15 {1.22} to ∞ / 0.07 {0.10} to 1	
Min. forward power	0.007 [0.07] W (specs met from 0.05 [0.5] W)	0.03 [0.3] W (specs met from 0.2 [2] W)

General data	NAP-Z3	NAP-Z4	NAP-Z5	NAP-Z6	NAP-Z7	NAP-Z8
Power measurement range [1]	0.01 W to 35 W	0.03 W to 110 W	0.1 W to 350 W	0.3 W to 1100 W	0.05 W to 200 W	0.5 W to 2000 W
Frequency range	25 MHz to 1 GHz	25 MHz to 1 GHz	25 MHz to 1 GHz	25 MHz to 1 GHz	0.4 MHz to 80 MHz	0.2 MHz to 80 MHz
SWR (referred to 50 Ω)	1.03 max.	1.03 max.	1.03 max.	1.05 max.	1.03 max. (1.02 max. from 1.5 MHz to 30 MHz)	
Insertion loss up to 0.3 GHz up to 0.5 GHz total frequency range	0.10 dB max. 0.25 dB max. 0.75 dB max.	0.08 dB max. 0.15 dB max. 0.35 dB max.	0.08 dB max. 0.15 dB max. 0.20 dB max.	0.05 dB max. 0.10 dB max. 0.15 dB max.	– – 0.015 dB max.	– – 0.015 dB max.
Directivity	30 dB min. (30 MHz to 1 GHz), 26 dB min. (25 MHz to 30 MHz)				35 dB min. (1.5 MHz to 30 MHz)	
Average power measurement						
Measurement range	0.01 W to 35 W	0.03 W to 110 W	0.1 W to 350 W	0.3 W to 1100 W	0.05 W to 200 W	0.5 W to 2000 W
Measurement uncertainty at 20 to 25 °C	6% of reading	6% of reading	6% of reading	6% of reading	6 [4] % of reading (1.5 MHz to 30 MHz) value in brackets: sensor-specific calibration factors taken into account	
Measurement of peak envelope power						
Measurement range	not possible	not possible	not possible	not possible	0.5 W to 200 W	5 W to 2000 W
AM Burst width t Repetition rate 1/T					30 Hz to 10 kHz 20 µs min. 30/s min.	30 Hz to 10 kHz 20 µs min. 30/s min.
Reflection measurement						
Measurement range for return loss/SWR/ reflection coefficient	0 dB to 23 dB / 1.15 to ∞ / 0.07 to 1 (30 MHz to 1 GHz)				0 dB to 28 dB/1.08 to ∞/0.04 to 1 (1.5 to 30 MHz)	
Minimum forward power	0.1 (0.6) W	0.3 (2) W	1 (6) W	3 (20) W	0.5 (10) W	5 (100) W
	specs met with power values in ()					

General data	NAP-Z10 (model 02)	NAP-Z11 (model 02)
Power measurement range [1]	0.005 W to 20 W	0.05 W to 200 W
Frequency range	35 MHz to 1 GHz	35 MHz to 1 GHz
SWR (referred to 50 Ω)	max. 1.03	max. 1.03
Insertion loss up to 0.3 GHz up to 0.5 GHz total frequency range	0.10 dB max. 0.25 dB max. 0.75 dB max.	0.08 dB max. 0.15 dB max. 0.20 dB max.
Directivity	30 dB min. from 40 MHz to 1 GHz 26 dB min. from 35 to 40 GHz	
Average power measurement		
Measurement range	0.005 W to 20 W	0.05 W to 200 W
Measurement uncertainty at 20 to 25°C	6.5% of reading	6.5% of reading
Measurement of peak envelope power		
Measurement range	0.05 W to 20 W	0.5 W to 200 W
AM Burst width t Repetition rate 1/T	50 Hz to 100 kHz min. 4,5 µs min. 50/s	50 Hz to 100 kHz min. 4,5 µs min. 50/s
Reflection measurement		
Measurement range Return loss/SWR/ Reflection coefficient	0 dB to 23 dB/1.15 to ∞/0.07 to 1 (40 MHz to 1 GHz)	
Minimum forward power	0.05 (0.35) W	0.5 (3.5) W
	specs met with power values in ()	
Measurement time	equal to measurement time of selected power measurement function, shortest with average power measurement	

Specifications in brief: R&S NRT basic unit

Frequency range	200 kHz to 4 GHz[3)]
Power measurement range	0.3 mW to 2 kW[3)]
Test inputs	1 to 3 (4), one active
for R&S NRT-Z sensors	one input on front panel, two additional inputs on rear panel (option R&S NRT-B2)
for NAP-Z sensors	one input on rear panel (option R&S NRT-B1)
Measurement functions	
Power	forward power and power absorbed by the load in W, dBm, dB or % (dB and % referred to measured value or reference value)
Power parameters[3)]	average, burst average, envelope peak, peak-to-average ratio (crest factor) and complementary cumulative distribution function (CCDF)
Reflection	SWR, return loss, reflection coefficient, reverse forward power ratio and reverse power
Frequency response correction	upon input of RF frequency, the stored correction factors of the power sensor being taken into account; for NAP sensors the R&S NRT basic unit offers memory for 3 sets of calibration factors
Display	LCD
Digital	simultaneous indication of power, reflection and frequency
Resolution	HIGH: 4½ digits (0.001 dB) LOW: 3½ digits (0.01 dB)
Analog	two 50-element bargraphs for indication of power and reflection with selectable or predefined scale-end values
Averaging	automatic, depending on selected resolution and sensor characteristics
Max/Min.	indication of current maximum, minimum or max-min value for the selected measurement functions
Remote control	to SCPI-1995.0 command set
IEC/IEEE bus	to IEC 625 (IEEE 488)
Serial interface	9-pin sub-D connector to EIA-232E; 1200, 2400, 4800 and 9600 baud
AUX connector	BNC connector as signalling output or trigger input (TTL)
General data	
Power supply	
AC supply	100 to 240 V, 50 Hz to 60 Hz or 100 to 120 V, 400 Hz; 35 VA, max. 0.4 A
Battery	with option R&S NRT-B3, operating time approx. 8 h with one R&S NRT-Z power sensor and option R&S NRT-B1; recharging within 2 hours in quick-charge mode
Dimensions	219 mm x 103 mm x 240 mm
Weight	3.5 kg with all options

Power Sensors R&S NRT-Z43/-Z44

Measurement channels	2 (for forward and reverse power)
Forward dir. 1 → 2	standard for all measurement functions
2 → 1	only for measurement of average and burst average power (at low levels)
Measurement functions	forward power and reflection
Power parameters	average, burst average, envelope peak, peak-to-average ratio and complementary cumulative distribution function (CCDF)
Reflection	return loss, SWR, reflection coefficient, reverse power
Range selection	automatic
Video bandwidth	4 kHz, 200 kHz and "FULL" available for all power parameters except average power measurement
Frequency response correction	upon input of RF frequency, the stored correction factors of both measurement channels being taken into account
RF connectors	N (female) on both ends
Remote control	via serial RS-422 interface, 6-pin LEMOSA connector
General data	
Power supply	6.5 to 28 V, approx. 1.5 W
Length of connecting cable	1.5 m
Length of extension cable	max. 500 m with 12 V supply voltage (via R&S NRT-Z3, R&S NRT-Z4 or line-operated R&S NRT) max. 30 m with 7 V supply voltage (battery-operated R&S NRT)
Dimensions (W x H x D)	120 mm x 95 mm x 39 mm
Weight	0.65 kg

Power measurement with R&S NAP power sensors and option R&S NRT-B1

Measurement channels	2 identical channels (for forward and reverse power)
Range selection	automatic
Frequency response correction	with NAP-Z7 and NAP-Z8 under consideration of calibration factors
Zero adjustment	with RF level switched off, duration approx. 5 s
RF connectors	N male/N female (NAP-Z6: 7/16 male, 7/16 female)
Length of connecting cable	1.5 m

Environmental conditions for R&S NRT and Power Sensors R&S NRT-Z and R&S NAP-Z

Temperature range	specifications to IEC 68-2-1, IEC 68-2-2 and MIL-T-28800D, class 5
Operating	-10 to +55°C
Specifications met	0 to 50°C (unless otherwise stated)
Storage	-40 to +70°C
Climatic load	+25/40°C cyclic at 95% rel.humidity (non-condensing) to IEC 68-2-30

Ordering information

Power Reflection Meter	R&S NRT	1080.9506.02
Power Sensors R&S NRT (incl. V-R&S NRT software)		
30 (75) W, 0.4 to 4 GHz	R&S NRT-Z43	1081.2905.02
120 (300) W, 0.2 to 4 GHz	R&S NRT-Z44	1081.1309.02
Power Sensors NAP		
35 W, 25 to 1000 MHz	R&S NAP-Z3	0392.6610.55
110 W, 25 to 1000 MHz	R&S NAP-Z4	0392.6910.55
350 W, 25 to 1000 MHz	R&S NAP-Z5	0392.7116.55
1100 W, 25 to 1000 MHz	R&S NAP-Z6	0392.7316.56
200 W, 0.4 to 80 MHz	R&S NAP-Z7	0350.8214.02
2000 W, 0.2 to 80 MHz	R&S NAP-Z8	0350.4619.02
20 W, 35 to 1000 MHz	R&S NAP-Z10	0858.0000.02
200 W, 35 to 1000 MHz	R&S NAP-Z11	0852.6707.02
Options		
Interface for NAP-Z Power Sensors	R&S NRT-B1	1081.0902.02
2 rear inputs for R&S NRT-Z Power Sensors	R&S NRT-B2	1081.0702.02
Battery supply with built-in charger and NiMH battery	R&S NRT-B3	1081.0502.02
Extras		
NiMH Battery	R&S NRT-Z1	1081.1209.02
Extension Cable		
for R&S NRT-Z Power Sensors 10 m	R&S NRT-Z2	1081.2505.10
30 m	R&S NRT-Z2	1081.2505.30
for NAP-Z Power Sensors 25 m	R&S NAP-Z2	0392.5813.02
RS-232-C Interface Adapter for R&S NRT-Z Power Sensors including AC Power Supply	R&S NRT-Z3	1081.2705.02
PC Card Interface Adapter for R&S NRT-Z Power Sensors	R&S NRT-Z4	1120.5005.02
Carrying Bag with Straps and Pocket of Accessories	R&S ZZT-222	1001.0500.00
19" Rack Adapter	R&S ZZA-97	0827.4527.00

1) Dependent on measurement function.

2) Values in []: 2→1 forward direction (if different from 1→2 forward direction).

3) Sensor-dependent.

Directional Power Meter R&S NAS

1 MHz to 1990 MHz

10 mW to 1200 W

Convenient and precise power and SWR measurements in the entire field of radiotelephony

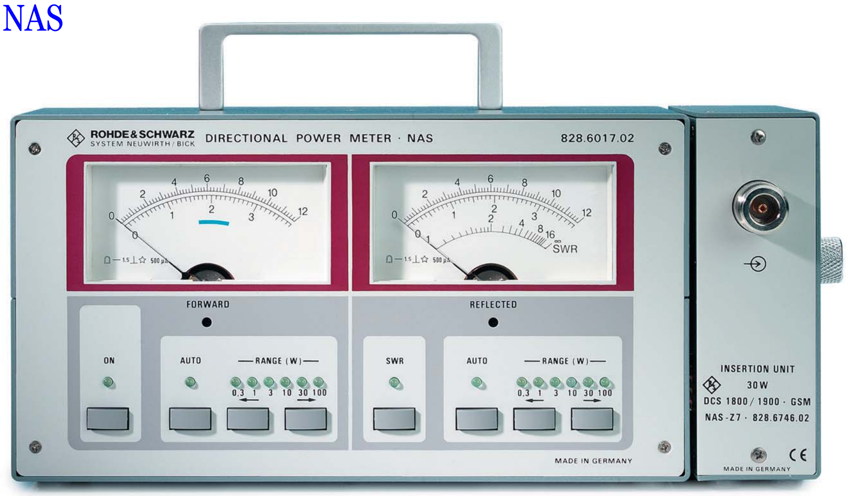


Photo 40346

Brief description

Directional Power Meter R&S NAS is the ideal servicing unit wherever power and SWR of all kinds of radio equipment have to be measured. Insertion units for mobile radio make the R&S NAS a versatile unit and an investment for the future.

Main features

- Two moving-coil meters
- Autoranging
- Battery operation
- Automatic switchoff
- High EMI immunity
- Excellent price/performance ratio

Operation

Operation of the R&S NAS is extremely simple and reliable thanks to microprocessor control. Forward and reflected power or forward power and SWR are simultaneously indicated on two large meters. Indication of SWR does away with the cumbersome use of tables.

Insertion units

Insertion units are either plugged to the side of the R&S NAS or connected via a 1.5 m long cable for measurements at test points that are difficult to reach. Each insertion unit contains its individual calibration data which are read by the R&S NAS and considered in the measurement results.

GSM 900/1800/1900 applications

Insertion Units R&S NAS-Z6 and -Z7 measure the peak envelope power (PEP) of the clocked signal with due consideration of the timing laid down in the GSM specifications. Therefore the insertion units are ideal too for measurements on mobile stations which according to definition are sending signals in only one of the eight timeslots. Transient overshoots of the signal bursts are eliminated by a signal-controlled circuit so that the forward and reflected power as well as the SWR can be correctly measured and indicated.

Standard applications

The standard Insertion Unit R&S NAS-Z5 with its wide frequency range is suit-able for almost any application and practically covers all commercial analog RT services including air navigation.

Shortwave applications

Insertion Units R&S NAS-Z1 and -Z2 have been especially designed for the frequency range up to 30 MHz. R&S NAS-Z2 is for powers up to 1200 W for use in long-range shortwave communication systems.

Terminated power measurements

For measurements on transmitters, a Termination NAZ 10 or NAZ 30 acting as a dummy antenna is connected to the output of the insertion unit.

Directional Power Meter R&S NAS

Specifications in brief: Insertion Units R&S NAS-Z

Model	**R&S NAS-Z1**	**R&S NAS-Z2**	**R&S NAS-Z3**	**R&S NAS-Z5**	**R&S NAS-Z6**	**R&S NAS-Z7**
Frequency range	1 MHz to 30 MHz	1 MHz to 30 MHz	25 MHz to 200 MHz	70 MHz to 1000 MHz	890 MHz to 960 MHz[1]	890 MHz to 960 MHz[1] and 1710 to 1990 MHz
Power measurement range	0.01 W to 120 W	0.1 W to 1200 W	0.01 W to 120 W	0.01 W to 120 W	0.01 W to 120 W	0.01 W to 30 W[6]
Accuracy (of rdg)	±4.5%	±6.5%	±5.5%	±6.5%[2]	±5.5%	±6/8.5% (≤20 W)[5], ±7/9.5% (<30 W)[5]
SWR	<1.07	<1.07	<1.07	<1.07[3]	<1.1	<1.15
Directivity	>30 dB	>30 dB	>30 dB	>30 dB[4]	>26 dB	>26 dB

Connector, characteristic impedance: N female, 50 Ω
Dimensions (W x H x D); weight: 55 mm x 120 mm x 90 mm; 0.7 kg

1) Useful frequency range: 100 to 1000 MHz for R&S NAS-Z6, 850 to 2000 MHz for R&S NAS-Z7 (with wider error tolerances).

2) 100 to 1000 MHz; 75 to 100 MHz: –11 to +5.5% of rdg; 70 to 75 MHz: –15 to –5.5% of rdg.

3) f <500 MHz; at f ≥500 MHz: <1.1.

4) f <500 MHz; at f ≥500 MHz: >26 dB.

5) Wider error tolerances are valid within a frequency range of 1880 MHz to 1990 MHz.

6) Up to 100 W with wider error tolerances.

Specifications in brief: basic unit

Display	two moving-coil meters for forward and reflected power, plus SWR indication
Range selection	automatic or manual, separate for forward and reflected power
Accuracy (18°C to 28°C)	±1.5% of selected range + error of power sensor
Additional uncertainty at temperatures >28°C and <18°C	≤0.25% of rdg/°C
Automatic switchoff	approx. 1 h after last keystroke
General data	
Power supply	5 dry batteries IEC R20, service life >150 h (alkaline-manganese batteries)
Dimensions (W x H x D); weight	210 mm x 145 mm x 90 mm; 2 kg

Ordering information

Directional Power Meter	R&S NAS	0828.6017.02
Insertion Unit	R&S NAS-Z1	0828.6317.02
	R&S NAS-Z2	0828.6417.02
	R&S NAS-Z3	0828.6517.02
	R&S NAS-Z5	0828.6717.03
for GSM900	R&S NAS-Z6	0828.6723.02
for GSM 900/1800/1900	R&S NAS-Z7	0828.6746.02
Extras		
Connecting Cable (1.5 m) for detached operation of insertion units	R&S NAS-Z9	0828.6969.02
Carrying Bag	R&S NAS-Z10	0828.6917.02
Termination	R&S NAZ10	R&S NAZ30
Power-handling capacity (for 1 min)	10 W (15 W)	30 W (50 W)
Frequency range	0 Hz to 2 GHz	0 Hz to 4 GHz
VSWR	≤1.15	≤1.1 to 2 GHz
Connector, impedance	N male, 50 Ω	N male, 50 Ω
Order number	1029.2408.02	1029.2508.02

Level Meter R&S URV35

DC to 3/40 GHz

200 µV to 1000 V; 100 pW to 30 W

Power and voltage measurement with a unique analog/digital display

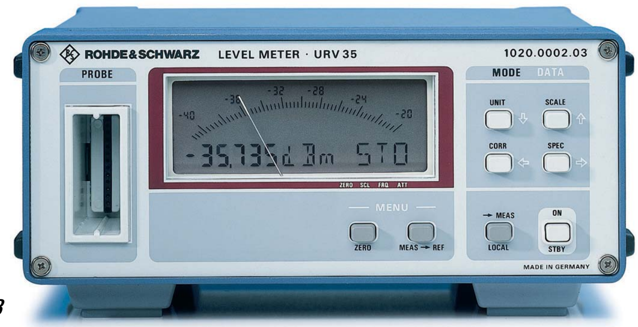


Photo 43227-3

Brief description

R&S URV35 is a voltmeter and power meter for versatile applications in service and production as well as for precision measurements in RF and microwave labs. A large variety of probes and sensors allows voltage measurements up to 3 GHz and power measurements up to 40 GHz.

Main features

- Compact, handy and mobile
- Voltmeter and power meter in one unit
- Rugged design
- Combined (true) analog and digital display
- Menu-guided operation
- AC-supply or battery operation
- Large choice of probes and sensors
- DC frequency input for tracking frequency-response correction
- Analog output for YT recorder
- RS-232-C interface
- Test generator for checking the probe or sensor (optional)

Specifications in brief, voltage probes page 381, power sensors page 368

Probes and sensors	all R&S URV5 probes and NRV sensors
Display	backlit LCD, moving-coil meter with short response time
Absolute readout	dBm, dBµV, V or W
Relative readout	dB, referred to stored reference value
Resolution of digital display	4½ digits: 19999 steps; 0.001 dB 3½ digits: 1999 steps; 0.01 dB
Analog display	steps of 1-2.5-5 for V, W and dB, 5 (10) dB for dBm and dBµV with windows of 10 (20) dB
Entry of scaling	left- and right-hand scale limits
Display filtering	level-dependent digital averaging filter
Accuracy (18°C to 28°C)	
Digital display	±0.02 dB ±1 digit
Moving-coil meter	1.5% of full scale
Zero adjustment	via interface or manually, approx. 4 s
Hold function	for displayed measurement result
Measurement rate	5 readouts/s in manual mode
Frequency-response correction (selectable)	sensor-specific calibration data taken into account
Attenuation compensation (selectable)	external attenuation or gain taken into account, range ±199.99 dB
Entry of reference value	measured value on keystroke, or value entered via interface or keypad
Reference impedance	50 Ω/75 Ω, automatic/selectable

Sensor check source (option R&S NRVS-B1)

Output	50 MHz/1 mW ±0.7%; N connector
VSWR	1.05

Interfaces

Remote control	serial interface (V.24, RS-232-C)
DC frequency input	BNC, R_{in} = 9 MΩ
Input voltage range	±12 V, linear with selectable scale
DC voltage output	BNC, R_{out} = 1 kΩ, EMF proportional to pointer deflection
Left-/right-hand scale limit	corresponding to 0/+3 V
Additional settling time	250 ms
Accuracy	±5 mV

General data

Model 02 power supply	
Battery, standard	5 x 1.5 V alkaline-manganese LR20
Operating time	125 h
Rechargeable battery, retrofittable	5 x 1.2 V NiCd IEC KR35/62
Operating/charging time	60 h/24 h
AC supply with UZ-35, European version	230 V ±10%, 47 to 63 Hz
AC supply with UZ-35, US version	120 V ±10%, 57 to 63 Hz
Model 03 (AC supply)	115 V +15%/–22%, 47 to 440 Hz 230 V +15%/–22%, 47 to 63 Hz (switch-selectable); 6 VA
Dimensions (W x H x D)	220 mm x 100 mm x 240 mm
Weight model 02	3.1 kg/2.3 kg with/without batteries
model 03	2.4 kg

Ordering information

Level Meter		
battery-operated	R&S URV35	1020.0002.02
AC-supply model	R&S URV35	1020.0002.03
Options		
Sensor Check Source	R&S NRVS-B1	1029.2908.02
Power Supply/Charger (for model 02)[1]	R&S UZ-35	1020.1709.02
Power Supply/Charger (for model 02)[2]	R&S UZ-35	1020.1709.04
Service Kit	R&S URV35-S1	1029.2608.02

1) European power supply.

2) US power supply.

Millivoltmeter R&S URV5

DC, 9 kHz to 3/26.5 GHz

200 µV to 1000 V

Voltage, level, power measurements; trend indication

Photo 33034

Brief description

Millivoltmeter R&S URV5 is a broadband voltage, level and power meter of high accuracy and sensitivity. It is suitable both for manual operation and for use in systems. A wide choice of individually calibrated probes and sensors allows R&S URV5 to be used for a great variety of measurements:

- With RF probe and DC probe for no-load AC and DC voltage measurements
- Voltage (and power) measurements in coaxial 50 Ω and 75 Ω systems using low-reflection and low-loss insertion units
- Power measurements up to 26.5 GHz using Power Sensors R&S NRV-Z1 to -Z6

Main features

- Two test inputs
- High accuracy through µP-controlled error correction: ±1%
- Dynamic range >94 dB
- IEC/IEEE bus interface
- Readout in all standard units with selectable reference impedance; relative measurements
- Optional DC output
- PEP measurement

Specifications in brief,

voltage probes page 381, power sensors page 368

Probes and sensors	all R&S URV5 probes and R&S NRV sensors, except R&S NRV-Z3x and R&S NRV-Z5x, -Z15
Test channels	2 (A and B)
Absolute measurement	A, B
Relative measurement	A/REF$_A$, B/REF$_B$, A/B, B/A
Absolute readout	V, W, dBm, dBV
Relative readout	ΔV, ΔW, Δ%, ΔdB, X/REF
Resolution	0.01% or 0.01 dB
Accuracy of voltage readout in V (18°C to 28°C)	±0.15% of rdg per channel
Filter	to reduce display noise in 6 steps (F0 to F5), selectable
Zero adjustment	via keyboard or remote control
Measurement rate (manual)	approx. 1 measurement/s with filter F0, up to 30 measurements/s with filter F5
Measurement time (IEC/IEEE bus)	approx. 0.05 s with filter F5, up to 20 s with filter F0

PEP measurement
Pulse width approx. 200 µs to CW
Min. pulse repetition frequency

Filter	F0	F1	F2	F3	F4	F5
f_{min}/Hz	0.05	0.25	1	5	25	100

Frequency-response correction (selectable)	sensor-specific frequency response after entry of test frequency
Attenuation compensation (selectable)	one attenuation value per channel can be entered (–199.99 to +199.99 dB)
Reference value for relative measurements	one value per channel

Optional DC Output R&S URV5-B2

Output voltage range (EMKF)	–1.999 to +1.999 V, R_{out} = 1 kΩ
Resolution; error	1 mV (10 digit); ±2 mV

General data

Remote control	IEC 625-1 (IEEE 488) for control of all instrument functions
Interface functions	SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, PP1
Power supply	100/120/220/240 V ±10% 47 Hz to 63 Hz, 400 Hz, 30 VA
Dimensions (W x H x D); weight	241 mm x 110 mm x 340 mm; 4.4 kg

Ordering information

Millivoltmeter	R&S URV5	0394.8010.02
Options		
DC Output	R&S URV5-B2	0079.0631.00
Service Kit for Calibration	R&S UZ-8	0394.9968.02

Millivoltmeter R&S URV55

DC to 3/40 GHz

200 µV to 1000 V

100 pW to 30 W

RF/DC voltage, level and power measurements

Photo 43228-3

Brief description

Millivoltmeter R&S URV55 is suitable for voltage measurements up to 3 GHz as well as for power and level measurements up to 40 GHz. Thanks to probes with calibration data memory and temperature sensors, which make adjustments by the user superfluous, R&S URV55 provides at all times high-precision measurements free of operator's errors.

Main features

- Voltage, level and power measurements
- Large choice of intelligent probes and sensors (R&S URV5-Z, NRV-Z)
- IEC/IEEE bus interface
- DC frequency input for tracking frequency-response correction
- Analog output for YT recorder
- Storage of 20 complete instrument setups
- 13 digital filters for noise suppression, automatic or manual filter selection
- Sensor check source (optional)

Measuring heads

The range of measuring heads includes high-impedance probes with plug-on dividers and adapters (R&S URV5-Z7, -Z1) as well as insertion units for voltage measurements on coaxial lines (R&S URV5-Z2, -Z4). All power sensors of the R&S NRV-Z series can be used without any restrictions.

Measurement time in seconds (from trigger to output of first byte) depending on filter setting

Resolution	Filter number												
	0	1	2	3	4	5	6	7	8	9	10	11	12
R&S NRV-Z1 to -Z15	0.045	0.05	0.06	0.08	0.15	0.27	0.49	0.95	1.85	3.6	7.2	14.5	28.5
R&S NRV-Z31 mod. 02	1.04	1.04	1.05	1.07	1.13	1.24	1.44	1.84	2.7	4.3	7.5	14	27
R&S NRV-Z31 to -Z33, mod. 03, 04	0.135	0.14	0.15	0.17	0.23	0.34	0.54	0.94	1.77	3.4	6.6	13	26
R&S NVR-Z32 mod. 05	0.435	0.44	0.45	0.47	0.53	0.64	0.84	1.24	2.07	3.7	6.9	14	27
R&S NRV-Z51 to -Z55	0.115	0.12	0.13	0.15	0.21	0.32	0.52	0.92	1.75	3.4	6.6	13	26
R&S URV 5-Z2, -Z4, -Z7	0.065	0.07	0.08	0.1	0.2	0.38	0.72	1.45	2.8	5.5	11	22	44

Millivoltmeter R&S URV55

Specifications in brief,

voltage probes page 381, power sensors page 368

Measurement functions	average power, pulse power, peak envelope power, AM, reflection, DC voltage (depending on sensor)
Frequency and level range	DC to 40 GHz, 100 pW to 30 W 9 kHz to 3 GHz, 200 mV to 1000 V (depending on sensor)
Probes and sensors	all NRV sensors and R&S URV5 probes
Display	LCD for digits, units, menu-guided operation and analog display, adjustable backlighting
Display of results	single-channel (with optional display of correction frequency) or dualchannel
Absolute readout	W, dBm, V, dBmV
Relative readout	dB, %W or %V relative to a stored reference value
Analog display	automatic or with selectable scale
Digital display and resolution	max. 4½ digits, resolution selectable (0.1/0.01/0.001 dB)
Display filtering	averaging over 1 to 512 readings to reduce display noise; manual or automatic setting depending on measurement range and resolution
Display noise	see sensors from page 381/368
Measurement rate	see table below
Accuracy (without sensor)	
18°C to 28°C	±0.02 dB ±1 digit
10°C to 40°C	±0.04 dB ±1 digit
0°C to 50°C	±0.06 dB ±1 digit
Zero adjustment	manual or via IEC/IEEE bus, duration approx. 4 s
Frequency response correction	sensor-specific calibration data taken into account; numerical entry of test frequency (keyboard or via IEC/IEEE bus) or by frequency-proportional DC voltage
Attenuation compensation	external attenuation or gain taken into account; data entry via keyboard or IEC/IEEE bus, range ±200 dB
Entry of reference value	measured value on keystroke or numerical entry via keypad or IEC/IEEE bus
Reference impedance	for conversion between voltage and power, automatic readout of reference impedance from sensor data memory or numerical entry via keyboard or IEC/IEEE bus (for RF probe)
Remote control	IEC 625 (IEEE 488), control of all instrument functions
Interface functions	SH1, AH1, T6, L4, SR1, RL1, DC1, DT1, PP0,
DC frequency input	
Connector	BNC
Input voltage range	±12 V, linear with selectable scale
DC output	
Connector	BNC, R_{out} = 1 kΩ, EMF proportional to analog display
Left-/right-hand full-scale value	corresponding to 0/+3 V
Accuracy	±5 mV
Channels	1, 2
Sensor check source	option R&S NRVS-B1
Output power	1 mW ±0.7%
Frequency	50 MHz
VSWR	1.05
RF connector	N female
General data	
Power supply	115 V +15/–22% (–15%) 47 Hz to 63 (440) Hz; 230 V +15/–22%, 47 Hz to 63 Hz, 13 VA
Dimensions (W x H x D)	219 mm x 103 mm x 350 mm
Weight	3.2 kg

Ordering information

Millivoltmeter	R&S URV55	1029.1701.02
Option		
Sensor Check Source	R&S NRVS-B1	1029.2908.02
Extras		
Rack adapter	R&S ZZA-97	827.4527.00
Transit case for R&S URV55, sensors and accessories	R&S UZ-24	1029.3379.02
Service Kit	R&S NRVS-S1	1029.2708.02

Probes and Insertion Units R&S URV5-Z1, -Z2, -Z4, -Z7, -Z9 for voltage and level measurement

RF Probe R&S URV5-Z7 (photo 40621-10)

DC Probe R&S URV5-Z1 (photo 40621-11)

Brief description

R&S URV5-Z probes and insertion units are indispensable tools for RF and microwave labs, test departments and service. They cover the frequency range from 9 kHz to 3 GHz and thus fill the gap between low-frequency voltage measurement at one end and microwave power measurement at the other end.

All corrections of the rectifier such as linearization, temperature compensation or frequency-response correction are made numerically. Each probe or insertion unit has a built-in calibration data memory with its individual data which are continuously read by the meter.

All AC probes read out the RMS value for unmodulated sinewave voltages.

RF Probe R&S URV5-Z7

A versatile tool for measuring high-frequency voltages. Thanks to its low input capacitance of 2.5 pF ideal for practically no-load measurements on non-coaxial circuits up to about 500 MHz (with accessories up to 1 GHz). Measurement range with plug-on dividers 1000 V (input capacitance 0.5 pF).

Accessory Set R&S URV-Z6

– Plug-on divider 20 dB and 40 dB for extending the measurement range and reducing the input capacitance to100 V/1 pF or 1000 V/0.5 pF.
– BNC adapter for level measurements on coaxial 50 Ω lines (see also Insertion Units R&S URV5-Z2, -Z4).

Adapters R&S URV-Z50 (50 Ω), R&S URV-Z3 (75 Ω)

With integrated termination for power measurements on matched sources.

DC Probe R&S URV5-Z1

Due to its low input capacitance ideal for DC voltage measurements on high-frequency modules.

Insertion Units R&S URV5-Z2 (50 Ω), R&S URV5-Z4 (50 Ω)

Insertion units are used for non-interrupting level measurements between source and load and for power measurements with wide dynamic range. They are made up of a short, reflection-free and low-loss line section with voltage tap and rectifier in the middle of the line.

With a well-matched load, the transmitted power P can be calculated for the measured voltage V_{rms} and the characteristic impedance Z_0 according to the formula $P = V_{rms}^2/Z_0$.

Specifications in brief

The indicated measurement uncertainties are valid in the temperature range 18°C to 28°C. Influences of the basic unit, meter noise, zero error, mismatch and temperature effects (beyond the indicated range) must also be taken into account.

Model	Frequency range Impedance	Voltage measurement range Max. load	Power measurement range Level meas. range	Max. VSWR (reflection coefficient)		Meas. uncertainty in dB (% of voltage)		RF connector
RF Probe R&S URV5-Z7	20 kHz to 500 MHz 2.5 pF/80 kΩ	200 µV to 10 V 15 V (RMS) 22 V (PK) 400 V (DC)	1 nW to 2 W –60/+33 dBm	–	–	0.07 to 1.1	(0.8 to 12)	BNC female/ female[1])
with 20 dB divider (R&S URV-Z6)	1 to 500 MHz 1 pF/1 MΩ	2 mV to 100 V 150 V (RMS) 220 V (PK) 1000 V (DC)	100 nW to 20 W –40/+43 dBm	–	–	1.1 to 1.9	(12 to 20)	BNC female/ female[1])
with 40 dB divider (R&S URV-Z6)	0.5 to 500 MHz 0.5 pF/10 MΩ	20 mV to 1000 V 1050 V (RMS) 1500 V (PK) 1000 V (DC)	10 µW to 20 W –20/+43 dBm	–	–	0.63 to 1.9	(7.3 to 20)	BNC female/ female[1])
with 50 Ω Adapter R&S URV-Z50	20 kHz to 1 GHz 50 Ω	200 µV to 10 V 10 V (RMS) 22 V (PK)	1 nW to 2 W –60/+33 dBm	20 to 50 kHz >0.05 to 50 MHz >50 to 100 MHz >100 to 500 MHz >500 to 700 MHz >0.7 to 1 GHz	1.03 (0.015) 1.03 (0.015) 1.06 (0.030) 1.11 (0.050) 1.22 (0.10) 1.44 (0.18)	0.90 0.12 to 0.20 0.20 0.30 to 0.63 1.0 to 1.4 1.0 to 1.4	(10) (1.3 to 2.3) (2.3) (3.3 to 7.3) (11 to 18) (11 to 18)	BNC female (male)
with 75 Ω Adapter R&S URV-Z3	20 kHz to 500 MHz 75 Ω	200 µV to 10 V 12 V (RMS) 22 V (PK)	500 pW to 1.3 W –62/+31 dBm	20 to 50 kHz >0.05 to 100 MHz >100 to 200 MHz >200 to 500 MHz	1.03 (0.015) 1.03 (0.015) 1.06 (0.03) 1.22 (0.10)	0.90 0.12 to 0.20 0.38 1.10	(10) (1.3 to 2.3) (4.3) (12)	BNC male 2.5/6 male 1.6/5.6 male
DC Probe R&S URV5-Z1	3 pF/9 MΩ	1 mV to 100 V 400 V (PK)	–	–	–	0.013 dB 0.030 dB	(0.15%)[2]) (0.35%)[3])	BNC male
10 V Insertion Unit R&S URV5-Z2	9 kHz to 3 GHz 50 Ω	200 µV to 10 V 15 V (RMS) 22 V (PK) 50 V (DC)	1 nW to 2 W –60/+33 dBm	9 to 20 kHz >20 to 50 kHz >50 kHz to 200 MHz >200 to 500 MHz >500 MHz to 1 GHz >1.0 to 2.0 GHz >2.0 to 3.0 GHz	1.04 (0.02) 1.04 (0.02) 1.04 (0.02) 1.10 (0.048) 1.22 (0.10) 1.35 (0.15) 1.35 (0.15)	0.20 to 0.35 0.17 to 0.20 0.13 to 0.17 0.20 to 0.25 0.25 to 0.30 0.30 to 0.50 0.40 to 0.75	(2.3 to 4) (2.0 to 2.3) (1.5 to 2.0) (2.3 to 2.8) (2.8 to 3.4) (3.4 to 5.6) (4.5 to 8.3)	N female/ male
100 V Insertion Unit R&S URV5-Z4	100 kHz to 3 GHz 50 Ω	2 mV to 100 V 150 V (RMS) 220 V (PK) 1000 V (DC)	100 nW to 200 W –40/+53 dBm	100 to 200 kHz >200 to 500 kHz >0.5 to 3 MHz >3 to 200 MHz >200 to 500 MHz >0.5 to 1 GHz >1 to 2 GHz >2 to 3 GHz	1.04 (0.02) 1.04 (0.02) 1.04 (0.02) 1.04 (0.02) 1.04 (0.02) 1.07 (0.035) 1.07 (0.035) 1.10 (0.048)	0.50 to 1.50 0.25 to 0.60 0.13 to 0.20 0.13 0.17 to 0.20 0.20 to 0.25 0.30 to 0.50 0.45 to 1.05	(5.6 to 16) (2.8 to 6.7) (1.5 to 2.3) (1.5) (2.0 to 2.3) (2.3 to 2.8) (3.4 to 5.6) (5.0 to 11.4)	N female/ male

Ordering information

DC Probe with ground cable, clip tip and BNC adapter	R&S URV5-Z1	0395.0512.02
10 V Insertion Unit (50 W, 3 GHz)	R&S URV5-Z2	0395.1019.02
100-V Insertion Unit 50 Ω, 3 GHz	R&S URV5-Z4	0395.1619.02
RF Probe with case, ground cable, ground sleeve and tape, hook and solder tip	R&S URV5-Z7	0395.2615.02
Accessory Set for RF Probe Plug-on divider 20 dB and 40 dB, BNC adapter 50 Ω, reducing sleeve for divider, ground sleeves and ground tape	R&S URV-Z6	0292.5364.02
50 Ω Terminating Adapter BNC female connector, with adapter to BNC male	R&S URV-Z50	0394.9816.50
75 Ω Terminating Adapter with adapters to BNC, 2.5/6 and 1.6/5.6 connectors	R&S URV-Z3	0243.9118.70

1) With BNC adapter (R&S URV-Z6); maximum power is limited by power loss of the adapter.

2) 1 mV to 100 V.

3) 100 V to 400 V.

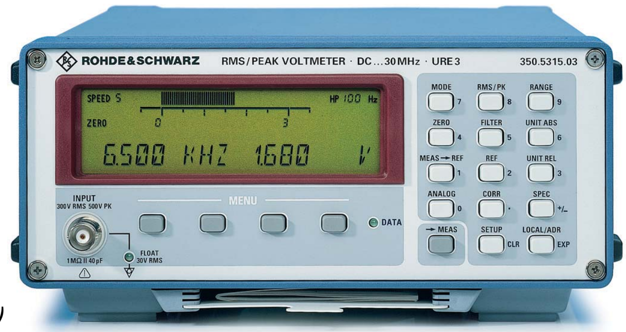
RMS Voltmeter R&S URE2, RMS/Peak Voltmeter R&S URE3

R&S URE2: DC, 10 Hz to 25 MHz

R&S URE3: DC, 20 mHz to 30 MHz

R&S URE2 and R&S URE3:

50 µV to 300 V (AC); 0 to 300 V (DC)



R&S URE3 (photo 43236)

Brief description

R&S URE2 is a broadband RMS voltmeter featuring extremely high accuracy and speed. A patented rectifier circuit allows measurement of signals with a crest factor of up 7 and frequencies of up to 25 MHz. RMS/Peak Voltmeter R&S URE3 further enhances the range of applications due to its greater frequency range and higher accuracy, built-in frequency counter and additional peak-responding rectifier.

Fields of application

- Level measurements in audio range
- Interference measurements on switch-mode power supplies
- Measurement of extremely fast dialling signals and detection of simultaneously transmitted supply voltages in radiotelephony
- Automatic quality control of audio and video tapes
- High-frequency measurements in digital magnetic storage and optical data storage
- Peak weighting in video measurements (sync signals)
- Secondary calibration standard

Main features

- True RMS weighting for AC and AC + DC
- More than 30 measurements/s
- 4½-digit display and analog display with selectable scale
- Very high measurement accuracy
- Highpass and lowpass filters
- Relative measurement, maxima/minima
- Convenient menu-guided operation
- Use of commercial probes, taking into account their division factor in the displayed result
- IEC bus (IEEE488)

Additional features of R&S URE3

- Peak-value measurement (positive, negative, peak-to-peak) without tilts and overshoots
- Fast RMS measurement even of very low-frequency signals
- Frequency measurement up to 30 MHz
- Ultrahigh measurement accuracy through automatic frequency response correction
- In/out option: dual-channel analog output, ready output, trigger input, TTL frequency counter input

Characteristics

Measurement accuracy

A patented rectifier circuit with microprocessor-controlled autocalibration makes for the outstanding measurement characteristics of R&S URE2 and R&S URE3. In order to further enhance the accuracy, correction factors are determined for each instrument and measurement range and stored in a nonvolatile memory.

A zero function allows noise voltages and the inherent noise to be compensated for, the measurement accuracy being thus increased in particular at low levels.

The measured frequency value is used by R&S URE3 for an internal frequency response correction. This method increases the accuracy mainly at the higher frequencies. Distortion-free measurement of signals is ensured by:

- high input impedance
- low input capacitance
- highpass and lowpass filters that can be switched in to suppress hum or high-frequency noise voltages

Specifications in brief: R&S URE2

Measurement functions	RMS value, DC voltage
Range selection	automatic or manual
Input/impedance	BNC connector, floating/1 MΩ || 40 pF
Display	LCD, 4½-digit readout, digital and analog in V, W, dBV, dBm, dBµV or dBu; difference, deviation in % or dB and ratio to a reference value
Remote control	to IEC625-2

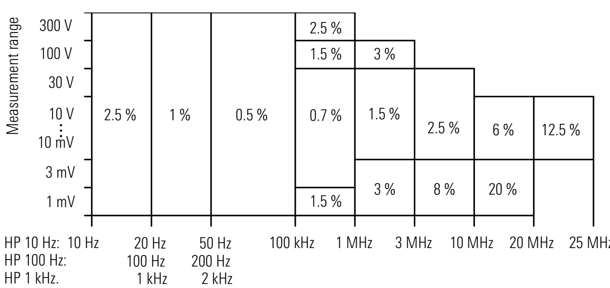
Specifications in brief: R&S URE2

RMS measurement

Voltage measurement range	50 mV to 300 V
Ranges	1 mV to 300 V, 10 dB steps
Maximum reading	3800 or 12000 counts
Frequency range AC coupling	10 Hz to 25 MHz
Frequency range AC + DC	DC, 10 Hz to 25 MHz
Selectable lowpass filters	20 kHz, 100 kHz Butterworth (3 dB cutoff freq., 40 dB/decade)
Selectable highpass filters	10 Hz, 100 Hz, 1 kHz (lower meas. limit, AC component in AC + DC)
Time of triggered measurement	32 ms to 1.3 s (selectable; shortest meas. time with 1 kHz highpass only)
Maximum crest factor (S)	7 for nominal range
Measurement uncertainty for non-sinusoidal voltages (spectral components up to 25 MHz)	S <5: <1%, S <7: <3% (for S <3: included in basic error)

DC voltage measurement, general data same as R&S URE3

DC voltage measurement	see R&S URE3
General data	see R&S URE3



Accuracy of RMS measurement (T_{amb} = 23 ±5°C), plus 10 counts for DC coupling (inherent noise taken into account by zero function)

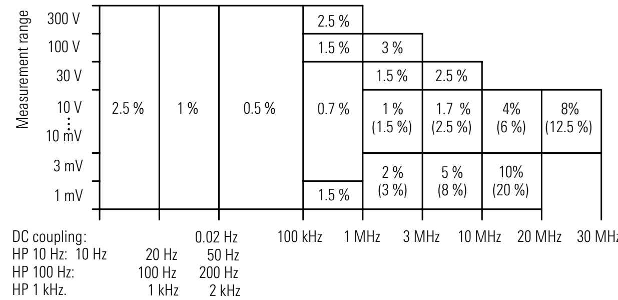
Specifications in brief: R&S URE3

Measurement functions	RMS/peak value, DC voltage, frequency
Range selection	automatic or manual
Input	BNC connector, either floating or grounded, switch-selectable
Input impedance	1 MΩ || 40 pF
Display	backlit LCD, $4^1/_2$-digit level and 5-digit frequency indication, digital and analog in V, W, dBV, dBm, dBmV, dBu or Hz; difference, deviation in % or dB and ratio to a reference value
In/out option	two simultaneous analog outputs (level and frequency), frequency input, trigger input, ready output
Remote control	to IEC 625-2

RMS measurement

Voltage measurement range	50 mV to 300 V
Ranges	1 mV to 300 V, 10 dB steps
Maximum reading	3800 or 12000 counts
Frequency range AC coupling	0.02/10/100/1000 Hz to 30 MHz
Frequency range AC + DC	same as AC coupling, plus DC compon.
Selectable lowpass filters	same as R&S URE2, plus 1 MHz Bessel
Selectable highpass filters	same as R&S URE2
Time of triggered measurement	32 ms to 60 s (selectable; shortest meas. time with 1 kHz highpass only)
Maximum crest factor (S)	7 for nominal range

Measurement uncertainty for non-sinusoidal voltages same as R&S URE2



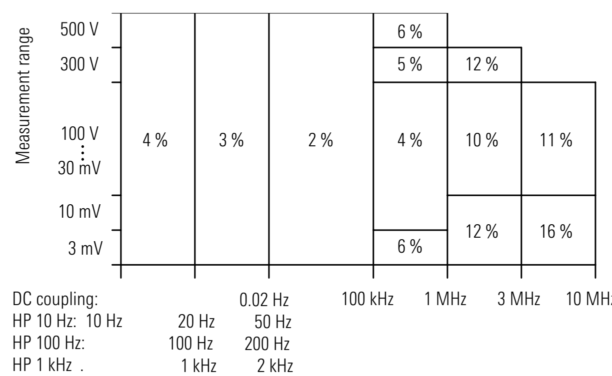
Accuracy of RMS measurement (T_{amb} = 23 ±5°C), plus 10 counts for DC coupling (inherent noise taken into account by zero functions); values in parentheses without frequency response correction

Peak measurement

Voltage measurement range	0.1 mV to 500 V
Ranges and resolution	3 mV to 1000 V, 10 dB steps
Maximum reading	1200 or 3800 counts
Frequency range AC coupling	10/100/1000 Hz to 10 MHz
AC + DC	DC, 0.02 Hz to 10 MHz
Selectable highpass/lowpass filters	same as RMS measurement
Time of triggered measurement	65 ms to 60 s (selectable; shortest measurement time with 1 kHz highpass or DC coupling only)

Frequency measurement

Frequency range	0.02 Hz to 30 MHz
Display	5 digits
Time of triggered measurement	75 ms to 60 s (selectable)
Sensitivity	min.10 dB below nominal range



Accuracy of peak measurement (T_{amb} = 23 ±5°C), sinewave signal

DC voltage measurement

Voltage measurement range	0 to ±300 V
Ranges	10 mV to 1000 V, 20 dB steps
Maximum reading	12000 counts
Time of triggered measurement	32 ms to 60 s (selectable)
Accuracy	±(0.1% of rdg +10 counts)

General data

Power supply	100/120/240 V ±10%, 230 V –10%/+6% 47 to 440 Hz (25 VA)
Dimensions (W x H x D); weight	219 mm x 103 mm x 350 mm; 4.5 kg

Ordering information

RMS Voltmeter	R&S URE2	0350.5315.02
RMS/Peak Voltmeter	R&S URE3	0350.5315.03
Input/Output Option	R&S URE3-B2	0351.1513.02

Digital Multimeter R6552

High-speed and high-resolution true RMS digital multimeter

Brief description

R6552 is a high-speed and high-resolution true RMS digital multimeter which can be used for instance for measuring the current consumption of mobile phones. The product is ideal for integration into test systems and its various measurement modes allow reliable determination of current consumption of mobile phones in different operating modes.

Main features

- Display range up to 319999 (5½ digits)
- Full remote-control capability via IEC/IEEE bus and RS-232-C
- 12 different settings for measurement of DC voltage/current, AC voltage/current, 4- and 2-wire resistance, frequency and diodes
- Resolution of 0.1 μV or 100 μΩ for resistance measurements
- True RMS measurement of AC voltage/current even of distorted waveforms
- Measurement of DC component of AC+DC currents or voltages
- Max. sampling rate 1000 sample/s
- FAST, MED and SLOW setting modes
- BURST and LONG-IT modes for measurement of standby current of PDC, PHS and other mobile phones
- External trigger input, end-of-measurement signal output
- NULL adjustment, smoothing, range selection, dB/dBm display, comparator function and MAX/MIN functions
- High-speed autoranging
- High-intensity fluorescent display

Specifications in brief

Max. display range	319999 (5½ digits)
Resolution for DC voltage measurement	0.1 μV
Resolution for resistance measurement	100 μΩ
Max. sampling rate	1000 sample/s (for BURST measurement)
Accuracy	
DC voltage	±0.01% of reading
AC voltage	±0.06% of reading
DC current	±0.05% of reading
Integration time for averaging repetitive signals	can be set in steps of 10 ms between 100 ms and 60 s
GPIB and RS-232C interfaces	standard
Data memory	for up to 10 000 measured values
Memory	for four instrument settings

Ordering information

Digital Multimeter	R6552

Universal Counter R5362B

High-quality universal counter for general-purpose laboratory use up to 3 GHz

New

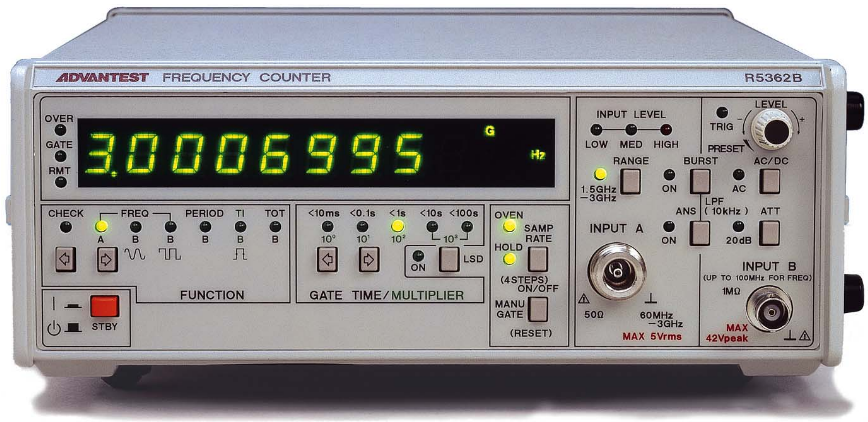


Photo 43900-1

Brief description

The R5362 is a high-grade universal counter for general-purpose laboratory and field use up to 3 GHz. Optional reference oscillators afford stability of up to 5 x 10^{-10}/day. A great variety of settings is available to facilitate measurements, control and analysis and to reduce measurement times.

Main features

- 9-digit display with 2 digits overflow
- 10 mV sensitivity up to 900 MHz
- Reciprocal method up to 1 MHz for short measurement times, e.g. 0.1 Hz resolution of 100 kHz signal for 1 s measurement time
- Masking function for precise time interval measurements of noisy signals and signals with superimposed noise pulses, e.g. relay bounce
- High-frequency signal input A allows burst signal measurement by synchronizing the time gate signal to the burst signal. Accuracy can be further enhanced by setting a delay
- Lowpass filter of low-frequency input B suppresses noise signals
- Input C incorporates RF protective fuse against high input levels
- Auto trigger facilitates instrument setting
- The counters are available with either GPIB plug-in interface or BCD output for automatic test assemblies
- In addition to AC supply operation, the counters can be operated from DC supply of +10 V to 30 V
- The use of Calculation Unit TR1644 as an external accessory adds further analysis functionality, e.g. arithmetic operations between the two signal inputs, frequency deviation, comparator function and min./max. value storage

Options

Reference Timebase

- Standard stability
  - 5 x 10^{-8}/day, 2 x 10^{-7}/year
- Stability with option
  - 20: 2 x 10^{-8}/day, 1 x 10^{-7}/year
  - 21: 5 x 10^{-9}/day, 8 x 10^{-8}/year
  - 22: 2 x 10^{-9}/day, 5 x 10^{-8}/year
  - 23: 5 x 10^{-10}/day, 2 x 10^{-8}/year

Universal Counter R5362B

Specifications

Frequency

Frequency range	
Channel A	60 MHz to 3 GHz
Channel B	0.2 mHz to 100 MHz (1 MΩ)
Frequency accuracy	± timebase ± 1 digit
Frequency display/digits	9, with 2 digits overflow
Frequency resolution	
Channel A	6-digit/1 to 9 ms gate time 9-digit/1 to 9 s
Channel B	µHz to kHz
Gate times	10 ms to 100 s
Clock rate	10 ms, 80 ms, 320 ms, 2.5 s, HOLD
Period measurement	10 ns to 5000 s, channel B
Resolution	see frequency, channel A
Time interval measurement	200 ns to 9000 s, channel B
Event counting	0 to 10^{10}, DC to 50 MHz

Reference frequency (timebase)

Stability standard	5×10^{-8}/day, 2×10^{-7}/year
Option 20	2×10^{-8}/day, 1×10^{-7}/year
Option 21	5×10^{-9}/day, 8×10^{-8}/year
Option 22	2×10^{-9}/day, 5×10^{-8}/year
Option 23	5×10^{-10}/day, 2×10^{-8}/year
Reference frequency output	10 MHz, 1 V_{pp}, 50 Ω
External reference input	1, 2, 5, 10 MHz, 1 to 5 V_{pp}, 500 Ω

Input voltage

Channel A	
f <900 MHz	10 mV to 5 V_{pp}, (+27 dBm)
900 MHz < f < 1500 MHz	20 mV to 5 V_{pp}, (+27 dBm)
1500 MHz < f < 2800 MHz	35 mV to 5 V_{pp}, (+27 dBm)
2800 MHz < f < 3000 MHz	50 mV to 5 V_{pp}, (+27 dBm)
RF attenuator	20 dB, automatically switched in for signals >500 mV_{rms}
Overload protection	12 V_{rms}
Level monitor	low, medium, high
Channel B	
RF attenuator 0 dB	
f <10 kHz	25 mV to 10 V_{rms}
10 kHz to 60 MHz	25 mV to 1 V_{rms}
60 MHz to 100 MHz	25 mV to 500 mV_{rms}
RF attenuator 20 dB	
f <10 kHz	500 mV to 100 V_{rms}
10 kHz to 60 MHz	500 mV to 10 V_{rms}
60 MHz to 100 MHz	500 mV to 5 V_{rms}

Input impedance

Channel A	50 Ω
Channel B	1 MΩ, 25 pF
Trigger (channel B)	–1.2 V to +1.2 V, continuously variable
Noise suppression	
Channel A	automatic, ANS
Channel B	10 kHz lowpass filter, switch-selected

General data

Display	7-segment green LED
Settings memory	1
Analysis functions	with Calculation Unit TR1644: comparator, frequency offset, difference, frequency deviation, standard deviation max./min. value storage, ppm deviation, average value, arithmetic operations
Nom./operating temperature range	0°C to +40°C
Storage temperature range	–20°C to +70°C
Power supply	200 V to 240 V AC ±10%, 100 V to 120 V AC ±10%, 48 Hz to 440 Hz
Power consumption	approx. 50 VA, DC 30 W
Dimensions (W x H x D)	240 mm x 88 mm x 360 mm
Weight	approx. 4.5 kg

Ordering information

Universal Counter

0.2 mHz to 3 GHz	R5362B

Extras

Calculation Unit	TR1644
GPIB Plug-In Interface	R13002B
Carrying Case	R16204A
Front Cover	A02801

"System integration with the aid of software and engineering efforts will be given more emphasis than ever before – and the development of powerful and convenient system solutions take on importance." (photo 43443-13)

Contents of Chapter 9

The future lies with systems

Customer-specific solutions are implemented to an increasing extent by integrating measuring instruments and specially developed devices into overall systems. This is proven by the valuable experience made with turnkey EMC test centers, type-approval test systems for mobile phones of digital radio networks, mobile test systems for coverage measurements and mobile phone production lines.

System applications

In numerous branches of industry measurements and tests often have to be carried out repeatedly on a series of DUTs, e.g. in:

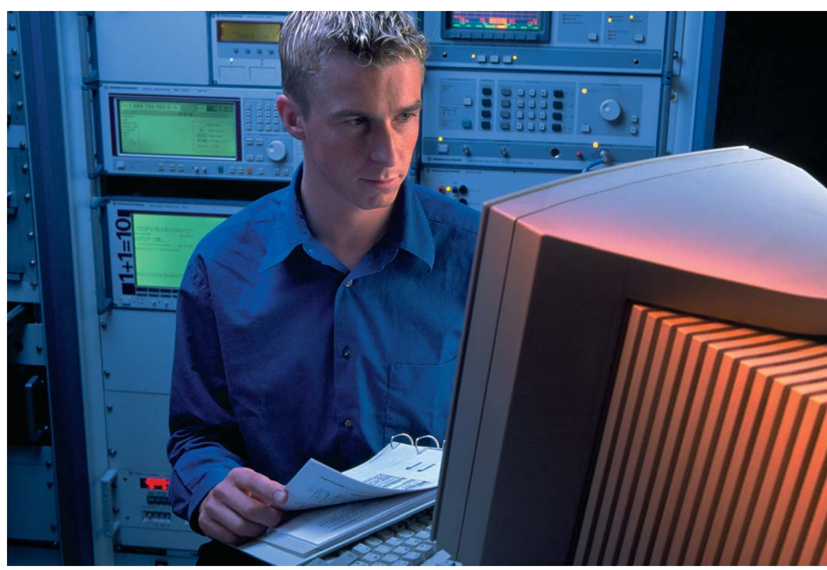
- Incoming inspection: component or module tests
- Production: automatic alignment
- Quality assurance: testing at the various stages of production and final testing
- Research & development: series measurements on prototypes
- Service: long-time measurements (such as temperature) at defined test intervals

The quantity of devices under test required to make investments and software development worthwhile depends on the complexity of the measurement task. The necessary expenditure may even be justified for a few DUTs if a measurement is to be continuously repeated, e.g. at many different frequencies (intermodulation measurement of antenna amplifiers), or if a parameter is to be monitored as a function of time (long-term drift).

Project handling by R&S

A high-performance measurement system requires extensive development and design efforts. The choice of the right instruments and components as well as their careful installation make for the high performance and availability of a system.

System design at Rohde & Schwarz ensures full utilization of a large variety of measuring instruments of advanced technology and highest precision both of Rohde & Schwarz and other make. System responsibility lies always with Rohde & Schwarz, irrespective of the origin of the measuring equipment and individual system components.



Rohde & Schwarz has experienced and optimally trained staff to implement a project from initial planning through to the operational system.

Our range of test systems

- Production test systems, board testers
- Type-approval test systems for mobile phones
- Coverage measurement systems for all modern radio networks
- EMC test systems and test centers

Production test systems, board testers – a strong concept

A development and production chain is only as strong as its weakest links which used to be highly complex measurement systems and time-consuming final testing. Market launch of the products was thus held up. Today, production test systems and type-approval systems from Rohde & Schwarz can be used wherever electronic equipment is produced. Efficient solutions in this field range from precompliance test equipment through to complete production lines. In addition to the classical method of board testing, there are also completely new methods such as optical checking. The unique modular hardware and software concept of Rohde & Schwarz allows a large variety of test combinations with respect to alignment, RF test, optical check, board test, etc.

Our production test systems are tailored to the needs of the customers and provide overall solutions: measurements with DUT adaptation up to 2 GHz via test prods; with conveyor belts; networking within user-specific computer network; logistics; consulting and advice in the selection of suitable tests for optimization of measurement times and test depth.

Type-approval test systems for mobile phones of analog and digital radio networks

Test systems from Rohde&Schwarz, especially for type-approval testing, are at the leading edge in their field. Our customers are benefiting from this high innovation potential. Specialists at Rohde&Schwarz have implemented well in-time the latest requirements for type-approval measurements in the appropriate test systems and were able to use ultramodern measuring equipment off our production. This synergy of available equipment and new system applications brings about optimum results. Thus it is for instance possible to achieve maximum test depth while ensuring the highest degree of ergonomics and operational reliability. And another great advantage is self-calibration. This means a whole bundle of benefits which the customer can utilize to make his products fit both for the future and present-day market.

Coverage measurement systems for all modern radio networks

Test systems from Rohde&Schwarz are not only used where electronics is produced but also where it is made to "work": in mobile radio networks for instance. Our range of mobile coverage measurement systems ensures full monitoring of analog and digital radio networks as well as smooth and best possible operation.

EMC test systems and test centers

Rohde&Schwarz supplies complete EMC test systems covering all aspects of this complex field. The manufacturer need no longer combine individual instruments – systems will do it. Whole EMC test chambers? No problem for Rohde&Schwarz: after handing over the turnkey system, all your staff trained by us has to do is to switch on the DUT and the test will be carried out fully automatically. This is to the benefit of test houses as well as manufacturers performing comprehensive EMI and EMS measurements themselves. The test systems from Rohde&Schwarz check for full compliance with all relevant standards.

Future-oriented design

Measurement and test systems from Rohde&Schwarz feature extremely flexible hardware and software concepts allowing adaptation to modified requirements any time.

Support

Test stations from Rohde&Schwarz are powerful instruments for increasing productivity in automated production. Rohde&Schwarz products include a complete service package, which allows the full performance of the system to be utilized from the very first day. This package includes training, application support, maintenance, fixture design, 24-hours spare parts service and a telephone hotline.

References

Measurement and test systems from Rohde&Schwarz are used to success all over the world: tailored to the needs of the customers, the test systems can be found at renowned industrial companies, test houses and government institutes – the impressive list of references can be supplied on request.

Service for systems

First-hand service

Rohde & Schwarz systems combine the latest achievements in hardware and software with the knowhow and experience gained over many decades. According to the Rohde & Schwarz system philosophy, the high level of competence does not stop with system development but is maintained during the operational life of the systems in terms of the services offered.

Hotline support, continuous updating of system software, fast replacement and repair of equipment and modules in case of a fault are essential prerequisites for high availability of an operational system.

Rohde & Schwarz offers complete packages and solutions for servicing the systems. The service concept is of modular structure and consists of unit blocks providing a whole series of services for hardware and software.

Services available

During warranty period

- Enhanced warranty service
  - Problem report service
  - Hotline service
  - Access to a pool of spare modules
- Calibration service

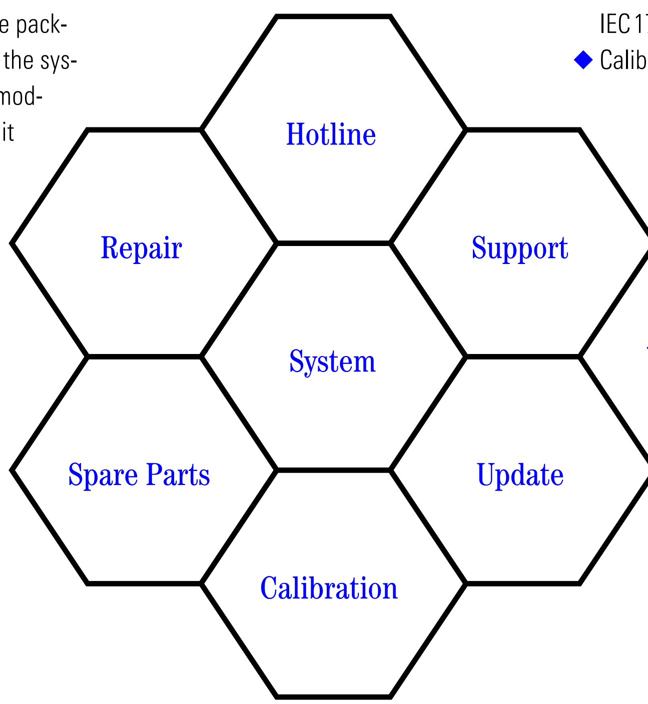
After warranty period

- After warranty service
  - Problem report service
  - Hotline service
  - Access to a pool of spare modules
- Software service
- Calibration service

Service products

Enhanced warranty service

The enhanced warranty service supplements the standard warranty services of Rohde & Schwarz to satisfy already during the warranty period the high demands placed on system availability and offers a service time of eight hours and defined response time.



- Database-supported information system with direct customer access
- Hotline service
- Access to a pool of spare modules
- On-site repair, if necessary
- Escalation procedure

After warranty service

The after warranty service contains all the unit blocks of the enhanced warranty service plus the following:

- Repair of faults
- Supply of software updates

Calibration service

The calibration service assures you that the parameters of your system will be checked at regular intervals and corrected if necessary.

- Calibration by an accredited calibration laboratory in line with EN ISO/ IEC 17025
- Calibration at specified calibration intervals in line with DIN EN ISO 9001
  - Traceability of calibration to national or international standards
  - Calibration reports and certificates
- On-site calibration possible

Production Test Systems – Contents

Designation	Type	Description	Page
Test Workstation	R&S TSA	Extremely compact board test system, adaptable to complexity of units under test and test requirements	396
Universal Test System	R&S TSU	Extremely versatile solution for automated testing, system platform for functional test systems	399
Production Test System Software	R&S TSS	High-level test language R&S TSL, for use under Windows NT on PCs	400
Production Test Systems	R&S TS 7100 R&S TS7180	Scalable solutions from low-cost standard system to turnkey production system	404
Bluetooth Productions Test System	R&S TS7160	The complete manufacturing test solution for all *Bluetooth* products	408
Production Test Platform	R&S TSVP	Standardized modular platform for the adaptation and electrical testing of subassemblies and units in production environments	410
Communication System Panel	R&S TS-CSP	Easy and fast integration of measuring instruments into production testing	412
Universal Relay Card	R&S TS-PRL1	Production test of communication, automotive electronics or general industrial electronics	414
Extreme Temperature Tester	R&S E-Line	Temperature tests on wireless components in a shielded environment	415

Quality is measurable and testable

Quality management
Quality management is one of the central aspects of modern electronics production. Whatever the size of the company, the quality of the products depends on the electronic components functioning perfectly. The introduction of lean production methods has placed new and greater demands on automatic testing techniques.

Economy

Product quality, product liability
Today, excellent product quality is not only important in giving the edge in international competition but also saves cost. Our test systems help to eliminate defects early in production, thus preventing the high costs involved in the removal of defects in the final stages of production or after delivery to the customer.

In-depth testing is possible due to the wide range of precise measuring facilities provided by the workstations and test stations from Rohde & Schwarz, so faults can be detected early in production and their cause removed immediately.

Start small – upgrade later

Test stations from Rohde & Schwarz are more than simply autonomous testers – they have specifically been designed for integration into development, production and service. Fixtures and programs can be exchanged directly between the testers. The systems can thus be used to maximum effect: all test stations can be utilized optimally at all times; if the unit under test is large, subsequent upgrading to larger systems is no problem; fixtures can be adopted for servicing at any time.

Due to the modular design of the Rohde & Schwarz test stations, investment decisions can be made to satisfy the requirements of today, and, at the same time, options be left open for expanding capacity or testing new products as well as for incorporating future test strategies or supplementary test facilities at a later date. Investments, costs of adaptation and running costs of the test stations can be optimized for different products and production methods.

Low follow-up costs
Budget-priced fixture sets can be offered thanks to a standardized fixture interface. Thus costs of adaptation are low, which is of major importance for products manufactured in small quantities only. The reliable and easy-to-service concept ensures high availability, so running costs are reduced to a minimum.

Electrical in-circuit test

Strategy
The electrical in-circuit test for a board checks all connections and the individual components independent of their environment.

This tried-and-tested method is an extremely reliable means of detecting and diagnosing the majority of typical manufacturing defects, such as shorts, opens, soldering and insertion defects. The influence of neighbouring components can be eliminated to a large extent, and a high degree of precision achieved, by means of 2-, 3-, 4- or 6-wire measurements, guarding and in-phase quadrature

Production Test Systems – Test strategies

measurements. The measured values are stabilized, even under unfavourable conditions, by averaging, autocalibration and autodelay technique. The depth of testing is far superior to that of conventional prescreeners.

The electrical in-circuit test checks the following:

- Contact
- Shorts and opens
- Resistances, inductances and capacitances
- Impedances by magnitude and phase
- Diodes, Zener diodes, LEDs
- Transistors (current amplification)
- IC contacting with vectorless procedure
  - ICC (measurement of diodes)
  - Stick probe (capacitive sensor)
- Multipole components such as potentiometers, relays, operational amplifiers, optocouplers

Hybrid in-circuit test

Strategy

This test serves for checking digital and hybrid (mixed analog/digital) boards from simple to complex VLSI boards. The digital tests check the functions of each digital IC and the correctness of insertion. The influence of neighbouring components is eliminated by means of controlled backdriving, digital guarding and disabling.

Procedure

Functional and digital in-circuit tests, wide-ranging patterns with high clock rate of up to 10 MHz, test voltage up to ±15 V or 0 to 30 V, algorithmic patterns with loops, subroutines and conditional branches.

- All the procedures of analog in-circuit test
- Bus test and automatic diagnosis in the event of bus conflicts
- Signature analysis (CRC) for RAMs, PROMs
- Cluster test

Vectorless IC test

Analog and digital ICs, for which a test model is not available in the library (customer-specific circuits, FPGAs, etc), are tested by measurement using analog vectorless methods. The aim of this test is to verify that all component pins are soldered and that it is the correct IC with the correct orientation.

IC check method

Node impedance measurement:

Measurement of the ohmic resistance of each pin to GND and VCC. If all parallel circuits are relatively high impedance with respect to the pin, a significant difference is shown if the pin is not soldered or the IC twisted.

- Very fast method
- Does not work with bus nodes
- Free of charge (standard test function)

Stick-Probe method

Contact-free method:

A sensor positioned above the IC detects the current flowing through the IC-Pins.

- Also works with bus nodes
- Very high recognizing of shorts even at NC pins

Combined IC check and Stick-Probe

- First all "simple" nodes are checked with the aid of the IC check method (minimum debug effort, no additional mechanical parts)
- All other nodes are tested by Stick-Probe

Analog functional test

Strategy

Defined analog input signals are applied to the unit under test and the output signals are measured. This test checks all functions of the UUT and the interaction of its components.

Procedure

Rohde & Schwarz test stations provide all standard signals and measurement functions via appropriate stimulus and measurement modules. The signals are accessible either via very short paths at special fixed pins, or via the signal bus and the switch module at any pin.

The modules are equipped to trigger and synchronize with each other, the UUT, or external instruments. External IEC/IEEE bus instruments can be connected to the test stations.

Digital functional test

Strategy

The digital functional test checks all functions of a digital circuit as close as possible to operating conditions.

It covers all technologies from SSI to VLSI, microprocessors, ASICs and SMDs. Digital input patterns are applied, and the output signals are measured and compared with the reference patterns.

Production Test Systems – Test strategies – Overview of R&S TSA System Family

Due to the varying complexity – from simple to complex VLSI boards – and the widely differing timing requirements, the user is given the opportunity of choosing the most economical of the various testing procedures available. The type of fixture can thus also be varied via the connectors of the UUT, the bed-of-nails (including 2-stage fixture), a clip or probe.

Procedure

Overall functional test with reference patterns: digital patterns (vectors) are applied to the connections of the UUT in realtime mode and with a high clock rate; the response is then measured and compared with the reference values. The patterns can be generated algorithmically with loops, subroutines and conditional branches, whereby the program flow is determined by the UUT.

- The cluster test checks the functions of associated parts of a circuit. Subdividing the circuit into several different parts makes the tests simpler and more transparent. The clusters are isolated by means of backdriving
- Signature analysis is used to measure complex patterns and check them in reduced form
- Logic-state display performs the function of a logic analyzer during debugging and when unknown signals are recorded

Combinational test

The combinational test unifies various test strategies in a single tester with one program and one fixture, eliminating the handling time for separate testers. The user can select a combination which is specially tailored to his needs. This concept allows the peculiarities of customer-specific requirements to be taken into account, for instance the production environment, production quality, test strategy, complexity of UUT and special factors such as stipulated or impermissible test procedures, inaccessible nodes or varnished boards.

Mobile radio – a dynamic market

The mobile radio market is undergoing dynamic changes and 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

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.

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.

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.

Test Workstation R&S TSA

R&S TSA – extremely compact board test system, adaptable to complexity of units under test and test requirements

Stimulus and measurement modules are inserted into the rear of R&S TSA (photo 38860)

Brief description

Test Workstations from the R&S TSA Family are powerful benchtop test systems for testing loaded printed circuit boards and modules in production and service. The test workstations meet the test requirements of industrial and consumer electronics sectors, such as communications, measurements, control engineering, automobile and accessories industry. R&S TSA systems are suitable both for small-batch production entailing boards of many different types, and mass production.

Main features

- In-circuit, functional or combinational tests
- Low initial investment making for excellent price/performance ratio
- Low costs of adaptation due to automatic program generation
- Low repair costs of UUTs thanks to automatic fault diagnosis
- Paperless repair and quality management
- High throughput
- In-depth testing and fault location
- Easy integration into systems thanks to 19" design
- Networking with CIM
- Compatible with Rohde&Schwarz tester family R&S TSU
- Fast amortization

Design

Test unit

The test unit is the core of the system; it has 23 slots for accommodating the stimulus and measurement modules, a fixture interface with support plate and a UUT and system power supply. Extremely short signal paths ensure high-quality signal transmission between UUT and measurement modules. Due to its VLSI design, the 19" unit features on a minimum of space a maximum of measurement capabilities that were previously not possible. Moreover, the R&S TSA is ergonomically designed and satisfies even the most stringent requirements regarding operating convenience.

Fixture concept (pylon system)

The proven fixture system transfers the signals between measurement modules and UUT. User-specific connectors can be plugged into three free ports of the fixture interface. The type of fixture is determined by the selected test strategy and the UUT. Two vacuum connectors with built-in valves allow single-chamber, double-chamber or two-stage fixtures with bed-of-nails to be used.

Test Workstation R&S TSA

Pneumatic, mechanical or double-sided SMD fixtures are also available. When fixtures are used that make contact with the UUT via the connectors, in-depth measurements can be made within the circuit via clips and a probe.

Modules
The modules inserted into the 23 slots determine the measurement functions. The control module performs general transfer and control tasks. The remaining 22 slots can be filled up from a selection of 24 analog stimulus and measurement modules, digital modules, switch and application modules so that practically any requirement can be fulfilled. Distributed intelligence achieved by integrated processors on different modules makes for high measurement speed.

Expansions
For special applications, external devices can be controlled via the IEC/IEEE bus which is fitted as standard. The signals are connected via various switch modules (DC, AC, video and power up to the line-voltage range) and routed to the fixture and UUT via suitable contacts. The user can integrate special circuits into the test workstation using a universal application module.

DC source	up to 10 V/200 mA, 4-quadrant operation
Voltage sources	up to 10 V/5 mA (2 ea.)
High-voltage buffer	up to –100 V to +100 V (200 V V_{pp})/10 mA/10 kHz
Isolation amplifier	±10 V/5 mA/10 kHz
Voltage/current measurement unit	up to 100 V DC/AC max. 1 A
Voltage measurement unit	up to 500 V DC/AC
Arbitrary waveform generator	up to 20 V V_{pp}/16.8 M sample/s, 2 channels (with high-voltage buffer and isolation amplifier up to 200 V V_{pp} floating)
Waveform analyzer	max. 500 V V_{pp}/10 MHz sampling rate 2 channels with timing measurement unit
Integrated switch matrix	12 analog busses, 8 trigger busses

Measurement configuration

AMV configuration (can be retrofitted in existing systems)
All systems of the R&S TSA family are equipped with the multifunction module AMV (R&S TSS 5.0 or higher required). In addition to a complete high-speed in-circuit measurement unit the AMV features comprehensive functional test capabilities in the DC/AF range covering practically any requirements (see table). An intelligent trigger concept allows extensive test sequences to be executed in absolute real-time. The unique search and analysis functions of the dual-channel waveform analyzer that are included in the module's firmware are top features and outperform many an oscilloscope.

AMV completely fits into the existing range of modules. It can be used instead of the VMM/CMM/DCS modules to replace the in-circuit measurement unit (existing in-circuit test programs can still be used with minor modifications) or used in addition, allowing practically any combination with the simultaneous use of up to four AMV modules in a system. The in-circuit measurement unit made up of the VMM/CMM/DCS modules or of the AMV covers three or two slots in the front.

With this range of comprehensive measurement functions implemented for the first time in the AMV and downloading of the complete operating firmware, AMV is setting new standards in terms of functionality, compact size and future-proof design.

Analog in-circuit test
- Voltage and current measurement modules VMM, CMM for DC voltage measurement from 80 µV to 100 V and DC current measurement from 8 nA to 256 mA
- Alternatively: AMV (see AMV configuration)
- DC stimulus module DCS as a four-quadrant current/voltage source up to 25.6 V and 200 mA (can also be used in addition to AMV)

Test Workstation R&S TSA

Hybrid in-circuit test

- Analog in-circuit measuring unit (VMM, CMM, DCS or AMV)
- Timing and address modules (TIM, ADM) for realtime control of timing and sequences of dynamic digital test (see digital functional test)
- Driver/sensor/switch modules

Analog functional test

- Analog multifunction module AMV (see explorer configuration)
- Voltage source module (VSM): provides four floating programmable sources up to 10 V. Two of them can be used for programming the programmable power module (PPM)
- DC stimulus module (DCS)
- Fixed voltages 5 V/8 A, 2 x 12 to 15 V/ 2 A (resistance programming)
- Programmable power module (PPM) 2 x 4.5 to 30 V/1 A (with VSM)
- External power supply units up to 100 V/10 A
- Secondary matrix module (SMM) for universal pins
- Instrument multiplexer module (IMM) for connection of external devices to hybrid switch equipment
- Input/output module (IOM) for switching and control tasks with input/output ports and assignable relays
- Application module (APM) for switching AC supply modules and user-specific expansion. Additional circuits can be fitted on this module or external devices be driven via opto-decoupled inputs/outputs
- Application relay module (ARM) with 32 assignable relays for analog and digital signals as well as 4 relays for AC voltage

Maximum configuration for analog in-circuit test

Switch modules	Pins/module	Slots/module	No. of modules	Maximum No. of pins
SMH	64	1	max. 19	1184

Maximum configuration for hybrid in-circuit test

Module	Test rate	Test voltage	Multiplex	Pins/module	Max. config.
Driver/sensor/ switch module DSH	10 MHz	±5 V	1 : 4	64 hybrid pins	1088 hybrid pins

Overview of driver and sensor modules

Driver/sensor module	Max. test rate	Max. level	Channels/ module	Max. No. of modules	Max. No. of channels
DSH	10 MHz	±5 V	16	17	272
DSH	10 MHz	±5 V	16	17	272

Digital functional test

- Timing module (TIM), vector rate up to 10 MHz, resolution up to 10 ns, 2 clocks, external synchronization up to 50 MHz
- Address module with subroutines, loops, branches, conditional branches for almost unlimited pattern lengths; synchronization with external events
- Driver/sensor module DSH for two logic families; pin memory 4 K (5 bits), signature analysis, start/trigger/clock, pull-up/down, programmable slew rate, format selection, pin-by-pin logic analysis

Operation

Data entry, programming and debugging are made via the alphanumeric keyboard of the computer and the mouse. In the series test mode, the control panel is used to start programs, answer queries or control the vacuum. The program is selected automatically via barcode or using the fixture codes, so that even untrained personnel will be able to operate the testers after a brief training.

Universal Test System R&S TSU

Versatile solutions for automated testing

Photo 42319

Brief description

Universal Test System R&S TSU is an extremely versatile solution for automated testing. With the aid of a large variety of modules, the basic unit consisting of a module mainframe and a power supply can optimally be configured for any test application. The system features comprehensive test strategies such as functional test, combinational test, testing of power supplies, electronic power circuits, ISDN products through to the classical in-circuit test. A novel feature is that all test strategies can be combined with RF measurements (up to 4 GHz via a standard fixture). Due to its compact design and high modularity, the R&S TSU is also ideal for use as a basic unit for application- or branch-specific test systems.

Design

Universal Test System R&S TSU consists of a mainframe (for max. 13 modules), a system power supply, a 5 V/5 A UUT power supply and an optional low-power UUT power supply as well as an optional vacuum valve for use with exchangeable vacuum fixtures.

A customer-specific connector panel for the connection of signal lines to external IEC/IEEE bus devices is located in the upper section of the mainframe.

The necessary wiring to the functional test modules and the switching modules which are located in the lower section of the mainframe is implemented in the fixture.

The functional test and switching modules are plugged into the mainframe. All modules are now controlled by the central processing unit (control module R&S TS-CTE) in the R&S TSU. The control module coordinates all modules and also provides the interface to the IEC/IEEE bus. The internal data transfer in the R&S TSU takes place via the multibus.

Software and hardware concept

The modular concept and open system architecture of the R&S TSU allows almost all modules of the related test system family R&S TSA to be used. This applies in particular to the configuration with AMV (page 397) which in R&S TSU makes the special signals directly available at the fixture interface. Like R&S TSA, R&S TSU can also be retrofitted with up to four AMV modules. Simple interface cards (R&S TS-INK) are required for other modules.

In addition, the uniform software concept R&S TSSwindows (see page 400) employed in all the above test system families ensures full transparency throughout an entire test system installation.

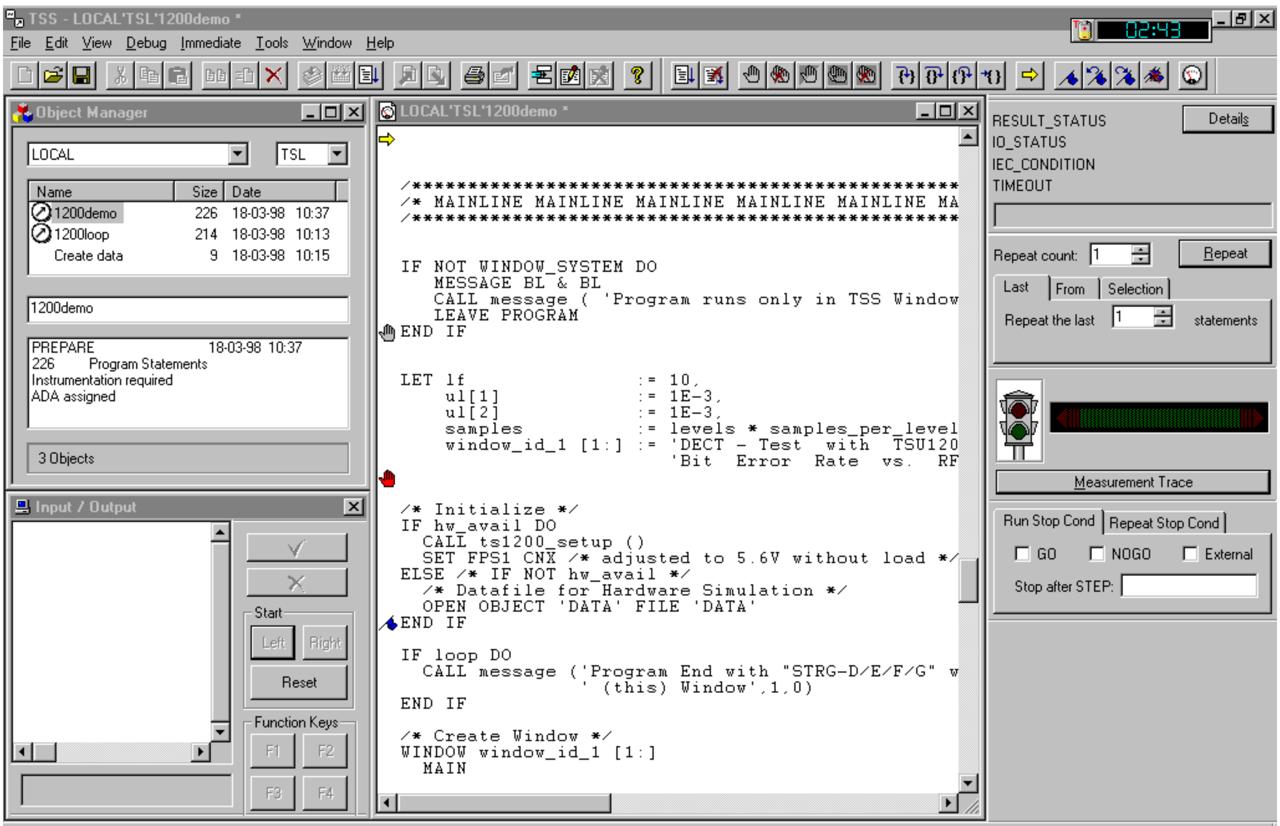
Through the use of multibus interface modules (R&S TS-MBI), not only the relay modules R&S TS-RELx but also customer-specific applications can be integrated into the system, ensuring an open system architecture also for the hardware.

The compatibility of all test systems also includes the options, so that the R&S TSU system can any time be upgraded or expanded.

Common test functions

- Analog in-circuit test
- Analog functional test
- Switching facilities from DC to 4 GHz and for power
- Use as a universal test system core

Production Test System Software R&S TSS 5.0



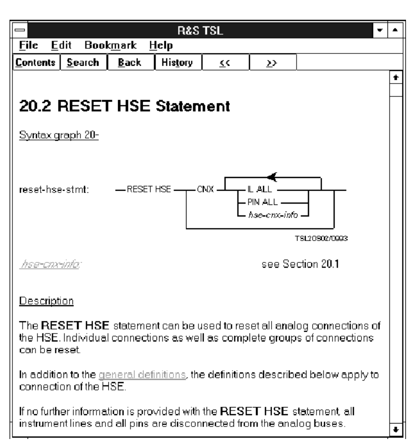
Testing under Windows NT on PCs

Brief description

R&S TSS 5.0 is an extremely powerful system software under Windows NT which can be used on PCs. This software features a menu-controlled user interface designed for ease of use. Since the menus only contain those functions which can really be performed in a particular mode, even the inexperienced user will soon be able to operate the system. The menu options can be selected using softkeys or the mouse, so ensuring fast and error-free operation. Entries can be made on forms containing default data derived from the current operating environment.

Windows help function

The programmer's manual for the test language R&S TSL is contained in the Windows help function. Clear graphics, references displayed at a keystroke, search and index functions help the user get to the sought information quickly and without having to go through the manual.



Convenient help function

High-level test language

The test language R&S TSL is a high-level language for in-circuit and functional testing. Standard terms make it easy to follow the tests that have to be performed during program generation and updating. Node and signal names make the test program independent of the fixture, so that any changes to the wiring do not have to be subsequently entered into the test program. The digital realtime test is fully integrated in the test programs and enables clear display of analog and digital tests especially when testing hybrid components.

Production Test System Software R&S TSS 5.0

User-friendly program structures are achieved with the aid of IF, CASE, FOR and WHILE constructs as well as modular technique. The test language makes user dialogs based on a form technique simple to implement so that the user will encounter a standard user interface.

Logic state display

The programming status of the digital test unit can be called up by a keystroke. The logic state display with pin functions, timing sets and command sequence allows even very complex digital tests to be analyzed.

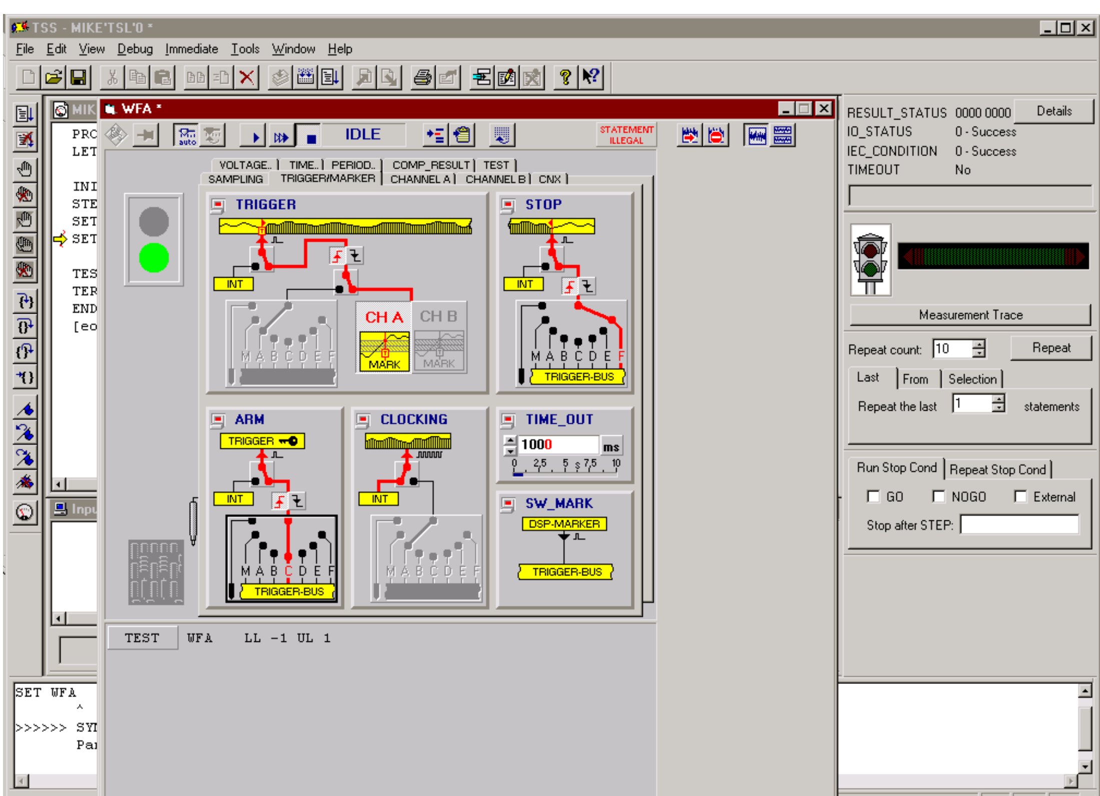
Short modification procedure

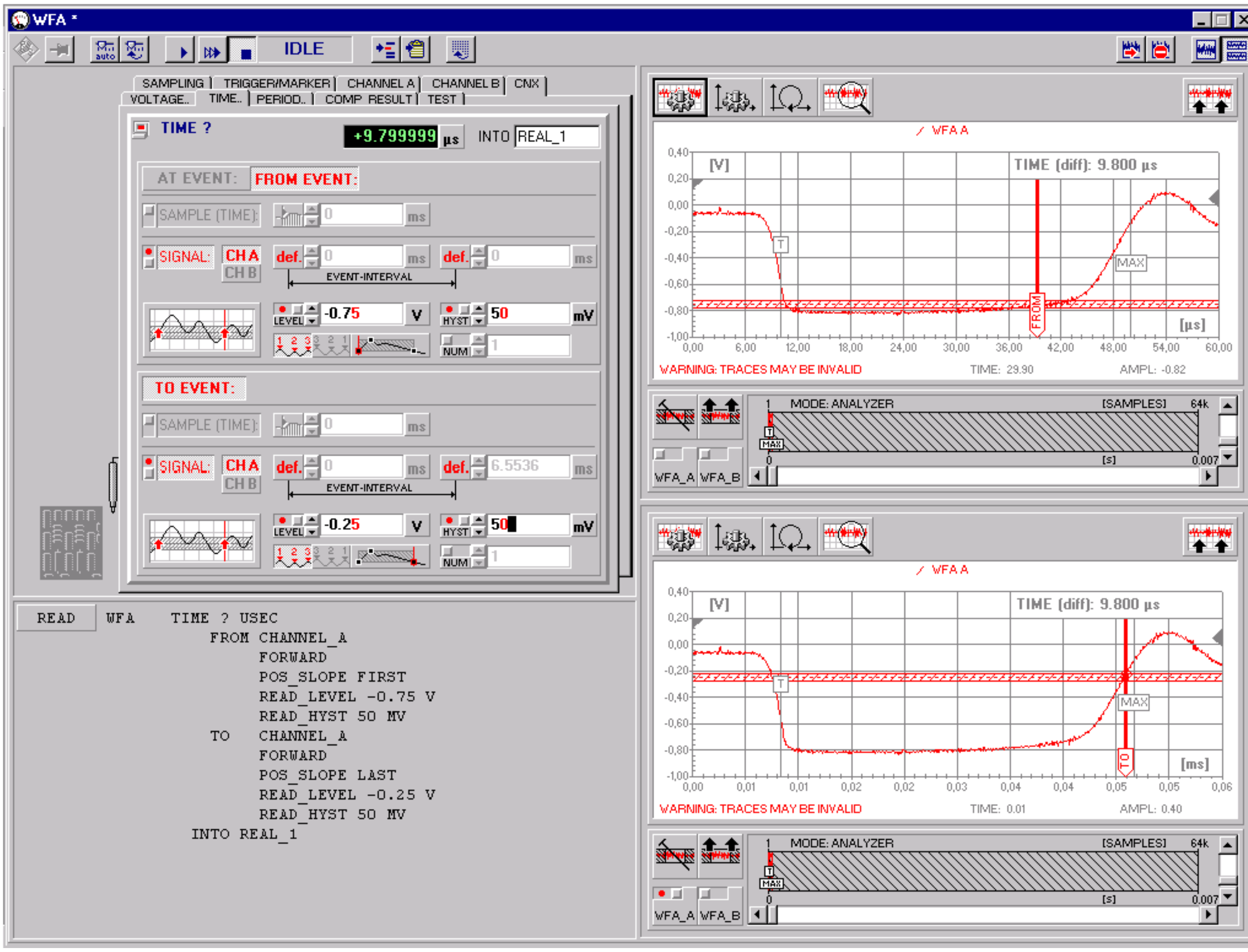
The whole software system R&S TSS 5.0 has been optimized for highly effective operation in particular with a view to the test language R&S TSL and the editor/ debugger to achieve fast program generation. The program is displayed on the screen throughout the debugging process and can be modified any time.

Modifications are directly imported into the program and can immediately be implemented without need for any time-consuming compiling. This is made possible by the "compreter" concept of R&S TSS where due to the use of a special segmenting method only the modified part of the program is compiled. This is done automatically and immediately after each modification and goes unnoticed by the user. Operation is thus similar like with an interpreter language (e.g. BASIC) without having to do without the benefits of a compiler language. A novel feature of R&S TSS 5.0 are the interactive virtual device control panels embedded in R&S TSS per OLE (object linking and embedding) standard. These control panels enable purely graphical control of individual devices within the R&S TSA/R&S TSU system families. An important feature is that the interactively generated device settings can be imported into the current program at the press of a button. If the control panels are called up from the debugger, the current hardware settings are automatically used in the control panel.

IEC/IEEE bus compatible devices

Convenient language constructs are provided for controlling external instruments via the IEC/IEEE bus. The configuration-dependent settings such as bus addresses and end characters are stored outside the program in the resource management system; this relieves the workload on the programmer and facilitates clearer programming based on the instrument names.





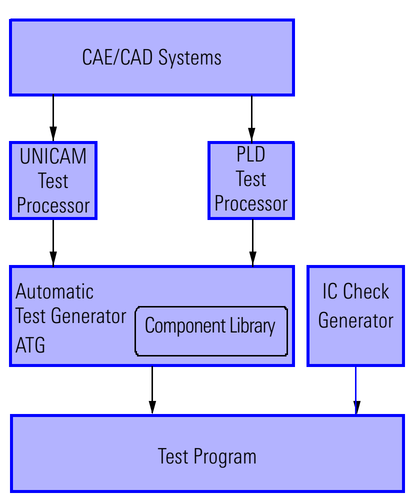
Open architecture

Any Windows applications can be called up from a test program. This, for instance, allows test data to be processed in MS Excel and graphically displayed. Programs for PC plug-in cards can also be included in the test run. A fully compatible DDE interface is available for this purpose.

Test methods

Hybrid in-circuit test

- The CAD test processor UNICAM converts CAD output lists in Editf-II code to the board description format of Test Workstation R&S TSA
- The PLD test processor generates tests for programmable logic components. Clock, force and disable sequences are generated using the standardized JEDEC format

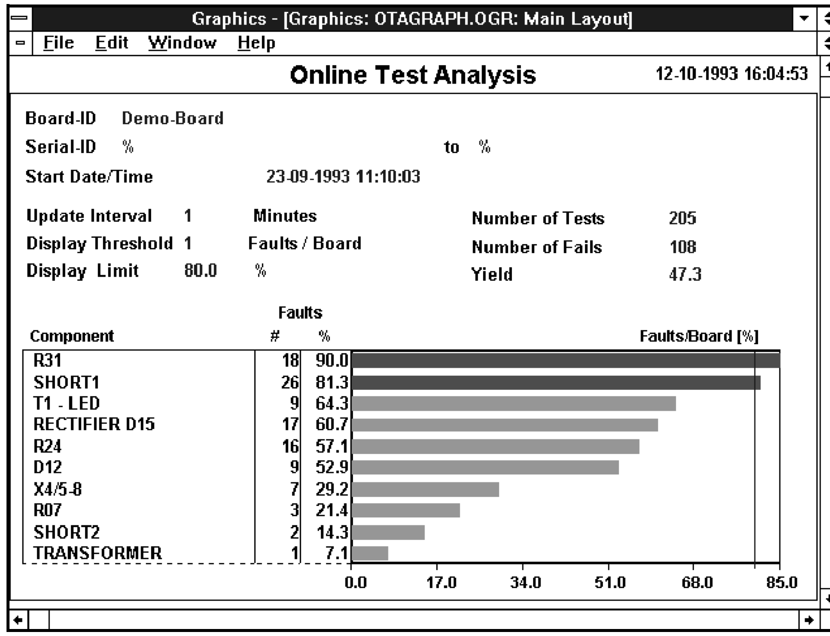


- The automatic test generator ATG generates an in-circuit/cluster test program on the basis of the board description
- The IC check generator is used to generate pin contacting tests for ICs by means of analog test facilities. In the case of a fault, an automatic diagnostic algorithm analyzes and evaluates the test results

Automatic in-circuit test generation with CAE/CAD data

Boundary scan test

The boundary scan method considerably simplifies testing of complex digital boards. A test pattern generator provides test patterns for checking the connections between the individual ICs. The boundary scan test can be combined with the in-circuit and the functional test.



Online test analyses for detection of weak spots in production process

Quality management and paperless repair

Relational database Oracle

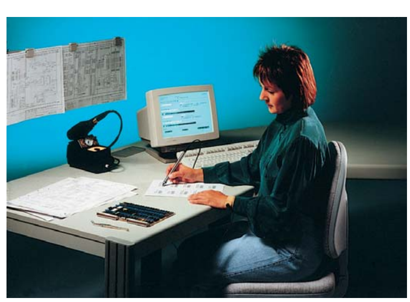
After each test, the relevant data are directly entered into the Oracle database and so are immediately avail-able for repairs and quality reports. Via an ASCII or DDE interface test and repair data can be loaded from other systems or transferred to other PCs. The database may also be incorporated in networked computers running under different operating systems (e.g. UNIX, Windows NT, OS/2). Quality analysis and paperless repair are carried out using the R&S TSA computer or a networked PC.

Quality reports

Online analyses with summary, detailed and trend reports including graphics permit weak spots in the manufacturing process to be analyzed and immediately eradicated. Alarm indications during the production test enable defects to be localized at an early stage and further defects to be avoided. An SQL interface provides access to the data stock.

Paperless repair

The test data of the boards to be repaired can be retrieved from the database in paperless form after the boards have been identified using a barcode reader. For every board unsuccessfully repaired, a test and repair report can be displayed by pressing a key. For each fault a list of the most frequent repairs carried out for this type of fault can be displayed at a keystroke. Experience made in the past



can thus be used to benefit which is a great advantage in particular where personnel frequently changes.

Windows NT – the modern platform

Windows NT from Microsoft is a high-end operating system with 32-bit architecture and preemptive multitasking. The user interface, which is basically the same as Windows, is very convenient and easy to learn.

Protection

The memory protection provides high system stability. The operating system and the applications have their own address ranges to prevent overwriting. The various user resources (programs, data, memories) are protected by the entry of a name/password.

Test Platform for Mobile Phone Production R&S TS7100/R&S TS7180

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

New

Test System R&S TS7180 (photo 43858-1)

Brief description

The R&S TS7180 and R&S TS7100 systems from Rohde & Schwarz are flexible solutions for mobile phone production tests. The low-cost version R&S TS7180 satisfies the requirements of most mobile phone production tests. The R&S TS7100 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.

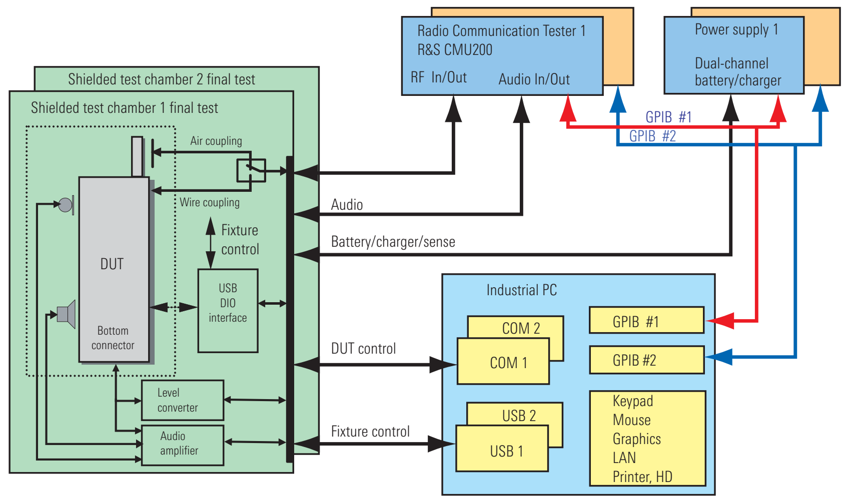
Main features

- 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 CMU200
- Scalable solutions
  - Comprehensive modular test library for immediate use or easy customization
  - Easy upgrade to 3rd generation mobile radios
  - Scalable from low-cost platform R&S TS7180 using industrial PC to modular system platform R&S TS7100 using CompactPCI/PXI
- Cost-effective solution
  - Low-cost solution R&S TS7180 with industrial PC
  - Maximum throughput owing to extremely short measurement times of CMU200 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 CMU200
  - All hardware and software components based on industry standards

Test Platform for Mobile Phone Production R&S TS7100/R&S TS7180

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.



Block diagram R&S TS7180

Low-cost Production Test System R&S TS7180

The R&S TS7180 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 CMU200, 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 TS7180 and the R&S TS7100.

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.

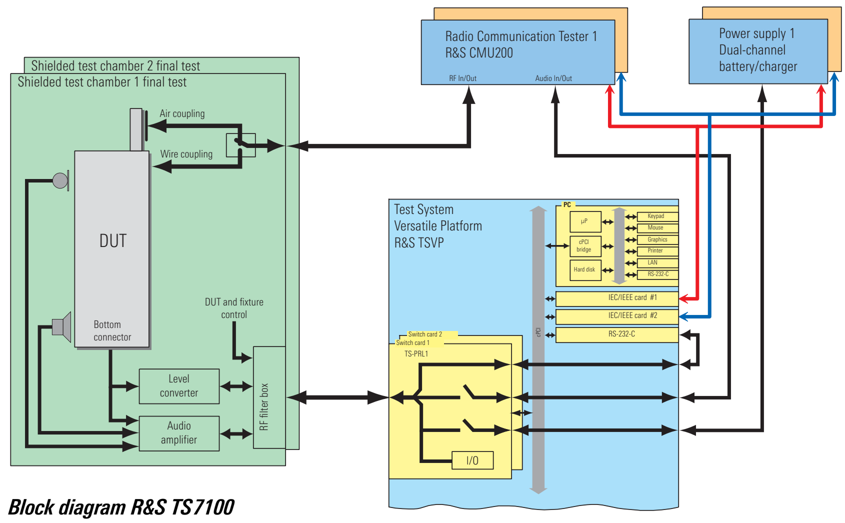
R&S TS7100 is the ideal platform for complex test requirements

The R&S TS7100 test system uses a CompactPCI/PXI frame with an embedded controller (PC) instead of the industrial PC employed by the R&S TS7180. 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.

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

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



Block diagram R&S TS 7100

CompactPCI/PXI – a compact and flexible standard

The R&S TS 7100 test system incorporates the CompactPCI/PXI system platform R&S 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.

Test system software

The software for the R&S TS7100 and R&S 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 standards.

A wealth of functionality for production testing

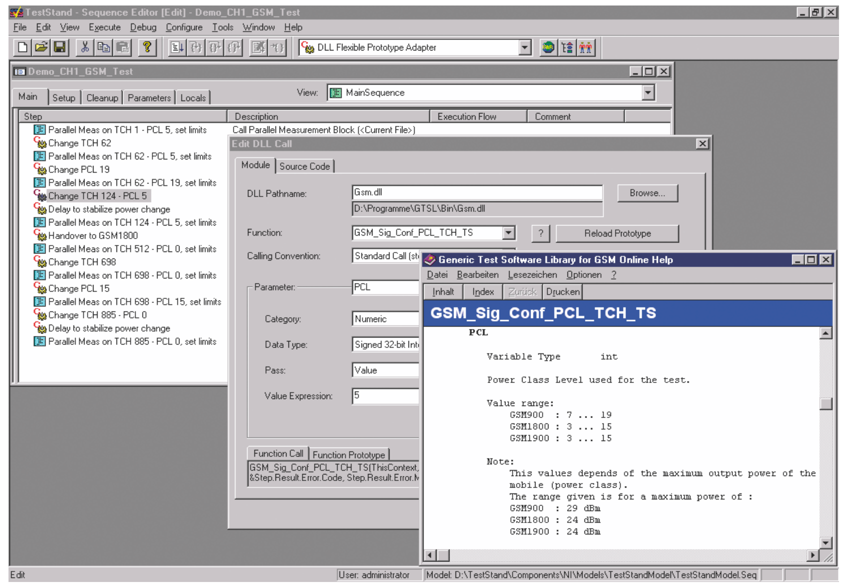
The TestStand test executive from National Instruments is used for test sequence control. This software package combines setup and measurement functions to form an executable test sequence and adds all other functions important for the manufacturing process:

- User administration
- Execution of several test sequences in multithreading or parallel mode
- Collection and storage of results
- Report generation

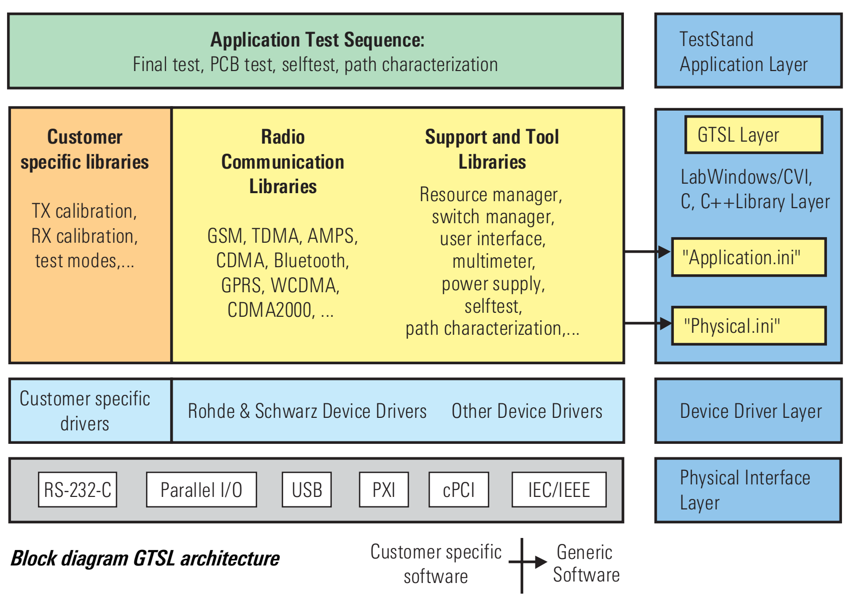
Test Platform for Mobile Phone Production R&S TS7100/R&S TS7180

Open system architecture for flexible extension

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.



Sequence editor



Block diagram GTSL architecture

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

Bluetooth Production Test System R&S TS7160

The complete manufacturing test solution for all *Bluetooth* products

Integration

Integration

Core equipment:
R&S CMU200, R&S TSVP and GTSL software toolkit for ready-to-run test cases.

R&S TS7000 family ready-to-roll production test systems:
R&S TS7160 for *Bluetooth*™ measurements

R&S TS7160 in-line test station for fully automated production

Brief description

The R&S TS7160 architecture demonstrates quite clearly a main goal of the system: to provide a cost-effective combination of electrical board tester and radio tester as a combination of two core instruments.

The R&S CMU200 sets up a *Bluetooth* connection to a device under test (DUT) via the RF interface. The tester switches the DUT to test mode and performs a comprehensive set of RF measurements (transmit and receive) to *Bluetooth* specifications. According to the *Bluetooth* Test Mode Specification, the DUT has to be locally enabled for test mode operation. The neccessary interfacing and control software can be integrated into the test sequence.

The R&S TSVP (Test System Versatile Platform) provides the basis for all the additional measurement equipment required. As a modular and open standard industrial platform based on CompactPCI and PXI, the R&S TSVP comprises a state-of-the-art embedded computer and a very flexible choice of instrument and data acquisition boards. Add modular functionality as required, using dedicated instrument boards from Rohde&Schwarz for DC and RF switching, I/O ports for fixture control, as well as commercial off-the-shelf boards (COR&S TS) for standard measurement functions such as digital multimeters, timer/counters and boundary scan modules.

Main features

- Ready-to-run test software for factory floor *Bluetooth* test scenarios
- Easy integration of application flash and PLD programming tools
- Shielded chambers for air coupling, or RF test pins and path calibration
- Very small footprint with comprehensive dual instrument architecture
- Variable integration of core instruments
- Interoperability with commercial off-the-shelf products
- Flexible core system based on open industrial platform
- Cost-effective combination of electrical board test and radio test
- Highest test throughput and accurate measurements with R&S CMU200
- Multiple DUT testing including RF switching for reduced costs
- Available worldwide: customized and supported by local system integration centers

Characteristics

R&S TS7160 test software library features

All instrument and equipment test functions are integrated as modular building

Bluetooth Production Test System R&S TS7160

blocks with seamless software support given by a standardized Generic Test Software Library (GTSL).

The software is generated using the LabWindows/CVI programming environment from National Instruments (NI). A user-friendly connection to the NI test sequencer software "TestStand" has been created for immediate use and easy customization.

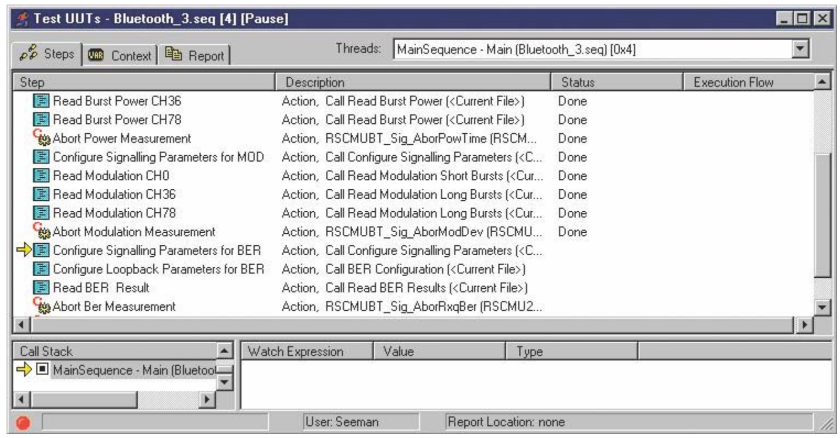
The TestStand software is completely customizable, so it can be modified and enhanced to match the specific needs, including custom operator interface, report generation, and sequence execution requirements.

Built on a high-speed, multi-threaded, parallel execution engine, TestStand and the GTSL libraries also deliver the performance to meet rigorous test throughput requirements.

R&S TS-LBT is the library for the *Bluetooth* test scenarios, which control and retrieve *Bluetooth* data from the R&S CMU200 with its options R&S CMU-B53, R&S CMU-K53 and the Signalling Unit R&S CMU-B21.

R&S TS7100 – the specialist for Bluetooth enabled phones

The R&S TS7100 cellular phone production test platform for all major mobile phone standards like GSM, CDMA and AMPS (3G under development) can also be extended with the R&S CMU200 *Bluetooth* hardware options to provide a comprehensive *Bluetooth* enabled mobile phone test system. With test scenarios running under R&S TS-LBT on the R&S CMU200 together with mobile phone test cases implementing multi-protocol and multiband testing, the result is a very cost-effective communication test system.



Example of Bluetooth test sequence at work

Integrating *Bluetooth* test capabilities makes the R&S TS7100 the ideal combined test system for *Bluetooth* enabled mobile phones. The R&S TS-LBT library can be used with both the R&S TS7100 and R&S TS7160 test systems. For the complete *Bluetooth* test scenarios executed by the R&S CMU200 a sample sequence is included, which can be reduced to selected subsets, ensuring manufacturing process stability and superior performance at the same time.

A sample list of R&S TS7160 system tasks - subject to be streamlined according to your requirements

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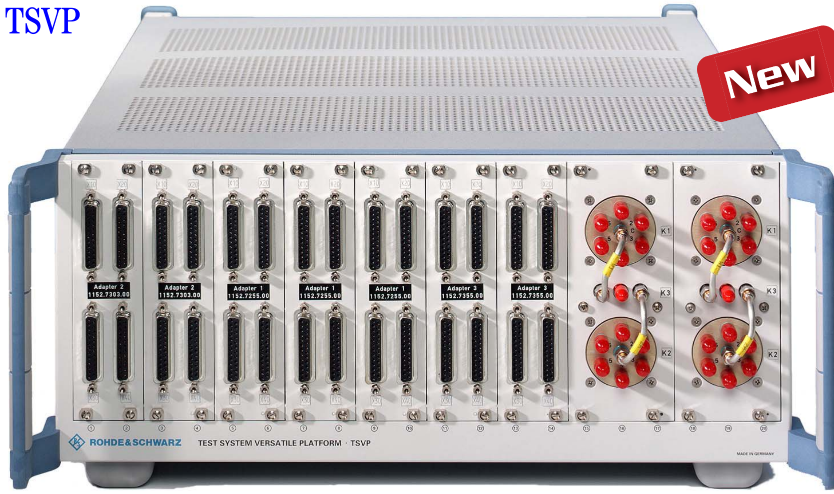
R&S TS7160 system task	System component
Product (DUT) identification	Barcode or dot-matrix scanning, database access
Measure DC voltages, fixture control	DMM, R&S TS-PSAM, R&S TS-PRL1
Download baseband and application software, give a unique BT_address to the device	Various in-system programming methods
Baseband oscillator tuning depending on chipset manufacturer's guidelines	Counter/timer board, R&S CMU200
Connect HCI to DUT and enable test mode	RS-232-C and level shifters, USB
Inquire/page DUT and set up RF connection	R&S CMU200
Set up test scenarios and hopping schemes	R&S CMU200
Precise power consumption measurements in various standby and transmit modes	DMM, communication test power supplies, e.g. R&S NGMO2
TX power measurements	R&S CMU200
TX modulation measurements	R&S CMU200
RX sensitivity and BER measurements	R&S CMU200
Voice quality	PCM decoder or audio analyzer
RF switching for multiple DUTs in one panel	RF multiplexer modules, R&S TS-PDM1
Create report to ASCII or HTML document, store via factory LAN	Embedded PC interfaces

Production Test Platform R&S TSVP



Test System Versatile Platform

Photo 43791-1

Brief description

R&S TSVP is a standardized modular platform for the adaptation and electrical testing of subassemblies and units in production environments. The high-performance system accommodated in a compact 19" enclosure (4 HU) has a maximum configuration of 31 modules to the CompactPCI (CPCI) or PXI standard.

R&S TSVP's main purpose is to standardize all the switching functions and basic measurement functions used by practically all T&M systems in facilities producing electronic subassemblies and units. R&S TSVP was designed mainly with modularity, flexibility of configuration and scalability in mind, so as to offer tailor-made solutions for a wide variety of applications. This does away with expensive hardware and software overheads.

A unique feature of R&S TSVP is the exclusive use of industry standards available worldwide (hardware: CPCI/PXI, software: LabWindows/CVI and TestStand), which were given a wider scope exclusively for production testing. It has thus become possible to use the industry standards where stringent production requirements have to be met.

R&S TSVP is the first single platform to provide a cost-effective system kernel for practically all test applications, and so cuts the high costs that would be involved in using many different systems. R&S TSVP is an economical choice even for development labs, as it features open system architecture and flexibility at a favourable price. This opens up entirely new vistas because test segments as well as laboratory-generated test sequences can be used both in the lab and in production, thus reducing overall production time.

Main features

- Integration of external and internal devices in line with test department requirements
- Standardized fixture interface
- Optional exchangeable fixture head
- Maximum configuration with 31 slots
- Conforming to PICMG 2.0 Rev. 2.1 Specification (CompactPCI)
- PXI backplane to PXI Specification Rev. 1.0
- Internal analog and trigger bus
- Integrated selftest concept, self-monitoring
- Full support of LabWindows/CVI and TestStand
- System monitoring functions (e.g. system temperature, power supplies)
- Extensive integrated selftest concept
- Signal bus system (analog bus, trigger bus)
- Simple signal routing concept for integration of external devices

System concept

R&S TSVP provides all the required hardware functions such as system controller and AF and RF signal routing. The optional software comprises a standardized user interface (LabWindows/CVI, National Instruments) and standardized test sequence control (TestStand, National Instruments). The straightforward internal signal routing concept for external extensions (patented) allows fast module replacement during servicing. A standardized exchangeable fixture head can be attached to the frame as an option. The system, cabling and plug-in modules are checked by a built-in selftest.

The system comprises several CPCI or PXI segments (scalability), which may be combined to form a system or can operate as independent single or combined subsystems. This means that requirements of the future – like parallel testing – can be met today.

Production Test Platform R&S TSVP

Specifications

Power supply

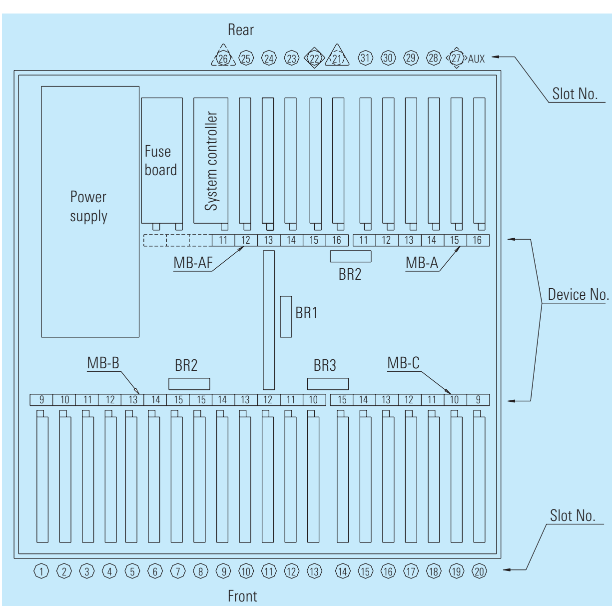
Power consumption/output power	500 W/350 W
Input voltage AC	100 V to 240 V, 50 Hz to 60 Hz
DC	150 V to 300 V
Output voltages	3.3 V, 20 A
	5 V, 50 A
	+12 V, 12 A
	–12 V, 6 A
	24 V to 27 V, 3 A

System interface

VG female connector strips	96 standard, 8 coax or 8 power contacts
Optional:	
exchangeable fixture head	single-lever pull-in mechanism, spring contact pins (Virginia Panel™), VG spacing

Modular backplane architecture

CPCI slots (front)	20
PXI slots (rear)	11
Plug-in modules 5 V, 3 HU	PICMG 2.0 Rev. 2.1 CPCI, PXI Specification Rev. 1.0
External signal feed	at rear, 30 standard plus 6 coax or 6 power signals per slot
Analog buses	12 (system-wide)
Trigger buses	8 (system-wide)



General data

Weight (without modules)	12 kg
Dimensions (H x W x D) in mm	178 (4 HU) x 48.26 (19") x 530
Ventilation	
Cooling capacity	350 W
Monitoring	two sensors, software-supported temperature measurement
Nominal temperature range	+5°C to +40°C
Operating temperature range	0°C to +50°C
Storage temperature range	–40°C to +70°C
Damp heat	+25°C/+40°C, 95% rel. humidity
Safety standards	CE, UL1950 applied for, EN61010 Part 1
EMC	EN55011, EN50082-2
Shock	40 g, MIL-STD-810, MIL-T-28800D, classes 3 and 5
Sinusoidal vibration	
5 Hz to 55 Hz	2 g, MIL-T-28800D, class 5
55 Hz to 150 Hz	0.5 g, MIL-T-28800D, class 5
Noise	
10 Hz to 300 Hz	1.2 g

PXI compatibility list (measurement-oriented configurations)

Slot		System controller in slot	
Number	Backplane segment	21	26
21	MB-AF	system controller	o.k.$^{2)}$
22	MB-AF	o.k.*	o.k.*
23	MB-AF	o.k.	o.k.
24	MB-AF	o.k.	o.k.
25	MB-AF	o.k.$^{1)}$	o.k.$^{1)}$
26	MB-AF	o.k.$^{2)}$	system controller
AUX	MB-A$^{3)}$	reserved	reserved
27	MB-A$^{3)}$	o.k.*	o.k.*
28	MB-A$^{3)}$	o.k.	o.k.
29	MB-A$^{3)}$	o.k.	o.k.
30	MB-A$^{3)}$	o.k.$^{1)}$	o.k.$^{1)}$
31	MB-A$^{3)}$	o.k.$^{2)}$	o.k.$^{2)}$

o.k.= fully compatible
o.k.*= must be star trigger slot in segments concerned
1) = fully compatible, PXI local bus signals only to left neighbouring slot
2) = fully compatible, but no access to PXI local bus
3) = only with R&S TS-PCX2 chassis extension

Note:
Slot rows 21 to 26 and 27 to 31 are not interconnected by local bus or star trigger.

Communication System Panel R&S TS-CSP

Easy and fast integration of measuring instruments into production testing

Photo 43371

Brief description

Automatic test systems for functional tests and final testing in the production of electronic products require a large variety of DUT fixtures, power supplies and stimulus signals. Communication System Panel R&S TS-CSP was developed for use in production test systems for efficient and cost-effective transmission of signals between DUTs and measuring instruments.

Simultaneous testing of several DUTs is made possible by flexible scaling and the large number of channels provided by R&S TS-CSP.

Development costs incurred in the configuration, maintenance and modification of test systems can be reduced significantly through the use of R&S TS-CSP.

Instead of a tangle of cables connecting the DUT fixture and the measuring devices, various relay boxes and even data acquisition cards and power supplies, switch matrix modules are used for DUT signal distribution.

Applications

- Functional test systems for telecommunication products such as mobile phones, cordless terminal equipment of all kinds and associated base stations
- Production testers for products from automation, sensor technology and telemetry sectors
- Automotive test systems
- Lab test sets

Main features

- Acquisition and switching of DUT signals for functional tests and final testing
- Scalable number of channels for multiple-panel board tests as well as simultaneous testing on several modules
- Efficient acquisition of RF signals using RF Switch Matrix R&S TS-RFM
- Integrated analog measurement functions and flexible switching using Universal Switch Matrix R&S TS-USM
- Input and generation of digital signals, adjustable signal levels
- Control via IEC/IEEE bus or high-speed PC card interface

Easy and fast system integration

Comprehensive driver support for C programming language has been made available under LabWindows/CVI for the R&S TS-CSP system components. The driver software conforms to the international VISA standard drawn up to facilitate the generation of test programs using standardized software modules.

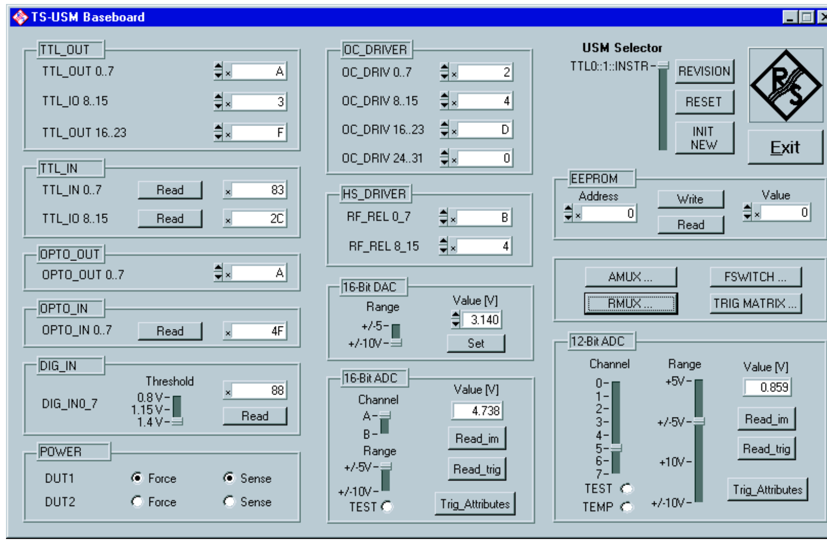
R&S TS-CSP also features the hardware and software selftest functions that are required for use in production environments.

Based on this driver software there is an operating program for the communication system panel which allows the user to control the panel simply by mouse clicks. This reduces familiarization time to a minimum.

As the relay matrix modules too can be controlled via a GUI, the test engineer can put into operation and test the fixture wiring interactively.

As the relay matrix modules too can be controlled via a GUI, the test engineer can put into operation and test the fixture wiring interactively.

Interactive operation of the Communication System Panel R&S TS-USM



Specifications

Universal Switch Matrix R&S TS-USM

Digital inputs

TTL levels	8 channels
Variable input threshold	8 channels, software-configurable
Isolated by optocouplers	8 channels, TTL or 24 V levels

Digital outputs

TTL levels	16 channels
Isolated by optocouplers	8 channels
Open collector driver	16 channels
R&S TS-RFM control	32 channels

Digital I/O ports

TTL levels	8 channels, can be switched as input/output or tristate

Analog inputs

Test channels, 12 bit resolution	8 channels
Voltage ranges	6 channels with 0 V to 5 V, ±5 V, 0 V to 10 V, ±10 V 2 channels with 0 to 5 V, ±5 V, 0 V to 10 V, ±10 V, 0 V to 20 V, ±20 V, 0 V to 50 V, ±50 V, 0 V to 100 V, ±100 V
Test channels, 16 bit resolution	8 channels with differential measurement and multiplexer 1 channel with direct measurement
Voltage ranges	±2.5 V and ±5 V with multiplexer or ±5 V, ±10 V direct

Trigger inputs for A/D converter

Trigger inputs	4 with separate matrix for crossbar switching, configurable

Analog output with 16 bit resolution

Number of channels	1
Voltage ranges	±5 V, ±10 V
Power relays	2 DUT supply switches each with 4 semiconductor switches for switching all poles of the force and sense lines
Voltage range	max. 40 V (max. 6 A)

Multiplexers

Relay multiplexer	16 floating reed relays, individually switchable
Configurations	2:1 multiplexer with a connecting relay between each relay pair, 4 x 4:1, 2 x 8:1, 1 x 16:1 multiplexer or other configurations
Analog multiplexer	32 inputs and 8 outputs switched as 4 independent multiplexers
Configurations	2 x 4:1 or 4 x 8:1multiplexer
Fixed-voltage outputs	3.3 V, 1 A stabilized, short-circuit-proof 5.0 V, 1 A stabilized, short-circuit-proof ±12 V, 1 A stabilized, short-circuit-proof 24 V, 2 A unstabilized

RF Switch Matrix Module R&S TS-RFM1

RF relays	12
Frequency range	DC to 8 GHz, further specifications on request

RF Switch Matrix Module R&S TS-RFM3

RF relays	4
Frequency range	DC to 8 GHz, further specifications on request

Basic unit

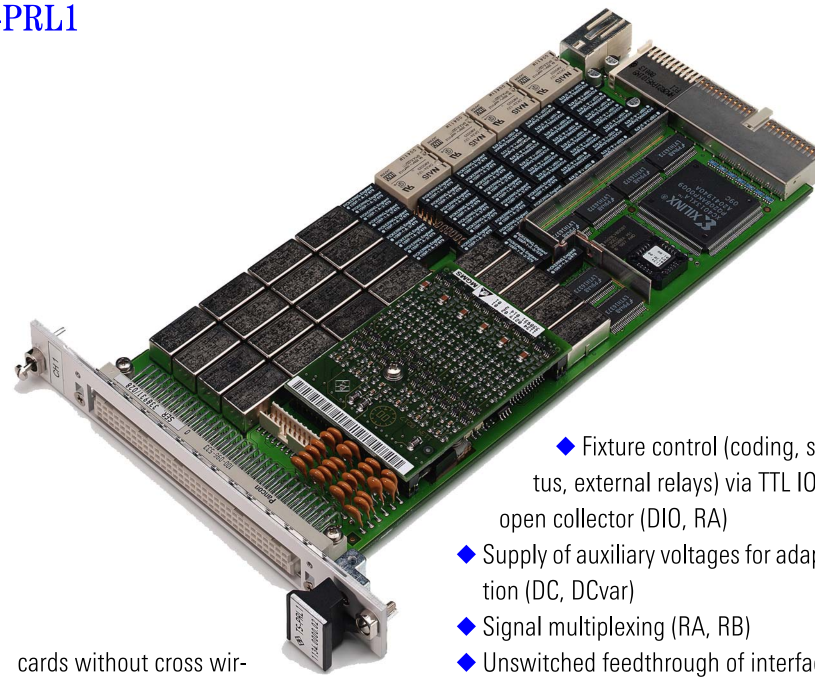
Slots	5, cabinet height of 4 HU
Control interface	GPIB or direct TTL with TTL I/O Interface PS-B11
Rated temperature range	+5 °C to +40 °C
Storage temperature range	–40 °C to +70 °C
Power supply	100 V to 120 V, 200 V to 240 V 50 Hz to 60 Hz, 150 VA, automatic voltage selection
Dimensions in mm (W x H x D)	465 x 198 x 495 4 HU
Weight (R&S TS-CSP with 4 HU + R&S TS-USM + TS-RFM3)	10 kg

Ordering information

Communication System Panel		
Basic unit 4 HU	R&S TS-CSP	1124.1504.04
Accessories supplied	power cable, fuses, operating manual	
Options		
Universal Switch Matrix TTL interface	R&S TS-USM	1113.5503.02
Universal Switch Matrix GPIB interface	R&S TS-USM	1113.5503.05
Fixture for R&S TS-USM	R&S TS-USMF	1124.3007.02
RF Switch Matrix	R&S TS-RMF1	1124.2500.02
RF Switch Matrix	R&S TS-RMF3	1124.2500.06
Extras		
19" Adapter for rackmounting	R&S ZZA-411	1096.3283.00
TTL I/O Interface	R&S PS-B11	1006.7303.04

Universal Relay Card R&S TS-PRL1

Production test of communication, automotive electronics or general industrial electronics



Brief description

The Universal Relay Card R&S TS-PRL1 provides basic functions that are often required in production environments. It can replace several special cards. The card (size 3 HU) has a CompactPCI interface and is inserted in the front of the Test Production Test Platform R&S TSVP. The integrated selftest capability allows the card to be checked in the system.

Signal routing concept

The production test environment requires simple and fast adaptation of the DUT via cable or fixture. This implies that complex cabling must be avoided at the interface. Multiple signal paths on the R&S TS-PRL1 ensure easy and flexible connection of external devices or other CompactPCI cards without cross wiring at the front panel. The digital IO channels provide a versatile interface to the DUT. The ranges from 1.2 V (low-voltage families) to 5 V or up to 50 V (open-collector voltages) are covered.

Typical applications

- Switching of supply voltages and loads (HiPwr, Pwr)
- Connection of the DUT to stimuli and measuring instruments (RA, RB, analog bus)
- Fixture control (coding, status, external relays) via TTL IO or open collector (DIO, RA)
- Supply of auxiliary voltages for adaptation (DC, DCvar)
- Signal multiplexing (RA, RB)
- Unswitched feedthrough of interface signals (AUX) such as RS232

Main features

- 16 standard relays SPST
- 4 power relays DPST
- 24 digital IO channels, 1.2 V to 50 V
- Switchable auxiliary voltages (5 fixed and 1 programmable)
- Access to 12-wire Rohde & Schwarz analog bus
- Integrated selftest capability

Specifications in brief

Control bus	CompactPCI (PICMG 2.0 Rev 2.1)
DUT connector (front)	96-contact according to DIN 41612
Application connector (rear)	32-contact
Power relays HiPwr, Pwr	1 (DPST)
Max. voltage/switched current (DC)	30 V/8 A
Power relays HiPwr, Pwr	3 (DPST)
Max. voltage/switched current (DC)	30 V/2 A
Standard relays RA, RB	16 (SPST)
Max. voltage/switched current (DC)	60 V/2 A
Direct feedthroughs, AUX	6
Analog-bus access (full matrix)	2 signals to 12 buses
Max. voltage/switched current (DC)	60 V/0.8 A
Auxiliary voltage sources DC, DCvar	DIO reference, all voltages ground-referenced and switchable
Fixed voltages	3.3 V, 5 V, +12 V, –12V, 24 V, max. 1 A each, limited
Programmable voltage (DAC)	–5 V to +5 V, max. 25 mA
Digital in/output channels DIO	24, IN/OUT, each configurable
Output channels	
DIO mode (high)	1.2 V to 5 V
Source/sink current	max. 5 mA/20 mA
Open-collector mode	0 V to 50 V, max. sink current 300 mA
Input channels	
Input voltage	–0.5 V to 50 V
Programmed threshold	0.5 V to 2.0 V
Nominal temperature range	+5° to +40°C
Operating temperature range	0° to +50°C
Power consumption	10 W to 60 W
Dimensions (W x H x L); weight	100 mm x 20 mm x 225 mm; 1.5 kg

Ordering information

Universal Relay Card	R&S TS-PRL1	1134.0000.02
Extras		
Production Test Platform	R&S TSVP	1133.6505.02
Generic Test Software Library	R&S TS-LBAS	1056.6117.02

Extreme Temperature Tester R&S E-Line

Temperature tests on wireless components in a shielded environment

Brief description

The Extreme Temperature Tester R&S E-Line is a measurement environment for wireless RF devices (e.g. mobile phones, *Bluetooth* devices, and remote keyless entry systems).

The R&S E-Line combines a shielded environment with a temperature-controlled chamber. Used as a test sequencer, the TSVP allows several devices to be measured in the same test run.

The R&S E-Line is software-controlled and handles all communication with the measurement system (e.g. a production test system from Rohde&Schwarz).

Main features

- Test of different DUTs and/or standards (e.g. GSM, WCDMA, *Bluetooth*) in the same test run
- Up to 12 DUTs
- Cost reduction of up to 80% compared to discrete solution (equipment and test time)
- Temperature range –40°C to +80°C (according to automotive component standards)
- Runs with any existing test system (e.g. production/conformance/QA test systems from Rohde& Schwarz)
- System software based on TestStand

Specifications

Electrical data	
Frequency range	0.5 GHz to 3 GHz
Shielding effectiveness	>60 dB
RF connectors	N type
Temperature	
Temperature range	– 40°C to +80°C
Temperature change rate	3.5°C/min, typ.
General information	
Height	2 m
Width	19" rack
Position of DUT panel	1 m above floor
Test volume	>150 l
6 HU for other devices are provided inside of the shielded part	
R&S E-Line is mounted on ESD wheels	
General feedthroughs within the system	RS-232-C VGA Ethernet mouse and keyboard mains air inlet
Mains supply	380 V AC, 3 phase

Type-Approval Systems for Mobile Radio

International benchmark for mobile radio test technology

Before being allowed onto the market, each and every mobile phone has to undergo a comprehensive series of checks which is referred to as the full compliance test (FTA). Rohde & Schwarz is the most important provider of system simulators of this kind for the world's most successful digital mobile radio systems.

System solutions for all significant mobile radio systems

We provide a whole range of integrated systems and components for full compliance tests on mobiles. The approach we offer is technically innovative, practice-oriented and gives optimal performance and user-friendliness.

We set the standards – you enjoy the benefits

With our compliance systems, you are guaranteed a high level of standard conformity and result reproducibility. This is why they have been accepted as standard test tools by test houses and accredited testing organizations all over the world. Mobile radio manufacturers know that equipment that has been developed using our systems will have no problems with official acceptance tests. You can be sure of the successful outcome of approval procedures without any bother.

Type	Designation	Applications	Page
R&S TS 1220	DECT Protocol Tester	Compliance testing of DECT fixed and portable parts to TBR 22	417
R&S TS 8916 R&S TS 8916B-4	GSM 900/1800/1900 Simulators	Compliance testing, QA and development of GSM 900/1800/1900 mobile phones	418
R&S TS 8950	3G Air Interface Simulator	Comprehensive testing of mobile communications equipment according to the 3GPP specification	420
R&S TS 8950G	RF Test System for GSM/GPRS/EDGE Mobiles	Reliable RF testing all the way from development to conformance testing	422
R&S TS 8960	*Bluetooth* Qualification and Compliance Test Systems	Full compliant to *Bluetooth* RF test specification	424
R&S TS 8965B R&S TS 8965C	RF Test Systems	Ideal test solution for RF pre-qualification and quality assurance in the development process	425
Other systems on request, e.g. ICO			

Future-proof thanks to high flexibility

The most striking features of the test systems from Rohde & Schwarz are the highly flexible hardware and software concepts which can be adapted to any changes in standards and any new technical requirements. Service packages tailored to your individual requirements secure your investment in equipment and keep your equipment at the leading edge of technology.

DECT Protocol Tester R&S TS 1220

Conformance testing of DECT fixed and portable parts to CTR 22

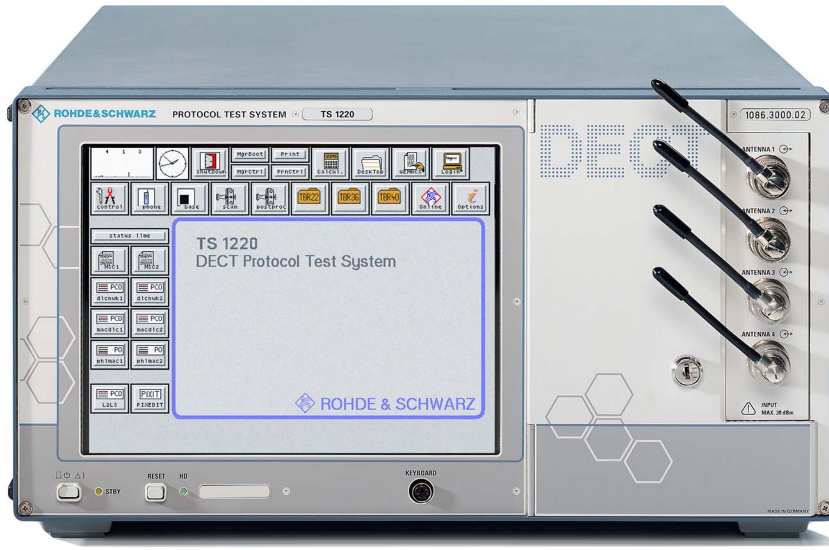


Photo 43431-1

Brief description

Classic PBXs which connect mobile stations to each other or to the PSTN by means of one or more base stations as well as PABX (private automatic branch exchange) systems are changing over to DECT, the European standard for digital, cordless information exchange.

Introducing the DECT access profile GAP (Generic Access Profile) the European Telecommunications Standards Institute (ETSI) ensured product compatibility on the market. If manufacturers want to test their products for compliance with the DECT access profile, they need a universal and versatile test system – this system is the DECT Protocol Tester R&S TS1220.

The Generic Access Profile (GAP) only applies to the DECT voice service, i.e. to those sections of the standard concerned with voice transmission. This means that only part of the standard which defines a general transit system (LAN, pager applications, etc, too) is binding for telephone applications. Protocol Tester R&S TS1220 from Rohde & Schwarz is a test system for development and conformance testing of DECT phones whose software performs all the necessary analysis and interpretation of data and timing sequences.

Further options such as the channel assignment (monitoring of air interface) ensure universal use of the test system. Software upgrades allow all DECT frequency bands (Europe, Latin America, China) to be covered.

Main features

- Full DECT-GAP implementation
- Ready-to-run TTCN test cases to CTR 22 (GAP + CAP)
- Any implementation for DECT transit systems thanks to open concept
- Frequency extensions for all DECT ranges available as an option
- Straightforward software updates to handle changes in standards and requirements

GSM900/1800/1900 Simulators R&S TS8916, R&S TS8916B-4

Test System R&S TS8916B with audio option for all GSM standards (photo 43211-2)

Conformance Testing, QA and development of EGSM, GSM900/1800/1900 mobile phones

Brief description

Simulators R&S TS8913, R&S TS8916B-4 and R&S TS8916B have been designed for development and QA requirements. Thanks to their extraordinarily powerful hardware and software, drastic reductions in test and development times are possible.

R&S TS8916B is a test system for development and conformance testing of GSM mobile phones. It covers the full range of present phase 2 conformance tests and provides at the same time the plat-form for complex phase 2+ tests for HSCDS and GPRS.

The tests implemented in R&S TS8916B are validated by independent test houses and can be used for official conformance tests. The measurement functionalities of R&S TS8916B forming the basis of the official tests are also available for development applications and can be accessed via an easy-to-handle graphical user interface.

R&S TS8916B-4 is identical with R&S TS8916B except for the number of RF channels fitted. Development-accompanying RF tests are the main field of applications of this system. The tests implemented in R&S TS8916B-4 are also validated by an independent test house.

The test systems thus accompany mobile phones from the development through to final testing and provide a worldwide renowned basis for compliance with the required quality standards.

GSM900/1800/100 Simulators R&S TS8916, R&S TS8916B-4

Main features

- RF transceiver tests, analysis of spurious emissions
- RF transmitter tests, e.g. quality of the RF output spectrum
- RF receiver tests, immunity to interference
- Link management tests (synchronization characteristics)
- Layer-2 and layer-3 signalling tests
- Multislot signalling tests and RF tests for HSCSD and GPRS
- Audio tests
- Test of supplementary services
- Short familiarization thanks to easy-to-use software (test cases and maintenance menu)
- Development of user-specific test programs in the standardized programming language C under MS-DOS

Tests to ER&S TS 300 607-1

Thanks to Simulators R&S TS8916 and R&S TS8916B-4, you can test GSM900, GSM1800, GSM1900 as well as dual-band GSM900/1800 mobiles according to the test requirements of the european R&TTE Direktive, the GCF (GSM Certification Forum) and the Northern America PCTRB to the 3GPP Norm 3G R&S TS 51.010-1. There are more than 200 system test cases for each band, offered in functional groups. Besides these all test case packages for the Digital Radiocommunication Test Set CRTC can be run on the systems R&S TS8916B and R&S TS8916B-4. Furthermore we also offer a dedicated research and development tool which allows in-depth analysis of RF performance beyond the limits of predefined test cases.

The test systems are therefore ideal:

- verification tools for development environments (prescreening)
- QA test systems
- simulators for conformance tests

3G Air Interface Simulator R&S TS 8950

Comprehensive testing of 3rd generation mobile communications equipment according to the 3GPP specification

Photo 43413-1

Brief description

The future 3G Air Interface Simulator R&S TS 8950 from Rohde & Schwarz is a modular test platform for mobile radios and base stations that meets requirements of third-generation mobile radio according to the 3GPP specification.

The overall conceptual guidelines of the system design – flexibility and openness – shall guarantee adherence to the ongoing evolution of the 3G standard. In order to provide the appropriate test functionality right in time, the initial configuration of R&S TS 8950 will be upgradeable in three steps (A, B, C) thus matching with the testing needs in all phases of 3G product development.

During gradual evolution of R&S TS8950 the range of applications spans from:

- Step A: RF testing without signalling (Tx basic measurements)
- Step B: RF testing with basic L1 signalling (Rx and Tx advanced meas.)
- Step C: RF testing with L1-L3 signalling (Full Tx/Rx conformance test)

The system features excellent measurement accuracy thanks to high-performance components like

- Signal Analyzer R&S FSIQ
- Vector Signal Generator R&S SMIQ
- I/Q Modulation Generator R&S AMIQ
- and RF Signal Switching and Conditioning

Convenient access to any application range

The flexible software concept ensures conformity of the system with the 3GPP standard despite the presently still unstable test specifications (R&S TS25.141 or R&S TS34.121). R&S TS 8950A uses individually parameterizable test methods instead of rigid test cases that can be combined into any desired test scenario.

For generating customized test sequences the test system therefore provides different types of access to the individual layers of the system software. Access is either in the form of a dialog via the graphical user interface AUP (advanced user panel) or on the application programming interfaces API.

At the device level, a separate dialog is available for each system component that can be remotely controlled. The instrument dialogs are tailored to 3G requirements and organized in logical blocks for emulating mobile radios, base stations and services. Entries can also be made for individual device command strings, e.g. GPIB commands. Every instrument dialog comprises a macro recorder/player for recording and replay of specific device settings (macros).

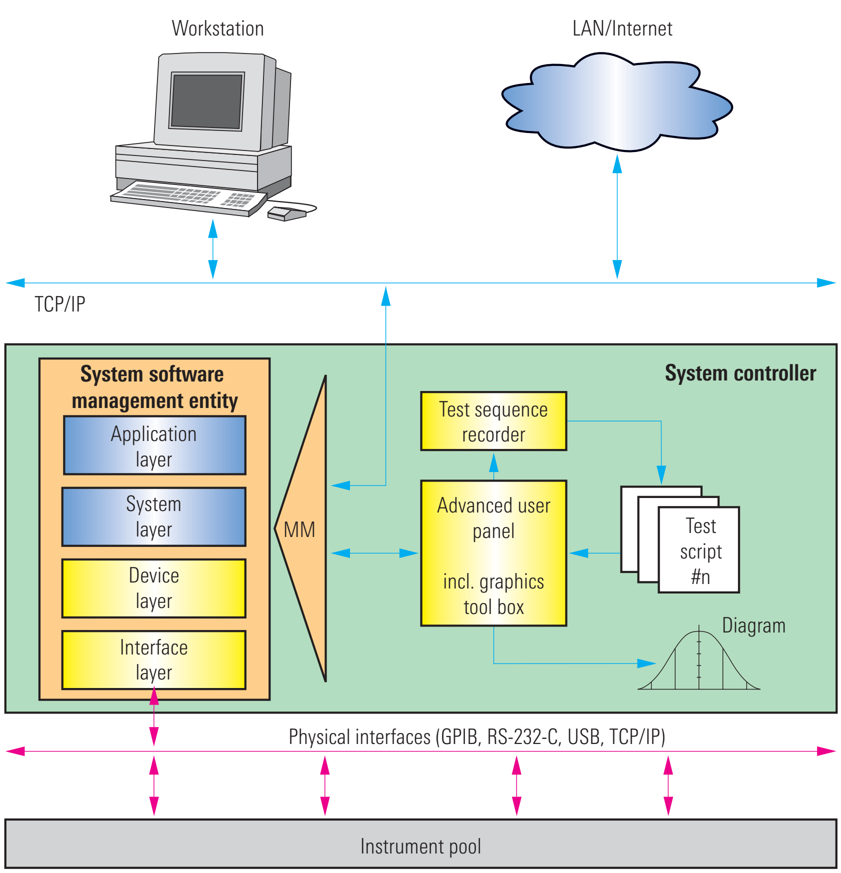
3G Air Interface Simulator R&S TS 8950

Rx/Tx measurements and result analysis at the system level are also dialog-controlled. The AUP provides a defined script for each measurement which can be edited and extended. This plain command file (PCF) allows direct addressing of the device layer and thus direct access to the individual instruments including the switching and conditioning unit. With the aid of a macro sequence manager, individual macros can be combined into sequences permitting complex measurements.

User management ensures that simultaneous access by different users does not cause a configuration conflict. Of course this restriction does not apply to simultaneous access of test results for analysis.

A logging mechanism stores all the settings made.

The AUP also supports service dialogs that perform fully automatic RF path compensation, for instance, or simplify system maintenance and configuration by selftest and diagnostic routines of individual components. The RF compensation routines of Signal Switching and Conditioning Unit SSCU need not follow fixed test-case patterns but can be started in compliance with user specifications.



Available and planned configuration levels of R&S TS8950

The application range of the R&S TS8950A system covers basic Rx/Tx tests without signalling.

Measurements at the transmitter end
- frequency stability,
- occupied bandwidth,
- maximum output power,
- adjacent-channel leakage power,
- spurious emissions,
- transmitter intermodulation,
- transmitter on/off ratio,
- modulation accuracy, (EVM, rho factor),
- code domain power analysis (offline).

The following can be measured at the receiver end:
- sensitivity,
- selectivity (e.g. adjacent-channel selectivity, blocking).

The subsequent model R&S TS 8950B, which is available as of May 2000, extends the application spectrum especially by performance tests requiring channel coding.

The transmitter measurements of this system include:
- code domain power analysis,
- output power control (inner loop, outer loop).

Additional measurements at the receiver end:
- spurious emission,
- receiver intermodulation,
- spurious response and blocking,
- receiver dynamic range.

Model R&S TS8950C finally performs all conformance measurements including complete layer 1 to layer 3 signalling.

RF Test System R&S TS8950G for GSM/GPRS/EDGE Mobiles

Reliable RF testing all the way from development to conformance testing

Photo 43476-2

Brief description

The R&S TS8950G is designed to perform RF tests of the transmitter and receiver of GSM mobile phones. These tests cover, for instance, measurements of the output spectrum produced by the mobile to evaluate the signal quality and to check possible interference with other services. For the receiver tests, interfering signals are added and signal propagation conditions are simulated using a fading simulator. In this case, the R&S TS8950G measures the receiver sensitivity to these disturbances by calculating the information loss (BER, BLER, FER). The test functionality of the R&S TS8950G is implemented as test methods. Each test method provides a generic test application and is fully configurable. Test cases are described by parameter sets. This provides significant benefits:

- Easy variation of test parameters for testing above and below the predefined test limits
- Fast definition of new tests (for development)
- Consistency between development tests and conformance tests
- Clearer view on the real performance of the mobile phone

Main features

- Platform for RF tests according to 3GPP R&S TS51.010-1
- Freely configurable RF test methods for R&D
- Supports GSM Ph2/Ph2+, GPRS, and EDGE
- Upgradable to WCDMA
- Open interfaces for easy integration into individual lab concept
- Control of custom equipment
- Full remote access
- Online measurement accuracy control

Applications

The R&S TS8950G provides three test application packages

- Transmitter tests
- Receiver tests
- Transceiver tests

Development of GSM mobile phones

Each of these test packages includes a fully configurable test method and example parameter sets. All parameters can be freely varied through the graphical user interface. The measurement results can be analyzed either with the R&S TS8950G control center or with other customer-specific software tools.

Conformance testing of GSM mobiles

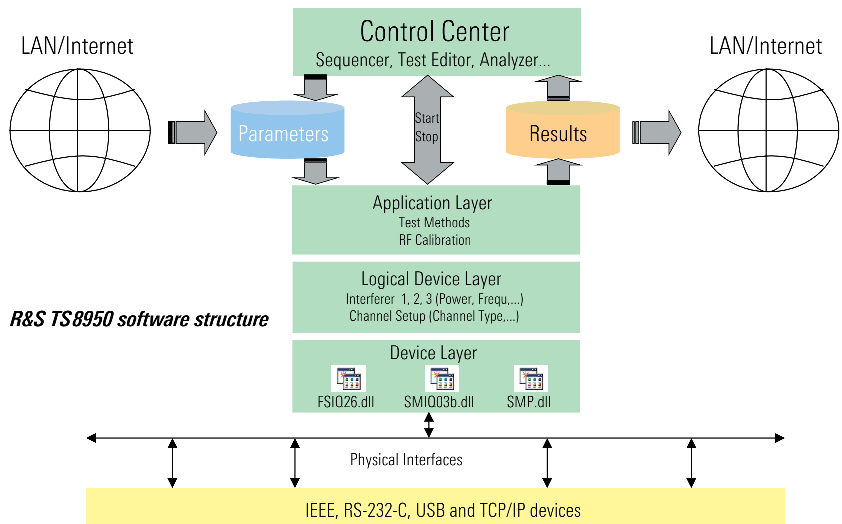
Together with the test methods, the parameter sets for the relevant test cases to 3GPP R&S TS51.010-1 are supplied as write- protected, frozen files. All test cases will be validated by independent test houses.

Platform concept

The R&S TS8950G test system has been developed as a true platform to cover the full range of mobile phone RF tests. The test philosophy of the R&S TS8950G is to have one core system for all extension levels. This core system ensures measurement accuracy and provides appropriate interfaces at the hardware and software level, allowing user friendly system configuration. The R&S TS8950G is available with different extension levels:

RF Test System R&S TS8950G for GSM/GPRS/EDGE Mobiles

Receiver performance test system
The lowest extension level of the R&S TS8950G includes a Radio Communication Tester R&S CMU200 as the signalling unit and BER tester, with one or more signal generators to produce interfering signals and with a baseband fading simulator. The purpose of this minimum configuration is to evaluate the performance of a mobile receiver. If more detailed protocol functionality is required, a Universal Protocol Tester CRTU-G for GSM can be installed instead of the R&S CMU200.



R&S TS8950 software structure

Basic RX/TX test system
This system is equipped with the basic RF equipment including a vector signal analyzer. The signalling unit in the basic RX/TX test system is either a R&S CMU200 or a CRTU-G protocol tester.

Full-performance RF test system
The full system with CRTU-G protocol tester and band-specific signal conditioning units (ASCUs) for each GSM band is the solution for conformance testing. It allows full comparison with measurement results obtained by means of one of the low-extension versions.

Customizing the system configuration
The R&S TS8950G control center allows flexible device handling: Instruments can be easily integrated into the system or removed from it without downtime. The instruments' capabilities are abstracted in a logical device layer, making the system widely independent of the individual instruments.

Custom control/analysis
The test methods in the R&S TS8950G are single executable files. This allows also the use of other software tools for system control, so that existing lab automation software can be extended to control the R&S TS8950G. Parameter files and result files can be accessed from anywhere within the company network so that test design and analysis can be performed offline allowing optimum utilization of human and test resources.

Access to the signal path
The R&S TS8950G switch unit provides access to both transmit and receive signal paths. Multiple RF connectors at the rear of the switch unit allow the introduction of customer-specific signal conditioning elements whenever required.

Further Characteristics

RF Path Calibration
The signals within the R&S TS8950G system are routed through a signal switching and conditioning unit. So no manual changes of the measurement setup, which can cause unpredictable path losses and phase shifts, are required. The switch unit has been optimized for reliability and accuracy. All signals paths used by the test applications are automatically calibrated for frequency-dependent losses. This includes connectors and different DUT (device under test) cables. The fixed internal cabling makes the switch unit insensitive to phase shifts.

The R&S TS8950G system monitors the performance of the RF paths to ensure optimum consistency and reproducibility of measurement results, which leads to a maximum confidence level.

Temperature monitoring
To further increase the information obtained by the tests executed, it is possible to monitor and record the temperature of the test site and the DUT with up to 3 PT100 probes.

Extensions/upgradability
The R&S TS8950G is designed for RF testing of GSM/GPRS/EDGE mobiles operating in the GSM850/900/1800 or GSM1900 frequency band. Extensions for other frequencies are easily possible. In the future, the R&S TS8950G will evolve to a dual-mode GSM/WCDMA test system.

Bluetooth Qualification and Conformance Test Systems R&S TS8960

Conformance Test System for *Bluetooth* RF Qualification, validated by *Bluetooth* SIG

Photo 43434-1

Brief description

R&S TS8960 is a qualification measurement system that is based on the *Bluetooth* Core Specification 1.1 and the *Bluetooth* RF Test Specification 0.91 which contains the obligatory RF measurements for the qualification of *Bluetooth* devices. The system can be used for conformance testing as well as for testing during the development phase and quality assurance process. For this purpose, the parameters of the test cases can be changed in a wide range.

Besides the test cases, the system offers a sophisticated software for RF path compensation. The wanted and interfering signals as well as the signal from the EUT are combined or split, attenuated or amplified, filtered and switched in a signal switching and conditioning unit (SSCU).

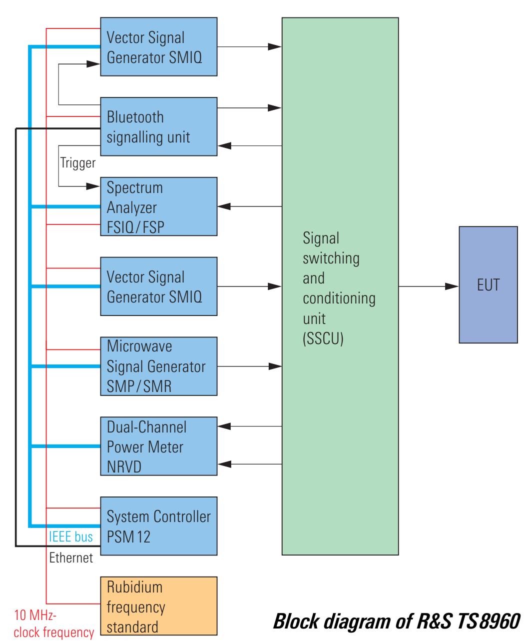
In addition to path compensation, the system offers a selftest. During this test, the main functions of the system devices are checked to ensure specification-conformant execution of the test cases. During the execution of the application programs (selftest, path compensation and test cases) a detailed test report is generated.

The automatically generated test reports with measurement diagrams are suitable for submittal to the BQB (Bluetooth Qualification Body) to obtain qualification for the *Bluetooth* device under test.

The system is controlled via a graphical user interface. The software platform is LINUX (version 7.2), the graphical user interface is based on the Qt Library.

Main features

- All test cases to *Bluetooth* RF Test Specification v0.91 implemented as automatic test routines (for qualification)
- All test cases executable with variable parameters (for development and optimization)
- Additional test cases (free receiver, search sensitivity)
- Signalling unit for "Signalling" test mode upgradeable to protocol tester (PTW60)
- Comprehensive selftests and high measurement accuracy due to automatic path compensation
- Additional options: remote control of climatic chamber, etc.



Block diagram of R&S TS8960

RF Test Systems R&S TS8965B, R&S TS8965C

Ideal test solution for RF pre-qualification and quality assurance in the development process

New

Photo 43919-7

Brief description

The R&S TS8965 RF Test System series comprises of

- R&S TS8965B, designed for pre-qualification and quality assurance
- R&S TS8965C, designed for conformance testing

The R&S TS8965B offers an ideal test solution for RF pre-qualification and quality assurance in the development process. The RF test system is adapted to the *Bluetooth* Core Specification 1.1 and the *Bluetooth* RF test specification 0.91, which defines the RF measurements for the qualification of *Bluetooth* devices.

In the basic version the R&S TS8965B is able to support 8 test cases, i.e. 7 transmitter and 1 receiver test cases. By adding further software and hardware options the R&S TS8965B can be upgraded to a pre-qualification RF test system that supports all 16 RF test cases (non-compliant) of the above mentioned test specification.

Main features

R&S TS8965B

- Cost-efficient RF test system for *Bluetooth* RF development and verification
- Performs all in-band transmitter test cases and maximum input level receiver test case in basic version (non-compliant)
- Extendable to the full set of 16 test cases, i.e. 5 test cases by software upgrade and 3 test cases by hardware and software upgrade (non-compliant)
- The R&S TS8965B can be upgraded to the compliant pre-qualification *Bluetooth* RF Test System R&S TS8965C and to the full qualification *Bluetooth* RF Test System R&S TS8960
- Contains standard test instruments, which can as well be used outside the *Bluetooth* RF Test System R&S TS8965B
- Contains the Rohde & Schwarz signaling unit, which can be upgraded to the *Bluetooth* Protocol Tester R&S PTW60
- Uses same well tried software platform and user-friendly GUI as the *Bluetooth* RF Test System R&S TS8960
- Creation of own test scenarios by variation of parameters
- Automatic generation of detailed test reports
- Built-in self-test ensures reliability of test results
- Static calibration tables guarantee defined measurement results

R&S TS8965C

- Cost-efficient RF Test System for *Bluetooth* RF pre-qualification, ideally suited for the startup phase of a BQTF (*Bluetooth* Qualification Test Facility) or to backup a fully booked R&S TS8960
- Performs all in-band transmitter test cases including the carrier frequency drift test case and receiver test cases such as maximum input level and sensitivity (compliant to *Bluetooth* RF test specification 0.91)
- The R&S TS8965C can be upgraded to the full qualification *Bluetooth* RF Test System R&S TS8960
- Contains the Rohde & Schwarz Signaling Unit, which can be upgraded to the *Bluetooth* Protocol Tester R&S PTW60

RF Test Systems R&S TS 8965B, R&S TS 8965C

- Uses same well tried software platform and user-friendly GUI as the *Bluetooth* RF Test System R&S TS8960
- Creation of own test scenarios possible by variation of parameters
- Tests can be executed in fully automatic mode
- Automatic generation of detailed test reports
- Built-in self-test ensures reliability of test results
- Automatic RF path calibration and Signal Conditioning Unit guarantee a measurement accuracy according to *Bluetooth* RF Test Specification 0.91

Hardware Components

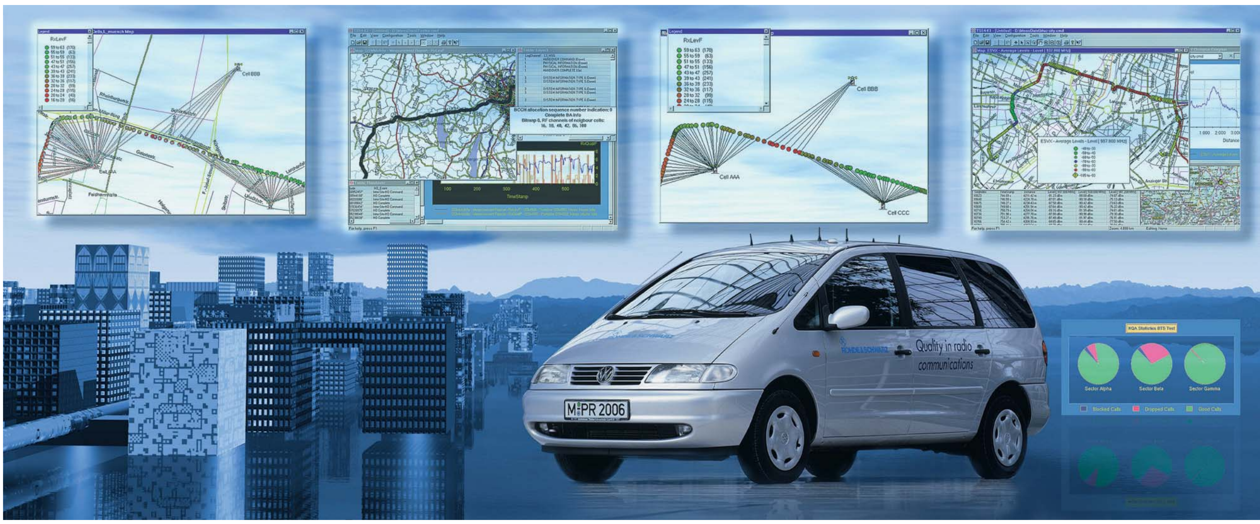
R&S TS8965B

- System Controller (R&S PSM or PSL 3)
- *Bluetooth* Signaling Unit R&S PTW 60
- Spectrum Analyzer R&S FSP 3
- Directional Coupler and Attenuator
- RF Signal Generator R&S SMIQ 03B (optional)
- Microwave Signal Generator R&S SMR 20 (optional)

R&S TS8965C

- System Controller R&S PSM
- *Bluetooth* Signaling Unit R&S PTW 60
- Spectrum Analyzer R&S FSP 3
- RF Signal Generator R&S SMIQ 03B
- RF Signal Generator R&S SML 01
- Power Meter R&S NRVD
- Signal Conditioning Unit R&S SCU

Coverage Measurement Systems (Mobile Radio or DAB) – Overview



Successful know-how transfer: innovative ideas for coverage measurements

In the field of radio coverage measurements too, the name of Rohde&Schwarz has over the years become worldwide synonymous with top quality. As the only manufacturer of a complete range of high-performance and practice-oriented system solutions, Rohde&Schwarz is setting standards in this field.

Customer satisfaction is your capital – and your dividends

Our systems are unrivalled regarding fast and high-precision field-strength measurements wherever the location may be, detailed analysis of the receiving conditions for digital radio signals and absolute reliability of the measured data, e.g. through compliance with the Lee criterion. They thus create the basis for interference-free network operation as well as for the economic success of your network. Only a satisfied customer will be a faithful customer too. Therefore your aim should be lasting customer satisfaction which will pay out dividends over and over again.

The optimized network – minimum investment returning maximum performance

Whether in densely built-up areas or in the mountains: the patented interference measurement equipment of Rohde & Schwarz will show you how many base stations are in fact required and where it is best to install them. You benefit two-fold: low investment costs in the network installation phase and maximum reliability in the operational phase. Your customers will appreciate it.

Digital mobile radio systems – a new challenge to measurement technology

Multipath reflection, scatter, diffraction and interference mean a new challenge to every operator in the digital radio network business. Digital mobile radio systems are far more complex than their analog counterparts. Field-strength measurements alone often prove to be inadequate to evaluate the radio coverage in difficult areas. The unique, patented interference measurement system from Rohde & Schwarz analyzes the multipath propagation of a signal as well as noise or co-channel and adjacent-channel interference - and it detects extraneous signals. There is no potential interference factor whatsoever that is not taken into account. This means that with the measuring systems from Rohde&Schwarz you are always on the safe side and optimally equipped for future digital communication.

Reliable planning through practice-oriented measurement

The dilemma in this context is that only practical experience will furnish useful data about the functioning of a network. This knowledge is required early in the planning phase to optimize the network prior to its commissioning. The solution is in operational measurements using test transmitters. The point of the Rohde& Schwarz solution is that our test transmitters are not only suitable for calibrating the planning software, but can be switched to signalling mode. This allows testing under realistic conditions with exactly the same signals that are later used by the network.

Coverage Measurement Systems (Mobile Radio or DAB) – Overview

This stage will show whether the theoretically determined transmitter sites are suitable and the realistic receiving conditions are sound. It's no longer a matter of hope ("will it run smoothly?"). You can put your radio network installed with the aid of Rohde & Schwarz test equipment into operation and be sure that you provide the customer with a fully developed and tested infrastructure.

From a single source

Efforts involved in building up a radio network are enormous: carrying out market research, procuring the licence, ensuring financing, planning the sites, determining the mobile radio method, choosing the service and sales partners, setting up the administration network, installing the network, testing, optimizing and maintaining it. Therefore it is good to have reliable partners providing competent support in important areas of the implementation and ensuring that the project remains calculable both in time and in money. To live up to all this we supply a complete range of ideally matched measuring systems and components embedded in a consistent software environment. Whether you decide for budget-priced portable test mobile systems or fully equipped test vehicles, whether you wish to make field-strength measurements or signalling measurements - the solutions offered by us are technically innovative, proven in practice and feature maximum performance and ease of use. Numerous network operators – including all providers of full-coverage digital radio networks in Germany – rely on Rohde & Schwarz systems. Our range of cost-optimized network measurement tools certainly includes the right solution for your specific requirements.

Overview of systems

Type	Designation	Description	Application	Page
R&S TS9955	High-Performance Coverage Measurement System	High-performance measurement system for all coverage measurements; basic model for CW measurements; can be upgraded for signalling and interference measurements, Measurement Software "R&S ROMES"	Field-strength measurement Signalling measurement Interference measurement Network optimization Quality monitoring Network planning and installation	429
R&S TS9951 Outdoor	Portable Coverage Measurement System	Compact case system with 1 to 4 test mobiles for network-specific measurements as well as network comparison measurements	Signalling measurement Network optimization Quality monitoring Network installation	430
R&S TS9951 Indoor	Handheld Coverage Measurement System	Special solutions for signalling measurements with 1 or 2 test mobiles	Signalling measurement Network optimization Quality monitoring Network installation	430
R&S TS9958 ROGER	GSM Interference Analyzer	Quick and easy detection of CO and adjacent channel interferences for mobile applications	Network optimization Quality monitoring	432
R&S TS9953	Test Transmitter System	System for emitting network-specific digital or CW signals	Signalling measurement Interference measurement Network planning and installation	435
R&S TS9954 ROSEVAL	Evaluation Software	Evaluation software for all Rohde & Schwarz coverage measurement systems	Field-strength measurement Signalling measurement Data analysis Network optimization Network planning and installation	437
UMR&S TS PN-Scanner	Drive Test Equipment	PN scanner is embedded in the modular software R&S ROMES 3. It consists of a dedicated driver, which has to be installed in the basic R&S ROMES 3 software	Network planning, design Installation, optimization Quality assurance Service	438

Coverage Measurement System R&S TS9955 (Mobile Radio or DAB/DVB)

Highly accurate and fast coverage measurements in mobile radio or DAB/DVB networks

Photo 43218-1

Brief description

R&S TS9955 is a high-performance system for measurements carried out in the planning, installation, optimization and quality monitoring of mobile radio or DAB networks. This system is not only suitable for high-precision and fast field-strength measurements, but in an upgraded configuration (see following pages) also for a comprehensive interference analysis which in this unique form is offered by Rohde&Schwarz only.

R&S TS9955 means an investment in a highly efficient equipment providing extremely fast and reliable measurements. It is basic configuration for field-strength measurements, the system is able to measure four GSM900 channels simultaneously at a speed of up to 90 km/h (63 mph) and with the Lee criterion being adhered to, i.e.a distance of a few centimeters between the measurements. Preparing field-strength profiles and detecting any field-strength gaps is thus speeded up considerably so that accurate data required for calibrating the planning tools are quickly available.

Main features

- Measurement of field strength; up to four GSM channels at a time at speeds of up to 90 km/h and the LEE criterion being complied with
- Frequency hopping over 124 channels
- All filters required for GSM900/1800/1900 and analog systems or DAB
- Integrated test mobiles for various standards
- Acquisition of RxQual, RxLev and layer-3 information via test mobile in GSM 900/1800/1900 and GPRS networks
- Acquisition of signalling data for other mobile communication standards such as ETACS and CDMA
- Collection of positioning data via GPS (Global Positioning System)
- Removable hard disk for easy data handling (PC card)
- Realtime graphics
- Ten user-definable event keys, various system events with freely definable thresholds
- User-friendly measurement software for controlling all system components
- Comprehensive evaluation software

System configuration

The complete measurement equipment can be accommodated in a car. The system installed in the car mainly consists of test receiver, navigation systems, test mobiles, process controller and software. The core of the system is the powerful Test Receiver ESVD (ESVB for DAB, DVB-T and CDMA) which is not only extremely fast but also provides maximum level accuracy and frequency stability. Unlike conventional controllers, the robust Coverage Analyzer R&S PCSP features excellent electromagnetic shielding so that it is absolutely neutral to the highly sensitive measuring equipment.

Software

Measurement Software ROMES integrates and administrates all system components and is ideally supplemented by the Software Package ROSEVAL (see page 437) for drafting and evaluating the test tours.

Coverage Measurement System R&S TS9951 (Mobile Radio or DAB)

Compact case system with 1 to 4 test mobiles for network-specific measurements and network comparison measurements

Photo 43210-2

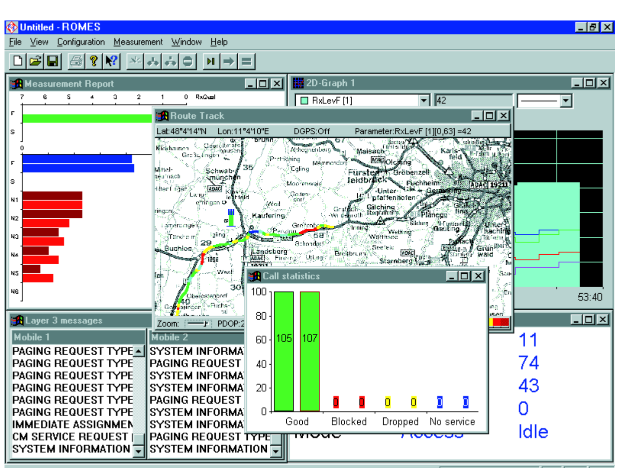
Brief description

Out and about with compact systems

System R&S TS9951 is a budget-priced compact solution for network-specific quality parameter measurements during network installation, but mainly for quality monitoring during regular network operations. Through the integration of the main system components in a robust transit case, the systems are ready for use at any time and easy to transport. They can optionally be fitted with GSM900/1800/1900 test mobiles, as well as ETACS or CDMA test mobiles.

Simultaneous measurement of different networks to save time

R&S TS9951 with up to four (maximum of three GSM) test mobiles allow mobiles of different standards to be used at the same time to carry out simultaneous measurements on several networks available at a site, or various antenna models or antenna positions on the vehicle to be tested. The test mobiles can readily be exchanged in no time. This flexibility is a great advantage in particular for service enterprises that have to carry out measurements on different networks on behalf of their customers often under an enormous pressure of time.



Coverage Measurement Software R&S ROMES

The right system for every application

Different requirements call for different solution

- R&S TS9951 for outdoor application with one to four test mobiles for measurements in operational network or for use in conjunction with Test Transmitter System R&S TS 9953 (GSM technology)
- R&S TS9951 for indoor measurements

Main features

- Compact case system with built-in GPS receiver and with IBM-compatible laptop
- Test mobiles available for GSM900/ 1800/1900 CDMA or ETACS
- One, two, three or four test mobiles
- Test mobiles (level table storable)
- Basic measurement in passive idle mode – no call setup required
- Camp mode for determining the cell boundaries
- Recording of signalling and analysis of OSI layer-3 information

Coverage Measurement System R&S TS 9951 (Mobile Radio or DAB)

- Realtime graphical display of test report
- Realtime alphanumeric display for presenting signalling information
- Realtime presentation of selected parameters on underlaid road maps
- Automatic or manual measurement mode
- Outdoor positioning with the aid of GPS navigation
- GSM Network Quality Analysis (NQA) Software running under Excel 5.0 or 8.0 for statistical evaluation of network availability, quality of connection, time required for call setup, call hold time, etc
- DC (12 V) or AC supply
- Indoor navigation modes

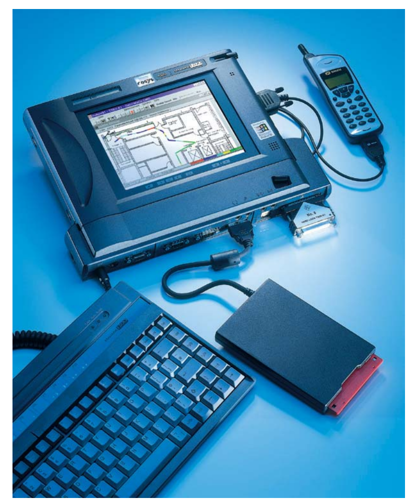
System configuration

The systems use the intelligence of the radio telephones, i.e.they automatically find the operating frequencies of the radio service. The measurements are not only carried out in the dedicated mode, but also in the RxQual idle mode of the mobile. The great advantage of these systems is that quality measurements can be made in conjunction with a digital test transmitter such as the R&S TS 9953 (see page 435) so that a full-featured base station is not required.

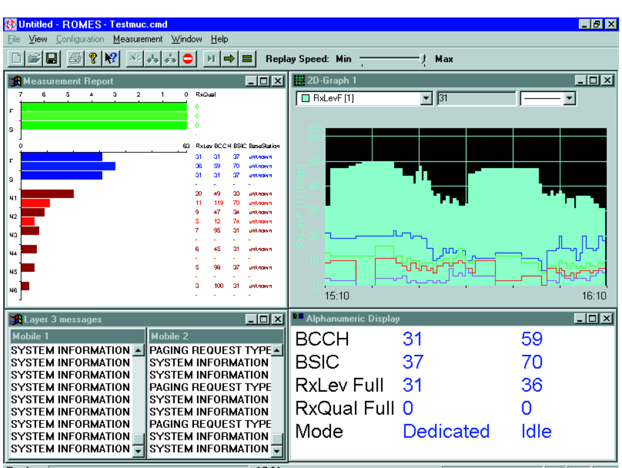
The test mobiles used are modified by adding vital measurement functions. They also allow measurements on cell boundaries to be readily performed (camp mode). Moreover, the mobiles can be calibrated for high measuring accuracy. The built-in GPS receiver can be supplemented by a Travelpilot or sensor system to handle situations in which GPS reception via satellite is not possible, for instance in road tunnels.

Software

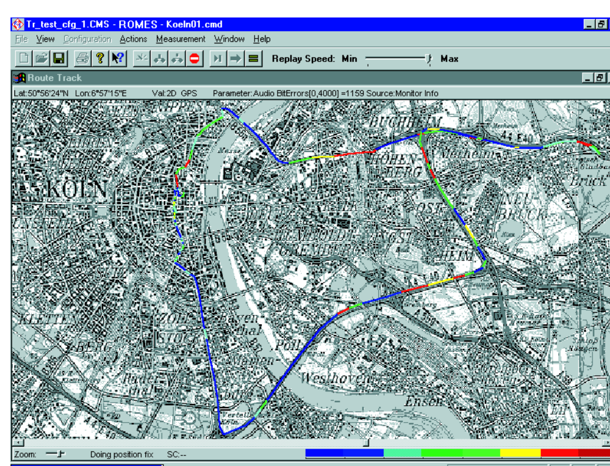
R&S TS9951 not only features an extraordinary hardware but also a very special software providing far more than the usual capabilities. In addition to the display of standard parameters such as RxQual, RxLev or SSI, this system also allows graphical processing of data and presentation on underlaid road maps.



R&S TS9951 for indoor measurements



Four typical windows in replay mode



Full-screen display of Route Track window with a complete DAB test tour

GSM Interference Analyzer R&S ROGER (R&S TS9958)

Quick and easy detection of CO and adjacent channel interferences for mobile applications

Photo 43590-4

Brief description

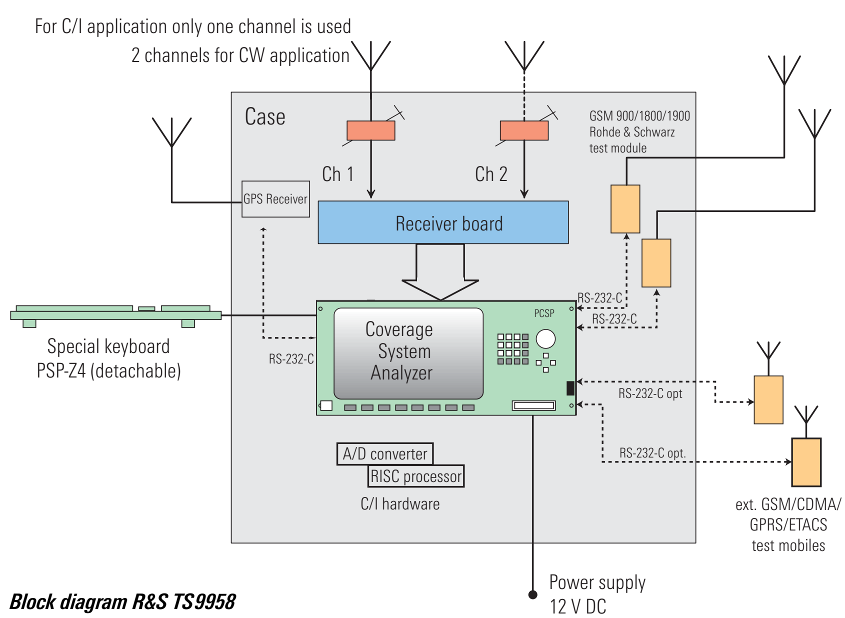
The GSM Interference Analyzer R&S TS9958 is a highly practical solution for co-channel interference measurements that are mobile and fully automatic, making the way for simple analysis.

R&S ROGER consists of:
- Test Receiver R&S TS55-RX
- up to four test mobiles of different make
- a GPS receiver
- a process controller equipped with A/D converter card and signal-processing card

Test Receiver R&S TS55-RX is accommodated in the controller, making R&S ROGER a highly compact, lightweight unit. The system uses Coverage Measurement Software ROMES 3 from Rohde&Schwarz, affording a state-of-the-art operating concept and the repeated use of position data sources and mobile-phone linkups. Using an indoor module, the software even allows interference detection inside buildings. R&S ROGER can optionally be fitted with a position trigger so that it can carry out classic measurement of coverage in addition to interference. In particular the option of extending the system by up to eight additional mobiles of different standards (GSM 900/1800, CDMA, GPRS) allows space- and cost-saving performance of different tasks with a single unit.

Main features

- Fully automatic measurements, no manual control necessary
- Mobile measurement detects interferences everywhere
- Easy and simple evaluation of the real source of interference
- For all GSM/GPRS networks with hopping or non-hopping channels
- Not only experts can make reliable mobile C/I measurements
- Quick and reliable graphical evaluation
- A MUST for GPRS networks due to high data transmission rates
- Drastic reduction of all measurement costs
- Significant improvement of fast and reliable results
- Real interferer identification within seconds



Block diagram R&S TS9958

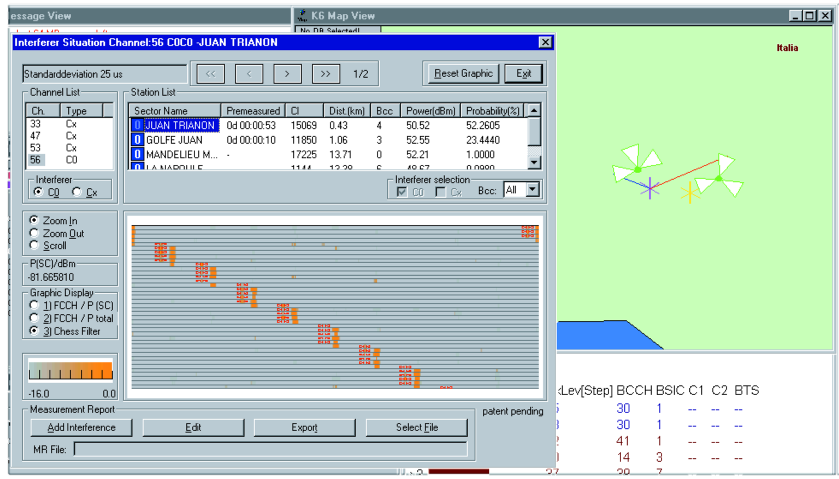
GSM Interference Analyzer R&S ROGER (R&S TS9958)

How R&S ROGER works

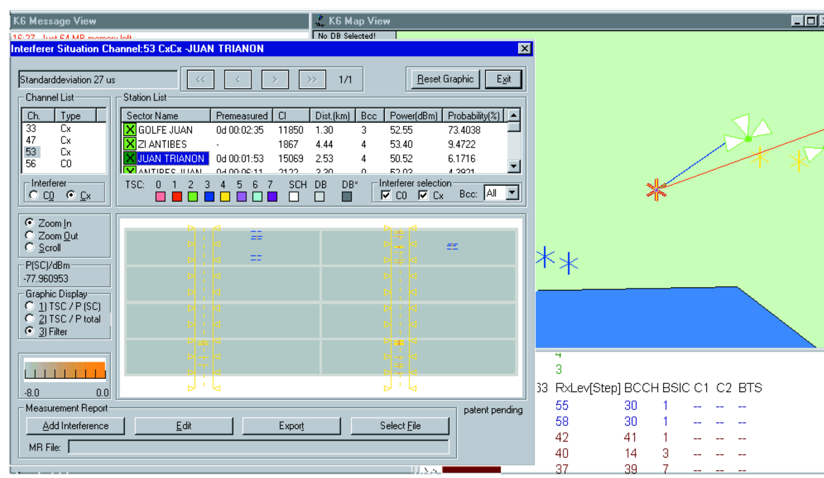
Just a short configuration of R&S ROGER, and the test tour can start. The test run is automatically controlled by up to four mobile phones, doing away with any manual control. High vehicle speeds are no problem for R&S ROGER either. Interference measurement is performed in three steps:

- detection of interference
- measurement of interfered/interfering signals
- assignment of these signals to base stations

The signals found can be assigned to the emitting base stations already during the test tour or afterwards on a conventional PC.



R&S PCSD-K6 Evaluation Display (here BCCH (C0) with interference from another BCCH (C0))



R&S PCSD-K6 Evaluation Display (here TCH (Cx) with interference from another TCH (Cx))

Signal display

There are signal displays for two test modes: for C0 (BCCH) and Cx (TCH) measurements. From the disturbed composite signal, R&S ROGER filters out frequency-correction bursts (FCCHs) for the identification of C0 carriers and displays them. The time axis is structured in lines comparable to a TV frame, arranged such that neighbouring FCCHs of an M51 frame (51 TDMA frames) come vertically one below the other. Because of the idle burst at the end of each M51 frame, a staircase pattern is obtained for each detected C0 carrier. So the graphical presentation of the C0 channel of the serving cell (SC) reveals a staircase with the FCCHs of the SC itself and further patterns in the case of C0 interference. In the analysis window for adjacent channels or TCH channels of the SC, each staircase pattern indicates the presence of C0 interference.

In Cx measurement, the composite signal is analyzed in greater detail. Synchronization as well as dummy-burst and training sequences are filtered and visualized grouped according to timeslots. The measured sequences of different base stations are shown in time grids corresponding to two vertical stripes in the Cx display. Different base stations are represented by stripes at different positions along the x axis. Interference can be identified immediately: from any further stripes displayed next to the two SC stripes. In mobile measurements, the selected signals fluctuate due to fading, reflection and other external influences, resulting in a variety of signal patterns. R&S ROGER therefore processes interference signals for graphical representation, as the human eye can analyze complex patterns with high reliability.

GSM Interference Analyzer R&S ROGER (R&S TS9958)

Fast identification of base stations
To trace interference back to the emitting base station, a feature characteristic of each BR&S TS is used: the expected arrival times of specific signals at the measuring instrument. The times are determined from the measurement position, the expected sending time and the site of the BR&S TS. When a BR&S TS is selected, the expected arrival time is superimposed on the displayed sequences in the form of a template. If this matches a signal measured, the latter can be assigned to the selected BR&S TS. In the case of Cx measurements, the number of possible base stations is reduced by a factor of eight to those whose base-station colour code and training-sequence code are identical. The selected BR&S TS is additionally shown on a map, allowing comparison of the propagation conditions of server and interferer.

Power measurement
In the interference charts, the power values are colour-coded, allowing a basic evaluation of interference. For purposes of optimization, the measurement system provides the dynamic C/I value for each base station after the SC and interference signals have been selected. The measured and averaged power values can be visualized and if necessary modified. Modification enables evaluation of the range of interference obtained with mobile measurements. The results of power analysis are stored in a file, and a test report of the analyzed interference signals is generated. The latter may serve as a basis for network modifications.

Specifications in brief

Controller	
Processor	AMD K6, 300 MHz minimum
RAM	32 Mbyte (standard), with PSP-B2 expandible to 64 Mbyte 512 kbyte cache
Hard disk	1.6 Gbyte minimum
Disk drive	1.44 Mbyte, 3½"
Operating system	MS-Windows version 98
Test & measurement software	LabWindows/CVI
Display	
PSP2	none
PSP7	LCD colour, 8.4", screen anti-glare
Resolution	
with integrated LCD	VGA standard: 640 x 480 pixels
for external monitors	1280 x 1024, 1024 x 768, 800 x 600, 640 x 480 pixels, 2 Mbyte video memory
Interfaces	
Internal	ISA, 3 x 16 bits
External	
IEC/IEEE	IEEE488.2, compatible with NI TNT
Serial	2 x RS-232-C
Printer	Centronics LPT1 (ECP, EPP)
PCMCIA	release 2.0, type III, connector
Keyboard, mouse	5-contact DIN, 5-contact PS/2
Interference measurements	GSM 900, GSM (DCS) 1800 and GSM (PCS) 1900 networks
Detection and analysis of C0 and Cx interferences	on the C0 (BCCH), Cx (TCH) and optionally on adjacent channel of the Serving Cell (SC)
Trigger on interferences	automatically or manually based on 1 to 4 GSM test mobiles

Displayed dynamic range

Type of interference	Total[1)]	compared to SC[2)]
C0 – C0	–16 dB to 0 dB	–13 dB to 3 dB
Cx – C0	–16 dB to 0 dB	–13 dB to 3 dB
Adj – C0	–8 dB to 0 dB	–8 dB to 8 dB
C0 – Cx	–8 dB to 0 dB	–10 dB to 6 dB
Cx – Cx	–8 dB to 0 dB	–10 dB to 6 dB
Adj – Cx	–8 dB to 0 dB	–8 dB to 8 dB

General data	
Rated temperature range	+5°C to +45°C
Operating temperature range	0°C to +50°C
AC supply	100 V to 120 V ±10%, 50 Hz to 400 Hz 220 V to 240 V ±10%, 50 Hz to 60 Hz
DC supply	DC, 12 V
Max. power consumption	300 W typ. (12 V DC/25 A)
Dimensions (W x H x D)	500 mm x 200 mm x 800 mm
Weight	19.8 kg

Ordering information

GSM Interference Analyzer R&S ROGER	R&S TS9958	1132.2506.02
Options		
Additional, external GSM/GPRS Test Mobiles	on request	

1) Compared to the total power in the underlaying time slot.

2) Compared to an average power level of the SC, measured directly before and after the actual interference.

GSM Test Transmitter System R&S TS9953

Ideal positioning of base transceiver stations in frequency and network planning

Photo 42659-7

Brief description

Planning of base transceiver stations
Complex frequency planning tools are used to ensure optimum positioning of a base transceiver station (BTS). The efforts involved, especially for tasks such as obtaining permissions, rental agreements etc, are very high. The GSM network operator therefore needs to be sure that the site calculated is suitable for the BTS installation.

Test Transmitter System R&S TS9953 fulfils all requirements

- Unmodulated transmitter:
  CW data obtained by means of a test receiver serve as a feedback and for the calibration of frequency planning systems
- Modulated transmitter:
  For measurement tasks in network optimization, a BCCH bit sequence is transmitted by the system as a modulation signal for synchronization with a GSM test mobile. RxLev and RxQual are measured using suitable test mobiles (R&S TS95XMO, R&S TS95MMx).

A GSM antenna with appropriate alignment and downtilt is set up on a stable tripod (4 m) or a robust, small mast (5.4 m) on the site determined for a BTS. The antenna is fed by a 20 W amplifier via an RF cable.

The amplifier is equipped with a GMSK modulator connected ahead of the built-in RF oscillator. A BCCH test sequence stored in the transmitter supplies the modulation signal. The test transmitter simulates a BTS on the downlink.

If the theoretically determined site proves to be unsuitable for a BTS, the test team can simply choose an alternative site since the R&S TS9953 system is so easy to set up. The data measured on the new site can subsequently be confirmed by the frequency planning department.

Main features

- Modular transmitter system
- RF amplifier, CW transmitter (generator, amplifier), GSM test transmitter (modulator, generator, amplifier)
- Three convenient RF power classes: 2 W, 20 W, 50 W (on request)
- 2 W GSM test transmitter as exciter for subsequent booster
- Extremely easy selection of frequency and output power
- Built-in display for forward and reflected power, and VSWR
- Rugged cabinet design suitable for transportation
- Comprehensive useful accessories (weather protection, tripods, antennas, cables, power meter, emergency power supply

R&S TS-TX9 and R&S TS-TX18

For handling measurement tasks within buildings or microcell structures Rohde & Schwarz has developed two very compact test transmitters with 2 W output power. They can be operated via built-in batteries or an external power supply unit. These mini-transmitters are also fitted with a built-in GMSK modulator/oscillator. A suitable BCCH sequence can be loaded via the serial interface. 2 W GMSK transmitters come in two models:

- R&S TS-TX9 for GSM 900, GSM-R, GSM-E
- R&S TS-TX18 for GSM 1800

A control circuit monitors the set RF power and battery voltage. If a constant RF level cannot be ensured by the supply voltage, the test transmitter is switched off to prevent erroneous measurements.

Mini-transmitter R&S TS-TX

The 2 W GSMK Transmitter R&S TS-TX9/R&S TS-TX18 can also be used as an exciter for subsequent RF boosters.

GSM Test Transmitter System R&S TS9953

R&S TS9953 for UMTS/WCDMA

To find out about the real propagation conditions in future UMTS/WCDMA networks, a 20 W RF amplifier is available that is ideally suited for the next generation of mobile radio networks because of its wide frequency band (800 MHz to 2700 MHz). This amplifier can be driven by a generator with WCDMA capability (e.g. R&S SME03E, R&S SMIQ) and then supplies a signal that can be measured with conventional coverage measurement systems (e.g. R&S TS9955 from Rohde&Schwarz).

A suitable converter for the frequency band expansion is available for the Test Receivers R&S ESVD/ ESVB.

BCCH Editing Software R&S TS53-K1

The R&S TS53-K1 software allows easy generation of individual BCCH bit sequences. R&S TS53-K1 runs under Windows 9x, NT or 2000 /XP on a PC, laptop or notebook and can be used for all R&S TS9953 systems.

The sequence is loaded to the modulators via a serial interface.

Specifications

Frequency range	
R&S TS-AMPG	935.2 MHz to 959.8 MHz / channels 1 to 124
R&S TS-AMPD	1805.2 MHz to 1879.8 MHz / channels 512 to 885
R&S TS-TX9	921 MHz to 959.8 MHz (incl. GSM-R and GSM-E)
R&S TS-TX18	1805.2 MHz to 1879.8 MHz / channels 512 to 885
Channel spacing	200 kHz
CW mode	unmodulated carrier
GMSK modulation mode	BCCH sequence max. 8 Mbit
Frequency settings	
R&S TS-AMPG, R&S TS-AMPD	by means of decade switches
R&S TS-TX9, R&S TS-TX18	via softkeys, indication on LCD
Frequency stability	
in operating temperature range	± 0.1 ppm
short-term	$\pm 5.0 \times 10^{-10}$/s
long-term	$\pm 2.0 \times 10^{-9}$/day
	$\pm 0.5 \times 10^{-6}$/year
	after 30 days of operation
Output power	
R&S TS-AMPG, R&S TS-AMPD	43 dBm; ± 1 dB (for 1 dB compression)
R&S TS-TX9, R&S TS-TX18	33 dBm; ± 1 dB (for 1 dB compression)
Harmonics suppression	>50 dBc
Nonharmonics suppression	>50 dBc
Overload switchoff	automatic
Service connector for data transfer	9-pin sub-D male
RF connector	
R&S TS-AMPG, R&S TS-AMPD, R&S TS-UMTS	N female for input/output
R&S TS-TX9, R&S TS-TX18	SMA connector
UMTS amplifier	
R&S TS-UMTS	800 MHz to 2700 MHz
Output power	20 W (25 W typ.)
Gain	40 dB (min. ±1.2 dB)
VSWR input	1.8 (max.)

General data

Operating temperature range	
R&S TS-AMPG, R&S TS-AMPD, R&S TS-UMTS	–10°C to +40°C
R&S TS-TX9, R&S TS-TX18	+5°C to +45°C
Power supply	
R&S TS-AMPG, R&S TS-AMPD, R&S TS-UMTS	230 V AC (47 Hz to 63 Hz) or 110 V AC
R&S TS-TX9, R&S TS-TX18	7.2 V battery
Cabinet	
R&S TS-UMTS	19"/2 HU/300 mm depth
R&S TS-AMPG, R&S TS-AMPD	19"/3 HU/460 mm depth
R&S TS-TX9, R&S TS-TX18	
Dimensions in mm (W x H x D)	84 x 260 x 35
Weight	approx. 700 g

Ordering information

R&S TS9953 System		
GSM900 Generator Amplifier with internal GMSK Modulator	R&S TS-AMPG	1070.5689.05
GSM1800 Generator Amplifier with internal GMSK Modulator	R&S TS-AMPD	1072.1051.05
GSM900 Transmitter with internal GMSK Modulator	R&S TS-TX9	1090.8460.02
GSM 1800 Transmitter with internal GMSK Modulator	R&S TS-TX18	1090.8477.02
Editor Software for generation of BCCH bit sequences on a PC	R&S TS53-K1	1117.5714.02
UMTS Amplifier	R&S TS-UMTS	1148.1804.02
Accessories		
Transportation Case, plastic cover for weather protection	R&S TS-SUIT	1070.5908.04
Transportation Case	R&S TS-SUIT	1070.5908.02
Transmitting Antenna for GSM900	R&S HF065D1	4044.1508.02
Transmitting Antenna for GSM1800	R&S HF065E1	4043.8509.02
Tripod, 4 m	R&S TS-MAST	1070.5708.02
Portable Mast, 5.4 m	R&S TS-MAST	1070.5708.04
7 m Antenna Cable	R&S TS-CABL	1070.5714.02
Emergency Power Supply	R&S TS-AGGR	1070.5737.02

Evaluation Software R&S ROSEVAL

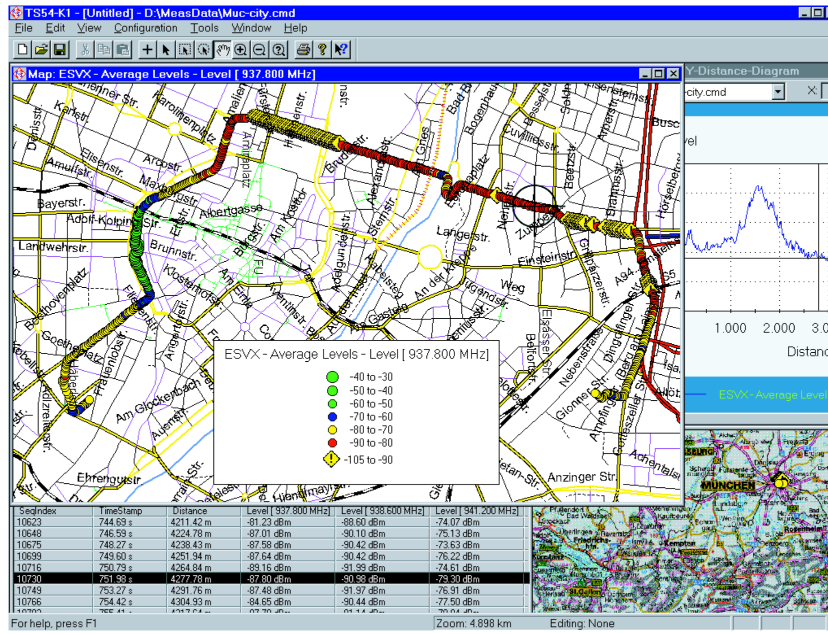
High-performance evaluation software for field-strength analysis

Brief description

The high-performance Evaluation Software R&S TS9954 "Roseval" (**Ro**hde&**S**chwarz **eval**uation software) is an excellent tool for analyzing all measurement data from data collection systems (Rohde&Schwarz Systems R&S TS9951 or R&S TS9955) by means of different methods.

With the aid of this software the user can ensure high network quality during the installation, optimization, service and maintenance of his network. As a Windows application it can easily be handled and installed on a standard PC. The concept is modular and adaptable to the most familiar digital networks like GSM, ETACS, CDMA.

As a subunit the well-known GIS software MAPINFO is used for geographical evaluations. The full power of this embedded software is open for designing new customer-specific layers.



Graphical representation of RxLev and RxQual along a route

Main features

- Generation of structured meta files
- Highly effective evaluation through the use of filtered and selected data
- Efficient file management of measurement data (central server)
- Fast access to all local temporary data
- Freely definable legends and comments
- Selection and evaluation of multiple measurement files in database only limited by system resources
- Exact reference of measured points to the measurement device they originate from
- Statistical evaluation and area data mapping
- Wide range of attributes assignable to each signal (colour, icons, pattern, ranges) to get the most efficient visualization of parameters
- SQL (structured query language) data selection and evaluation
- User-definable derived signals
- Global data selection (interactive and SQL)
- No special expensive hardware is needed (recommended Pentium class 300 MHz or better)

Available technologies

The most important digital network technologies and Rohde&Schwarz Test Receivers R&S ESVx are supported.

- CW, Field-Strength Test Receiver R&S ESVx
- GSM900/1800/1900 test mobiles, signalling
- ETACS test mobile, signalling
- CDMA test mobile, signalling
- CIR (channel impulse response) analysis
- C/I (carrier/interference ratio)

R&S UMTS PN-Scanner

New

Drive test equipment for network planning, design, installation, optimization, quality assurance and service

Photo 43835-3

Brief description

The PN scanner is embedded in the modular software R&S ROMES3. It consists of a dedicated driver, which has to be installed in the basic ROMES 3 software (see data sheet R&S ROMES 3, PD 0757.6679).

R&S ROMES3 is based on a modular system concept, allowing any type of data to be collected and analyzed. Any sensor (e.g. test receiver, test mobile or GPS receiver) capable of result transfer to a PC or Laptop can be used. This opens a wide range of use, from measurements in mobile radio to almost any kind of exotic application. The modular concept enables the implementation of very small systems and high performance systems alike. And it makes the software future-proof, as it can easily be extended to accommodate up coming technologies.

Main features

- Automatic PN code (node b) detection and analysis
- Signal strength measurement for different networks (UMTS, GSM, IS95, ...)
- Full spectrum analyzer function available
- Coverage measurement software Romes3 as a modular base
- Standard ESPI Test Receiver or R&S FSP Spectrum Analyzer as RF front end
- GPS integrated
- Laptop or system controller application
- 120 dBm sensitivity

R&S UMTS PN scanner can be configured to five packages

Laptop configuration for PN scanning

- Laptop equipped with PCMCIA IEEE bus interface or LAN interface (recommended)
- R&S FSP (spectrum analyzer) or R&S ESPI (test receiver)
- GPS system (e.g. Garmin mouse)
- Measurement software R&S ROMES3 with PN scanner option

Laptop configuration for CW measurements

- Laptop equipped with PCMCIA IEEE bus interface or LAN interface
- R&S ESPI (test receiver) with preselector
- GPS system (e.g. Garmin mouse)
- Measurement software R&S ROMES3 with PN scanner option

Laptop configuration for CW measurements and PN scanning

- Laptop equipped with PCMCIA IEEE bus interface or LAN interface
- R&S ESPI (test receiver)
- GPS system (e.g. Garmin mouse)
- Measurement software R&S ROMES3 with PN scanner option

Process controller configuration for PN scanning

- Process Controller R&S TSPC2 equipped with network interface
- External 15,1" LC display
- R&S FSP (spectrum analyzer) or R&S ESPI (test receiver)
- Inertial GPS navigation system
- Power supply control unit
- Measurement software R&S ROMES3 with PN scanner option

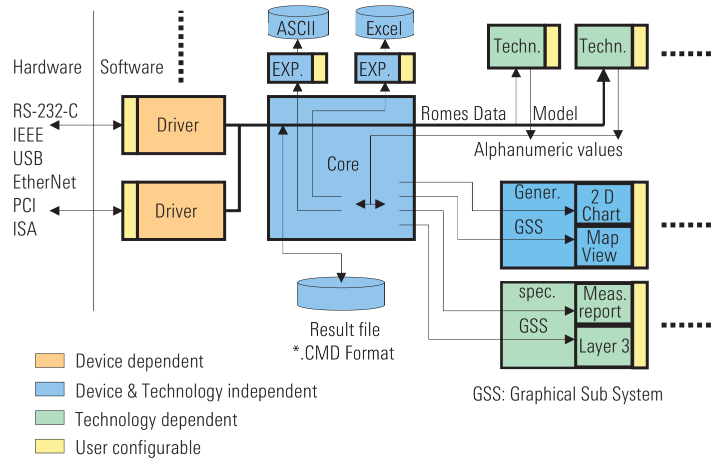
High performance system for PN scanning and CW measurement

- System Process Controller R&S TSPC2 equipped with network interface
- External 15,1" LC display
- R&S ESPI (test receiver)
- Inertial GPS navigation system with distance trigger unit and external distance pulse generator
- Power supply control unit
- Measurement software R&S ROMES3 incl. PN scanner and CW option

Software user interface

A core unit is acting as a shunting station. It transfers the data from the external hardware via the driver to the result file and to the displays. In general two different display types are supported, one is the general view e.g. 2 D-chart, alpha or map view, the other is the technical specific view, e.g. GSM measurement report, PN-Scan view etc.

R&S UMTS PN-Scanner



In addition post processing of our data with an external tool e.g. Excel is possible.

A comfortable, freely definable export function and a lot of specific exports are also available. Upgrading to new hardware is easy. Only a new driver has to be installed by the user.

Specifications

General	RSSI of received channel
P-SYNC	Graphical display of correlation result Relative power of detected peaks Time delay of detected peaks
P-CPICH	Code group Scrambling code Total power of CPICH Parameters per scrambling code

:

Result	**Description**	**Specification**
RSCP	Received signal code power	TS 25.215; 5.1.1
SIR	Signal to interference ratio	TS 25.215; 5.1.3
ISCP	Interference signal code power	TS 25.215; 5.1.3
E_c/N_0	The received energy per chip divided by the power density in the band	TS 25.215; 5.1.6

Parameters per identified peak per Scrambling Code:

Result	**Description**	**Specification**
Power	Power of identified peak	–
Time	Relative time of arrival	–

Code channel power	code channel power of code channels spreading factor
Spectrum	Spectrum of channel Spectrum History of channel

Update rates

Update rates depend on three general aspects:

- Required measurements
- Number of node Bs and reflections in the air PC
- Performance

The following table represents typical update rates on a Pentium III 750 MHz System. The calculations were done with Version ROMES 3.16 and 15 UMTS Slots.

Raw Data	✓	✓	✓	✓	✓	✓
P-SYNC		✓	✓	✓	✓	✓
P-CPICH			✓	✓	✓	✓
Peaks					✓	✓
# Node Bs	–	4	1	4	1	4
Update [s]	0.7	0.9	1.2	1.5	1.4	1,8

Dynamic Ranges

C-PICHs are analyzed successfully up to the following values:

E_c/N_0	–20 dB
RSCP	–100 dBm

Ordering Information

Laptop Configuration		
Laptop Computer	R&S TS951PC	1070.5872.10
IEC625/IEEE-488 PCMCIA type II card	R&S TS-IEC	1042.0970.02
GPS Navigation System	R&S TS95GPS	1090.8348.02
EMI Test Receiver[1)]	R&S ESPI3	1142.8007.03
Option preselector for R&S ESPI[2)]	R&S ESPI-B2	1129.7498.02
LAN Interface 10/100 BaseT for R&S FSP/ESPI	R&S FSP-B16	1129.8042.02
OCXO 10 MHz for R&S FSP/ESPI	R&S FSP-B4	1129.6740.02
Power Supply 12 V DC	R&S TS-HW	1042.5771.02
Documentation of Calibration Values	R&S DCV-2	0240.2193.09
Trigger for Coverage Measurements with R&S FSP/ESPI3	R&S ESPI-K50	1106.4386.02
CW Driver for R&S ESPI	R&S TS5K10E	1143.8198.02
Synchronization Unit for R&S UMTS PN Scanner	R&S TS-PNSY	1114.4817.00
R&S ROMES3 R&S UMTS PN Scanner Software Driver for UMTS	R&S TS5-C50C	1063.0579.02
Basic Measurement Software R&S ROMES3	R&S TS5K00	1143.7991.02
Evaluation Software Roseval	R&S TS54-K1	1117.5495.02
UMTS High Performance System		
System Controller, LC-Display and Interfaces		
System Process Controller	R&S TSPC2	4049.9571.00
High-performance GPIB Interface	R&S TS-IEC	1042.1276.02
RS-232-C Interface[3)]	R&S TS95SER	1029.5871.02
Network Adapter	R&S TS95NET	1029.7997.02
15,1" TFT-Display	R&S TS-LCD1	1064.5800.02
19" Rack for R&S TS9955 (15 HU)	R&S TS955RA	1053.5590.02
Measurement Cable Set for R&S TS9955	R&S TS955KS	1042.9631.02
Hardware Integration into rack for R&S TS9955	R&S TS955HI	1053.5603.02

All other options as in the Laptop configuration

1) FSP can replace R&S ESPI for PN Scan only, no CW use

2) Factory installation only for R&S ESPI

3) For System Process Controller R&S TSPC2.

Brief description

Uses

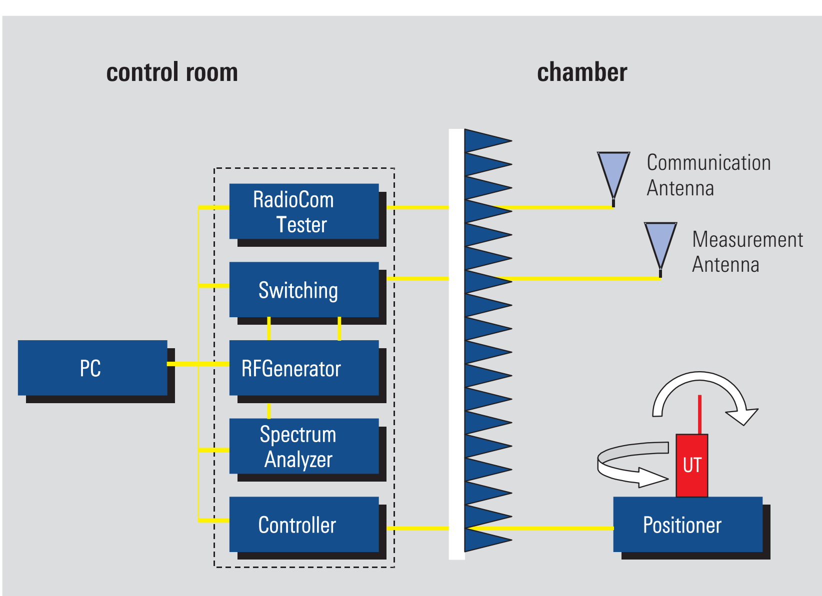
Test System R&S TS9970 has been designed for measuring main RF parameters of wireless communication equipment under realistic operating conditions. In addition to the spatial radiation characteristic of the communication antenna, receiver parameters such as signal-to-noise ratio and bit error rate as a function of EUT orientation can be determined.

R&S TS9970 can be effectively used both in design and type approval testing.

Configuration

As shown in block diagram, R&S TS9970 is made up of the following main components:

- The communication tester in conjunction with the communication antenna serves for establishing a radio link to the EUT
- Depending on the type of measurement to be performed, the measurement antenna is connected via a switch matrix either to the spectrum analyzer, RF generator or communication tester
- The EUT is mounted on a positioning device which is remote-controlled by a controller. An artificial head or body may be used to simulate the operator's influence
- A central process controller including the appropriate software provides for automatic measurements with documentation of results
- To simulate open area conditions, a shielded anechoic chamber or comparable test cell (i.e. R&S M-LINE from Rohde & Schwarz) is required for testing



Main features

- Determination of spatial radiation and receiving characteristics of EUT
- Especially suitable for EUTs with integrated antenna
- Measurement of main RF parameters via air interface
- Automatic measurements and analysis of results
- Also available as extension for EMC lab systems

Block diagram R&S TS9970

RF Performance Test System R&S TS9970

System versions

Version 01 – Basic system

Main components
- Signal generator
- Spectrum analyzer
- Positioning device
- Communication tester
- Relay matrix
- RF attenuator
- Test and communication antennas
- System software

Version 02 – Extension for EMV systems

Since existing EMC systems often contain most of the instruments used in the R&S TS9970 basic system, version 02 is available for extending such systems. Rohde & Schwarz offers an upgrade package tailored to the specific needs.

Standards

Almost any digital and analog radio standard can be implemented in the system. A suitable communication tester is the only prerequisite. Rohde & Schwarz testers support the following standards:

TACS, AMPS	R&S CMS52/54	0840.0009.52/54
GSM900/1800/1900	R&S CMD55/65	1050.9008.05/65
DECT	R&S CMD60/65	1050.9008.60/65
CDMA, D-AMPS	R&S CMD80	1050.9008.84
D-AMPS	R&S CMD80	1050.9008.84

Implementation of Universal Communication Tester R&S CMU into the R&S TS9970 is also possible.
Configurations for other standards on request.

Test parameters
- Bit error rate
- Effective radiated power (ERP) or equivalent isotropically radiated power (EIRP)
- Transmission parameters such as RXQUAL, RXLEV, etc
- S/N ratio at receiver input, etc.

System software

Main features
- Standard test routines for measurement of 3D directional pattern in a spherical or semispherical volume
- Standard test routines for measurement of 2D directional pattern (azimuth pattern)
- Setting of all test parameters via the software user interface
- Automatic evaluation of results (referred to limit values, e.g. conforming to GSM, DECT, etc)
- Graphical and tabular display of results
- Automatic generation of test reports
- Expandable for magnitude and phase measurements (network analyzer)

Specifications

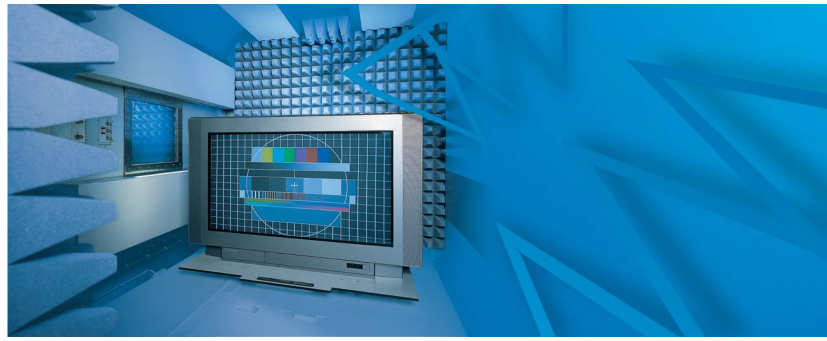
Operating temperature range	+15°C to + 40°C
Relative humidity	95% at 40°C
Power supply	110 V AC, 230 V AC
Certification	CE, VDE
The system comes in a 19" rack	

Accessories

Test environment	R&S M-LINE
Controller	R&S TS-PCS
Controller integrated in rack	R&S PSM 17
Artificial head	R&S TS-HEA
Artificial body	R&S TS-BOD

EMC Test Systems

From small systems through to complete equipment of test houses with shielded anechoic chamber and the complete infrastructure required



Planning and implementation of practice-oriented EMC test systems requires a great deal of specialized knowledge and experience. This is what Rohde & Schwarz specialists have. All their expertise goes into turnkey EMC test systems which provide the fastest way of yielding correct EMC measurements. These systems are always tailored to the specific needs of the customer to provide the optimum solution to the tasks on hand. We can offer everything from small systems through to complete equipment of test houses with shielded anechoic chamber and the complete infrastructure required. Naturally, the main emphasis is on fully automatic measurements with comprehensive documentation of the test results and, if desired, statistical evaluation. One of the important factors of automatic EMC test systems is calibration and continuous monitoring of the measurement accuracy to make sure that all test results will pass another compliance test.

System overview

Type	Description	Application	Special	Page
R&S TS9970	RF Performance Test System	Measuring main RF parameters of wireless communication equipment under realistic operating conditions	Common RF	440
R&S TS9975	EMI Test System	EMI measurements of conducted and radiated interference	Commercial, military	443
R&S TS9976	Emission Test System	EMI and spurious emission measurements on wireless communication equipment during EMC and type approval testing	Conducted, radiated	444
R&S TS9980	EMI Test System	EMS measurements on sound broadcast and TV receivers, satellite receivers and DVB receivers; automatic and objective picture assessment in susceptibility tests	EN 55020 or CISPR 20	446
R&S TS9981	EMS Test System	Measurement of susceptibility to electromagnetic fields	IEC-61000-4-3, EN 61000-4-3 and other norms	448
R&S TS9982	EMS Test System	Combination of R&S TS9981 and R&S TS9986	IEC61000-4-3 and IEC61000-4-6	450
R&S TS9986	EMS Test System	measurement of susceptibility to conducted interference	IEC61000-4-6 and other norms	450
R&S TS998xM	EUT Monitoring System	Monitoring of the equipment under test for proper functioning during EMS measurements	For R&S TS9981 and R&S TS9986	451
R&S TS9983	EMS Test System	Measurement of susceptibility to electromagnetic fields	Field-strength level >20 V/m	452
R&S TS9994	EMC Test System	Modular EMC solution for development of car components	Immunity (EMS) 9 kHz to 2.5 GHz, up to 200 V/m, Emissions (EMI) 9 kHz to 3 GHz	453
EMS-K1	EMS Software	Basis for the automatic control and monitoring of EMS test systems and for the acquisition and analysis of measurement data	Universal EMS software package that can be used for just about any measurement method	454
EMON-K1	CAN-Bus Monitoring	CAN-bus monitoring when performing EMS measurements with EMS-K1		456
EMC32	EMC Measurement Software	For use in development, for compliance and batch testing (see chapter 2)		100

EMI Test System R&S TS9975

EMI measurements of conducted and radiated interference

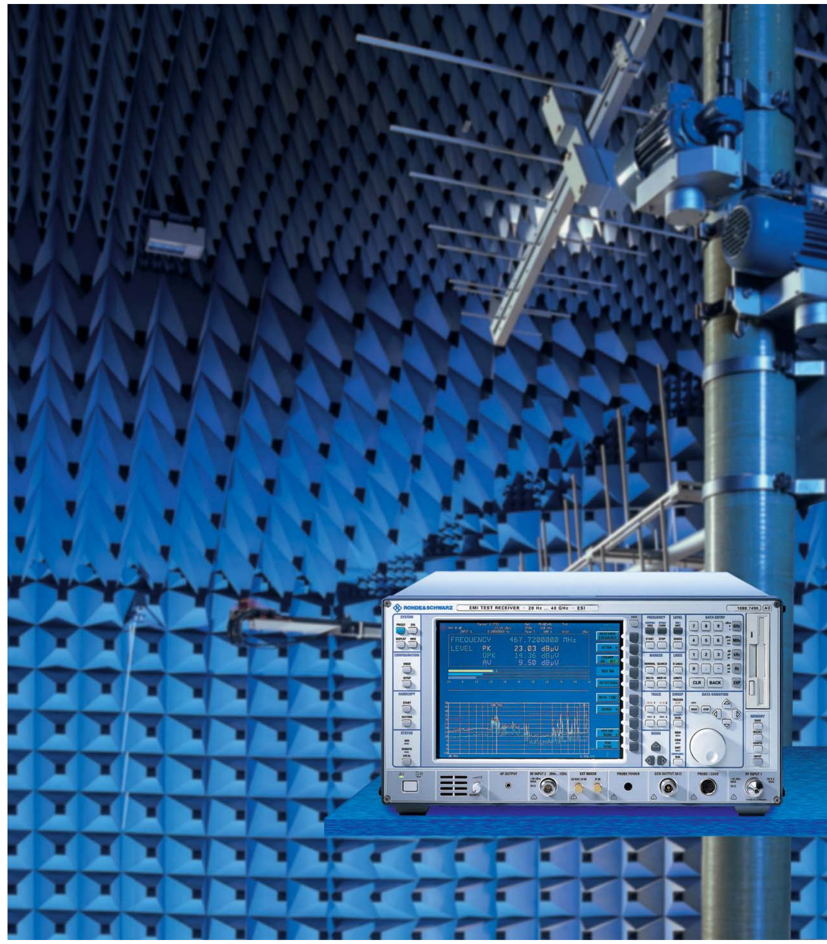


Photo 40816-1

Brief description

EMI Test System R&S TS9975 is used for all EMI measurements of conducted and radiated interference.

Commercial standards
- CISPR11–22
- EN55011–55022
- VDE0872–0879
- ANSI-C63.4
- FCC15, 18
- EACL1–8

Military standards
- VG95370–95377
- DEF-STAN49–41
- GAM-EG13
- MIL-STD-461/462

Customer-specific adaptations to other standards or different regulations can be integrated into Test System R&S TS 9975 without any problems.

System configuration

The system features a highly modular hardware and software concept. Customized systems can be configured from a variety of instruments and software options. The system is a complete package of hardware and user-friendly software as well as system services so that the user will be familiar with the system within the shortest possible time.

Hardware
A Process Controller (PC) is the core of the system; it controls the complete measurement system via its IEC/IEEE bus interface. Depending on the frequency range to be covered and the special test requirements, measurements are carried out by one or several test receivers.

Hardware expansions
- Artificial Mains Networks ESH2-Z5 and ESH3-Z5
- System Control Unit R&S TS-RSP for switching antennas and transducers
- Rohde & Schwarz test antennas (i.e. HL562)

Moreover, Rohde&Schwarz can offer the integration of products from other manufacturers into Test System R&S TS 9975, if required.

Software concept

EMI Software ES-K1 from Rohde & Schwarz (page 98) is used in EMI Test System R&S TS9975.

Brief description

Applications

System R&S TS9976 is used for EMI and spurious emission measurements on wireless communication equipment during EMC and type approval testing. Typical DUTs are mobile phones, base stations, radio sets and short-range devices.

Relevant standards

Measurements of this type are based on the standards and technical regulations published by ETSI (European Telecommunications Standards Institute). For example, EMI measurements on GSM systems are defined by ETS 300-342, measurements of spurious emissions by ETS 300-607 (GSM11.10), ETS 300-609 (GSM 11.20) and by TBR 5 and 9 (technical basis for regulation). ETS 300-339 provides the generic standard for the EMC of radio equipment.

Specified emission measurements

The above standards stipulate a wide variety of measurements in a very wide frequency range, all of which can be covered with R&S TS9976:

- Conducted EMI measurements from 0.15 MHz to 30 MHz in line with EN55022
- Radiated EMI measurements from 30 MHz to 1000 MHz in line with EN55022
- Conducted spurious emission measurements from 100 kHz to 12.75 GHz on antenna connector of DUT
- Radiated spurious emission measurements from 30 MHz to 4 GHz

For some radiocommunication systems (e.g. short-range devices), higher frequency limits (e.g. 40 GHz) are already stipulated for spurious emission measurements. R&S TS9976 can be modified accordingly to accommodate for this requirement.

Spurious emission measurements differ from EMI measurements to EN55022 mainly in that bandwidths matching the useful signal have to be set on the receiver instead of the typical EMC bandwidths (e.g. 200 Hz, 9 kHz, 120 kHz). It should also be noted that EMC bandwidths are referred to the 6 dB points of the IF filters, whereas the bandwidths for spurious emission measurements are referred to the 3 dB points. In spurious emission measurements, the peak detector takes the place of the quasi-peak detector. All these differences make it necessary that for spurious emission measurements a spectrum analyzer or test receiver with spectrum analyzer functionality be used rather than a pure EMC test receiver. In addition to EMI and spurious emission measurements, R&S TS9976 can also measure useful signals, for example the EIRP (equivalent isotropically radiated power) of radio sets and modules with integrated antenna.

Emission Test System R&S TS9976

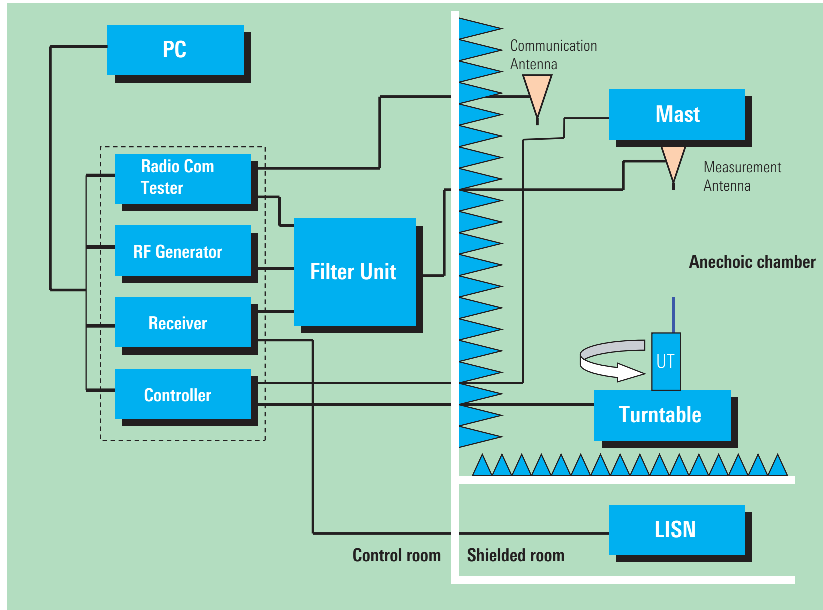
Main features

- Frequency range 0.15 MHz to 18 (40) GHz
- EMC measurements to IT standards (e.g. EN55022, FCC)
- Use in type approval testing (e.g. for GSM to ETS 300-607/609)
- Measurement of spurious emissions from radiocommunication equipment

System design

Test receiver
The test receiver forms the core of the system. As a typical EMC test receiver, it evaluates and displays emissions from 0.15 MHz to 1000 MHz in line with EN55022 and, in addition, it offers spectrum analyzer functionality for spurious emission measurements. If only the spurious is to be measured and if precompliance measurements are sufficient for EMC testing, a spectrum analyzer can be used instead of the test receiver.

Anechoic chamber
Radiated emissions are measured in an anechoic chamber. For this, a remote-controlled turntable and an automatic antenna mast with a control unit are required. These components can optionally be supplied with the system and controlled by the system software.



Block diagram R&S TS 9976

Test antennas
Suitable test antennas (usually log-periodic or horn antennas) and artificial mains networks are used for picking up emissions.

Filter unit
To measure spurious emissions, for example of mobile phones, in line with standards at a sufficiently wide dynamic range also with the DUT transmitting, the useful signal emitted by the DUT must be suppressed by means of bandstop or highpass filters.

To this effect, Rohde & Schwarz developed a special filter unit which, thanks to its flexible design, satisfies the common mobile radio standards (GSM900, GSM1800, DECT, CDMA, etc) and at the same time meets customer-specific requirements.

Communication tester
To switch the DUT to a defined operating state, a communication link has to be set up. This is done by a communication tester integrated in the system.

Signal generator
The signal generator is needed for system calibration and for substitution measurements which are prescribed by some standards.

Controller
The system components are controlled from a PC via the IEC/IEEE bus using EMI Software R&S ES-K1 from Rohde & Schwarz.

Software
The control software R&S ES-K1, which forms part of the system, enables fully automatic simple testing. The complete software package runs on a PC or PC-compatible industrial controller. The system components are driven via the IEC/IEEE bus interface.

EMS Test System Audio and Video R&S TS9980

EMS measurements on sound and TV broadcast receivers (photo 43206-6)

EMS measurements on sound and TV broadcast receivers, satellite and DVB receivers

Brief description

The Test System R&S TS9980 has been designed for automatic measurement of the electromagnetic susceptibility of sound and TV broadcast receivers to EN 55020 and CISPR 20.

The following measurements are covered:

- Input immunity (S1)
- Immunity to conducted voltages (S2a)
- Immunity to conducted currents (S2b)
- Immunity to radiated fields (S3)
- Shielding effectiveness (S4)

As part of ongoing technical development, system solutions for satellite receivers, DVB receivers and set-top boxes have been implemented. Particularly noteworthy is the new TV-MON option for automatic, objective picture assessment of video signals and monitor test pictures (recorded with TV-CAM). The Test System R&S TS9980 can be used for precompliance measurements, compliance measurements and batch testing.

R&S TS9980 Audio

The basic system R&S TS9980 Audio (R&S TS9980 A) is suitable for testing all analog sound broadcast receivers, tuners, amplifiers, equalizers, CD players, tape decks and accessories. The basic system R&S TS9980 Audio covers the following broadcast standards:

- FM: VHF (mono/stereo)
- AM: LF/MF/HF (mono)

R&S TS9980 AV Multistandard

The enhanced R&S TS9980 AV Multistandard System (R&S TS9980 AV-M) is suitable for all relevant EMS measurements on analog sound and TV broadcast receivers and video recorders. The following TV standards are covered:

- PAL: B/G, I, D/K
- SECAM: D/K, L/L'
- NR&S TSC: M/N

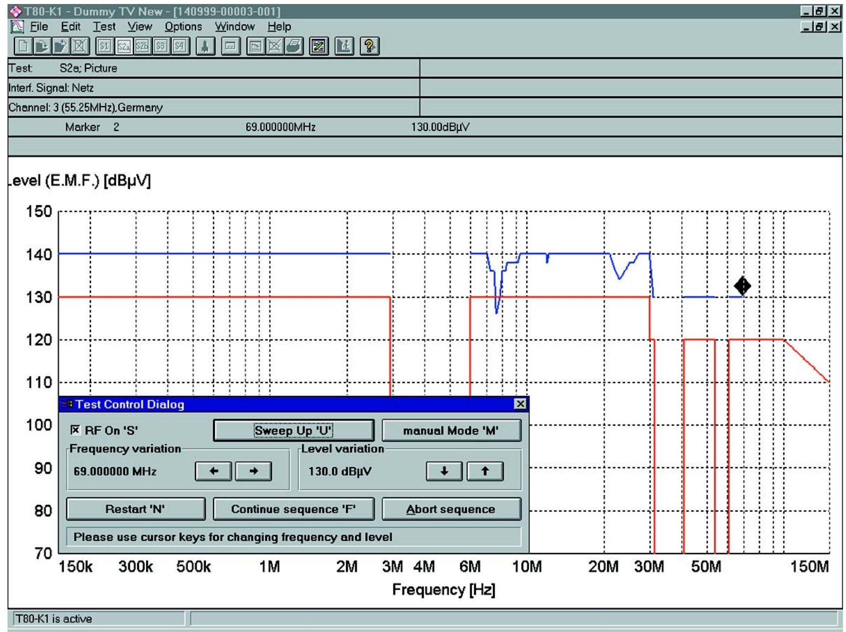
The relevant audio standards mono, dual sound, NICAM and BTSC (mono) are supported.

R&S TS9980 DVB Multistandard

The full-featured R&S TS9980 DVB Multistandard System (R&S TS9980 DVB-M) is suitable for all relevant EMS measurements on analog and digital sound and TV broadcast receivers, as well as on video recorders and set-top boxes (integrated receiver decoders). In addition to the analog TV standards, the following digital standards are covered:

- DVB-C QAM (quadrature amplitude modulation) to ETS300429
- DVB-S QPSK (quadrature phase shift keying) to ETS300421
- DVB-T OFDM (orthogonal frequency division multiplex) to ETS300744
- AR&S TSC 8VSB (vestigial sideband) to AR&S TSC Doc. A/53

EMS Test System Audio and Video R&S TS9980



Option TV-MON

The System Extension TV-MON allows for the first time fully automatic and objective picture assessment in susceptibility tests on TV receivers and associated equipment, independent of the subjective perception of the viewer. This is a special advantage in the very time-consuming and repetitive procedures required for batch testing and compliance measurements. TV-MON identifies analog as well as digital picture degradations using objective picture assessment, based on an algorithm-oriented comparison with a reference picture. For equipment under test (EUT) without integrated monitor (e.g. video recorders, set-top boxes), the reference and test pictures at the EUTs video output (CCVS) are used. For EUTs with monitor (e.g. TV sets, monitors) the test pictures are recorded with a video camera system (TV-CAM) available as an option.

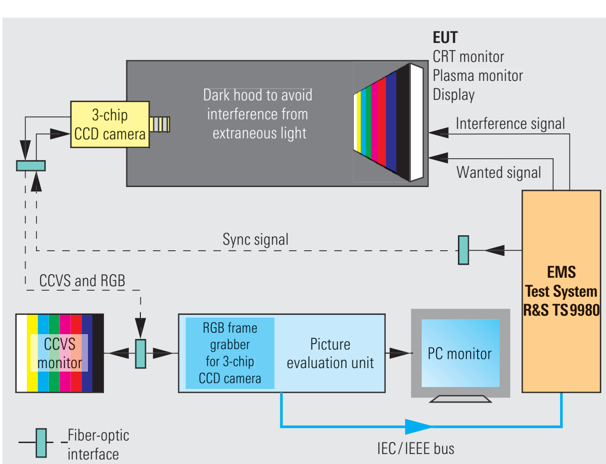
System Software T80-K1

System Software T80-K1 runs under Windows 9x/NT/2000/XP. The integrated DDE interface allows data exchange between various Windows programs. Each test result is stored together with the test parameters. The test parameters contain all definitions of the test configuration. Due to the joint storage of test results and parameters, any measurement performed can be repeated with exactly the same settings - even a long time afterwards.

With the modular options, the software can easily be upgraded to meet future requirements. The software packages are protected by passwords and various user levels.

DVD Compendium Professional R&S TestDVD

In many cases, measurement quality is determined to a considerable extent by the scope and quality of the available test signals. The DVD compendium offers a unique compilation of many different video and audio streams for professional applications. (see page 151).



Principle of objective picture quality assessment of TV receivers using TV-MON and TV-CAM

Software options

T80-K4A (option for TV-MON)
Control software for TV-MON for objective picture assessment of analog EUTs.

T80-K4D (option for TV-MON)
Control software for TV-MON for objective picture assessment of analog and digital EUTs.

T80-K5 (video upgrade)
Upgrade for EMS testing of analog TV broadcast receivers and video recorders.

T80-K6 (audio upgrade)
Upgrade for EMS testing of sound broadcast receivers.

T80-K7 (DVB upgrade)
Upgrade for EMS testing of satellite and DVB/AR&S TSC TV broadcast receivers.

T80-K13 (option S4)
Measurement of shielding effectiveness of sound and TV broadcast receivers.

EMS Test System R&S TS9981

EMS measurements to IEC801-3/ IEC61000-4-3/EN61000-3-4

Photo 43652-1

Brief description

With the European standards for electromagnetic compatibility and the relevant national EMC laws that came into effect, EMS tests on electrical and electronic equipment are required in all areas of the civilian sector.

The test procedure for determining susceptibility to electromagnetic fields is described in the international standard IEC 61000-4-3. In Germany, standard VDE0843, Part 3 was derived from this standard. Product-specific European standards (EN61000-3-4) based on valid national and international standards have been established. Test System R&S TS9981 from Rohde & Schwarz is for automatic EMS testing to IEC61000-4-3 and EN61000-3-4 with field strengths of ≥10 V/m in the frequency range 80 MHz to 1 GHz. On demand the frequency range is expandable up to 3 GHz, 18 GHz or 40 GHz. Hereby an efficient, flexible and reliable tool both for tests in development and acceptance tests is available.

Main features

Automatic measurement of susceptibility to electromagnetic fields to IEC-61000-4-3, EN61000-3-4 and other standards

- Measurements at all severity levels with test field strengths ≥10 V/m
- High accuracy and reproducibility of results
- Short preparation and test times with powerful software under MS-Windows95/98/NT4.0
- Automatic generation of detailed test reports
- Efficient test routines
- User-friendly operation

System configuration

System R&S TS9981 includes an EMS control unit, an amplifier, a transmitting antenna and a field probe. The system is fully computer-controlled (PC). This makes for reproducible and largely automatic test sequences.

The EMS control unit comprises a signal generator, a field strength meter, a power meter, and a directional coupler unit. The broadband power amplifier used in the system covers the whole frequency range from 80 MHz to 1 GHz.

To generate electromagnetic fields, Log-Periodic Antenna HL046 is used for the frequency range from 80 MHz to 1 GHz. EMS tests can be performed without changing the antenna, thus avoiding time-consuming interruptions.

EMS Test System R&S TS9981

Operation

Test System R&S TS9981 includes the Rohde & Schwarz System Software R&S EMS-K1 for Windows. The software makes it possible to perform automatic EMS measurements in line with all relevant standards. R&S EMS-K1 is a convenient, cost-effective and reliable tool, enabling fast and easy system operation and high throughput. The test and configuration capabilities ensure high reproducibility of results.

Expandability

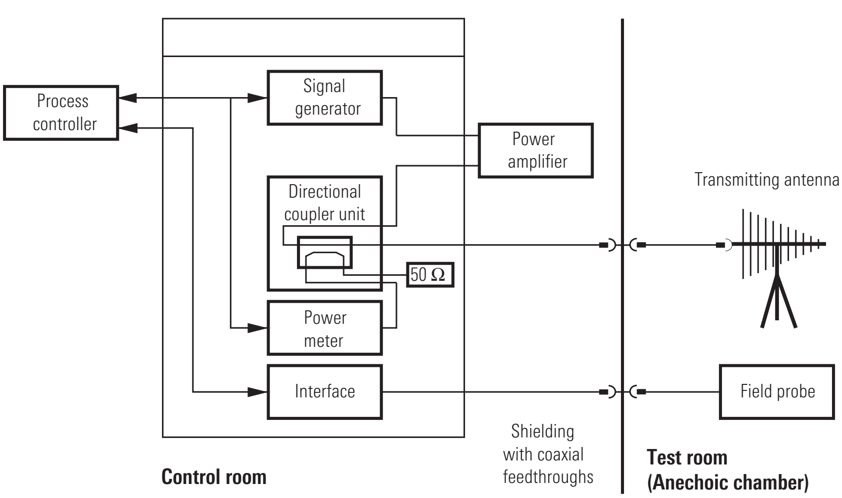
Test System R&S TS9981 is of modular design and can be extended by options. Various configuration levels allow for further automation of the test system, so giving an even higher throughput.

Optional components include:

- EUT Monitoring System R&S TS9981M (see page 451)
- Components and accessories for remote-controlled amplifier in separate room
- Shielded anechoic chambers
- TEM/GTEM cells

Overview of models

Model	Main applications	Technical features
R&S TS9981A	Favourably priced test system for development labs, EMC labs and test houses; compliance tests with field strengths according to selected amplifier output power	Generator SML01, Power Meter NRVS for measurement of forward power; EMS control unit designed as a 19" desktop; amplifier power depends on desired field strength
R&S TS9981B	Expandable test system for EMC labs (quality management) and test houses	Same as R&S TS9981A, but with EMS control unit designed as a 19" rack; measurement of forward and reflected power with NRVD



Block diagram R&S TS9981

EMS Test System R&S TS9986

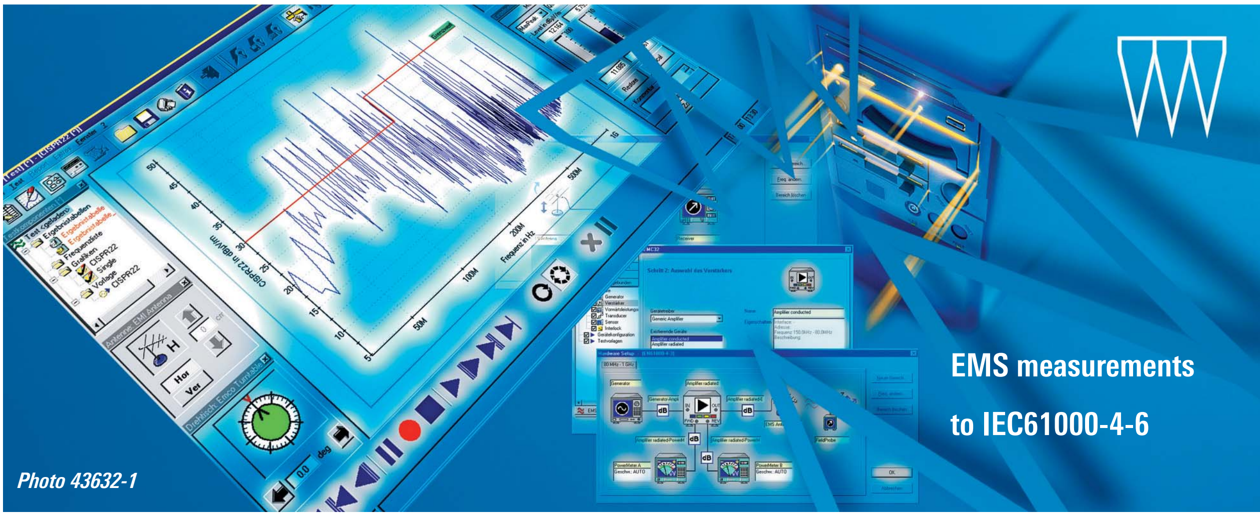


Photo 43632-1

Brief description

With the new European standards for electromagnetic compatibility and the relevant national EMC laws that came into effect, EMS tests on electrical and electronic equipment are required in all areas of the civilian sector. The test procedure for determining susceptibility to conducted RFI is described in the international standard IEC61000-4-6. In Europe, a corresponding EN standard was derived from this standard (EN61000-4-6).

Test System R&S TS9986 enables automatic EMS testing to IEC61000-4-6 with severity levels of up to 10 V in the extended frequency range 150 kHz to 230 MHz. It is an efficient and reliable tool both for tests in development and acceptance tests.

Main features

- Automatic measurement of susceptibility to conducted interference to IEC61000-4-6 and other standards
- High accuracy and reproducibility of results
- Short preparation and test times with powerful software under Windows
- Efficient test routines
- Automatic generation of detailed test reports
- User-friendly operation

System configuration

System R&S TS9986 includes a signal generator, a power amplifier and a power meter. The system is fully computer-controlled (PC) via the IEC/IEEE bus. This makes for reproducible and largely automatic test routines.

Software

Test System R&S TS9986 comes with the Rohde & Schwarz System Software EMC32 for Windows (see chapter 2, page 100). The software makes it possible to carry out automatic EMS measurements to all relevant standards. EMC32 is a convenient, cost-effective and reliable tool, enabling fast and easy system operation and high throughput. The extended test and configuration capabilities ensure high reproducibility of results.

Expandability

Test System R&S TS9986 comes in different configuration stages plus an option for automatic EUT monitoring. One or several different coupling/decoupling networks may be required in addition to the R&S TS9986 basic system configuration depending on the type and number of connections to the EUT. Further accessories including a computer desk, a wooden test bench with a copper surface, and feedthroughs for shielded walls are available to yield a system tailor-made to customer's requirements.

EMS Test System R&S TS9982

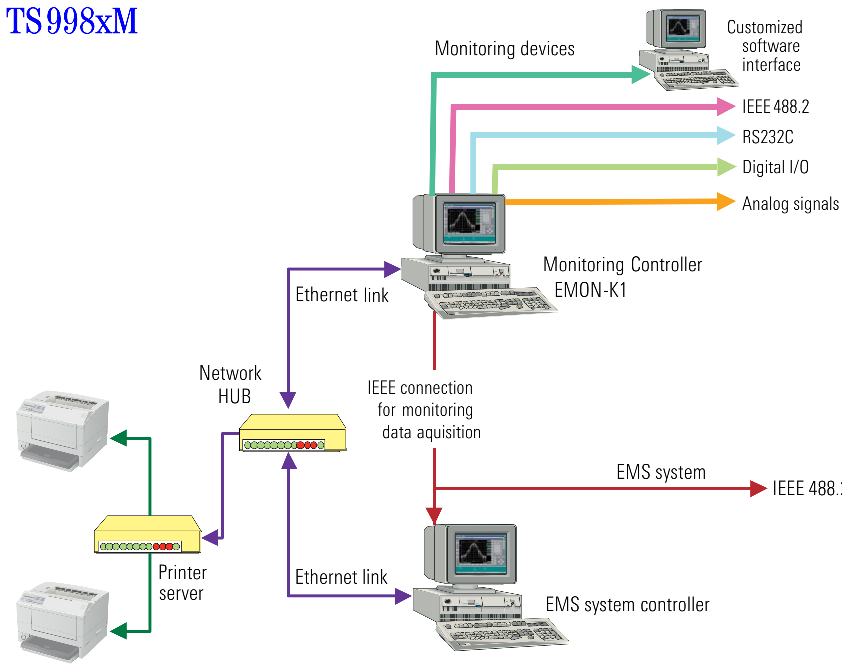
EMS measurements to IEC61000-4-3/6

This system is a combination of Test Systems R&S TS9981 and R&S TS9986, allowing EMS measurements in line with IEC61000-4-3 and IEC61000-4-6. It is a favourably priced alternative for users performing measurements in line with both standards.

EUT Monitoring Systems R&S TS998xM

EUT monitoring for Test Systems

R&S TS9981 and R&S TS9986



Brief description

EUT (Equipment under Test) Monitoring System R&S TS998xM is used for automatic monitoring of the equipment under test for proper functioning during EMS measurements. If the EUT does not function properly during the measurement, the field strength is reduced until the EUT resumes correct operation. The field strength is then increased until the EUT shows signs of malfunctioning or the nominal field strength is reached.

System configuration

The above block diagram shows an example of the system functionality. The EUT monitoring system is an option for the EMS test system.

- Various interfaces are available for evaluating and stimulating the EUT
  - Digital I/O signals
  - Analog signals
  - A/D inputs
  - Output of frequency-proportional voltage
- Various interfaces for driving measuring instruments
  - IEEE 488.2
  - TCP/IP
  - USB
  - RS232C
- Large number of drivers available, e.g.
  - DMMs
  - Oscilloscopes
  - Spectrum analyzers
  - Communication testers
  - Signal generators
  - Power meters
- Simple driving of other devices, including customer-specific devices, via generic drivers
- Monitoring and stimulation of complex EUTs via software interface. Existing programs can be included in the monitoring program by integrating a communication routine in the customer software
- Visual monitoring via video capture system. In addition to the storage of images, this system allows automatic monitoring of analog and digital displays in the case of EUT malfunctioning

Solutions for other special monitoring applications (e.g. CAN bus monitoring, see page 456) are available.

Software concept

Three different concepts are used for monitoring:

- Direct control of the devices with recording of any number of independent channels
- Use of an independent controller communicating with the EMS measurement software
- Device control via R&S EMON-K1 on the system controller or on a separate monitoring controller with the possibility of frequency-asynchronous or frequency-synchronous measurement

In all these cases optimum protection of the EUT is ensured by the definition of switch-off criteria.

EMS Test System R&S TS9983

1 GHz to 18 GHz (40 GHz option)

Automatic measurement of susceptibility to electromagnetic fields

Photo 42577-1

Brief description

The test procedure for determining susceptibility to electromagnetic fields in the frequency range 1 GHz to 18 GHz (40 GHz) is described in various national and international standards. EMS Test System R&S TS9983 allows automatic EMS measurements in line with these standards with a minimum field strength of 20 V/m (distance of 1 m between antenna and EUT) over the total frequency range. It is an efficient and reliable tool both for tests in development and acceptance tests.

Main features

- Minimum field-strength level of 20 V/m over the total frequency range and at a distance of 1 m to equipment to test
- High accuracy and reproducibility of results
- Short preparation and test times with powerful software under MS-Windows
- Automatic generation of detailed test reports
- Efficient test routines
- User-friendly operation

System configuration

The test system is made up of six functional components:

- Control module
- Generator module
- Switching module
- Amplifier module
- Antenna module
- Measurement module

To minimize the losses between generator, power amplifier and antennas, these system components are integrated in a rack which is accommodated in the anechoic chamber and controlled from the control room by the system controller via an IEC/IEEE bus fiberoptic converter. The field strength is set and monitored with the aid of a power meter and field probes.

Operation

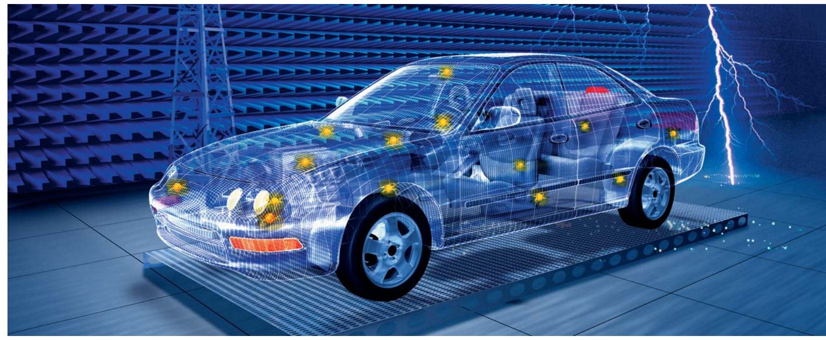
Test System R&S TS9983 includes the Rohde & Schwarz System Software R&S EMS-K1 for Windows (see page 454). The software makes it possible to perform automatic EMS measurements in line with all relevant standards. R&S EMS-K1 is a convenient, cost-effective and reliable tool, enabling fast and easy system operation and high throughput. The test and configuration capabilities ensure high reproducibility of results.

Expandability

Test System R&S TS9983 is of modular design and can be extended by options. Various configuration levels allow for further automation of the test system, so giving an even higher throughput. Optional components include:

- EUT Monitoring System R&S EMON-K1
- Components and accessories for remote-controlled antenna positioning
- Combination with EMI and other EMS test systems

EMC Test System R&S TS9994



Modular EMC solution for development of car components

Brief description

Introduction

Due to the increase in electronic subassemblies inside cars, EMC testing is essential for the development of car components. EMC testing throughout the R&D process with compact and local test systems reduces the time to market as well as the risk of subsequent, expensive product modifications.

Main features

- In line with all relevant automotive standards
- Modular system design
  - Different modules available
  - Open-ended for future requirements
  - Upgradable to full conformance test system
- Ideal for R&D laboratories
  - Compact system design
  - No special infrastructure required
- Immunity (EMS) 9 kHz to 2.5 GHz, up to 200 V/m
- Emissions (EMI) 9 kHz to 3 GHz
- Conducted and radiated measurements
- Covering current and future wireless bands
- Ready-to-use solution
- Test Software EMC32
  - Graphic operating concept (virtual instrument)
  - Intuitive user guidance

Efficiency

The preconfigured and completely tested R&S TS9994 system in combination with the Rohde & Schwarz installation on site guarantees the customer a ready-to-use EMC system. All necessary system accessories (e.g. for calibration) are included.

This system can be installed where it is most efficient, since it features the following benefits:

- GTEM cell
- No need for shielded environment
- Low acoustic noise of whole test system
- Compact system design
- No additional infrastructure required

Training on the system plus the Rohde & Schwarz support including hotline increase the efficiency and reliability of the system even more.

Applicability

The Test System R&S TS9994 has been designed to perform measurements in line with the frequency ranges and limits specified in the following standards for car components:

ISO11452, CISPR25 and SAE J1113.

Due to its modular design, the R&S TS9994 can be upgraded to a conformance test system at a later stage.

Flexibility

Customers have a choice of different system levels according to their requirements:

Level	Description
1	Radiated emission (EMI) 9 kHz to 3 GHz
2	Emission (EMI) Radiated 9 kHz to 3 GHz Conducted 10 kHz to 108 MHz
3	Radiated susceptibility (EMS) 9 kHz to 1 GHz
4	Susceptibility (EMS) Radiated 9 kHz to 1 GHz Conducted 1 MHz to 400 MHz (BCI)
5	Radiated + conducted EMC Combination of levels 2 and 4
6	Radiated susceptibility (EMS) 1.7 GHz to 2.5 GHz Extension for level 4 or 5

Level 6 is an extension for EMS testing of current and future wireless services (GSM, UMTS, Bluetooth etc) in the GHz range.

Easy-to-use Test System Software R&S EMC32

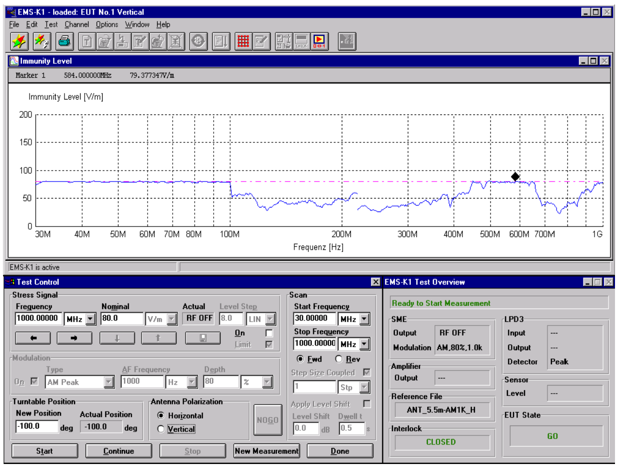
The intuitive control software, which is an integral part of the system, enables manual and fully automatic testing. For detailed information see page 100.

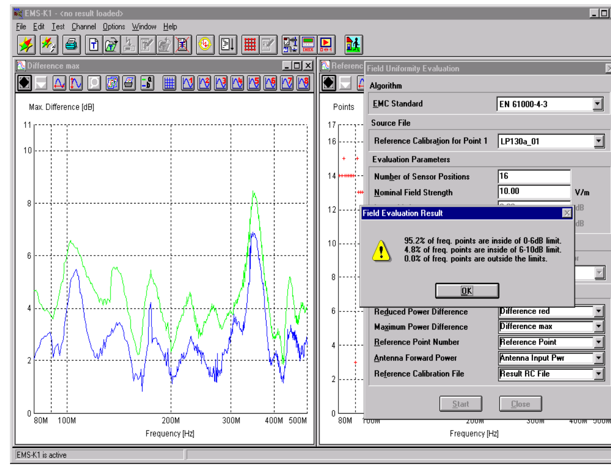
EUT monitoring

The system provides several alternatives for EUT monitoring applications:

- Via IEEE or RS232 interface
- Analog and digital I/O board (NI)
- Further alternatives on request

EMS Software R&S EMS-K1





Automatic measurement of electromagnetic susceptibility

Brief description

The powerful Software Package R&S EMS-K1 forms the basis for the automatic control and monitoring of EMS test systems and also for the acquisition and analysis of the measurement data. The advantages of automation are:

- high reproducibility and accuracy of results
- automatic generation of detailed test reports
- permanent system control
- automatic calibration and correction of frequency-dependent parameters

The software is extremely user-friendly and has been optimized both for tests in development and acceptance tests. Predefined automatic test sequences and procedures as well as high flexibility for easy adaptation to new EMC standards and test methods are further outstanding features.

The basic functions of the R&S EMS-K1 are:

- Automatic generation of test signals (field strength, current, voltage)
- Automatic monitoring of the EUT for malfunctions
- Determination of the immunity threshold at which an EUT malfunction occurs

The complete software package can be run on a PC or a PC-compatible industrial controller, e.g. Process Controller PSM (see page 462). The measurement devices are controlled via the IEC/IEEE bus using an integrated interface card.

Main features

- Automatic measurement of electromagnetic susceptibility in line with all commercial and military standards, e.g.
  - EN 61000 -4-3,-6
  - IEC 61000-4-3,6
  - ENV 50140/50141
  - ISO 11451/11452/10600
  - VDE 0843
  - DIN 40839
  - VG 95373, part 10,13
  - RTCA/DO-160C
- Running under Windows 9x/NT/2000/XP
- Open and modular system software concept
- High flexibility
- Programmable user interface
- Three types of user level:
  - normal
  - advanced
  - system manager
- Customer-specific test scripts
- Interface to other Windows programs
- Supports all EMS test systems from Rohde & Schwarz (TS 9981/82/83/86)

Automatic generation of immunity parameters

R&S EMS-K1 is a universal EMS software package that can be used for just about any measurement method and test system:

- measurement of immunity to radiated electromagnetic fields using an antenna, stripline, TEM or GTEM cell

EMS Software R&S EMS-K1

- measurement of immunity to conducted interference using coupling/decoupling networks or current clamps
- measurement of immunity to magnetic fields

Three operating modes are available for setting the immunity level:

- Transducer: the immunity test level is set by means of a specified transducer correction factor (constant or frequency-dependent) for the amplifier or generator output power
- Reference calibration: based on calibration data from a reference measurement, the immunity test level is set using the frequency-dependent amplifier power values derived from the calibration measurement
- Sensor: the test level is set to the required value using the actual level measured with a sensor

EUT monitoring

R&S EMS-K1 provides logical monitor channels which can handle analog or digital data. A practically unlimited number of channels can be defined; the crucial limiting factor is processor power and the time required for monitoring. Depending on the graphics resolution, any number of channels can be displayed as on-screen diagrams during a measurement. The operator can change the selection of displayed channels while the measurement is running. If there is a NoGo condition, i.e. malfunction of the EUT, a variety of responses can be adopted:

- store the frequency and the EUT measurement value and continue the measurement automatically
- stop the program run to enter operator comments or
- branch to a user application routine, for instance to re-initialize the EUT

It is also possible to combine the above responses in a number of ways. A flexible control concept is implemented in the R&S EMS-K1 by means of scripts.

Measurement sequence control

The measurement sequence control in R&S EMS-K1 software is encoded in scripts. The scripts are accessible to the user who can adapt them to his requirements. Scripts provide a high level of flexibility and are easy to modify.

The EMS measurement sequence is implemented by two standard scripts, the qualification mode and the susceptibility mode.

In the qualification mode the selected parameter profile (limits as a function of frequency) is run automatically and the responses of the EUT are recorded. If there is no malfunction detected, the EUT passes the test and fulfills the specified immunity limits. The measurement is thus completed. Only if there is a malfunction is the frequency in question noted automatically.

In the susceptibility mode the immunity threshold is automatically determined when a malfunction occurs. Level and frequency are recorded in the test report; the susceptibility profile of the EUT can then be displayed in the form of graphs or tables.

Ordering information

Basic package

System Software for Rohde & Schwarz EMS test systems TS9981 and TS9987 (EN 61000-4-3)	R&S EMS-K14	1084.4296.02
Complete Software Package R&S EMS-K14/15/16 with additional EUT Monitoring Drivers for EN 61000-4-3, -6	R&S EMS-K9	1084.3948.02

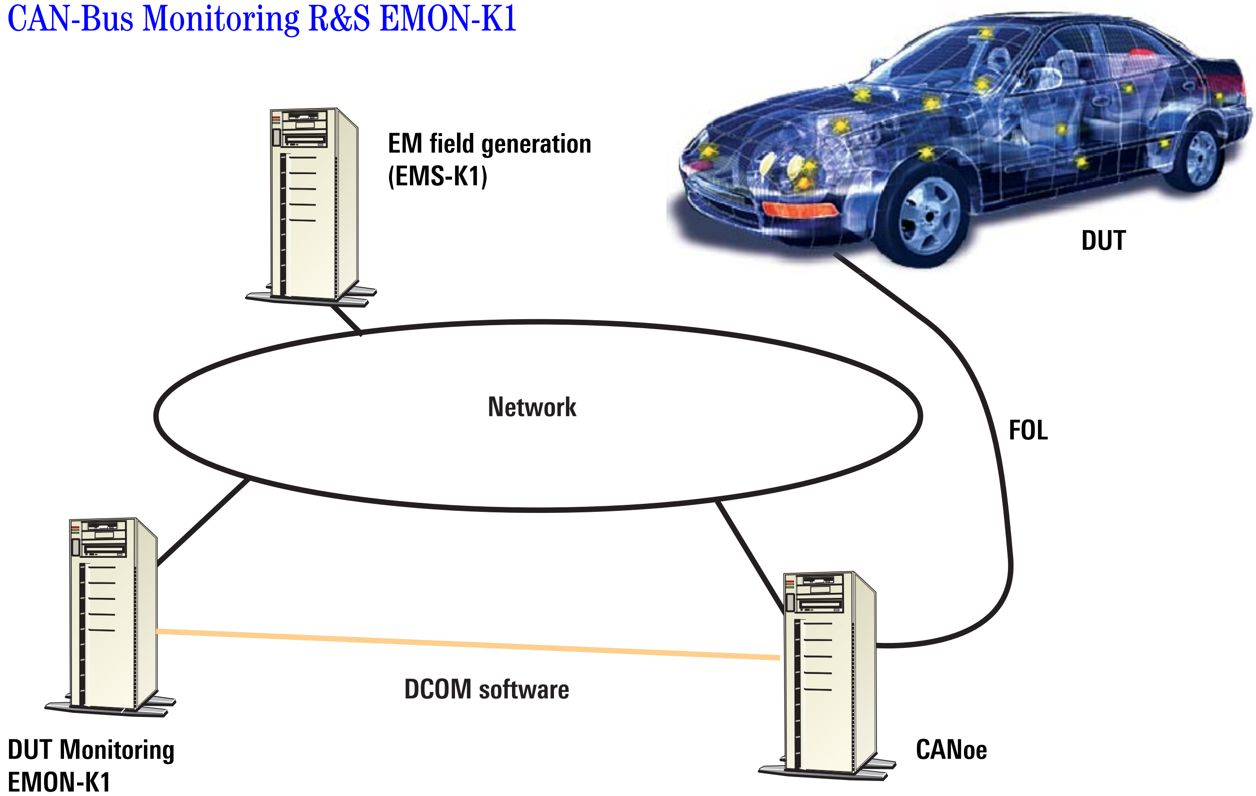
Extensions

Software extension for R&S EMS-K1 (Script development kit)	R&S EMS-K3	1084.3790.00
Standard device driver package for R&S EMS-K1 for EMS test systems 1 GHz to 18 GHz (e.g. TS9983), requires Basic Package R&S EMS-K14/15/16	R&S EMS-K8	1084.3890.00

EUT Monitoring

Software extension for R&S EMS-K1		
Basic device driver package for EUT monitoring	R&S EMS-K20	1084.4196.00
Interface driver for EUT monitoring with external PC	R&S EMS-K21	1084.4244.02
External EUT Monitoring Software EMON-K1, with interface driver for R&S EMS-K1	R&S EMS-K70	1084.6801.02

CAN-Bus Monitoring R&S EMON-K1



CAN-bus monitoring when performing EMS measurements with EMS-K1

Main features

- Runs under Windows NT 4.0
- Starts and stops measurements in CANoe
- Measurements:
  - CAN-bus signals
  - Parameters for bus statistics
- Weights measurement results according to settable criteria, e.g. DUT malfunction yes/no
- Graphical and tabular display of measurements versus frequency of interfering EM field
- Sends measured field parameters (frequency, level, antenna polarization) to CANoe and signals DUT failures
- Starts user-specific actions on the CAN bus
- Powerful reporting tool
- Loading of databases in CANoe from R&S EMON-K1 (as soon as supported by CANoe)

Software requirements

- CANoe, Vektor Informatik GmbH, as of version 3.0.40
- R&S EMON-K1, Rohde&Schwarz, version 2.0.0
- R&S EMS-K1, Rohde &Schwarz, Vers. 1.20 with option EMS-K70

Miscellaneous

- Networked PC or controller operation recommended
- Software packages R&S EMON-K1 and CANoe can be installed on the same PC or controller
- CAN-bus fiber-optic cable extender

Contents of Chapter 10

Perfection in mobile measurements and control: Portable Industrial Controller R&S PSP7 (photo 43267-3)

Measurement software is described in connection with its specific applications in the individual chapters of the catalog.

Portable Industrial Controller R&S PSP 7

Mobile measurements and their control made to perfection

Photo 42674

Brief description

At long last Portable Industrial Controller makes measurements and their control mobile. Thanks to its compact size and rechargeable batteries, the built-in test and measure- ment facilities of R&S PSP can be used at any location and in any situation. The principle of "switch on and go" was consistently applied to the development of the R&S PSP as with all of Rohde & Schwarz's previous process controllers. Everything one is likely to need is included as standard. Low emission and highly effective shielding are as much part of the R&S PSP as shock and vibration resistance.

Operation
The front-panel keypad comprises a numeric block, programmable func-tion keys and a cursor block with a spinwheel. The softkeys are fully integrated into Windows. The keypad includes as many keys as are needed to operate programs effectively under Windows, and few enough to avoid input errors. This is especially important for applications in the field of production. Whenever necessary, a keyboard and a monitor can be connected and run parallel to the front-panel keypad and the built-in display.

Fully independent powering
Through the DC input connector R&S PSP can be powered by a solar panel. R&S PSP also accepts DC voltages from cars, ships or aeroplanes. With the aid of cascadeable internal batteries the R&S PSP can be kept in operation for several hours. The power management function informs the user on how long the R&S PSP can operate with the remaining battery charge, and thus optimizes the available capacity and extends battery life.

Powerful hardware and software components
R&S PSP comes with an IEC/IEEE bus fitted as standard. Software drivers for almost any programming language are included so that the time-consum-ing task of installing hardware and software becomes unnecessary. More-over R&S PSP with LabWindows/CVI comprises a highly specialized tool for software development.

LabWindows/CVI
National Instruments' LabWindows/CVI (C for Virtual Instrumentation) is an interactive base for the programming of virtual instruments on the R&S PSP and is regarded by most as today's industry standard. The software is delivered with a selection of drivers and extensive analysis functions. With LabWindows/CVI a C source code can be generated in next to no time, allowing communication with measuring instruments via IEC/IEEE bus or serial interface.

Interfaces
Numerous interfaces like 2 x serial, 1 x parallel, IEC/IEEE bus, PC card are the links to communication between the controller and the controlled devices.

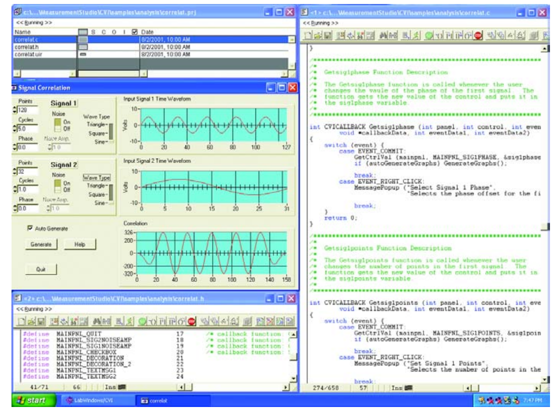
Modular expansion
Despite its small size, R&S PSP incorporates everything one needs for standard measurement tasks. And in the case that expansions should be necessary for unusual tasks, R&S PSP can accommodate up to four additional long-size measuring cards.

Best of EMC characteristics
R&S PSP was developed and imple-mented along existing EMC guidelines. Extensive filtering measures for the electric components paired with effective shielding and a novel design of the casing led to an industrial controller that can safely be employed even in the vicinity of highly sensitive receivers without impairing the measurement results.

Portable Industrial Controller R&S PSP7

Fit for the future
All of the components used in the R&S PSP were developed and selected with long-term availability in mind so that the R&S PSP will be able to be serviced or extended even in many years' time. An advantage that especially production engineers and system planners value.

Interactive development and testing of measurement software is a prominent feature of LabWindows/CVI



Specifications in brief

CPU	Intel Pentium III, 700 MHz (or faster) other processors on request
RAM	256 Mbyte, expandable to 512 Mbyte
Display	
Screen	LCD colour, 8.4" anti-glare
Mass storage	
Hard disk	20 Gbyte minimum
Disk drive	1.44 Mbyte, 3 ½"
Interfaces	
-internal-	
Available interfaces	3 x 16 bits, dimensions (L x H):
ISA	330 mm x 140 mm
ISA	330 mm x 140 mm
ISA	312 mm x 140 mm
ISA/PCI	1 x 16 bit or 32 bit with L x H: 312 mm x 140 mm
-external-	
IEEE	IEEE488.2, compatible with NI NAT
Serial	2 x RS-232-C
Printer	Centronics LPT1 (ECP, EPP)
PCMCIA	release 2.0, type III, connector
Keyboard	5-contact DIN, 5-contact R&S PS/2 for mouse & keyboard
USB	2 x USB 1.1
Ethernet	2 x 10/100 Mbit/s, RJ-45
Software	
Operating system	Windows XP Embedded (E) (optional)
Test & measurement software	LabWindows/CVI (optional)
Graphics	
With integrated LCD	VGA standard: 800 x 600 pixels
For external monitors	1600 x 1200 pixels max.
General data	
Rated temperature range	+5°C to +45°C
Operating temperature range	0°C to +50°C
Power supply	
AC supply	100 V to 120 V ±10%, 50 Hz to 400 Hz ±5% 220 V to 240 V ±10%, 50 Hz to 60 Hz ±5%
DC supply	DC, 10 V to 32 V
Dimensions (W x H x D)	412 mm x 198 mm x 380 mm
Weight	8 kg

Ordering information

Portable Industrial Controller	R&S PSP7	1099.6002.73
Accessories supplied	pocket guide, manuals, power cable, connector for external DC operation	

Options

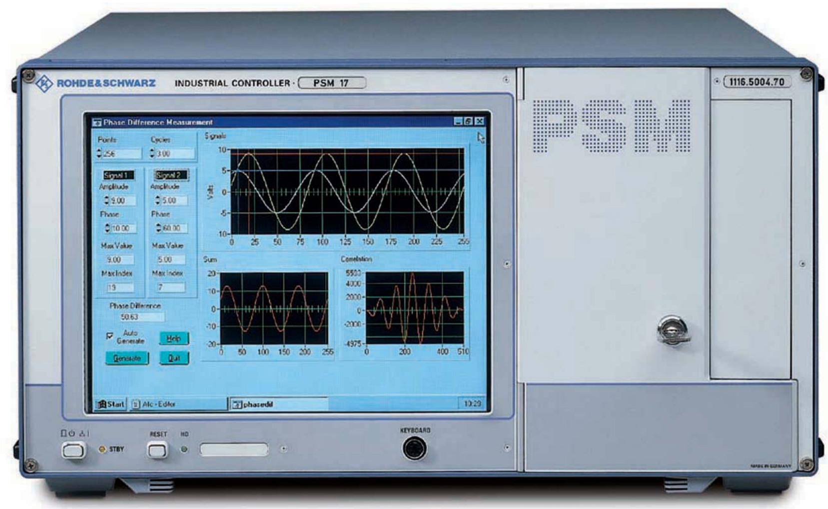
Software		
(only together with R&S PSP, factory fitted)		
Windows XP Embedded (E)	R&S PSP-K12	1091.4700.32
Windows XP Embedded (E) + LabWindows/CVI from NI	R&S PSP-K13	1091.4800.32
Interfaces		
2nd IEC/IEEE Bus (AT GPIB, 488.2)	R&S PS-B4	1006.6207.04
TTL I/O Interface, 40 I/O ports, 8 relays, 8 optocouplers, 3 timer	R&S PS-B11	1006.7303.02
TTL I/O Interface without relays, optocouplers, timers	R&S PS-B11	1006.7303.04
SCSI Host Adapter	R&S PS-B27	1064.5500.02
SCSI PC Card Adapter	R&S PS-B5	1134.8101.02
External USB CD-ROM Drive	R&S PS-B6	1134.8207.02
Memory		
PC Card Exchangeable Hard Disk 520 Mbyte (minimum)	R&S PSM-B9	1064.5700.02
256 Mbyte Memory Expansion	R&S PSP-B2	1091.3640.04
Extras		
Compact keyboards with integrated trackball (37 cm x 13.8 cm x 1.9 cm)		
German	R&S PSP-Z1	1091.4000.02
English	R&S PSP-Z2	1091.4100.02
(other keyboards on request)		
Color Monitor 17" (43 cm)	R&S PMC3	1082.6004.04
Color TFT Monitor 17" (43 cm)	R&S PMC3	1082.6004.10
IEC/IEEE bus Cable 0.5 m	R&S PCK	0292.2013.05
1 m	R&S PCK	0292.2013.10
2 m	R&S PCK	0292.2013.20
4 m	R&S PCK	0292.2013.40

Industrial Controller R&S PSM

Switch on and go...

R&S PSM has it all: a great variety of interfaces, comprehensive software and an interactive documentation system

Photo 43088-3



Brief description

Especially when it comes to professional measurements, the controller should not be the weakest member of a system but rather be able to meet special requirements: shock and vibration resistance, particularly when used in vehicles or industrial environment, ultra-low temperature effect, high immunity to interference even in strong electromagnetic fields as well as low self-generated emission so that measurements will not be impaired by fields produced by the controller. Commercial PCs do not fulfill these requirements.

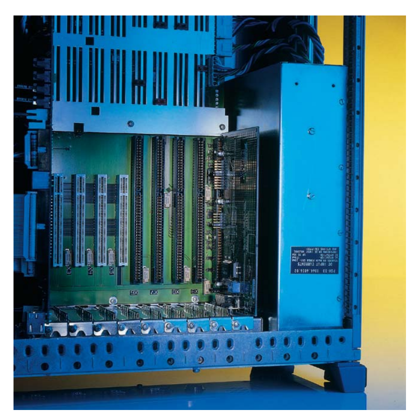
R&S PSM offers ideal characteristics for all key applications: shock resistance in mobile applications, rackability, built-in measurement facilities for use in production and high EM shielding. For mobile applications, a DC input is provided for powering R&S PSM from on-board supplies. The lockable cover of R&S PSM protects the CD ROM drive, floppy disk drive and PCMCIA interface against contamination and un-authorized access.

Main features

- Extremely high immunity to interference
- High shock resistance for mobile use
- Wide variety of interfaces: Ethernet, ultra/ultrawide SCSI,16-bit GPIB, PCMCIA
- Brilliant colour TFT display
- CD ROM drive
- Factory user port
- Windows user interface
- Safe investment through modular concept

Comprehensive basic configuration

When purchasing a controller, the customer frequently has to buy hardware, software and interfaces from different manufacturers and integrate them into his system. This is not the case with R&S PSM, which has been configured to cater for any demand. All key components are included in the basic unit: the built-in Ethernet interface makes it extremely easy to connect R&S PSM e.g. to a company network. The state-of-the-art ultra/ultra wide SCSI interface allows adding internal and external SCSI standard components, e.g. streamers. The 16-bit GPIB interface as well as a large number of serial and parallel ports have always been the standard in R&S PSM, likewise the Factory User Port (FUP), which provides a variety of extra functions (analog input, digital I/O, relays, optocouplers, pulse width modulator) required in automated test procedures. The fast CD ROM drive makes software installations a pleasure.



R&S PSM has a well organized interior and, while featuring comprehensive basic configuration, offers plenty of space for extensions

Industrial Controller R&S PSM

High flexibility

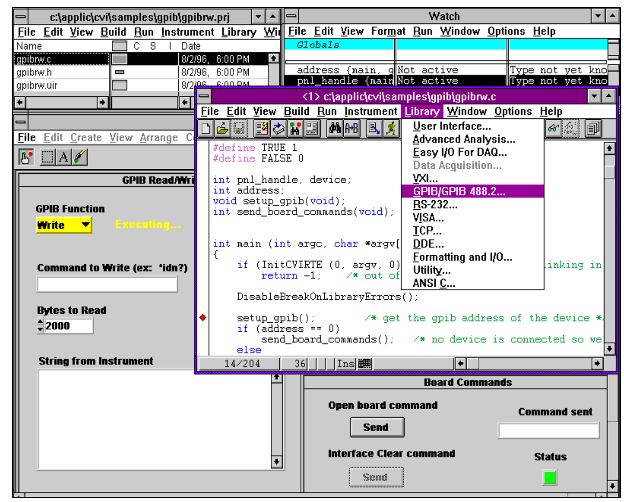
R&S PSM can be tailored to suit specific needs: 4 free 16-bit ISA slots and 3 free PCI slots or alternatively 3 free 16-bit ISA slots and 4 free PCI slots leave ample space for expansion. Additionally, 2 PCMCIA slots in the basic unit can be used for further extensions.

Unlimited memory expansion

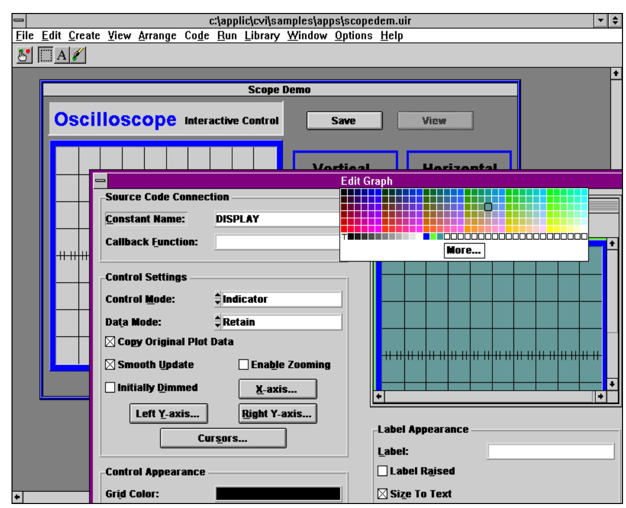
Expandability of memories is of particular importance. The standard 128 Mbyte RAM can be expanded to 256 Mbyte. Mass storage can be expanded to practically any size; a EIDE hard disk is installed as standard. The integrated SCSI interface allows any kind of SCSI peripherals, e.g. streamer drives, to be controlled.

Versatile auxiliary functions

For automating test procedures, control lines are needed which are not available in standard PCs. The digital I/O interfaces, partly isolated via optocouplers, allow external processes to be controlled or analog voltages to be measured without an IEC/IEEE bus-compatible voltmeter being needed. These interfaces are available as standard in R&S PSM via the factory user port (FUP).



Interactive development and rapid testing of test software is a salient feature of LabWindows/CVI



LabWindows/CVI simplifies the creation of displays, i.e. virtual instruments. The displayed data come from either a measuring card in the R&S PSM or from an external measuring instrument that is communicated with via the IEC/IEEE bus

R&S system software

A powerful computer requires a powerful software. The system software not only contains the operating system but also the professional LabWindows/CVI measurement software. It goes without saying that the software is installed on the hard disk and tailored to the R&S PSM hardware configuration. A CD ROM with all drivers, LabWindows/CVI and utility programs is supplied as a backup.

LabWindows/CVI
National Instruments' LabWindows/CVI (C for Virtual Instrumentation) is an interactive base for the programming of virtual instruments on the R&S PSM and is regarded by most as today's industry standard. The visual instruments for creating graphic user interfaces are an integral component of the C development environment allowing EXE programs and DLL files to be generated.

Industrial Controller R&S PSM

Options

TTL I/O Interface R&S PS-B11
The interface extends the control inputs/outputs of the factory user port. R&S PS-B11 offers 40 digital I/O lines, eight single-pole switching relays and four two-pole optocoupler inputs/outputs each that can be read or set just like the FUP by means of the supplied driver software. Eight of these 40 lines can be configured to detect interrupt events.

R&S PS-B11 is supplied with drivers for numerous programming languages such as R&S BASIC, QuickBASIC, MS-C or VisualBASIC for DOS and Windows. Interfaces are addressed by means of simple instructions.

PCMCIA Exchangeable Hard Disk R&S PSM-B9
Exchangeable hard disks simplify data logging and software installation. The handy hard disk is operated via the PCMCIA connector on the front of R&S PSM. Thanks to a compact design, the hard disk is particularly shock-proof and therefore ideal for mobile applications.

Security

Data security through the use of power-up passwords is a matter of course today. R&S PSM takes it even further and "hides" all drives (CD ROM, floppy, PCMCIA) behind a lockable cover. This not only enhances passive security but improves electromagnetic compatibility of PSM.

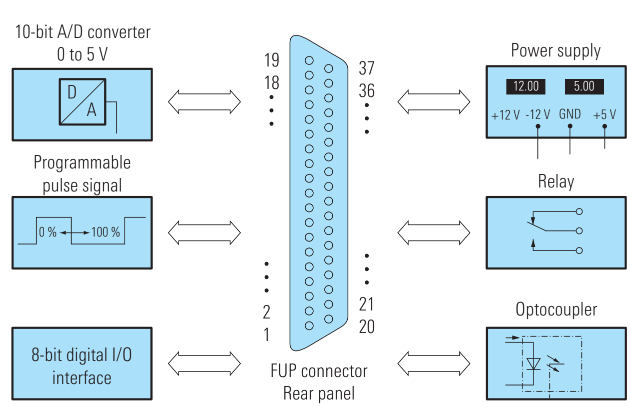
Safe investment thanks to modular concept

The high innovation rate in the computer industry results in short product lives. What is state-of-the-art today, will be at the bottom of the scale tomorrow. The possibility of boosting computer power is therefore of particular importance. This is one of the strong points of R&S PSM. Modules like the CPU and graphics are accommodated on a separate card which can easily be replaced when greater performance is required.

This is important especially for industrial controllers, where the cost of integrated computer functionality makes up only a minor part of total costs, the principal share being attributable to measures taken for compliance with requirements relating to shock and vibration resistance, thermal loading capacity and electromagnetic compatibility.

A variety of interfaces are included in the basic unit: e.g. Ethernet, ultra/ultra-wide SCSI, 16-bit GPIB. The factory user port adds versatile auxiliary functions

The factory user port (FUP) offers a variety of versatile auxiliary functions



Industrial Controller R&S PSM

Specifications in brief

CPU	CPU slot, CPU performance: min. AMD-K6-III+, 400 MHz; 128 Mbyte RAM (expandable to max. 256 Mbyte)
Display	
R&S PSM 12	none
R&S PSM 17	LCD colour, 10.4"
Mass storage	
Hard disk	15 Gbyte or more
Disk drive	1.44 Mbyte, 3 ½"
CD ROM drive	24 times or faster
Interfaces	
IEEE	IEEE 488.2, compatible with NI NAT
FUP (factory user port)	8 digital inputs/outputs 4 analog inputs: 0 to 5 V, 10-bit resolution 1 analog output: 0 to 5 V, 8-bit output via pulse width modulator optocouplers: 1 input, 1 output relays: 2 switches, SR&S PS driving
Serial	RS-232, COM1, 2, 3, 4 (16550-compatible)
Parallel	Centronics LPT1 (ECP, EPP), LPT2
PC CARD	release 2.1, type III (slot 1), type II (slot 2)
SCSI	ultra, ultrawide (internal)
Ethernet	10 base T (10 Mbit/s)
Keyboard connector	5-pin DIN connector (on the rear) R&S PS/2 connector (on the front)
Software	
Operating system	MS Windows 95 (free-of-charge option), MS Windows NT (option)
Measurement software	LabWindows/CVI (only with R&S PSM-K10)
Graphics	
Video memory	4 Mbyte
Resolution with integrated LCD	VGA standard: 640 x 480 pixels
Resolution for external monitors	max. 1280 x 1024 pixels

General data

Rated temperature range	+5 to +45°C
Operating temperature range	0 to +50°C
Storage temperature range	–20 to +60°C
Power supply	
AC	100 to 120 V ±10%, 50 to 400 Hz ±5%, max. 4 A, 200 to 240 V ±10%, 50 to 60 Hz ±5%, max. 2 A
DC	10 to 28 V
Dimensions (W x H x D)	435 mm x 236 mm x 460 mm
Weight R&S PSM12/R&S PSM17	approx. 13 kg/14 kg

Ordering information

Industrial Controller	R&S PSM12	1116.5004.21
	R&S PSM17	1116.5004.71

Please state desired option R&S PSM-K10 in your order.

Accessories supplied pocket guide, power cable, LabWindows/CVI for Rohde & Schwarz

Options

Interfaces		
2nd IEC/IEEE Bus (AT-GPIB, 488.2)	R&S PS-B4	1006.6207.04
TTL I/O Interface	R&S PS-B11	1006.7303.04
Memories		
PCMCIA Exchangeable Hard Disk		
520 Mbyte (minimum)	R&S PSM-B9	1064.5700.02
128 Mbyte Memory Expansion	R&S PSM-B2	1064.5880.04
Software (free-of-charge option)		
R&S System Software, Windows 95, German	R&S PSM-K10 [1)]	1116.7507.31
R&S System Software, Windows 95, English	R&S PSM-K10 [1)]	1116.7507.32
Windows NT, English	R&S PSM-K11	1116.7607.31
Extras		
Keyboards		
Rack-attachable Special Keyboard (English) with rollkey	R&S PSA-Z1	1009.5001.32
Standard Keyboard (English)	R&S PSA-Z2	1007.3001.32
17" Colour Monitor	R&S PMC3	1082.6004.04
17" Colour TFT Monitor	R&S PMC3	1082.6004.10
IEC/IEEE bus Cable	R&S PCK	
0.5 m		0292.2013.05
1 m		0292.2013.10
2 m		0292.2013.20
4 m		0292.2013.40
19" Adapter	R&S ZZA-95	0396.4911.00
Transit Case	R&S ZZK-954	1013.9395.00

1) Factory-installed only.

The R&S NGPS32 is a programmable voltage source with two isolated identical outputs. It is suitable for use in automatic calibration and adjustment systems and as a reference voltage source in control processes. (photo 43862-3).

Contents of Chapter 11

Range of Products, Introduction

The wide variety of Rohde&Schwarz power supplies falls into three main groups: bench models with output powers up to 350 W – eleven type series with a total of 29 basic models; 19" models with up to 2000 W output power – two type series with 29 basic models; system units/programmable power supplies with IEC625-1/ IEEE488 bus – five type series with 25 basic models.

General technical features

All power supplies from Rohde& Schwarz are designed to offer essentially the same features: floating outputs, permissible voltage of the outputs with reference to chassis or ground – or with multiple output power supplies to one another – 1000 V.

Setting of voltage and current

Settings start from a threshold near zero. The rated values specified for current and voltage are the maximally settable levels. Almost all types of the available power supplies are constant-voltage/constant-current units, which means that they can also be used as current regulators. Pilot lamps or LEDs indicate whether the unit is operating in the constant-voltage/constant-current mode or in the current limiting mode. All power supply units feature current limiting which can be continuously adjusted to any value between zero and the rated current. The current limiting of R&S NGAS models can be set to 1.5 times the rated current.

Parallel and series connection

If higher currents or voltages are required, all power supplies can be parallel- or series-connected. Protective circuits prevent the connected load or the power supply unit from being damaged.

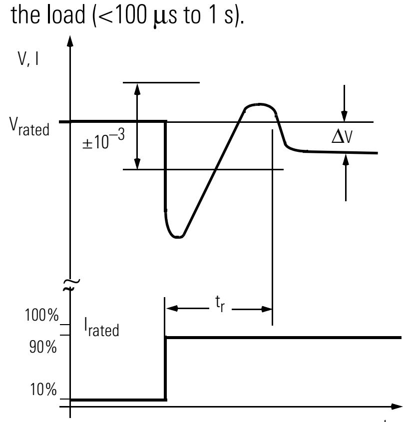
The parallel connection capability is restricted for instruments with fast down programming (R&S NGPV, R&S NGPX, R&S NGPE, R&S NGMO2, R&S NGSM).

Output impedance Z_{out}

The output impedance is specified in the tables to describe the effect of load variations on the output quantity. For instance, with constant-current operation of a 100 V/1 A unit, a specified output impedance of Z_{out}=30 kΩ means that a load variation between 0 and 100 Ω at a nominal current of 1 A will cause a current deviation of 3 mA corresponding to 0.3%.

Transient recovery time t_r

The value specified refers to a step change from 10% to 90% of the rated current in constant-voltage mode. After t_r the output voltage is again within tolerance. In constant-current mode t_r strongly depends on the load (<100 µs to 1 s).



Transient recovery time t_r following step change in load

Remote sensing

With models of >70 W output power, the voltage drop on the supply lead, which varies with the load current, can be corrected, if separate sensor leads are connected to the terminals of the load. A variation of 0.5 to 1 V on the positive and negative leads can be compensated for.

Remote control

R&S NGRE power supplies can be equipped for remote control on request. R&S NGRU models can be remote-controlled through external analog voltages.

Programming

Power Supplies R&S NGPT, NGPV, NGPX, NGSM (with option), NGPU, R&S NGMO2 and R&S NGPE are suitable both for manual operation and for control via IEC/IEEE bus, i.e. for use in automatic test systems.

Cooling

The power supplies cannot be damaged by thermal overloading. The models of the R&S NGM, NGK, NGMD, NGT, NGL and NGRU series have rear-mounted convectional heatsinks. Models of higher output power rating use a two-stage (R&S NGPT, NGSM, NGPX: continously variable) thermostat-controlled cooling fan. At low demands the fan is running at a speed that is hardly noticeable; only when high output is required is it switched to full power. The fans are driven by quiet, maintenance-free motors.

Overload protection

To provide protection against undesirably high voltages caused by maloperation or faults, the power supplies are fitted with independent crowbar circuits with an adjustable response threshold (exceptions see table). An external overvoltage protection is also available:
Overvoltage Protection R&S NG-Z, 4.5 to 100 V/10 A, Order No. 0100.5103.02

Output capacitor

The output capacitor can be switch-selected to match the load: small capacitance with little energy content for sensitive semiconductor circuits, large capacitance for dynamic loads.

Overview of Power Supplies

Type	Designation, Uses	Order No.	V_{max}/V	I_{max}/A	P_{max}/VA	RS	OVP	RC_{DC}	IEC	Page
R&S NGM 7,5	Universal constant-current and constant-voltage sources	117.7110.12	7,5	4	30	–	●	–	–	469
R&S NGM 15		117.7110.13	15	2	30	–	●	–	–	
R&S NGM 35		117.7110.14	35	1	35	–	●	–	–	
R&S NGM 70		117.7110.15	70	0,5	35	–	●	–	–	
R&S NGM 280		117.7110.06	280	0,1	28	–	–	–	–	
R&S NGK 15	Same as R&S NGM, but double output current	192.0003.02	15	4	60	●	●	–	–	469
R&S NGK 35		192.0003.03	35	2	70	●	●	–	–	
R&S NGK 70		192.0003.04	70	1	70	●	●	–	–	
R&S NGK 280		192.0003.05	280	0,2	56	●	–	–	–	
R&S NGA 7.5	Constant-voltage sources with adjustable current limiting	192.0010.02	7,5	15	112	●	❍	–	–	469
R&S NGA 15		192.0010.03	15	8	120	●	❍	–	–	
R&S NGA 35		192.0010.04	35	4	120	●	❍	–	–	
R&S NGA 70		192.0010.05	70	2	120	●	❍	–	–	
R&S NGAS 32/10	Same as R&S NGA, high surge capability	192.0803.04	16/32	10 (15)	160	●	❍	–	–	469
R&S NGB 32	Constant-voltage sources with adjustable current timing	117.7210.90	32	10	320	●	●	–	–	469
R&S NGB 70		117.7227.90	70	5	350	●	●	–	–	
R&S NGBI 35		192.0910.31	35	10	350	●	●	–	–	
R&S NGBI 70		192.0910.31	70	5	350	●	●	–	–	
R&S NGMD 35	Dual power supply	117.7127.02	2 × 35	2 × 1	70	–	●	–	–	470
R&S NGL 35	Triple power supplies	192.0026.02	3 × 35	3 × 0,6	63	–	❍	–	–	471
R&S NGT 20		117.7133.02	20/20/6	1/1/5	70	–	● (6 V)	–	–	
R&S NGT 25		192.0503.02	25/25/6	0,8/0,8/5	70	–	● (6 V)	–	–	
R&S NGT 35		191.2019.02	35/35/6	0,6/0,6/5	72	–	● (6 V)	–	–	
R&S NGRU 35	Precision power supplies	192.0210.03	35	10	150	●	●	●	–	472
R&S NGRU 50		192.0210.05	50	5	150	●	●	●	–	
R&S NGRU 100		192.0210.08	100	3	150	●	●	●	–	
R&S NGC 35	Universal high-power supplies	192.0032.02	35	30	1050	●	❍	–	–	474
R&S NGC 70		192.0032.03	70	15	1050	●	❍	–	–	
R&S NGRE 6…100		100.8xxx.xx	6…100	5…80	180 to 2000	●	❍	❍	–	475

RS = remote sensing
OVP= overvoltage protection
RC_{DC} = remote control with DC voltage
*=fast on/off switching via TTL-compatible signal
IEC = IEC 625-2 bus (IEEE 488)
● = standard
❍= option

Overview of Power Supplies

Type	Designation, Uses	Order No.	V_{max}/V	I_{max}/A	P_{max}/VA	RS	OVP	RC_{DC}	IEC	Page
R&S NGPU 70/10 R&S NGPU 70/20	Programmable power supplies	192.0049.92 192.0055.92	70 70	10 20	175 350	● ●	● ●	– –	● ●	477
R&S NGPV 8/10 R&S NGPV 20/5 R&S NGPV 20/10 R&S NGPV 40/3 R&S NGPV 40/5 R&S NGPV 100/1 R&S NGPV 100/2 R&S NGPV 300/0,3 R&S NGPV 300/0,6	Programmable power supplies	192.0310.8x 192.0310.2x 192.0326.2x 192.0310.4x 192.0326.4x 192.0310.1x 192.0326.1x 192.0310.3x 192.0326.3x	7,99 19,99 19,99 39,99 39,99 99,99 99,99 299,99 299,99	9,99 4,99 9,99 2,99 4,99 0,99 1,99 0,299 0,599	80 100 200 120 200 100 200 90 180	● ● ● ● ● ● ● ● ●	● ● ● ● ● ● ● ● ●	– – – – – – – – –	● ● ● ● ● ● ● ● ●	478
R&S NGPX 35/10 R&S NGPX 70/5 R&S NGPX 150/2,3	Programmable power supplies	192.0610.31 192.0610.71 192.0610.11	35 70 150	10 5 2,33	350 350 350	● ● ●	● ● ●	●* ●* ●*	● ● ●	480
R&S NGPE 40/40	Programmable high-power supply	192.0332.41	39,99	39,9	800	●	●	–	●	482
R&S NGPS 32	Programmable power supplies with arbitrary function	192.1016.31	±32	0,1	2 x 32	●	–	–	●	482
R&S NGMO 2	Dual-channel analyzer/ power supply	192.1500.24	2 x 15	2 x 7	2 x 37,5	●	●	●*	●	484
R&S NGPT 7 R&S NGPT 18 R&S NGPT 35	Programmable triple power supplies	192.0510.71 192.0510.21 192.0510.31	7/7/18 18/18/7 35/35/7	5/5/2 2/2/5 1/1/5	105 105 105	● ● ●	● ● ●	– – –	● ● ●	486
R&S NGSM 32/10 R&S NGSM 60/5	Programmable power supplies with arbitrary function	192.0810.31 192.0810.61	18/32 32/60	20/10 10/5	180 180	● ●	– –	– –	❍ ❍	488

RS = remote sensing
OVP= overvoltage protection

RC_{DC} = remote control with DC voltage
* = fast on/off switching via TTL-compatible signal

IEC = IEC 625-2 bus (IEEE 488)

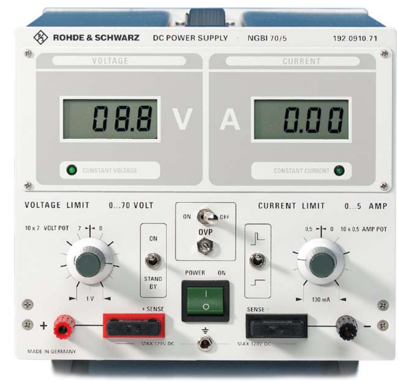
● = standard
❍ = option

Single Power Supplies

R&S NGM (photo 43655-1)

R&S NGK (photo 43659-1)

R&S NGAS (photo 43661-1)



R&S NGBI (photo 43653-1)

R&S NGM, R&S NGK: 30/70 W lab models

- Compact bench models
- High-resolution ten-turn potentiometer for voltage and current
- Single switchable meter on R&S NGM, separate meters on R&S NGK

The power supplies of the R&S NGM series can be used either as constant-voltage or as constant-current sources, e.g. in the laboratory. The power supplies of the R&S NGK series provide twice the output current of the otherwise identical R&S NGM models and are provided with remote-sensing sockets to compensate for voltage drops in the load leads.

R&S NGA: 120 W compact models

- High-resolution ten-turn potentiometer for voltage
- Separate meters, remote-sensing sockets

The power supplies of the R&S NGA series are constant-voltage sources with adjustable current limiting. They are mainly used for the supply of modules and systems in testshops and labs.

R&S NGAS: 160 W compact model

- High surge capability, twice the rated current can be drawn for short periods
- Use as battery eliminators
- Separate meters for voltage and current

R&S NGAS is suitable both for general lab applications and for the supply of loads with high surge or pulse-type current demands, e.g. test systems for car electronics or transceivers with switching power supplies.

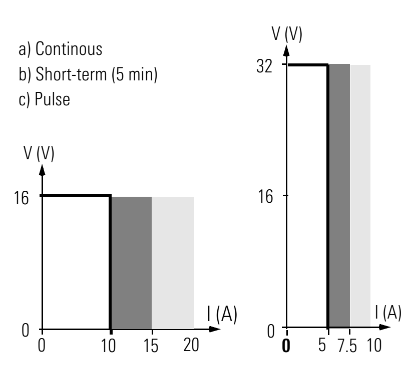
Thanks to its compact design, R&S NGAS is suitable for mobile use. It is insensitive to RF voltages radiated by other equipment or a nearby antenna.

The current limiting threshold can be set to 1.5 times the rated current which may be drawn for up to 5 minutes. Due to the delayed response of current limiting, twice the rated current may be drawn for several milliseconds. The output voltage range can be set to 16 V or 32 V.

R&S NGB, R&S NGBI: 350 W bench models

- High-resolution ten-turn potentiometer for voltage and current
- Surge current capability – several times the rated current may be drawn for short periods

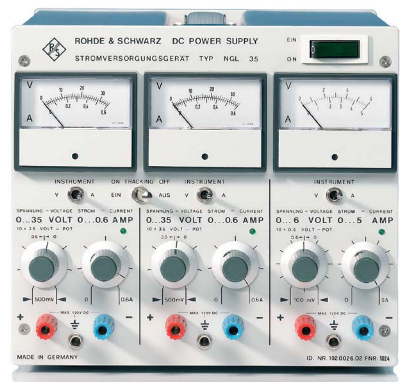
Suitable for use as constant-voltage/constant-current sources with automatic regulation of voltage-to-current transition (LED indication) and as battery eliminator with switch-selected delay for current regulation (higher surge current), e.g. for incandescent lamps, blinkers, voltage converters. Other features: large panel meters for voltage and current, voltage compensation on leads up to 1 V, adjustable overvoltage protection.



Current drain of R&S NGAS as a function of selected output voltage

Dual and Triple Power Supplies

R&S NGMD35 (photo 43656-1)



R&S NGL35

R&S NGT20 (photo 43658-1)

R&S NGMD 35 – 2 x 0 to 35 V/1 A

- Independent or tracking operation
- Isolated floating outputs, permanently shortcircuit-proof

Two R&S NGM 35 power supplies are accommodated in one cabinet and can be used either separately or in tracking mode. In the tracking mode, unit II follows unit I. Relative to a common reference point, R&S NGMD supplies a positive and a negative voltage of 0 to 35 V, which are concurrently and equally variable by a percentage of the voltage. The current limits can be set independently of each other.

R&S NGL 35 – 3 x 0 to 35 V/0.6 A

- Three voltages at a time, series or parallel connection
- Thermal overload protection, automatic power-up

R&S NGL 35 has three equal, separate and floating outputs. The voltages can be independently adjusted between 0 and 35 V and the current limiting threshold between 0 and 0.6 A. Voltage or current ratings can be tripled by parallel or series connection. A switchable panel meter is provided for each output.

R&S NGT – 2 x 0 to 20/25/35 V 1/0.8/0.6 A; 1 x 0 to 6 V/5 A

- Independent or tracking operation of 20/25/35 V outputs
- Shortcircuit-proof, adjustable overvoltage protection (6 V output)

R&S NGT models combine three independent voltage sources in one unit. A switchable panel meter is provided for each output. The 20 V, 25 V, 35 V outputs can be used separately, in series or parallel connection or in tracking mode. The independent 6 V output with its load rating of 5 A is especially designed for the supply of digital integrated circuits; overvoltage protection is adjustable.

Single Power Supplies, Dual and Triple Power Supplies

Specifications in brief of Single Power Supplies

Type R&S ...	Order No.	Setting ranges Voltage V	Setting ranges Current A	Resolution V %	Resolution I %	Max. deviation of output for ΔV AC supply ±10% V(%)	ΔV AC supply ±10% I(%)	Δtamb −10 to +40 ×C V(%/×C)	Δtamb −10 to +40 ×C I(%)	Z_{out} for V mΩ	Z_{out} for I kΩ	t_r for V µs	Max. PARD V_{rms} mV	Max. PARD I_{rms} mA	Remote sensing S	OV protec. O	Dimens. W x H x D Weight mm (kg)
NGA 7.5	192.0010.02	0.01 to 7.5	0.2 to 15	0.02	0.5	0.01	0.2	0.01	0.1	0.25	0.25	75	0.15	–	S	–	129/172/ 330 (8)
15	192.0010.03	0.01 to 15	0.1 to 8	0.02	0.5	0.01	0.2	0.01	0.1	0.375	1	75	0.3	–	S	–	
35	192.0010.04	0.01 to 35	0.05 to 4	0.02	0.5	0.01	0.2	0.01	0.1	0.875	4.4	75	0.6	–	S	–	
70	192.0010.05	0.01 to 70	0.025 to 2	0.01	0.5	0.01	0.2	0.01	0.1	3.5	17.5	75	1	–	S	–	
NGAS 32/10	192.0803.04	0.01 to 32 0.01 to 16	0.1 to 10 (15)	0.02	0.5	0.01	0.2	0.01	0.1	0.16	1	75	0.6	–	S	–	129/172/ 330 (8)
NGB 32	117.7210.90	0.01 to 35	0.02 to 10	0.02	0.02	0.001	0.002	0.01	0.01	0.43	14	50	0.2	10	S	O	190/172/ 330 (10)
70	117.7227.90	0.01 to 70	0.01 to 5	0.02	0.02	0.001	0.002	0.01	0.01	1.75	56	50	0.5	5	S	O	
NGBI 35	192.0910.31	0.01 to 35	0.02 to 10	0.02	0.02	0.001	0.001	0.01	0.01	0.438	14	50	0.2	1	S	O	190/172/ 330 (10)
70	192.0910.71	0.01 to 70	0.01 to 5	0.02	0.02	0.001	0.001	0.01	0.01	1.75	56	50	0.5	1	S	O	
NGK 15	192.0003.02	0.01 to 15	0.01 to 4	0.02	0.02	0.001	0.002	0.01	0.01	0.75	37.5	50	0.2	0.1	S	O	190/172/ 278 (8)
35	192.0003.03	0.01 to 35	0.01 to 2	0.01	0.02	0.001	0.002	0.01	0.01	1.75	175	50	0.4	0.05	S	O	
70	192.0003.04	0.01 to 70	0.01 to 1	0.01	0.02	0.001	0.002	0.01	0.01	7	700	50	0.8	0.015	S	O	
280	192.0003.05	0.01 to 280	0.002 to 0.2	0.01	0.02	0.001	0.002	0.01	0.01	140	700	50	3	0.005	S	–	
NGM 7.5	117.7110.12	0.01 to 7.5	0.01 to 4	0.02	0.02	0.001	0.002	0.01	0.01	0.75	10	50	0.2	0.1	–	O	95/172/ 278 (4)
15	117.7110.13	0.01 to 15	0.01 to 2	0.02	0.02	0.001	0.002	0.01	0.01	1.5	40	50	0.2	0.05	–	O	
35	117.7110.14	0.01 to 35	0.01 to 1	0.02	0.02	0.001	0.002	0.01	0.01	3.5	175	50	0.4	0.02	–	O	
70	117.7110.15	0.01 to 70	0.01 to 0.5	0.01	0.02	0.001	0.002	0.01	0.01	14	700	50	0.8	0.001	–	O	
280	117.7110.06	0.01 to 280	0.002 to 0.1	0.01	0.02	0.001	0.002	0.01	0.01	280	1400	50	3	0.002	–	–	

Specifications in brief of Dual and Triple Power Supplies

Type R&S ...	Order No.	Setting ranges Voltage V	Setting ranges Current A	Resolution V %	Resolution I %	Max. deviation of output for ΔV AC supply ±10% V(%)	ΔV AC supply ±10% I(%)	Δt_{amb} −10 to +40 °C V(%/°C)	Δt_{amb} −10 to +40 °C I(%)	Zout for V mΩ	Zout for I kΩ	tr for V µs	Max. PARD V_{rms} mV	Max. PARD I_{rms} mA	Over-voltage pro-tection	Dimen-sions W x H x D Weight mm (kg)
Dual Power Supplies																
NGMD35	117.7127.02	0.01 to 35 (2 x)	0.01 to 1	0.02	0.02	0.001	0.001	0.01	0.01	3.5	175	50	0.4	0.02	●	190/172/ 278 (8)
Triple Power Supplies																
NGL35	192.0026.02	0.01 to 35 (3 x)	0.01 to 0.6	contin.	1	0.01	0.2	0.1	0.1	3.5	15	75	0.2	–	–	190/172/ 278 (7)
NGT20	117.7133.02	0.01 to 20 (2 x) 0.01 to 6 (1 x)	0.01 to 1 0.01 to 5	0.02	1	0.01	0.2	0.01	0.1	2 1	9 0.4	75 75	0.15 0.2	–	– ●	190/172/ 278 (7)
NGT25	192.0503.02	0.01 to 25 (2 x) 0.01 to 6 (1 x)	0.01 to 0.8 0.01 to 5	0.02	1	0.01	0.2	0.01	0.1	2.5 1	10 0.4	75 75	0.2 0.2	– –	– ●	190/172/ 278 (7)
NGT35	191.2019.02	0.01 to 35 (2 x) 0.01 to 6 (1 x)	0.01 to 0.6 0.01 to 5	0.02	1	0.01	0.2	0.01	0.1	3.3 1	15 0.4	75 75	0.25 0.2	– –	– ●	190/172/ 278 (7)

Power Supplies R&S NGRU

R&S NGRU 35: 0 to 35 V/0 to 10 A

R&S NGRU 50: 0 to 50 V/0 to 5 A

R&S NGRU 100: 0 to 100 V/0 to 3 A

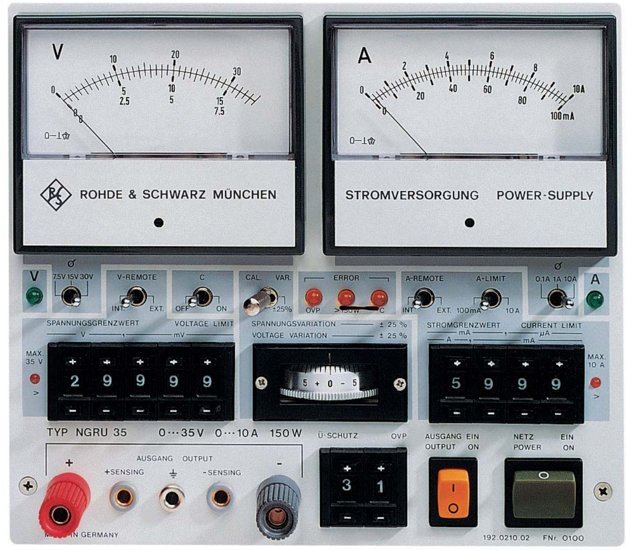


Photo 31460

Brief description

Power Supplies of the R&S NGRU series are precision laboratory units providing high accuracy and repeatability of voltage and current settings via digital potentiometers.

The power supplies can be used as constant-voltage or constant-current sources. The maximum output power is 150 W and remains constant over a wide voltage range. The current loadability depends on the output voltage.

Main features

- Compact bench models
- High resolution and reproducibility through digital potentiometers
- Output voltage continuously variable with calibrated potentiometer
- Automatic power matching ensuring full power over wide output voltage range
- Digitally settable overvoltage protection
- Output voltage can be modulated – simulation of interference factors
- Remote programming of voltage and current
- Panel meter for voltage and current indication in three ranges
- Large LED indicators for overload, overtemperature, overvoltage protection and selected operating mode
- Switch-selectable output capacitor
- Remote sensing

Operation

The voltage can be set in five digits and continuously varied by ±25% with a calibrated potentiometer.

The current can be set in four digits within two ranges. The low range is 100 mA for all R&S NGRU models so that even currents in the µA range can be reliably regulated.

The overvoltage protection is also set via digital potentiometer. In addition to manual operation, remote programming of voltage and current is possible by means of analog control signals.

Power Supplies R&S NGRU

Specifications in brief

Voltage setting	**R&S NGRU 35**	**R&S NGRU 50**	**R&S NGRU 100**
in 5 digits	<1 mV to 35 V	<1 mV to 50 V	<1 mV to 100 V
Resolution	1 mV	1 mV	1 mV
Max. error at 20°C	$\pm 10^{-4}$ of set value ±20 mV		
analog (continuously)	±25% with ±0.5% setting error of scale		
Resolution	0.25%	0.25%	0.25%
Current setting			
(2 ranges in 4 digits)			
High range	<1 mA to 10 A	<1 mA to 5 A	>12 mA to 3 A
Resolution	1 mA	1 mA	1 mA
Max. error at 20°C	$\pm 2 \times 10^{-3}$ of set value ±10 mA		
Low range	<10 µA to 100 mA		
Resolution	10 µA	10 µA	10 µA
Max. error at 20°C	$\pm 2 \times 10^{-3}$ of set value ±0.2 mA		
Max. constant current (150 W)	up to 15 V: 10 A 20 V: 7.5 A 35 V: 4.3 A	up to 30 V: 5 A 40 V: 3.8 A 50 V: 3 A	up to 50 V: 3 A 75 V: 2 A 100 V: 1.5 A
Constant-voltage source			
Deviation of output voltage with			
±10% AC supply variation	$<\pm 10^{-5}$		
between 0 and 40°C	$<\pm 10^{-4}$/K		
with 10 to 90% load	$<10^{-4}$		
PARD (V_{rms})	<0.3 mV	<0.5 mV	<1 mV
Transient recovery time	<75 µs	<75 µs	<75 µs
Constant-current source			
Deviation of output current with			
±10% AC supply variation	$<\pm 2 \times 10^{-5}$		
between 0 and 40°C	$<\pm 2 \times 10^{-4}$/K		
from 10 to 90% load	$<2 \times 10^{-4}$		
PARD			
in high range (I_{rms})	<2 mA	<1 mA	<0.3 mA
in low range (I_{rms})	<20 µA	<20 µA	<20 µA
Sensing sockets			
Max. voltage compens.	<0.5 V	<1 V	<1.5 V

Common data	
Modulation of output voltage (BNC female, floating)	V_{pp} = 10 V for 10 V modulation, 50 Hz to 1 kHz ±3 dB
Input impedance	approx. 3.5 kΩ
Overvoltage protection	
Setting range	1 to 99 V (response threshold approx. 5% higher)
Programming (external, analog)	
for output voltage	
0 to 100%´	0 to 10 V
for output current 0 to 100%	0 to 10 V
Setting time	<3 ms (to within ±1%)
Connector	5-contact Tuchel female
Input impedance	approx. 10 kΩ
Reference potential	positive terminal
General data	
Meter accuracy	±2.5% of full scale
AC supply	110/120/220/240 V ±10%, 47 to 63 Hz,
Dimensions (W x H x D); weight	190 mm x 180 mm x 330 mm; 9 kg

Ordering information

Power Supply	R&S NGRU 35	0192.0210.03
	R&S NGRU 50	0192.0210.05
	R&S NGRU 100	0192.0210.08

1000 W Power Supplies R&S NGC

R&S NGC35: 0 V to 35 V
0.05 A to 30 A
R&S NGC70: 0 V to 70 V
0.025 A to 15 A

R&S NGC35 (photo 24536)

Brief description

- Surge current capability – several times the rated current can be drawn for short periods
- High efficiency, 19" cabinet

The high efficiency of Power Supplies R&S NGC is achieved through continuous preregulation. A series-pass regulator ensures for excellent static and dynamic characteristics. Special constructional measures allow use in RF systems.

Specifications in brief

	R&S NGC 35		R&S NGC 70
Voltage	<10 mV to 35 V		<10 mV to 70 V
Current	<50 mA to 30 A		<25 mA to 15 A
Resolution	<0.02%		<0.02%
Deviation of voltage			
with ±10% AC supply variation		$<\pm 10^{-5}$	
between 0 and 40°C		$<\pm 10^{-4}$/K	
from 10 to 90% current		$<10^{-4}$	
Deviation of current			
with ±10% AC supply variation		$<\pm 10^{-4}$	
between 0 and 40°C		$<\pm 10^{-3}$/K	
from 10 to 90% voltage		$<10^{-3}$	
PARD			
Voltage V_{rms}	<1 mV		<2 mV
Current I_{rms}	<20 mA		<20 mA
Transient recovery time (10 to 90% load)		<60 µs	
Sensing sockets			
Surge current for 1 ms/0.2 s	80/60 A		40/30 A
Max. voltage compensation		0.5 V per lead	

General data

Rated temperature range	0 to +40°C
Meter accuracy	2.5 % of full scale
AC supply	220 V ±10%, 50 Hz, 2.4 kVA (other values on request)
Dimensions (W x H x D); Weight	484 mm x 194 mm x 509 mm; 40 kg

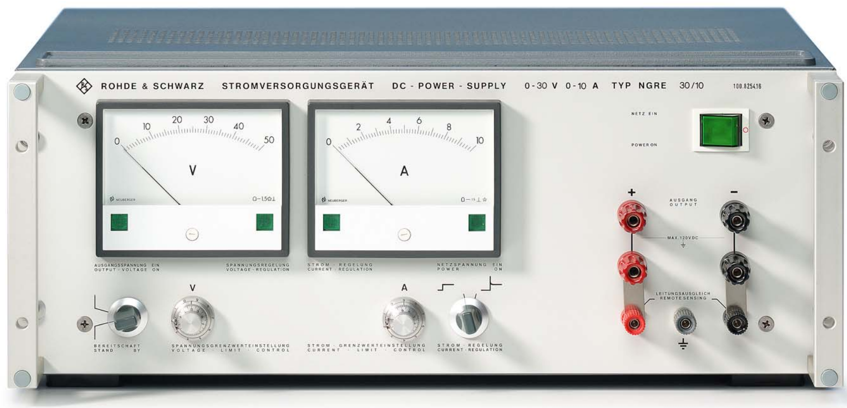
Ordering information

1000 W 19" Power Supply	R&S NGC 35	0192.0032.02
	R&S NGC 70	0192.0032.03

Power Supplies R&S NGRE

19" models – from about

200 W to 2000 W



R&S NGRE in design A and B:
cabinet model or rackmount, design B without operating controls (photo 43654-1)

Brief description

Power Supplies R&S NGRE provide high output power (from about 200 W). This type series is extremely versatile due to the use of standardized modules.

There are 27 basic versions (see table on next page), most of which come in five models. The basic versions only differ in the obtainable maximum voltage and current values and in the output impedance.

Each of these basic versions is equipped differently regarding meters, operating controls, connectors and available as a cabinet model or rackmount.

Power Supplies of the R&S NGRE series are designed for operation from 220 V AC supply. The power supplies can be adapted to other voltages upon request and at no extra cost.

Main features

- Sustained shortcircuit-proof, thermal overload protection
- Series and parallel connection of several units possible
- Built-in overvoltage protection (optional)

Operation

Voltage and current are set by means of high-resolution ten-turn potentiometers and indicated on separate panel meters. On request the power supplies are available with digital displays instead of analog panelmeters (Ordering information R&S NGRE MOD.DA). The power supplies are fitted with remote sensing sockets to compensate for voltage drops in the load leads. The two-stage cooling fan is thermostat-controlled and very quiet.

Setting the current ranges
R&S NGRE models 16 and 17 for currents up to 30 A are available on request with decade current ranges, e.g. a 10 A unit can be set to 0.1/1/10 A.

Remote control
The following functions of models 12, 13, 16, 17 can be modified for remote control: output voltage, output current, power switch on/off/standby and control of power regulating element. Power supplies which have been modified for remote control may be operated in master-slave mode (optional). This mode, in which the output quantity is controlled by only one of the supplies involved, is especially recommended for equally splitting up the load current at high powers.

Surge current capability
Two to three times the rated current may be drawn from the R&S NGRE Power Supplies. An external or internal (model code number …19) switch is provided for this purpose.

R&S NGRE MOD.DA fitted with digital displays (photo 43344)

Power Supplies R&S NGRE

Dimensions of different designs

	Cabinet model mm	Rackmount mm	Seated depth mm
Design A	484 x 194 x 436	483 x 177 x 425	347
Design B	484 x 194 x 509	483 x 177 x 498	420
Design C	608 x 394 x 284	–	–

Specifications in brief and order numbers

Setting ranges Voltage V	**Current** A	**Order number**	**Max. deviation of output for** ΔV AC supply ±10% V, I (%)	Δt_{amb} −10 to +40 °C V, I(%)	Z_{out} for V mΩ	(I) (kΩ)	t_r for V µs	**Max. PARD** V_{rms} µV	I_{rms} mA	**Power consumption** at 220 V/50 Hz kVA	**Available design**	**Weight** incl. case kg
0 to 6	0 to 30	100.8402.xx	±0.001	0.01	1	(1)	<50	300	9	0.9	A, C	22
	0 to 40	100.8419.xx	±0.001	0.01	0.1	(1)	<50	300	12	0.9	A, C	22
	0 to 60	100.8425.xx	±0.001	0.01	0.1	(1)	<50	300	18	0.9	A, C	28
	0 to 80	100.8431.xx	±0.001	0.01	0.1	(1)	<50	300	24	1.8	B, C	29
0 to 10	0 to 20	100.8354.xx	±0.001	0.01	1	(2)	<50	300	6	0.9	A, C	19
	0 to 30	100.8360.xx	±0.001	0.01	1	(2)	<50	300	9	0.9	A, C	28
	0 to 40	100.8377.xx	±0.001	0.01	0.1	(2)	<50	300	12	1.8	A, C	28
	0 to 60	100.8383.xx	±0.001	0.01	0.1	(1)	<50	300	18	1.8	A, C	37
0 to 15	0 to 20	100.8319.xx	±0.001	0.01	1	(2)	<50	300	6	0.9	B, C	28
	0 to 30	100.8325.xx	±0.001	0.01	1	(2)	<50	300	9	1.8	A, C	28
	0 to 40	100.8331.xx	±0.001	0.01	0.1	(2)	<50	300	12	1.8	A, C	37
	0 to 60	100.8348.xx	±0.001	0.01	0.1	(1)	<50	300	18	2.5	B, C	39
0 to 30	0 to 10	100.8254.xx	±0.001	0.01	1	(5)	<50	300	3	0.9	A, C	19
	0 to 15	100.8260.xx	±0.001	0.01	1	(5)	<50	300	4.5	0.9	A, C	28
	0 to 20	100.8277.xx	±0.001	0.01	1	(3)	<50	300	6	1.8	A, C	28
	0 to 30	100.8283.xx	±0.001	0.01	1	(2)	<50	300	9	1.8	A, C	37
	0 to 40	100.8290.xx	±0.001	0.01	0.1	(2)	<50	300	12	2.5	B, C	39
	0 to 60	100.8460.xx	±0.001	0.01	0.1	(2)	<50	300	18	3.5	C	50
0 to 50	0 to 10	100.8219.xx	±0.001	0.01	1	(5)	<50	300	3	0.9	A, C	28
	0 to 15	100.8225.xx	±0.001	0.01	1	(5)	<50	300	4.5	1.4	A, C	28
	0 to 20	100.8231.xx	±0.001	0.01	1	(5)	<50	300	6	1.8	A, C	37
	0 to 30	100.8248.xx	±0.001	0.01	1	(3)	<50	300	9	2.5	B, C	39
	0 to 40	100.8454.xx	±0.001	0.01	0.1	(2)	<50	300	12	3.5	C	50
0 to 100	0 to 5	100.8160.xx	±0.001	0.01	1	(10)	<50	500	1.5	0.9	A, C	28
	0 to 10	100.8183.xx	±0.001	0.01	1	(10)	<50	500	3	1.8	A, C	37
	0 to 15	100.8190.xx	±0.001	0.01	1	(5)	<50	500	4.5	2.5	A, C	39
	0 to 20	100.8448.xx	±0.001	0.01	1	(5)	<50	500	6	3.5	C	50

Completion of Order Numbers

Model code number (last two digits of Order No.)	Design	Voltage and current setting: Precision potentiometer on front panel	Screwdriver adjustment on rear panel	Current range in three decades (up to 30 A) at extra cost	Four additional fixed voltages, push button-selected	Large meters for voltage and current
13	19" cabinet		●			
17		●		●		●
12	19" rackmount		●			
16		●		●		●
19	Aluminium case	●			●	●

Programmable Power Supplies R&S NGPU

R&S NGPU 70/10: 175 W

(70 V/max. 10 A)

R&S NGPU 70/20: 350 W

(70 V/max. 20 A)

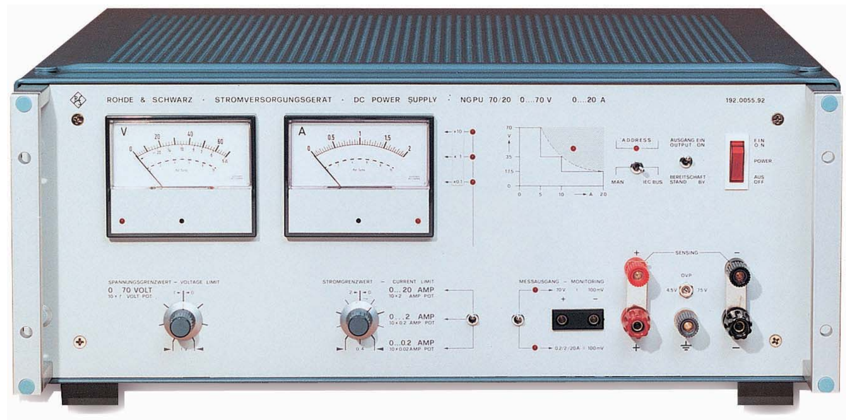


Photo 26310

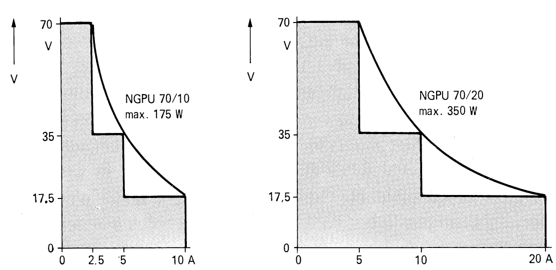
Brief description

R&S NGPU Power Supplies are constant voltage or constant-current sources, which can be programmed via IEC/IEEE bus or operated manually. Three selectable current ranges and one floating test output which can be switched between voltage and current make the R&S NGPU ideal for use in IEC/IEEE bus test systems.

Graduated current loadability
Since the current drain of many loads – for instance of transceivers – is inversely proportional to the supply voltage, a graduated current loadability is fully compatible with practical requirements. The maximum continuous current drain for the selected output voltage is indicated on a scale of the panel voltmeter. Brief current surges exceeding this load limit are tolerable. If above 15 V a current exceeding this limit is permanently drawn, the power supply is disconnected from the AC supply via the built-in temperature monitor.

Main features

- Programming via IEC/IEEE bus or manual operation
- Three-digit programming of voltage and current (1000 steps), resolution: 10 mV to 100 mV, 10 mA to 20 mA
- Output current in three decade ranges



Current loadability is graduated as a function of the output voltage. Full output current can be derived over almost 80% of the voltage range. As the figure shows, the characteristic practically combines the curves, i.e. the performance, of three individual supplies

Specifications in brief

Output quantities	adjustable via ten-turn potentiometer or IEC/IEEE bus	
Resolution manual control	0.02%	
Resolution IEC/IEEE bus	1000 steps/range; for voltage adjustable 10 to 100 mV/step	
Voltage	<10 mV to 70 V	
Current	**NPGU 70/10**	**NPGU 70/20**
3 ranges	0.1/1/10 A	0.2/2/20 A
Deviation of output voltage/current		
with ±10% AC supply variation	$<10^{-5}/<5 \times 10^{-5}$	
between 0 and 40°C	$<(10^{-4}/K+100\ \mu V)/<(10^{-4}/K+100\ \mu A)$	
with 10 to 90% load	$<10^{-4}/<5 \times 10^{-4}$	
PARD		
Voltage, V_{rms}	<1.5 mV	<1.5 mV
Current, I_{rms}	<5 mA	<10 mA
Transient recovery time (10 to 90% load)	<60 µs	<60 µs

	NPGU 70/10	**NPGU 70/20**
Remote control	IEC 625-1 (IEEE 488)	
Remote sensing	compens. for 0.5 V per lead	
Test output		
for voltage	100 mV ±1% at 70 V	
for current	100 mV ±2% for full scale	
Overvoltage protection	adjustable from 4.5 to 80 V	
General data		
AC supply	110/220 V ±10%, 50 to 60 Hz	
Power consumption	600 VA	1250 VA
Dimensions (W x H x D) in mm	492 x 161 x 514	492 x 205 x 514
Weight	14 kg	19 kg

Ordering information

Programmable Power Supply	R&S NGPU 70/10	0192.0049.92
	R&S NGPU 70/20	0192.0055.92

Programmable Power Supplies R&S NGPV

Power Supplies suitable for use in test systems and for general laboratory applications

Photo 31316-1

Brief description

Power Supplies of the R&S NGPV series are suitable for use in test systems and for general laboratory applications.

Nine different models are available

R&S NGPV 8/10	0 to 8 V/0 to 10 A
R&S NGPV 20/5	0 to 20 V/0 to 5 A
R&S NGPV 20/10	0 to 20 V/0 to 10 A
R&S NGPV 40/3	0 to 40 V/0 to 3 A
R&S NGPV 40/5	0 to 40 V/0 to 5 A
R&S NGPV 100/1	0 to 100 V/0 to 1 A
R&S NGPV 100/2	0 to 100 V/0 to 2 A
R&S NGPV 300/0.3	0 to 300 V/0 to 0.3A
R&S NGPV 300/0.6	0 to 300 V/0 to 0.6A

Each model comes in two versions

The version for use in systems and labs can be programmed via IEC/IEEE bus or operated manually. These power supplies are provided with the necessary operating controls, a digital LED display for indication of all input data including IEC/IEEE bus commands, and analog meters for indication of actual voltage and current values. The system version is without operating controls so that models for use in systems are lower-priced.

Main features

- Digital setting, high resolution
- No discrete output capacitance, true current source
- Programmable via IEC/IEEE bus and manual control
- Short setting time for down programming thanks to current sinking
- Two current ranges - high-resolution current monitoring output
- Display of operating status and faults
- Thermostat-controlled cooling fan
- 19" design

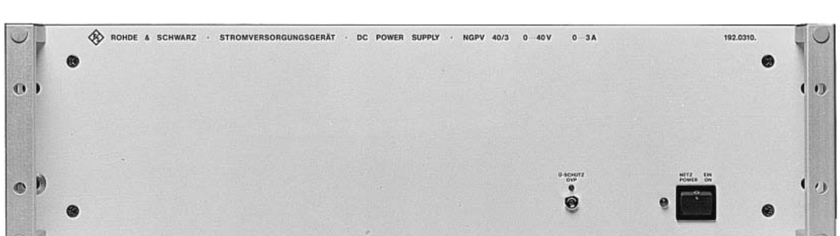
System use

Power Supplies R&S NGPV are ideal for use in systems because of the short setting time of 2 ms which applies both to the rise time and thanks to controlled current sinking also to the fall time.

The R&S NGPV models have no discrete output capacitance so that they can be used for regulating extremely low currents. Relay contacts will not be damaged by switching of current paths. A larger output capacitor can be switched into circuit manually or via the program.

Remote sensing

Remote sensing is a particularly system-friendly mode since it is set automatically with no sensing links involved. In the sensing mode, the maximum output voltage of the power supply exceeds the specified nominal voltage only by the amount of the voltage drop in the leads. The load is thus fully protected, even in the presence of a shortcircuit, wrong polarity or interruption of the sensing leads.



Power Supply R&S NGPV for use in systems (photo 31924)

Programmable Power Supplies R&S NGPV

Specifications in brief

Type	R&S NGPV 8/10	NGPV 20/5	NGPV 20/10	NGPV 40/3	NGPV 40/5	NGPV 100/1	NGPV 100/2	NGPV 300/0.3	NGPV 300/0.6
A1	0 V to 7.99 V	0 V to 19.99 V		0 V to 39.99		0 V to 99.9 V		0 V to 299.9 V	
A2	10 mV/800	10 mV/2000		10 mV/4000		100 mV/1000		100 mV/300	
A3	$<10^{-3}$	$<10^{-3}$		$<10^{-3}$		$<10^{-3}$		$<10^{-3}$	
B1	0 A to 9.99 A	0 A to 4.99 A	0 A to 9.99 A	0 A to 2.99 A	0 A to 4.99 A	0 A to 0.999 A	0 A to 1.99 A	0 A to 0.299 A	0 A to 0.599 A
B2	10 mA/1000	10 mA/500	10 mA/1000	10 mA/300	10 mA/500	1 mA/1000	10 mA/200	1 mA/300	1 mA/600
B3	$<10^{-3}$	$<2 \times 10^{-3}$	$<10^{-3}$	$<3 \times 10^{-3}$	$<2 \times 10^{-3}$	$<10^{-3}$	$<4 \times 10^{-3}$	$<3 \times 10^{-3}$	$<2 \times 10^{-3}$
B11	0 A to 999 mA	0 A to 999 mA		0 A to 999 mA		0 A to 99.9 mA		0 A to 99.9 mA	
B12	1 mA	1 mA		1 mA		0.1 mA		0.1 mA	
B13	$<10^{-3}$	$<10^{-3}$		$<10^{-3}$		$<2 \times 10^{-3}$		$<2 \times 10^{-3}$	
C	<200 µV	<250 µV		<400 µV		<600 µV		<900 µV	
D	500 pF/220 µF	500 pF/100 µF	750 pF/220 µF	500 pF/47 µF	750 pF/100 µF	500 pF/22 µF	750 pF/47 µF	500 pF/10 µF	750 pF/22 µF
E	4.5 V to 15 V	4.5 V to 25 V		4.5 V to 50 V		5 V to 110 V		5 V to 330 V	

Output voltage
A1: setting
A2: resolution (mV/steps)
A3: deviation (of fs)

Output current (A range)
B1: setting
B2: resolution (mA/steps)
B3: deviation (of fs)

Output current (mA range)
B11: setting
B12: resolution (1000 steps)
B13: deviation (of fs)

C: PARD, V_{rms}

D: output C (OFF/ON)

E: overvoltage protection (OVP)

Common data

Constant-voltage source

Deviation of output voltage	
with ±10% AC supply variation	$<10^{-5}$
between 0 and 50°C	$<2 \times 10^{-5}$/K
with 10 to 90% load	$<10^{-4}$
Transient recovery time (10 to 90%/90 to 10%)	<75 µs (to within $\pm 10^{-3}$)

Constant-current source

Deviation of output current	
with ±10% AC supply variation	$<10^{-5}$
between 0 and 50°C	$<5 \times 10^{-5}$/K
with 10 to 90% load	$<10^{-4}$
Transient recovery time, output C OFF/ON	<50 µs/<2 ms
PARD, I_{rms}	
in mA range	10 µA
in A range	100 µA/A

Remote control	IEC 625-1 (IEEE 488)
Interface functions	SH0, AH1, T0, TE0, L1, LE0, SR0, RL1, PP1, DC1, DT1, C0
Setting time (0 to 100%/100 to 0%)	<2 ms (to within $\pm 2 \times 10^{-3}$)
Remote sensing	compensation for 1 V per lead
Current monitoring output	
mA range	100 mV ±1% for full scale
A range	10 mV ±1%/A
General data	
Meter accuracy	±2.5% of fs
AC supply	110/120/220/240 V ±10%, 47 to 63 Hz

Order No.	192.0310...	192.0326...
Power consumption	approx. 250 VA	approx. 500 VA
Dimensions (W x H x D) in mm	492 x 161 x 392	492 x 161 x 420
Weight	12 kg	19 kg

Ordering information

Type	R&S NGPV 8/10	NGPV 20/5	NGPV 20/10	NGPV 40/3	NGPV 40/5	NGPV 100/1	NGPV 100/2	NGPV 300/0.3	NGPV 300/ 0.6
F1	192.0310.80	192.0310.20	192.0326.20	192.0310.40	192.0326.40	192.0310.10	192.0326.10	192.0310.30	192.0326.30
F2	192.0310.81	192.0310.21	192.0326.21	192.0310.41	192.0326.41	192.0310.11	192.0326.11	192.0310.31	192.0326.31

F1: system version

F2: system and lab version

Programmable Power Supplies R&S NGPX

R&S NGPX 35/10:

0 to 35 V/0 to 10 A

R&S NGPX 70/5:

0 to 70 V/0 to 5 A

R&S NGPX 150/2.3:

0 to 150 V/0 to 2.3 A

Photo 42846

Brief description

Power Supplies R&S NGPX are high-performance programmable laboratory units (350 W) using linear regulation. With their excellent regulation characteristics these 19" units are ideal for use in development labs. Thanks to convenient manual operation and IEC/IEEE bus control they can readily be integrated into production test systems. A rear trigger input allows fast on/off switching of the output voltage to support current-saving applications.

Main features

- 350 W output power
- Low PARD thanks to linear regulation
- Accurate return signalling of voltage and current values, also via IEC/IEEE bus
- Effective current measurement with dynamic loads
- Fast up and down programming (10 µs typ. for R&S NGPX35/10)
- Large alphanumeric LCD display for output of nominal and actual values as well as status information
- Nominal value input via numeric keypad; increment and decrement key
- Rear, isolated trigger input
- Rear isolating and polarity reversal relay (optional)
- Current monitor in 3rd current range with 25 µA resolution (optional)
- Nonvolatile storage of 10 complete instrument setups
- Selectable foldback function
- Temperature-controlled cooling fan
- Soft limits for current and voltage
- Hardware overvoltage protection
- Remote sensing
- 19" system unit with IEEE488.2

Programmable Power Supplies R&S NGPX

Specifications in brief

Constant-voltage source	**35/10**	**70/5**	**150/2.3**
Voltage setting	0 to 35.00 V	0 to 70.00 V	0 to 150.00 V
Resolution (mV/steps)	10/3500	20/3500	50/3000
Deviation			
from nominal value (±1 LSB)	<25 mV	<50 mV	<125 mV
with ±10% AC supply variation	<±0.35 mV	<±0.7 mV	<±1.5 mV
with load variation (10% to 90% of fs)	<±1 mV	<±2 mV	<±3.5 mV
Transient recovery time with load variation (10% to 90% of fs) to ±0.15%	<75 µs	<75 µs	<75 µs
Rise/fall time of output voltage (fast mode)	<10 µs typ.	<20 µs typ.	<20 µs typ.
PARD, V_{rms} (C_{ON}/C_{OFF})	<0.25/<0.5 mV	<0.5/<1.0 mV	<1/<2 mV
Voltage measurement	0 to 40.95 V	0 to 81.9 V	0 to 204.75 V
Resolution (mV/steps)	10/4095	20/4095	50/4095
Deviation from measured value (±2 LSB)	<±35 mV	<±70 mV	<±150 mV
Current setting	0 to 10.00 A	0 to 5.00 A	0 to 2.30 A
Resolution (mA/steps)	2.5/4000	1.25/4000	1/2300
Deviation from nominal value[1]	<±10 mA±1 LSB	<±10 mA±1 LSB	<±5 mA±1 LSB
with ±10% AC supply variation	<±0.2 mA	<±0.2 mA	<±0.2 mA
with load variation (10 to 90% of fs)	<±1 mA	<±1 mA	<±0.5 mA
PARD, I_{rms} (C_{ON}/C_{OFF})	<0.2/<0.6 mA	<0.1/<0.3 mA	<0.05/0.15 mA
Current measurement in range 1	0 to 10.2375 A	0 to 5.1188 A	0 to 4.095 A
Resolution (mA/steps)	2.5[1]/4095	1.25[1]/4095	1/4095
Deviation from measured value ±2 LSB)	<±20 mA	<±10 mA	<±5 mA
Current measurement in range 2	0 to 1.02375 A	0 to 511.88 mA	0 to 409.5 mA
Resolution (µA/steps)	250/4095	125[2]/4095	100/4095
Deviation from measured value ±2 LSB)	<±2 mA	<±1 mA	<±0.5 mA
Current measurement in range 3 (option)		0 to 102.375 mA	
Resolution (µA/steps)	25[3]/4095	25[3]/4095	25[3]/4095
Deviation from measured value (±2 LSB)	<±30 µA[3] ±2.5 µA/°C	<±30 µA[3] ±2.5 µA/°C	<±30 µA[3] ±2.5 µA/°C

Overvoltage protection			
Operating range	4 to 99.95 V	4 to 99.95 V	4 to 200 V
Resolution	50 mV	50 mV	100 mV
Response accuracy	±4 V	±4 V	±4 V

General data	
Refresh rate of display	3 updates per second
Refresh rate of measured value	update on each query
Setting time (incl. command processing)	4ms typ. (R&S NGPX mode)
Outputs	floating, max. 250 V DC
AC supply	100/120/220/240 V; 47 to 63 Hz; 1400 VA
Dimensions (W x H x D); Weight	492 mm x 161 mm x 513 mm; 23 kg
Programming	IEC625-2/IEEE488.2

Ordering information

Programmable Power Supply	R&S NGPX35/10	0192.0610.31
	R&S NGPX70/5	0192.0610.71
	R&S NGPX150/2.3	0192.0610.11
Options		
Rear isolating and polarity reversal relay for	R&S NGPX 35/10	0192.0610.32
	R&S NGPX 70/5	0192.0610.72
	R&S NGPX 150/2.3	0192.0610.12
Current monitor in current range 3 for	R&S NGPX 35/10	0192.0610.33
	R&S NGPX 70/5	0192.0610.73
	R&S NGPX 150/2.3	0192.0610.13

1) Readout roundet to full mA.

2) Readout roundet to full 100 µA.

3) Readout roundet to full 10 µA.

Programmable Power Supply R&S NGPE 40/40

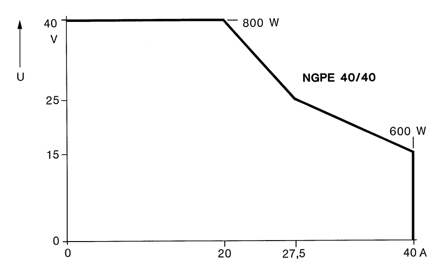
Brief description

Programmable Power Supply R&S NGPE is suitable for use in test systems and for general laboratory applications. The relatively small output capacitance, the short setting time even for down programming (thanks to built-in current sinking) as well as the voltage and current monitoring outputs are significant benefits in system use.

Photo 43554

Main features

- ◆ 0 V to 40 V/0 V to max. 40 A
- ◆ Primary-switched regulator with high efficiency and low heat dissipation
- ◆ Low PARD, excellent EMC, RFI suppression grade B
- ◆ Good regulation characteristics even with partial loading thanks to push-push converter configuration using power FETs
- ◆ Wide AC supply regulation range: 190 V to 265 V/95 V to 135 V
- ◆ Clear front-panel layout and LED display for voltage and current as well as IEC/IEEE bus commands
- ◆ Manual setting or via IEC/IEEE bus
- ◆ Separate panel meters for voltage and current, each with two switch-selected ranges
- ◆ High resolution and reproducibility due to decade setting
- ◆ High setting speed (for up programming independent of preset current limit, for down programming due to current sinking)
- ◆ Current monitoring output (two ranges)
- ◆ Voltage monitoring output
- ◆ Overvoltage protection (OVP)
- ◆ Thermostat-controlled cooling fan
- ◆ Remote sensing similar to R&S NGPV
- ◆ 19" system unit



The autoranging output characteristic shows that higher currents are available at lower voltages. At 15 V and 40 A the output power is still 600 W

Specifications in brief

Voltage setting, in 4 digits	0 to 39.99 V	
Resolution/Deviation	10 mV (4000 steps)/<10^{-3} of full scale	
Current setting, in 3 digits	0 to 39.9 A	
Resolution/Deviation	100 mA (400 steps)/<2x10^{-3} of full scale	
Constant-voltage source		
Deviation of output voltage		
with ±10% AC supply variation	<10^{-4}	
between 0 and 45°C	<2 x 10^{-5}/°C	
with 10 to 90% nominal current	<10^{-4}	
Transient recovery time at 40 V,		
from 2 to 18 A or conversely	2.0 ms (to 150 mV)	
from 2 to 4 A or conversely	0.2 ms (to 50 mV)	
from 16 to 18 A or conversely	0.2 ms (to 50 mV)	
Setting time	without load	with load
from 0 to 39 V	50 ms	60 ms
from 39 to 0.4 V	100 ms	30 ms
from 39 to 0.1 V	120 ms	40 ms
PARD, V_{rms}/V_p	2 mV/20 mV	
Constant-current source		
Deviation of output current		
with ±10% AC supply variation	<10^{-4}	
between 0 and 45°C	<10^{-4}/°C	
with 10 to 90% nominal current	<10^{-4}	
PARD, I_{rms}	<40 mA	

Remote control	IEC 625-1 (IEEE 488)
Functions	SH0, AH1, T0, TE0, L1, LE0, SR0, RL1, PP1, DC1, DT1, C0
Remote sensing	compensation for 0.5 V per lead
Panel meters	
Voltmeter (2 ranges)	10/40 V ±2.5% of full scale
Ammeter (2 ranges)	4/40 A ±2.5% of full scale
Monitoring output	
for current	400 mV corresp. to 4 A, 2% of fs 400 mV corresp. to 40 A, 0.2% of fs
for voltage	0 to 40 V, 0.2% of fs
General data	
Overvoltage protection (OVP)	4.5 to 50 V
AC supply, selectable	95 to 135 V or 190 to 265 V, 47 to 63 Hz, 1600 VA
Dimensions (W x H x D); weight	492 mm x 161 mm x 420 mm; 14 kg

Ordering information

Programmable Power Supply	R&S NGPE 40/40	0192.0332.41

Programmable Voltage Source R&S NGPS32

2 x –32 V to +32 V, max. 100 mA,

500 µV resolution

New

Photo 43862-1

Brief description

The R&S NGPS32 is a programmable voltage source with two isolated identical outputs. The bipolar output voltages (–32 V to +32 V) can be set with high resolution either manually or via the IEEE488 interface. Two integrated simple arbitrary generators allow independent output of low-frequency waveforms. The R&S NGPS32 is suitable for use in automatic calibration and adjustment systems and as a reference voltage source in control processes.

Main features

- 2 x –32 V to +32 V with 500 µV resolution
- Selectable current limit (100mA or 10mA)
- Two integrated simple arbitrary generators
- High thermal and long-term stability
- Floating output voltages, combinable as required
- Rear outputs with additional sensing connectors
- Ease of operation

In addition to static voltage values, low-frequency waveforms can be output. For this purpose, reference points (consisting of voltage value and time) can be entered manually or via IEC/IEEE bus. Between two neighbouring points, the arbitrary generator operates like a ramp generator, i.e. the programmed voltage difference is sampled as a ramp with the time T of the preceding point. The step size of the ramp is calculated automatically. The arbitrary generator can output the waveform only once or cyclically. The reference points are stored in a nonvolatile memory.

Specifications in brief

Outputs	2 isolated, floating channels with rear outputs on terminal strip
Output voltage (per channel)	–32.7675 V to 32.7675 V in 131071 steps
Setting	via decimal keypad, rotary knob or IEEE488 bus
Setting resolution	500 µV
Deviation of full scale	± 2 mV
Display	alphanumeric LCD display with 2 lines and 16 characters/line with adjustable LED lighting
Output current	selectable current limit 10 mA or 100 mA, short-circuit-proof
Accuracy of current limit	±25%
Voltage deviation with AC supply variation of ±10%	±10 ppm
Voltage deviation with temperature variation from 0° C to +40° C	±10 ppm/°C
Instability	±1 ppm/h
Ripple and noise (20 Hz to 1 MHz)	<500 µV
Nonlinearity	<500 µV
Settling time	<700 µs over full output voltage range <100 µs for smallest programming step (500 µV)
Sensing voltage compensation	max. 250 mV per output line

Arbitrary generator	
Programming range	–32.7675 V to 32.7675 V in 500 µV steps
Max. number of reference points	200
Smallest time interval between 2 reference points	1 ms
Largest time interval between 2 reference points	32767 ms
Operating temperature range	0° C to +40° C
AC supply	100/120/220/240 V ±10%, 50 Hz to 60 Hz; 62.5 VA
Dimensions (W x H x D)	465 mm x 110 mm x 400 mm
Weight	6.75 kg

Ordering information

Dual Programmable Voltage Source (bipolar) with arbitrary function	R&S NGPS32	0192.1016.31
Options		
19" Rack Adapter 2 HU	R&S ZZA-211	1096.3260.00

Dual-Channel Analyzer/Power Supply R&S NGMO 2

Precise power supply and measurements under critical test conditions

New

Brief description

The Dual-Channel Analyzer/Power Supply R&S NGMO 2 from Rohde & Schwarz is more than just a simple power supply for test and measurement applications. This is shown by its advanced features:

- Accurate high-speed voltage source,
- Programmable DC load,
- Precise digital voltmeter,
- Transient recorder,
- Simple squarewave generator delivering high output power,

and two of each of these features are provided. Two independent channels, installed in an enclosure which is ½ 19" wide and only 2 U high, guarantee a simple and accurate power supply for battery-operated mobile-radio products now and in the future.

Main features

- Two channels 15 V/2.5(5) A with 7 A peak
- Fast load regulation
- Result memory for fast current and voltage measurements
- Internal and external triggers
- Two separate voltage measurement channels
- Sinking to 2.8 A (static)
- High-resolution voltage settings
- Precise measurements in µA range
- Minimal ripple and noise
- Adjustable output impedance for battery emulation
- OVP/OCP
- Detection of open sense pins
- Auxiliary inputs/outputs (output inhibit, relay, complete, trigger)
- Compact design (2 HU, ½ 19")
- IEEE488.2, RS-232-C, USB (under preparation) interfaces
- Fast programming
- Convenient manual operation

Further characteristics

Critical test environments involving pulsed current drain, e.g. GSM mobiles
Power-saving transmission technologies have been, and will continue to be, the key to expanding the capabilities of mobile radio. This is particularly true of transmission technologies that make use of time division multiplexing, for example GSM or TDMA, and also applies to the "slotted mode" used for CDMA – in both cases power supplies have to meet special requirements. R&S NGMO 2 can meet voltage drops without any hint of output voltage instability.

Emulation of various battery types and charging states
The R&S NGMO 2 can be used to emulate this critical case as its output impedance is adjustable. This also means that different types of batteries (NiCd, NiMH, Li-ion, Li-polymer etc) can be emulated to a certain extent. This guarantees that nothing can happen to invalidate tests despite the general trend to lower supply voltages.

Current-/voltage transient analysis
conclusions can be drawn about whether or not the subassemblies to be tested are functioning properly by forming the differences of the measured current drain of a sequence of signals occurring in rapid succession.

It goes without saying that long-term monitoring (current drain) can also be performed on DUTs by choosing sampling intervals of the appropriate length so that the effect of other operating parameters on current drain can be investigated. However, power consumption is also becoming more and more critical for subassemblies which are not battery-operated. Operating modes such as idle, sleep or power down are being encountered more frequently in electronic equipment

Dual-Channel Analyzer/Power Supply R&S NGMO2

because higher clock frequencies coupled with an increasing level of integration are making it impossible to ignore efficient energy management.

High-resolution current measurements and voltage settings
There are extremely wide variations in the current taken by mobile telephone operating modes. It is essential to have enough resolution to detect deviations from the normal mobile mode whenever they might occur. The R&S NGMO2, therefore, has different current measurement ranges for both static and dynamic current measurements. The R&S NGMO2 also has the necessary voltage setting resolution to calibrate and adjust DUTs and to provide reproducible voltage levels.

Recording characteristics of semiconductor components
The R&S NGMO2 has two completely identical supply and measurement channels. This means that this small power supply unit can be used to form the basis of an independent parameter test setup for semiconductor components. The R&S NGMO2 can also handle up to four relays and respond to remote control commands. As each channel has an inhibit input, if required, a pulsed supply voltage can be fed to the components to prevent overheating during tests or to simulate a standard pulsed operating mode (e.g. TDMA power amplifier).

Specifications

Constant voltage source	**Channels 1 + 2 (both channels with identical specs)**
Voltage setting	0 to 15 V
Resolution	1 mV
Deviation	0.05% + 5 mV
at ±10% AC supply fluctuation	0.5 mV
at 10 to 90% nom. current	0.01% + 3 mV
Settling time on load steps (0.1 A to 1.6 A) at ≤20 mV	
Deviation at large bandwidth	
directly connected	<35 μs
on "long" lines, with sense lead	<50 μs
Deviation at small bandwidth	
directly connected	<80 μs
on "long" lines, with sense lead	<100 μs
Temporary voltage drop after load step (0.1 A to 1.6 A)	
at large bandwidth	
on "long" lines, with sense lead	<60 mV
Ripple (rms)	<1 mV
Output impedance	0 to 1 Ω, adjustable in 10 mΩ steps
Voltage compensation	up to 1 V (4 V) per line
Constant current source	
Peak current (1 ms)	7 A
Current setting from 1.8 V to 5 V	0 to 5 A
Current setting outside 1.8 V to 5 V	0 to 2.5 A
Resolution	1 mA
Deviation	0.1% + 5 mA
at ±10% AC supply fluctuation	1 mA
at 10% to 90% nom. current	0.01% + 2 mA
Sinking	2.8 A (0 to 5 V), dropping to 1 A at 15 V
Voltage measurement	
Range	–5 V to +25 V
Resolution	1 mV
Deviation	0.03% + 3 mV
Measurement rate	2 ms to 200 ms, adjustable
Averaging of	1 to 10 values
Current measurement	
Ranges	7 A/0.5 A/5 mA
Resolution	200 μA/10 μA/0.1 μA
Deviation	0.2% + (2 mA/100 μA/1 μA)
Measurement rate	2 ms to 200 ms, adjustable
Averaging of	1 to 10 values
Transient measurement	
Sample memory	1 to 5000 samples
Sampling interval (adjustable)	10 μs to 1 s in 10 μs steps
Averaging of	1 to 100 values
Measurement system trigger	
Current transients	
Measurement ranges	5 A / 0.5 A
Adjustable trigger thresholds	
Range 5 A	0 mA to 5 A in 200 μA steps
Range 0.5 A	0 mA to 0.5 A in 10 μA steps
Voltage transients	–5 V to +25 V in 1 mV steps
Pre-/posttrigger	–5000 to +50000 samples
Measurement functions	Peak Min, Peak Max, Hi, Low, RMS, Average
Protection functions	
OVP	1.5 V to 22 V, adjustable
OCP	on/off
Detection of sense line interruptions	
General data	
Programming	IEEE488.2, RS-232-C, USB1.0 (under preparation)
Inputs	2 x measurement system trigger, 2 x output inhibit
Outputs	2 x complete, 4 x relay, fault
AC supply	115/230 V, 47 Hz to 63 Hz
Dimensions (W x H x D), without feet	210.8 mm x 87.6 mm x 420 mm,
Weight	7.5 kg

Ordering information

Dual-Channel Analyzer/ Power Supply	R&S NGMO2	192.1500.24
Front-Panel Output Connectors	R&S NGMO2-B0	192.1500.00
19" Adapter for 1 unit	R&S NGMO2-B1	192.1500.01
19" Adapter for 2 units	R&S NGMO2-B2	192.1500.02

Triple Power Supply R&S NGPT

R&S NGPT35:

2 × 35 V/1 A and 1 × 7 V/5 A

R&S NGPT18:

2 × 18 V/2 A and 1 × 7 V/5 A

R&S NGPT7:

2 × 7 V/5 A and 1 × 18 V/2 A

Photo 40648

Main features

- ◆ Insensitive to RF voltages radiated by device under test or nearby antenna
- ◆ Very low PARD (periodic and random deviation) due to linear regulation
- ◆ 14 bit resolution
- ◆ Precise and stable over wide temperature range
- ◆ Simultaneous readout of nominal and actual values of all channels
- ◆ Output voltage of all channels simultaneously variable by a percentage value
- ◆ Nonvolatile storage of up to six complete setups
- ◆ Software calibration via IEC/IEEE bus without potentiometer adjustment
- ◆ Coupled protection mode for DUTs which should not be supplied from an asymmetrical voltage source
- ◆ Floating outputs, max. 120 V DC
- ◆ Remote sensing (0.5 V per lead)
- ◆ Soft limits for defined voltage and current limiting
- ◆ Hardware overvoltage protection
- ◆ Quiet, temperature-controlled fan
- ◆ 19" system unit, full system capability via IEC/IEEE bus interface (IEC625-1/IEEE488-2)

Operation

Setting and display

Three displays are provided for indication of the nominal and actual values. A separate display is provided for status information and menu-guided operation.

Variable by percentage

For module testing, R&S NGPT35 provides the possibility of varying the output voltage of all three channels simultaneously in percent. After selection of the channels to be included in this operating mode, the desired variation can either be set via the numeric keypad or in steps of 0.1%, 1% or 10% using the increment/decrement keys.

Triple Power Supply R&S NGPT

Specifications in brief

Constant-voltage source	**35 V**	**18 V**	**7 V**
Voltage range	0 to 35 V	0 to 18 V	0 to 7 V
Resolution	2.5 mV	2.0 mV	0.5 mV
Deviation of full scale	<0.01%	<0.01%	<0.01%
with ±10% AC supply variation	<0.001%	<0.001%	<0.001%
from 0 to 45°C	<0.005%/°C	<0.005%/°C	<0.005%/°C
with 10 to 90% rated current	0.01%	0.01%	0.01%
Transient recovery time following load variation	75 µs	75 µs	150 µs
Programming time	35 ms	35 ms	35 ms
PARD (V_{rms})	200 µV	200 µV	100 µV

Constant-current source			
Current range	**0 to 1 A**	**0 to 2 A**	**0 to 5 A**
Resolution	0.1 mA	0.2 mA	0.5 mA
Deviation of full scale	<0.02%	<0.02%	<0.02%
with ±10% AC supply variation	<0.002%	<0.002%	<0.002%
from 0 to 45°C	<0.01%/°C	<0.01%/°C	<0.01%/°C
with 10 to 90% rated voltage	0.02%	0.02%	0.02%
Transient recovery time following load variation	10 ms	10 ms	5 ms
Programming time	60 ms	60 ms	60 ms
PARD (I_{rms})	20 µA	20 µA	100 µA

Display			
Voltage measurement	0 to 40 V	0 to 32.7660 V	0 to 8 V
Resolution	2.5 mV	2.0 mV	0.5 mV
Deviation of full scale	<0.01%	<0.01%	<0.01%
from 0 to 45°C	<0.005%/°C	<0.005%/°C	<0.005%/°C
Measurement rate	2 per s	2 per s	2 per s

Current measurement	0 to 1 A	0 to 3,2766 A	0 to 5 A
Resolution	0.1 mA	02 mA	0.5 mA
Deviation of full scale	0.02%	0.02%	0.02%
from 0 to 45°C	<0.01%/°C	<0.01%/°C	<0.01%/°C
Measurement rate	2 per s	2 per s	2 per s

Soft limits			
Voltage range	0 V to 35 V	0 V to 18 V	0 V to 7 V
Resolution	2.5 mV	2.0 mV	0.5 mV
Current range	0 to 1 A	0 to 2 A	0 to 5 A
Resolution	0.1 mA	0.2 mA	0.5 mA

Overvoltage protection			
Voltage range	1.5 to 40 V	1.5 to 25,55 V	1.5 to 10 V
Resolution	100 mV	50 mV	20 mV
Deviation of full scale	<2%	<2%	<2%
Response time	50 µs	50 µs	50 µs

Voltage variation			
Resolution	0.1%	0.1%	0.1%
Range	0 to 35 V	0 to 18 V	0 to 7 V

General data

AC supply	100/120/220/40 V ±10%, 50 to 60 Hz, 350 VA
Dimensions (W x H x D); weight	492 mm x 161 mm x 514 mm; 16 kg

Ordering information

Triple Power Supply	R&S NGPT35	0192.0510.31
	R&S NGPT18	0192.0510.21
	R&S NGPT7	0192.0510.71

DC Power Supplies R&S NGSM 32/10, R&S NGSM 60/5

R&S NGSM 32/10:

0 V to 18 V/10 A (20 A)

0 V to 32 V/5 A (10 A)

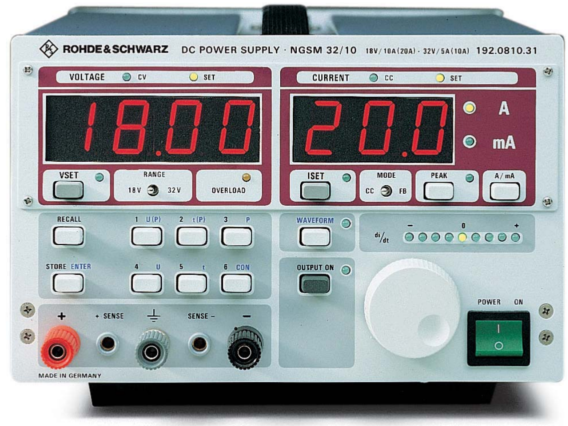
R&S NGSM 60/5:

0 V to 32 V/5 A (10 A)

0 V to 60 V/2.5 A (5 A)

Designed for car electronics applications in service, laboratory and production

Photo 42945



Brief description

DC Power Supplies R&S NGSM are versatile supply and measuring units for testing electronic car components by simulating real operating conditions. In addition to a wide field of car electronics, it can be used in mobile radio, car hifi applications and mechanical engineering. Due to its compact design, the units take up only one half 19" width. A 19" adapter is available for mounting the R&S NGSM into test racks.

Main features

- Excellent RF shielding and standby current measurement – ideal for mobile radio applications
- Trend indication for current measurements
- Car electronics testing by simulating motor startup
- Currents up to 20 A for car hifi applications
- Voltages up to 60 V for 42-V power-net in motor vehicles
- Storage of up to 12 device setups for short tests
- DUT protected against erroneous settings by ON/OFF output key
- IEC/IEEE bus or RS-232-C interface for use in production environments (optional)
- Acoustic signal upon changeover from voltage to current regulation – ideal for long-time testing
- Great ease of operation despite numerous functions

Application-specific characteristics

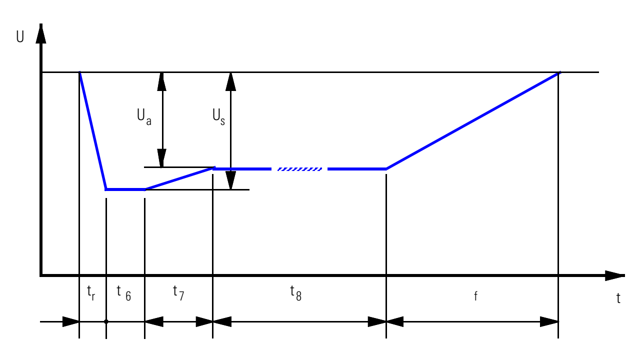
Car electronics

R&S NGSM is a precise and, thanks to its versatility, an extremely economical tool for use in the production of electronics. With the aid of an IEC/IEEE bus or RS-232-C interface (optional), the power supply can readily be integrated into in-line production systems. The startup curve in line with DIN 40839 can be adapted to other factory standards by reprogramming it. High surge currents typically occur in applications such as central locking or ABS, but with a pulse current of up to 30 A, R&S NGSM 32/10 is ideally prepared for these applications.

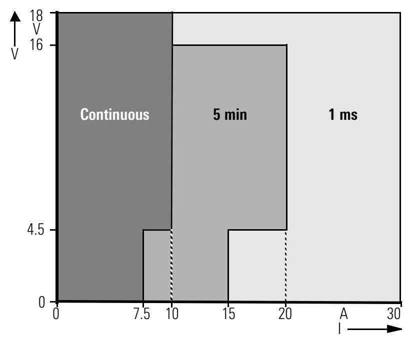
Mobile radio systems

The high resolution for current measurements allows the maximum operating time of a mobile phone to be accurately predicted; typical voltage drops during the startup of a car – which have to be tolarated by telephones operated at a car net – can be simulated.

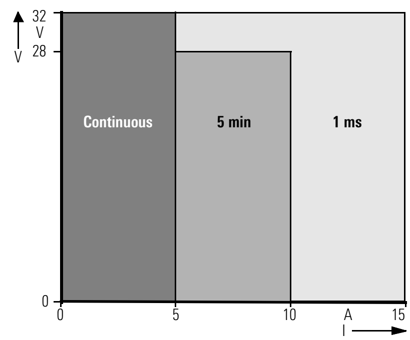
Startup curve to DIN 40839



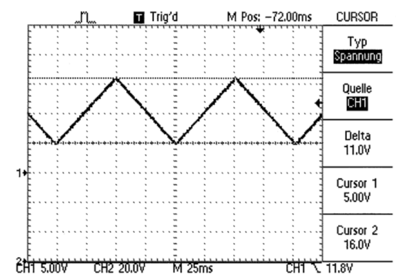
DC Power Supplies R&S NGSM 32/10, R&S NGSM 60/5



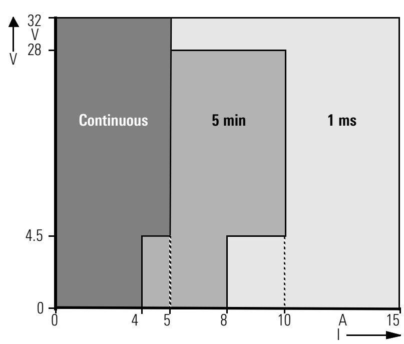
R&S NGSM 32/10:
Current loadability in 18 V range



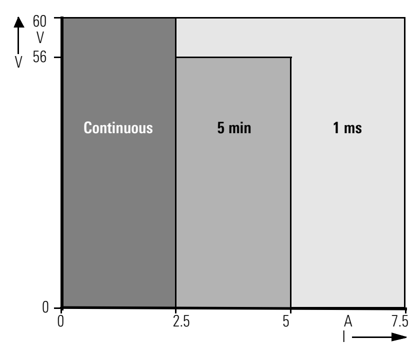
R&S NGSM 32/10:
Current loadability in 32 V range



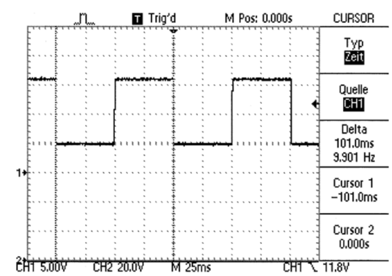
Example of a triangle function, generated with R&S NGSM



R&S NGSM 60/5:
Current loadability in 32 V range



R&S NGSM 60/5:
Current loadability in 60 V range



Example of a rectangle function, generated with R&S NGSM

DC Power Supply R&S NGSM is insensitive to the RF voltage conducted from a device under test or radiated from a nearby antenna.

Car hifi

With a short-term load current of 20 A (R&S NGSM 32/10), even boosters can be supplied. Peak current measurements allow the power loading of devices to be predicted. Simulation of the startup curve to DIN 40839 is also very useful in car hifi applications, e.g. to spot problems due to unexpected data loss of theft-proof car radios with security code.

Simple arbitrary generator

R&S NGSM can also be used as a simple arbitrary generator – but with the high output power of a power supply unit. Up to 60 reference values are available per voltage range which have to be programmed with lenghts of stay of each 1 ms to 4 s. R&S NGSM automatically interpolates between two values.

Operation

DC Power Supply R&S NGSM features a large-size, extremely easy-to-read display and simple operation despite its versatile functions. It always stores the last instrument setting used. Up to six settings as well as the data of the arbitrary generator can be stored for each voltage range and recalled whenever required. Any faults occurring during operation are immediately displayed and signalled by an acoustic alarm; for protection of the DUT in the event of a fault, the user can choose between the constant-current mode or automatic switch-off. The sensing lines are provided with an integrated protection against wrong polarity for added safety.

DC Power Supplies R&S NGSM 32/10, R&S NGSM 60/5

Specifications in brief

Constant-voltage source	**R&S NGSM 32/10**		**R&S NGSM 60/5**	
Voltage setting	0 V to 18 V	0 V to 32 V	0 V to 32 V	0 V to 60 V
Resolution	10 mV	10 mV	20 mV	20 mV
Deviation of full scale	<0.4%	<0.2%	<0.2%	<0.2%
with ±10% AC supply variation	<0.01%	<0.01%	<0.01%	<0.01%
between 0 and 45°C	<0.02%/°C	<0.02%/°C	<0.02%/°C	<0.02%/°C
with 10% to 90% nom. current	0.01%	0.01%	0.01%	0.01%
Transient recovery time after load variation	0.1 ms	0.1 ms	0.1 ms	0.1 ms
PARD, V_{rms}	1 mV	1 mV	2 mV	2 mV

Constant-current source	**R&S NGSM 32/10**		**R&S NGSM 60/5**	
Current setting	0 A to 20 A	0 A to 10 A	0 A to 10 A	0 A to 10 A
Resolution 0 A to 9.99 A	10 mA	10 mA	10 mA	10 mA
10 A to 20 A	100 mA	100 mA	100 mA	100 mA
Deviation of full scale	<0.5%	<1.5%	<1.5%	<1.5%
with ±10% AC supply variation	<0.02%	<0.02%	<0.02%	<0.02%
between 0°C and 45°C	<0.05%/°C	<0.05%/°C	<0.05%/°C	<0.05%/°C
with 10% to 90% nom. voltage	0.2%	0.2%	0.2%	0.2%
PARD, I_{rms}	20 mA	20 mA	20 mA	20 mA
Current loadability				
Continuous current	0 A to 10 A*	0 A to 5 A	0 A to 5 A	0 A to 2.5 A
Surge current (max. 5 min)	0 A to 20 A*	0 A to 10 A	0 A to 10 A	0 A to 5 A
Impulse current (max. 1 ms)	0 A to 30 A*	0 A to 20 A	0 A to 15 A	0 A to 7.5 A

*reduced output currents at V ≤4.5 V

Display	**R&S NGSM 32/10**		**R&S NGSM 60/5**	
Voltage measurement	0 A to 40 V	0 A to 40 V	0 A to 80 V	0 A to 80 V
Resolution	10 mV	10 mV	20 mV	20 mV
Deviation of full scale	<0.2%	<0.1%	<0.1%	<0.2%
between 0°C and 45°C	<0.02%/°C	<0.02%/°C	<0.02%/°C	<0.02%/°C
Measurement rate	6/s	6/s	6/s	6/s
Current measurement in mA range	0 mA to 199 mA	0 mA to 199 mA	0 mA to 199 mA	0 mA to 199 mA
Resolution 0 mA to 99.9 mA	0.1 mA	0.1 mA	0.1 mA	0.1 mA
100 mA to 199 mA	1 mA	1 mA	1 mA	1 mA
Current measurement in A range	0 A to 40 A	0 A to 40 A	0 A to 40 A	0 A to 40 A
Resolution 0 A to 9.99 A	10 mA	10 mA	10 mA	10 mA
10 A to 40 A	100 mA	100 mA	100 mA	100 mA
Deviation of current meas. (mA, A)	<0.5% ±1 LS of rdg	<0.5% ±1 LS of rdg	<0.5% ±1 LS of rdg	<0.5% ±1 LS of rdg
between 0°C and 45°C	<0.1%/°C	<0.1%/°C	<0.1%/°C	<0.1%/°C
Peak current measurement	0 A to 40 A	0 A to 40 A	0 A to 40 A	0 A to 40 A
Resolution	100 mA	100 mA	100 mA	100 mA
Deviation of peak current meas.	<2% of fs	<2% of fs	<2% of fs	<2% of fs
between 0°C and 45°C	<0.2%/°C	<0.2%/°C	<0.2%/°C	<0.2%/°C

General data

Outputs	max. 120 V DC, floating	
Voltage compensation	1 V per lead (remote sensing)	1 V per lead (remote sensing)
AC supply	100/120/220/240 V ±10%, 50 Hz to 60 Hz, 690 VA	
Dimensions (W x H x D); weight	211 mm x 150 mm x 350 mm; 8 kg	

Ordering information

DC Power Supply	R&S NGSM 32/10	0192.0810.31
	R&S NGSM 60/5	0192.0810.61

Options

19" Adapter (3 HU, 2.8 kg)	R&S NGSM-B0	0192.0810.00
RS-232-C Interface for R&S NGSM 32/10	R&S NGSM-B1	0192.0810.01
IEEE-488 Interface for R&S NGSM 32/10	R&S NGSM-B2	0192.0810.02
RS-232-C Interface for R&S NGSM 60/5	R&S NGSM-B3	0192.0810.03
IEEE-488 Interface for R&S NGSM 60/5	R&S NGSM-B4	0192.0810.04

RF Step Attenuator R&S RSP up to 2.7 GHz (photo 37354)

Contents of Chapter 12

RF Step Attenuators R&S RSP, R&S RSG, R&S DPSP, R&S DPS

R&S RSP (photo 36277)

Brief description

Attenuator sets are two-port networks providing adjustable attenuation and the same constant characteristic impedance at the input and output.

Switching characteristics (R&S RSP, R&S RSG)
During the switch-on routine the attenuators are set to DC and an attenuation of 40 dB. During switchover between two attenuation values it is ensured that there will be no reduction to lower attenuation values. During switching off the maximum attenuation value is always obtained.

Design (R&S RSP, R&S RSG)
R&S RSP and R&S RSG are accommodated in compact 19" cases. The connectors can be refitted from the front to the rear panel. Since the attenuator module is electrically isolated from the unit itself, the attenuator pads have no ground or AC supply connections.

Main features (R&S RSP, R&S RSG)

- Lifetime >5 x 10^6 switching operations per step
- Low input and output reflection coefficient
- Connectors electrically isolated from chassis ground
- High setting accuracy and switching reliability
- Short setting time of 20 ms
- Residual attenuation taken into account
- Frequency-dependent attenuation correction (R&S RSP)
- Programmable via IEC/IEEE bus

RF Step Attenuator R&S RSG
Attenuation can be set in 1 dB steps from 0 to 139 dB. The low residual attenuation with 0 dB setting can be determined by means of a special function. The attenuation accuracy can be improved by taking into account the correction values which are displayed on the front panel and can be recalled via IEC/IEEE bus.

Precision Attenuator R&S RSP
R&S RSP provides attenuation values between 0 and 139.9 dB in the frequency range 0 to 2.7 GHz. Above 1 dB, the smallest step is 0.1 dB. R&S RSP can be used as an attenuator pad from 1 dB to 139.9 dB.

R&S DPSP
RF Step Attenuator R&S DPSP allows manual settings with two rotary switches, the carry being executed automatically. For remote control, R&S DPSP has an IEC/IEEE bus interface and can be used in automatic test systems.

R&S DPSP can be mounted into 19" racks using an adapter. The connectors can be refitted from the front to the rear panel with no change of cables being involved.

R&S DPS
RF Step Attenuator R&S DPS features manual operation and the same electrical characteristics as the programmable R&S DPSP. The desired attenuation is set with decade switches. Built-in batteries, which are charged during AC supply operation, make R&S DPS ideal for all applications where a power cable would be troublesome, e.g. in servicing and in outdoor measurements.

R&S DPSP (photo 26970)

R&S DPS (photo 26972)

RF Step Attenuators R&S RSP, R&S RSG, R&S DPSP, R&S DPS

Specs in brief	R&S RSG		R&S RSP		R&S DPSP, R&S DPS	
Frequency range	0 to 5.2 GHz		0 to 2.7 GHz		0 to 2.7 GHz	
Attenuation range	0 to 139 dB		0 to 139.9 dB		0 to 139 dB	
Smallest step	1 dB		0.1 dB (from 1 dB)		1 dB	
Residual attenuation (0 dB position)	DC	≤0.1 (typ. 0.05) dB	DC	≤0.12 (typ. 0.08) dB	≤200 MHz	≤0.4 dB
	≤1 GHz	≤0.8 (typ. 0.5) dB	≤1 GHz	≤1.2 (typ. 0.8) dB	≤1 GHz	≤0.8 dB
	≤3 GHz	≤1.2 (typ. 0.8) dB	≤2.7 GHz	≤1.8 (typ. 1.4) dB	≤2.7 GHz	≤1.2 dB
	≤5.2 GHz	≤1.6 (typ. 1.3) dB				
Maximum attenuation error (in dB + % of attenuation value)	≤1 GHz	±(0.2 dB + 1%)	≤1 GHz	±(0.2 dB+ 1%)	±(0.2 dB + 1.3%), max. 1 dB	
	≤3 GHz	±(0.4 dB + 1%)	≤2 GHz	±(0.3 dB+ 1%)	typical: ±(0.1 dB + 0.6%),	
	≤5.2 GHz	±(0.6 dB + 1.3%)	≤2.7 GHz	±(0.4 dB+ 1%)	max. 0.5 dB	
Maximum attenuation error with correction			≤0.5 GHz	±(0.05 dB + 0.5%)	–	
			≤1 GHz	±(0.1 dB + 0.5%)		
			≤2 GHz	±(0.15 dB + 1%)		
Correction data stored for each attenuation setting	at 50 MHz intervals		at 50 MHz intervals		–	
VSWR	≤3.5 GHz	≤1.1 + 0.2 f/GHz	≤2 GHz	≤1.2 + 0.15 f/GHz	≤1.5 GHz	≤1.1 + 0.2 f/GHz
	≤5.2 GHz	≤1.8	≤2.7 GHz	≤1.5	≤2.7 GHz	≤1.4
Power-handling capacity						
Continuous	1 W		1 W		1 W	
Pulse	200 W/10 µs, max. 150 V		200 W/10 µs, max. 150 V		200 W/10 µs, max. 150 V	
Duty cycle						
Life	>5 x 10^6 switching operations/step		>5 x 10^6 switching operations/step		>5 x 10^6 switching operations/step	
Switching time	≤20 ms (atten. not corrected)		≤20 ms (atten. not corrected)		≤20 ms	
Selftest	checking of correction values		checking of correction values			
Power supply	100/120/220/240 V ±10%, 47 to 440 Hz		100/120/220/240 V ±10%, 47 to 440 Hz		115/125/220/235 V ±10%, 47 to 440 Hz	
Dimensions (W x H x D)	435 mm x 103 mm x 359 mm		435 mm x 103 mm x 359 mm		241 mm x 110 mm x 234 mm	
Weight	5.5 kg		5.5 kg		3 kg	

Ordering information

RF Step Attenuator	1009.4505.02	0831.3515.02	R&S DPSP: 0334.6010.02 R&S DPS: 0334.7217.02
Extras			
	0358.5414.02	matching Pad RAM (50/75 Ω)	

RF Relay Matrix R&S PSU

DC to 6 GHz

RF Relay Matrix for IEC/IEEE bus programming

Photo 25289

Main features

- Six independent 50 Ω coaxial relays:
  - three with N connector up to 6 GHz,
  - three with BNC connector up to 500 MHz
- RF and pulse applications
- Easy to operate, LED indication
- Remotely controllable via IEC/IEEE bus

Specifications in brief

	Relays 1 to 3	**Relays 4 to 6**
Connectors	50 Ω N female on front panel	50 Ω BNC female on rear panel
Frequency range	DC to 6 GHz	DC to 500 MHz
VSWR	<1.22 to 1 GHz	<1.1 to 100 MHz
Insertion loss	0.3 dB to 1 GHz	0.2 dB to 100 MHz
Crosstalk attenuation	>80 dB to 1 GH	>40 dB to 100 MHz
Max. power-handling capacity	100 W at 0.1 GHz 50 W at 1 GHz	1 A at 28 V
Switching time	<25 ms	<7.5 ms

General data

Lifetime	>1000000 switching operations
Power supply	115/125/220/235 V ±10%, 47 to 420 Hz; max. 25 VA
Dimensions (W x H x D); weight	211 mm x 112 mm x 346 mm; 4.8 kg

Ordering information

RF Relay Matrix	R&S PSU	0290.8014.02

Matching Pads, Attenuators, Terminations

R&S DNF (photo 36389)

R&S RBS 1000 (photo 31777)

R&S RDL50 (photo 39853-1)

R&S RNB (photo 27202)

R&S RAU, 100 W (photo 33901)

R&S RNA (photo 36390-1)

R&S RAD (RAD50), photo 29356

R&S RAM (RAZ), photo 34891-1

Brief description

Attenuators

Attenuators are ideal for use in test setups in which the attenuation values do not have to be frequently changed. Their compact design and ease of handling (easy to replace) makes them also highly suitable for use in mobile test setups.

High-power attenuators

These are used as dummy loads for transmitter and power amplifiers. They have a test output with exactly defined attenuation for the connection of a measuring instrument such as power meter, analyzer or counter.

Terminations

They provide reflection-free termination of instruments and cables and can also be used as a reference impedance for VSWR measurements. In contrast to high-power attenuators, terminations do not have a test output.

Matching pads, feedthrough terminations

Matching pads are used to provide the necessary matching between measuring instruments and transmission lines of different characteristic impedances or as feedthrough terminations for matching 50 Ω lines to measuring instruments of high input impedance.

Specifications in brief/Ordering information for attenuators, terminations, matching pads

Designation	Type R&S xxx, Order No.	Characteristic impedance	Power rating	Nominal insertion loss	Frequency range	VSWR	Accuracy of insertion loss	Max. peak pulse voltage	Connectors	Dimensions, weight
Attenuators	DNF 0272.4010.50	50 Ω	2 W[1]	3 dB	0 to 12.4 GHz	≤1.1 (up to 4 GHz) ≤1.2 (up to 10 GHz) ≤1.25 (up to 12.4 GHz)	±0.3 dB up to 8 GHz[2] ±0.5 dB up to 12.4 GHz[2]		N male, N female	20.5 mm dia. x 55 mm, 69 g
	DNF 0272.4110.50			6 dB						
	DNF 0272.4210.50		1 W[1]	10 dB			±0.3 dB up to 8 GHz[2] ±0.6 dB up to 12.4 GHz[2]			
	DNF 0272.4310.50			20 dB			±0.5 dB up to 4 GHz[2] ±0.6 dB up to 8 GHz[2] ±0.8 dB up to 12.4 GHz[2]			
	DNF 0272.4410.50			30 dB			±1 dB up to 12.4 GHz[2]			
High-Power Attenuators	RBU 50 1073.8695.03	50 Ω	50 W[3]	3 dB	0 to 2 GHz	≤1.1	±0.5 dB up to 1.5 GHz ±0.75 dB up to 2 GHz	5 kW (1 µs, 1%)	N male, N female, to MIL-C39012	180 mm x 77 mm x 90 mm, 0.8 kg
	RBU 50 1073.8695.06			6 dB			±0.5 dB up to 1.5 GHz ±0.75 dB up to 2 GHz			
	RBU 50 1073.8695.10			10 dB			±1 dB up to 2 GHz			
	RBU 50 1073.8695.20			20 dB			±1 dB up to 2 GHz			
	RBU 50 1073.8695.30			30 dB			±1 dB up to 2 GHz			
	RBU 100 1073.8820.03	50 Ω	100 W[3]	3 dB	0 to 2 GHz	≤1.1	±0.5 dB up to 1.5 GHz ±0.75 dB up to 2 GHz	5 kW (1 µs, 1%)	N male, N female, to MIL-C39012	236 mm x 140 mm x 141 mm, 2.8 kg
	RBU 100 1073.8495.06			6 dB			±0.5 dB up to 1.5 GHz ±0.75 dB up to 2 GHz			
	RBU 100 1073.8495.10			10 dB			±1 dB up to 2 GHz			
	RBU 100 1073.8495.20			20 dB			±1 dB up to 2 GHz			
	RBU 100 1073.8495.30			30 dB			±1 dB up to 2 GHz			
	RDL50 1035.1700.52	50 Ω	50 W (input) 10 W (output)	20 dB	0 to 6 GHz	≤1.15 (up to 2 GHz)	±0.5 dB	2 kW/5 µs	N male, N female	114 mm x 89 mm x 68 mm, 0.5 kg
	RBS 1000 0207.4010.55	50 Ω	≤1000 W (≤600 W)	40 dB	0 to 0.4 GHz (1 GHz)	≤1.2 input	± 1 dB[4]	10 kW/1 µs	N female	500 mm x 285 mm x 152 mm, 12 kg
Terminations	RNA 0272.4510.50	50 Ω ±1%	1 W[1]		0 to18 GHz	≤1.02 (up to 1 GHz) ≤1.02 + 0.004 x f [GHz]			N male	21 mm dia. x 46 mm, 36 g
	RNA 1028.4994.72	75 Ω	1 W[1]		0 to 3 GHz	≤1.02			N male	21 mm dia. x 46 mm, 65 g
	RNB 0272.4910.50	50 Ω	1 W[1], 2 W peak		0 to 4 GHz	≤1.05 (up to 1 GHz) ≤1.1 (up to 2 GHz) ≤1.2 (up to 4 GHz)			N male	20.5 mm dia. x 35 mm, 36 g
	RAU 0200.0019.55	50 Ω	100 W[5]		0 to 2 GHz	≤1.05 (up to 1 GHz) ≤1.1 (up to 1.5 GHz) ≤1.4 (up to 2 GHz)		2 kV	N female	95 mm x 152 mm x 235 mm, 2 kg
Feedthrough terminations	RAD 0289.8966.00	50 Ω	500 mW[6]		0 to 1 GHz	≤1.05 (up to 0.1 GHz)[7] ≤1.1 (up to 0.5 GHz) ≤1.2 (up to 1 GHz)			BNC male, BNC female	14.5 mm dia. x 50.5 mm, 22 g
	RAD50 0844.9352.02	50 Ω	2 W		0 to 500 MHz	≤1.1 (up to 200 MHz) ≤1.25 (up to 500 MHz)			BNC male, BNC female	15.3 mm dia. x 50.5 mm, 22 g
Matching pads	RAM 0358.5414.02	50 Ω → 75 Ω	2 W[8]	5.72 dB	0 to 2.7 GHz	≤1.06 (up to 2 GHz) ≤1.2 (up to 2.7 GHz), both terminals	+ 0.15/–0.05 dB		N male, N female, on 75 Ω end	21 mm dia. x 73 mm, 105 g
	RAZ 0358.5714.02			1.76 dB		≤1.06 (up to 2 GHz) ≤1.2 (up to 2.7 GHz), at 75 Ω terminal	± 0.2 dB			

1) At a max. ambient temperature of 30 °C; decreasing linearly to 0 W at 130°C.
2) Attenuation change at a temperature change of 1 K: ≤0.0001 dB/dB. At a load change of 1 W: ≤0.001 dB/dB.
3) Continuous load up to a max. ambient temperature of 20°C, decreasing linearly to 0 W at 125°C; power-handling capacity at output up to 20 W.
4) The frequency response of the insertion loss is specified on a label on R&S RBS 1000 as 0.1 dB measurement error.
5) Overload capacity 100% (max. 5 s).
6) Continuous load up to a max. ambient temperature of 70 °C; decreasing linearly to 0 W at 130°C.
7) Measured with open-circuit output.
8) Ambient temperature 25°C.

Junction Boxes/Power Splitters

Photo 27807

Photo 27603

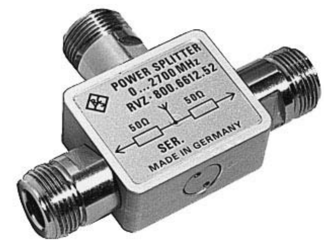


Photo 35789

Power Splitter/Combiner R&S DVS

- Distribution or combination of signals
- High isolation between inputs
- Low insertion loss

Specifications in brief

Frequency range	0.1 to 400 MHz
Characteristic impedance	50 Ω
VSWR	1.2 dB typ.
Insertion loss	3 dB typ.
Isolation between inputs	20 to 40 dB
Max. continuous load	1 W = 7 V into 50 Ω
Dimensions	57 mm x 36 mm x 41 mm

Ordering information

Power Splitter/ Combiner	R&S DVS	0342.1014.50

Four-Port Junction Box R&S DVU4

- Four-port junction box for splitting up into or combining three channels with correct impedance matching
- For use e.g. in 3-signal measurements on radiotelephone equipment

Specifications in brief

Frequency range	0 to 1500 MHz
Characteristic impedance	50 Ω
VSWR	<1.1 (up to 1 GHz) 1.2 typ. (up to 1.5 GHz)
Insertion loss	9.5 dB
Max. load per connector	0.25 W
Max. permissible voltage spikes	300 V
Connectors	N female
Dimensions	120 mm x 120 mm x 35 mm

Ordering information

Four-Port Junction Box	R&S DVU4	0201.4018.03

Power Splitter R&S RVZ

- Power distribution to signal paths of exactly the same waves
- Measurement of correct transmission factor (reference: forward wave)

Specifications in brief

Frequency range	0 to 2700 MHz
Characteristic impedance	50 Ω
VSWR	≤1.1
Level deviation of outputs	≤0.1 dB
Phase deviation of outputs	≤2°
Insertion loss from input to each output	6 dB –0.1/+0.5 dB
Power-handling capacity	1 W
Connectors	N female
Dimensions	47 mm x 70 mm x 16 mm

Ordering information

Power Splitter	R&S RVZ	0800.6612.52

Adapters for RF Connectors

All RF connectors can be adapted for use in other systems by means of screw-in connectors, see table on the right. The maximum power values for frequencies other than 1000 MHz are obtained by means of the following formula:

$$P_{max} = P_{(1\,GHz)}/\sqrt{f_{(GHz)}}$$

Conversion to	Male connector	Female connector	Max. power at 1000 MHz
N	017.7532.00	017.5398.00	0.6 kW
BNC	017.7832.00	017.5730.00	0.4 kW
4.1/9.5	017.9106.00	017.8516.00	0.8 kW
7/16	017.9258.00	017.8739.00	1.0 kW
Dezifix B	018.2486.00	018.2486.00	1.3 kW

Coaxial Components

Brief description

Measuring instruments from Rohde & Schwarz are fitted with internationally used standard connectors. Depending on the requirements (frequency range, power rating, reflection characteristics, etc), connector systems N, PC-3.5 or BNC are used.

The following overview also shows the most frequently required couplings, angle junctions and T connectors.

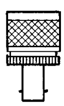
Note

Order numbers are bold-faced.

Adapters to systems of other make

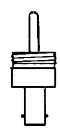
50 Ω
N female/
BNC male

0541.8030.00



50 Ω
N male/
BNC female

0118.2812.00

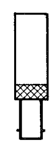


Screw-in connector
4/13 male/
BNC female

0017.5975.00

4/13 female/
BNC male

0408.4509.00

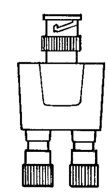


4/13 male/
BNC female

0408.4480.00

BNC male/
knurled terminal

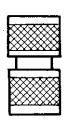
0541.8030.00



BNC male/
dual knurled
terminal

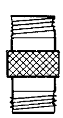
0017.6742.00

Couplings, angle junctions and T connectors, 50 Ω



N
male/
male

0092.6581.00

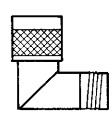


N
female/
female

0092.6700.00

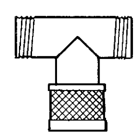
BNC
female/
female

0017.6559.00



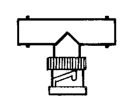
N
male/
female

0018.4495.00



N
female-female/
male

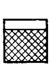
0018.4537.00



BNC
female-female/
male

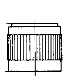
0017.6588.00

Shortcircuits



N connector
(male)

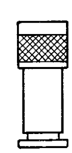
0017.8080.00

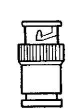


N connector
(female)

0017.8145.00

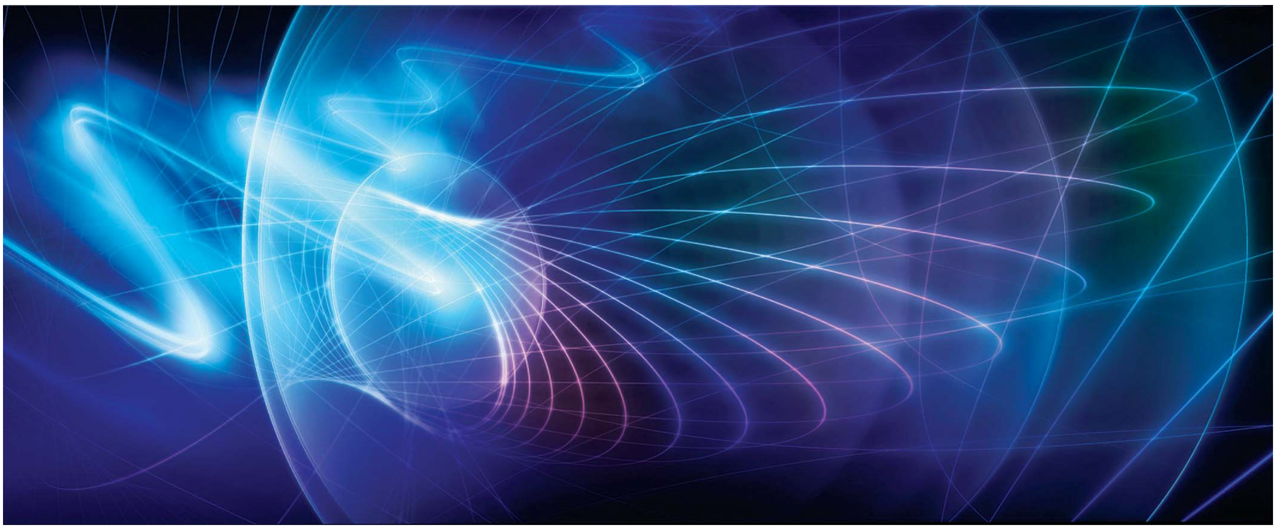
Cable-mounting connectors (male)





For cable	N, 50 Ω	BNC, 50 Ω
RG 58 C/U	**0472.9714.00**	**0017.6536.00**
RG 8/213/214U	**0415.9502.00**	**0017.6442.00**

Rohde & Schwarz Customer Service



Contents of Appendix

Development services for radiocommunications, broadcasting, test and measurement

Professional

from start to finish

Benefit from the know-how of a high-tech provider

With its wide selection of electronic products for the capital goods sector, Rohde & Schwarz ranks among the world's technology leaders. Take advantage of our creative and innovative potential to achieve your objectives. We provide development services in the following areas:

- Radiocommunications
- Broadcasting
- Test and measurement

and over a wide spectrum:

- Feasibility studies, pre-investigations
- Software
- Hardware with major emphasis on RF and digital technology
- Mechanical and electrical design
- System integration
- Productionalization
- Production at Rohde & Schwarz plants

With its development services, Rohde & Schwarz has created a whole new task area. Success justifies the decision – turnover is continuously growing and manpower is being increased to meet the demand.

A qualified team with ideas to support your vision

It is only natural for us to be informed about all new trends. Everything we do profits from the expertise gained in innumerable projects. The latest development tools and spacious work areas equipped with every possible facility create a positive atmosphere for our staff.

The company is certified to EN ISO 9000: 1994 standard. Development processes are structured and transparent for the customer in all stages of a project. Modern project management is implemented for utmost efficiency.

You can be sure of our support throughout the project. If you wish, we can come aboard as early as the definition phase. We are always ready to listen to your requirements and very flexible in responding to new conditions.

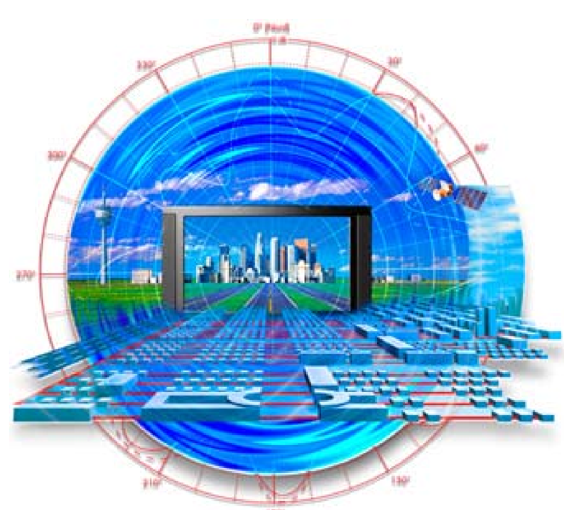
A representative selection of reference projects

- Hardware development and series production for digital trunked radio
- Hardware development for data transmission within video signal, including small-batch production
- High-power amplifier for electron accelerator
- Hardware development for RF matching systems
- Software development for audio measurements
- Software development for tactical radio
- Software development for MPEG/ ATM measurements
- Software development for monitoring systems

Development services for radiocommunications, broadcasting, test and measurement

Software

- Applications for device control on Win32 API basis
- Internet protocols
  - TCP/IP applications and integration of Internet protocols
    - SMTP
    - HTTP
    - IP
  - UDP/TCP socket communication
  - Protocol design of Internet RFC conventions
- Radiocommunication protocols in C and C++
- Software architectures
  - CORBA: IDL linkup on various platforms
- Drivers
  - Device drivers for Windows NT, 2000
  - INDIS miniport drivers
- User interfaces
  - MFC (Windows)
  - QT Library (Windows, Linux)
- Realtime applications
  - Controllers
    - MPC860
    - C167
    - 80186
    - 80552
  - Operating systems
    - Enea OSE
    - PSOS
    - VRTX
    - RTX
  - C assembler programming for
    - 80C551
    - -C186
    - -C167
    - -C176
    - various peripheral ICs
- DSP programming
  - TMS320C542, -C6201B
  - FPGA programming with VHDL
- System software
  - Fast file system under Windows NT, 2000



Hardware

- Digital hardware
  - Design and implementation of embedded platforms
    - µP + peripherals
    - DSP
    - FPGA
  - Programming of CAN bus systems
- RF equipment
  - RF power output stages up to 100 kW, tubed and klystron
  - Solid-state exciter and output stage amplifiers 1.5 MHz to 1.5 GHz
  - RF power couplers
  - Low-noise amplifiers
  - Synthesizers
  - Low-noise oscillators
  - Receivers
- Power supply units up to 200 kW
- Circuits for video broadcasting

Mechanical and electrical design

- All forms of cast, sheet metal and cut parts
- Electrical circuits, PCB design
- Circuit diagrams, layout
- Miniaturization, lightweight construction
- Design for outdoor use, IP65 and IP67 packaging
- Use of modern materials
- Design for thermodynamic requirements

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Documentation – medium between man and technology

Technical documentation from Rohde & Schwarz prepared to customer's order – also for non-R&S products

- Review and appraisal of existing documentation for compliance with standards and guidelines
- Operating instructions and user's guides
- Maintenance instructions
- Service and calibration instructions
- Repair instructions
- Fault diagnosis instructions
- Leaflets
- Brochures
- Data sheets
- Materials management concepts
- Technical manuals
- Design drawings with 2D and 3D illustrations
- Spare parts catalogs and illustrated spare parts lists
- Program-controlled input and printout of modular documents
- Training documentation

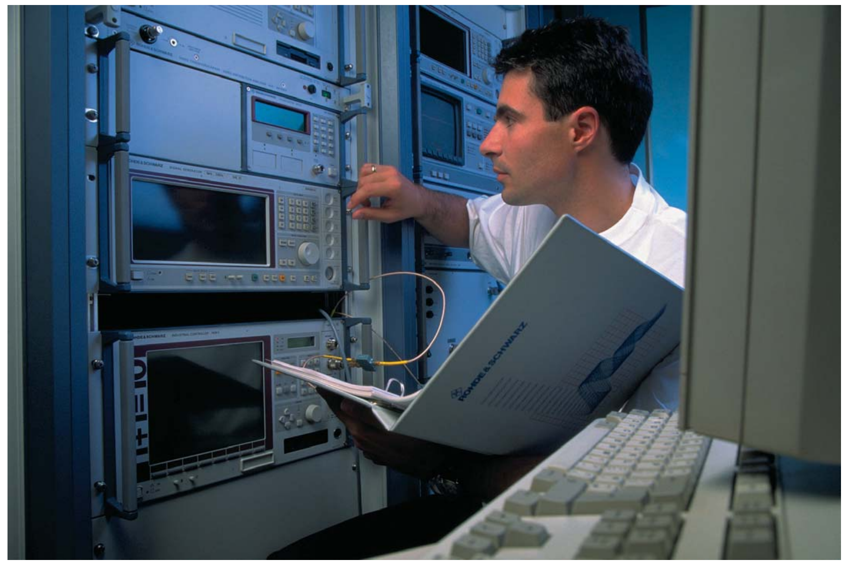

Photo 43499-III-1

Keeping pace with new requirements

Laws, standards and directives place high demands on technical documentation. We guarantee that the documentation prepared by us conforms to all relevant standards, directives, regulations and laws, including for instance the:

- EU directives for
  - machinery
  - low voltage
  - EMC
- medical products law
- EN, ISO and VDI specifications
- DIN specifications
- product liability law
- product safety law
- multimedia law

New tools for your technical documentation

Your documentation will be tailored to your specific needs. We undertake the complete project handling through to the finished data medium.

More than just a translation

Our translations cover all fields of activity of our company. Technical documentation is translated into any desired language mainly by native speakers. The texts are translated technically correctly and edited. The result is a comprehensible, reliable and accurate match of your original documentation.

Drawing on qualified sources

Our staff at the Cologne Plant has a solid background of experience and know-how. This is the result of close cooperation with headquarters ranking among the market leaders worldwide in the fields of communications and test and measurement, as well as of numerous projects handled for other branches of industry. Benefits are also gained from the broad range of services provided by the Cologne Plant, including maintenance and repair, calibration, generation of special software, training and over 30 years of experience in documentation. We are always technically up to date. This is ensured by our participation in standardization bodies and joint ventures with leading international companies, by our intensive R&D work as well as by holding or attending lectures at universities and institutes of technology.

Documentation – medium between man and technology

This up-to-date technical know-how is of course also a benefit for product documentation where our staff can provide valuable information and recommendations.

Photo 43546-II-1

Documentation just in time

Market success is also determined by the "time to market". This means: if development and documentation take place simultaneously, time to market can be reduced substantially. Therefore we can make available on request an expert or whole team to support you on site in generating optimized documentation just in time in close cooperation with your specialists.

Documentation as you like it

You choose the hardware and software to be used for generating, storing and duplicating your documentation. The technical documentation furnished by us can easily be revised or completed – of course also by your staff. The documentation you receive is your individual solution: a manual, an illustrated catalog, detailed operating instructions – as a hardcopy, disk, tape, microfiche or CD-ROM.

Further support provided by Rohde & Schwarz

- Logistics concepts
- Material maintenance concepts
- Repair concepts
- Spare parts stockkeeping concepts
- Equipment layout diagrams
- Integrated logistics support
- Illustrated spare parts catalog (complying with B007, C-1-4, SPEC 2000, ATA DMKL, NATO guidelines)
- Electronic spare parts management, spare parts catalogs, materials lists
- Electronic information systems
- 3D illustrations, exploded views

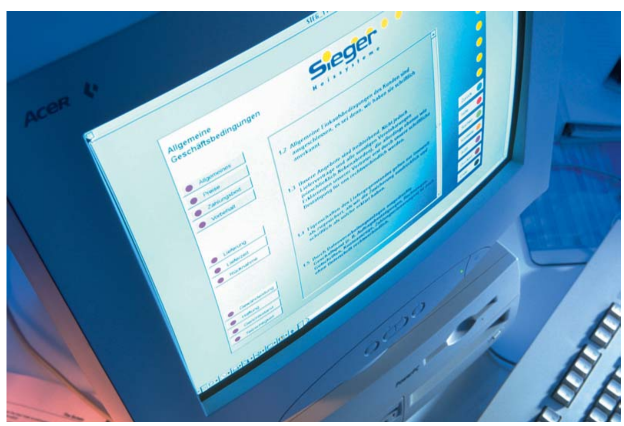

Photo 43546-IV

- Generation of circuit diagrams, block diagrams to standard
- Design drawings to DIN
- Generation of home pages for Internet
- Generation of documentation in SMGL or HTML format
- Online documentation
- Database programming and design
- Multimedia productions e.g. for maintenance, service, marketing and sales
- Multimedia product presentations including trainer or simulator
- Storage on CD-ROMs

Get in touch with us

Call us and put our competence to the test. We shall be glad to provide you with any further information.

Cologne Service Center
Telephone: +492203 49-51246
Telefax: +492203 49-51364

Photo 43546-II-2

Training

Committed cultivation of market and customer as well as the continuous training of your staff will ensure competitiveness of your company in the present and in the future

Photo 43544-I

Welcome to our training courses

Electronics as a basic technology calls for highly qualified staff. Rohde&Schwarz offers basic training, seminars, retraining, and training on instruments and systems in line with customer's requirements.

We provide our customers with what will be increasingly important in the future: practical training, transfer of know-how, helping you to help yourself. Our seminars are constantly being adapted to meet these objectives and to offer up-to-date solutions to your measurement problems.

Photo 43544-IV

Small groups for optimum results
The number of participants is limited for all seminars. This makes for enhanced receptivity and allows an intensive dialog between the trainees and the trainer. Thus, knowledge can be passed on at greater depth, and individual problems can be dealt with in greater detail. In most seminars, the emphasis is on practical exercises performed on modern test equipment, since this is the most efficient way of learning.

Training

Our training staff

Our communications, electrical and software engineers and physicists provide you with the knowledge you actually require. Having the latest know-how and many years of experience is one thing, being able to pass this on in an interesting and comprehensible way is another.

We therefore attach utmost importance to the qualified didactic training of our engineers picked to be your lecturers and trainers. Where appropriate and necessary, we call in lecturers from universities, authorities and from among users. We want to make sure that our customers have the best trainer available.

Photo 43544-III

Training courses kept up to date

All seminars are constantly reviewed and improved and new knowledge and relevant changes taken into account immediately. This guarantees that the technical know-how as well as the regulations and standard specifications presented to you are always up to date.

Rohde & Schwarz standard seminars

In our seminars your measurement problems, and not the Rohde & Schwarz test assemblies, are given top priority. Our training programs are structured so that both newcomers and specialists will find a seminar suiting their requirements.

Customer-specific seminars

We offer customized seminars for training tasks to be performed at your company. This starts with an analysis of the learning objectives and target group in the conceptual phase, which is followed by a proven methodical approach. This ensures an optimum benefit/cost ratio and avoids burdening the courses with unnecessary information. Within the framework of these seminars, we also offer special user and application courses for Rohde & Schwarz instruments to allow an even more time-saving and efficient use.

Training sites

Training courses are held at Rohde & Schwarz headquarters in Munich, at Cologne Service Center, our branch offices and representatives and at the customer's.

Training at Rohde & Schwarz

Highly qualified personnel and a complete range of measuring instruments and teaching aids make each seminar a success. Here you can get acquainted with state-of-the-art measurement and communications technology from Rohde & Schwarz.

Seminars at the customer's

You want to train several staff members at a time? To put learned matter into practice immediately? To solve specific problems within your own organization? To leave travelling to us? In this case we hold seminars at your company. These may be standard Rohde & Schwarz or customized seminars.

Ask for information on our seminars

Training Center Munich

Our brochure provides detailed information on the contents, dates, prices and other terms of our seminars.

Telephone: +4989 4129-13051
Telefax: +4989 4129-13335
e-mail: training.munich@rsd.rohde-schwarz.com

Training Center Cologne Service Center

Our training brochure gives you an overview of the seminars held at the Cologne Service Center.

Telephone: +492203 49-51405
Telefax: +492203 49-51333

For information on seminars held in other cities or at the customer's or seminars held in English please contact our sales offices (see address list on page 521).

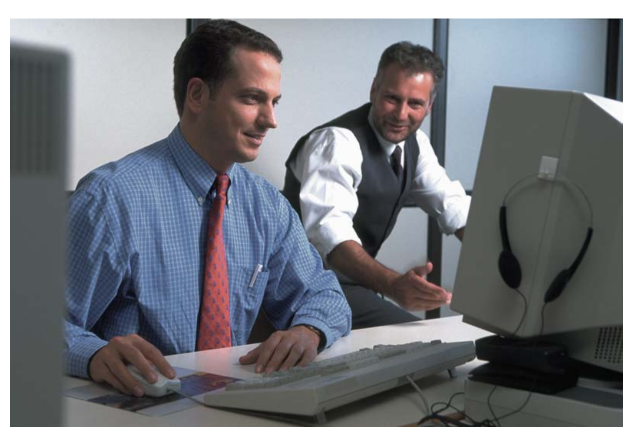

Photo 43544-V

Worldwide Service Network

Rohde & Schwarz produces test & measurement equipment of the highest quality for a wide range of applications in research, development, production and service

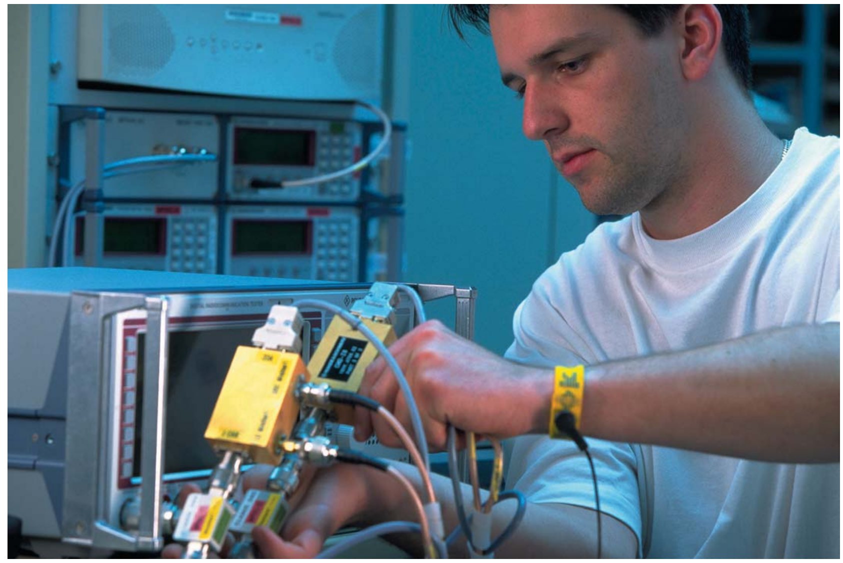

Photo 43498-IV-1

International Service

To ensure the longterm quality of its equipment under extreme conditions of use, Rohde & Schwarz maintains a worldwide service network
A multi-level and decentralized concept ensures that all equipment and systems from Rohde & Schwarz can be fully serviced by local centers and only have to be sent elsewhere in exceptional cases. The concept is based on three hierarchical competence levels that are available to all Rohde & Schwarz customers.

Local Rohde & Schwarz service centers worldwide are the competent and easy-to-contact partners on the spot
Usually they are local Rohde & Schwarz representatives. And the services they offer primarily focus on local requirements.

The majority of these local service centers are equipped with standardized test and calibration systems of the ACS 100 series to satisfy requirements for automatic diagnostics, fast repair and calibration.

Even where the use of automatic test and calibration systems is not yet economically attractive because too little equipment is in the field, all Rohde & Schwarz customers can still expect excellent service and utmost competence in the areas of video, RF and microwave technology. Because that is what the name Rohde & Schwarz stands for.

Efficient area support centers provide technical and logistics backup for local service centers
Located in the major industrial regions of the world, these area support centers can assist at virtually any level.

The two Rohde & Schwarz service centers in Cologne and Munich are the backbone of the worldwide service network
The tasks of these two centers include wide-ranging support, training at regular intervals and centralized stocking of spare parts. The Cologne and Munich service centers of course also provide on-site calibration, maintenance and repair of equipment and systems at the customer site.

Minimum downtimes
A large variety of services are offered by the worldwide centers of Rohde & Schwarz, with the aim of ensuring all customers maximum availability of Rohde & Schwarz equipment and systems. Especially in safety-critical fields (e.g. in medicine or aviation) or in cost-intensive production, Rohde & Schwarz customers have to rely on the precision of their products.

Qualified Service Staff

Rohde&Schwarz customers expect the same high standard from any Rohde&Schwarz service center worldwide

Rohde&Schwarz meets these expectations by extensive and continuous training of its staff and internal auditing of international service centers
Only those successfully meeting the stringent quality requirements may offer services in the name of Rohde&Schwarz.

Rohde&Schwarz service locations
The shortest distances mean the fastest response, so the worldwide Rohde&Schwarz service network features on the Internet. Our customers can find all facilities and services offered at www.rohde-schwarz.com. And when it is needed, the Rohde&Schwarz team is just a mouse click away.

Service by contract
T&M equipment and systems from Rohde&Schwarz guarantee utmost precision to every user. To maintain this guarantee reliably and permanently under any conceivable conditions of use, equipment and systems have to be inspected and serviced at regular intervals.

Depending on the scenario and the environment in which the equipment and systems are used, Rohde&Schwarz offers services tailored to specific customer needs:

- Calibration contract
- Maintenance contract
- Repair service contract

Photo 43499-I-1

For all Rohde&Schwarz customers this means service at its best as well as maximum operational reliability of their equipment and systems.

Local service centers are the competent partners to be contacted for determining and implementing service tailored to the customer's specific requirements.

Rohde&Schwarz service training
Rohde&Schwarz measuring instruments are high-tech products of outstanding precision. All Rohde&Schwarz service teams undergo continuous training so that they are able to properly service and repair complex equipment. In-house training covers the latest product developments, state-of-the-art technologies and procedures to ensure the best qualifications for all Rohde&Schwarz service staff worldwide. Rohde&Schwarz customers can be sure that only experienced and highly qualified personnel will service our products.

External participants may also profit from Rohde&Schwarz know-how. Customized training courses are available on the maintenance and repair of various products. This enables the user to carry out servicing and maintenance of instruments largely on his own.

Quality Assurance through Calibration

Modern quality management systems such as DIN EN ISO 9000 ff require the use of traceable calibrated measurement systems in development, production and service

The use of traceable calibrated instruments is gaining in importance especially in production in view of more stringent product liability regulations

Calibration system ACS 100

Rohde & Schwarz calibration laboratories
The laboratories maintained worldwide by Rohde & Schwarz carry out calibration to customer order. Calibration certificates in line with international regulations or standards are issued to document this service. Traceability to nationally or internationally recognized standards is guaranteed. Test parameters for which national standards are not available are traced to basic parameters by means of approved methods.

Calibration carried out by Rohde & Schwarz is of the highest quality
In addition to its worldwide local service centers, Rohde & Schwarz maintains calibration laboratories of the German Calibration Service (DKD) on its premises in Cologne, Memmingen and Munich. These laboratories are accredited by the German Standards Laboratory (PTB) in line with DIN EN 45001 and are subject to continuous supervision by the accrediting authority.

With the aid of its mobile DKD calibration lab, the service center in Cologne also carries out on-site calibrations.

Standardized calibration systems
Since 1996 the global Rohde & Schwarz service centers have been using the standard calibration system ACS 100. About 50 of these systems are currently installed at all major service centers all over the world.

The ACS 100 calibration system features:

- Precision
- Suitability for mobile use
- Worldwide standard test and calibration methods
- Automatic test run
- Uniform test report
- Universal use

Fast Spare Parts Supply
Service Addresses

Even the best equipment can fail sometime. And then you are thankful if replacement of faulty parts can be guaranteed fast. More than 30,000 different spare parts are centrally stored by Rohde&Schwarz in Munich

For the customer, this modern warehousing and logistics hub means extremely fast spare parts availability virtually anywhere in the world Rohde & Schwarz equipment is highly modular, which saves time and cuts costs if repair is needed. Rohde & Schwarz guarantees longterm spare parts availability also for older modules and systems.

Country	Address	Phone	Fax	e-mail
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Australia	R&S Australia Pty.Ltd. Unit 6, 2-8 South Street RYDALMERE, NSW 2116 Australia	+61 (2) 8845 4188	+61 (2) 9638 0832	service@rsaus.rohde-schwarz.com
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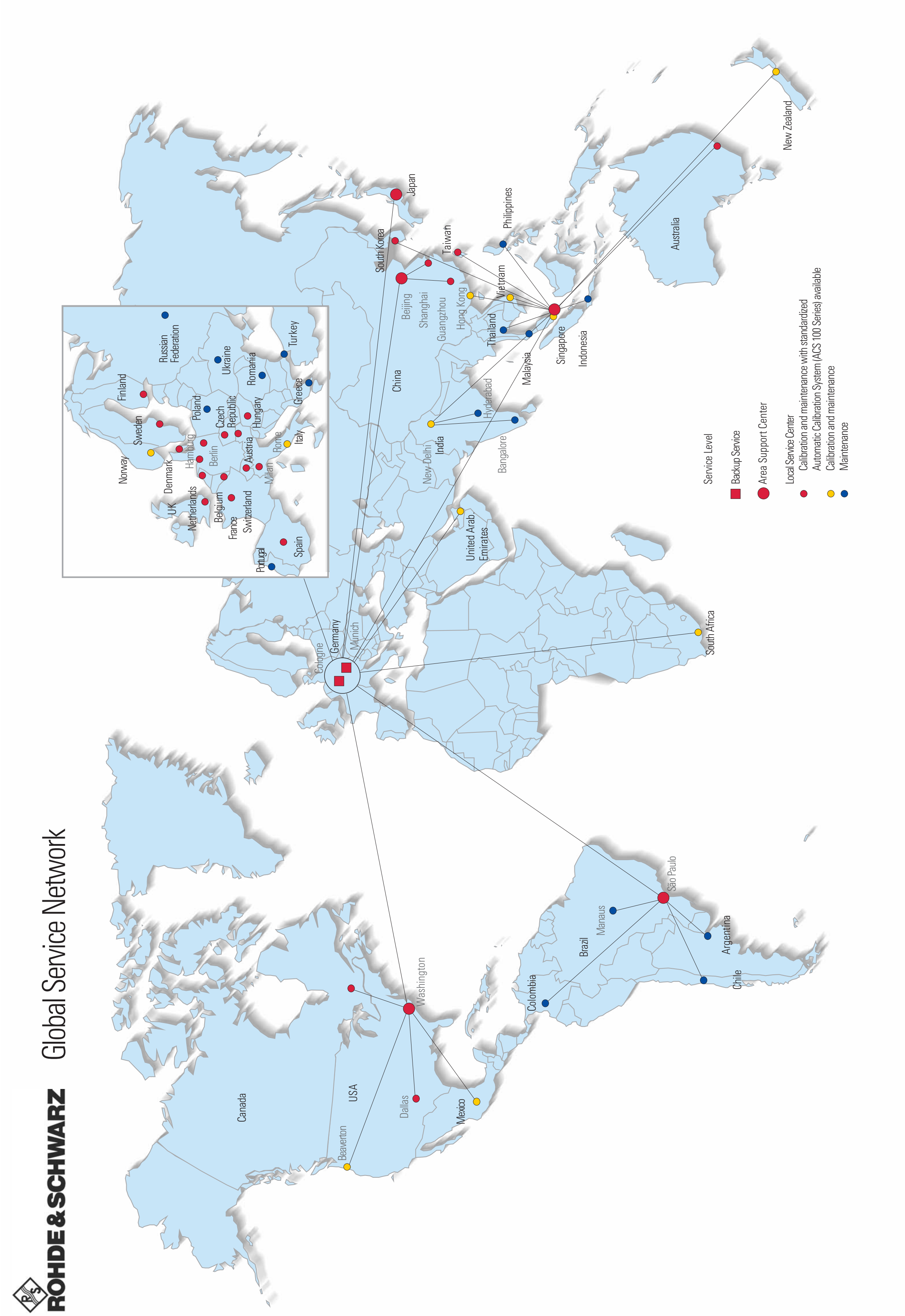
ROHDE&SCHWARZ
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Sao Paulo
Argentina
Chile
Germany
Cologne
Munich
South Africa
United Arab Emirates
India
New-Delhi
Bangalore
Hyderabad
China
Beijing
Shanghai
Guangzhou
Hong Kong
Thailand
Vietnam
Malaysia
Singapore
Indonesia
Philippines
Taiwan
South Korea
Japan
Australia
New Zealand
Russian Federation
Finland
Sweden
Norway
Denmark
Hamburg
Berlin
Poland
Ukraine
Czech Republic
Hungary
Romania
Turkey
Greece
Austria
Italy
Rome
Milan
Switzerland
France
Belgium
Netherlands
UK
Spain
Portugal
Service Level
Backup Service
Area Support Center
Local Service Center
Calibration and maintenance with standardized Automatic Calibration System (ACS 100 Series) available
Calibration and maintenance
Maintenance

Integrated customer support at Rohde & Schwarz

Financing

Rohde & Schwarz offers a variety of financing schemes based on rental and leasing contracts that allow the acquisition of test & measurement equipment at the time it is needed. Required T&M products are thus available fast and easily without any strain being placed on your liquidity.

Rental agreement with purchase option
You need an instrument only temporarily? Or you are not sure if an instrument is to be purchased at a later date? Or you have to bridge a momentary financial bottleneck? In such cases a rental agreement with purchase option is an ideal solution: you can rent an instrument for a period between six and 36 months, and buy the instrument after min. three and max. 30 months after the beginning of the rental agreement. If you buy the instrument, 75% of the paid rent will be credited against the price.

Leasing
Leasing is common practice in today's business transactions especially as far as medium-term investments are concerned. The lease of instruments expands your financial scope for implementing other, long-term investments, for instance a planned extension of your plant.

We are cooperating with well-established companies and can offer you a broad spectrum of leasing schemes. You can profit from state-of-the-art measuring equipment and systems from Rohde & Schwarz without binding your finances. This makes it possible to realize necessary investments immediately if budgets are tight and acquisitions would normally have to be postponed to the next fiscal period.

And, another important point: leasing is an interesting alternative also in terms of taxation since leasing payments are immediately and fully tax- deductible for example in Germany.

Service contracts

Repair service contract
Admittedly, not even equipment from Rohde & Schwarz is completely safe from failure. We therefore offer a repair service contract which you can conclude already at the time of purchasing your instrument so as to profit from this Rohde & Schwarz service right from the start and on the most favourable terms. The repair service contract extends the standard warranty period to three years. The contract price covers all services necessary to restore the instrument to proper operating condition.

Calibration and maintenance contract
In addition to the repair service contract for new equipment, Rohde & Schwarz offers a calibration and maintenance contract for the most common instruments and test antennas. Please direct your inquiry to:

Central Service Munich
Telefax: +4989 4129-13275

Application notes

Free-of-charge publications
Measuring instruments from Rohde & Schwarz are small, highly complex systems in themselves. They can be used for a variety of applications. The data sheets only cover a small selection of possible applications. Our application engineers are constantly working out solutions to new measurement problems and describing them in application notes. These notes are available to you free of charge. For some applications, we also offer a special software at a small nominal charge. Please contact your local Rohde & Schwarz representative.

Demo units

Rohde & Schwarz offers demo units at very favourable prices. These units have been in use very little, if at all, and are in an excellent condition. As a matter of course, the instruments are checked through before leaving our factory, and Rohde & Schwarz gives full warranty. Your local Rohde & Schwarz representative will be glad to inform you of available instruments.

www.shop-rohde-schwarz.com

Support center

Whatever your problem, our support center is there to help you. Your question will be dealt with fast and in detail, or a competent partner will be found for your problem. The staff of our support center is optimally trained to assist you in solving your problems.

- You are looking for a special type of instrument?
- You need competent support in the implementation of remote control concepts for test equipment for use in production?
- You have a question regarding the operation of equipment?
- Or you just want to find your local sales partner in order to take a look at our equipment?
- And so on...

Just call our support center, and we will be glad to assist you. You can get in touch with us in the following ways:

Telephone
+49180 512 4242

Fax
+4989 4129-13777

E-mail
CustomerSupport@rohde-schwarz.com

Our hotline team

The support center can work out a solution together with you for any aspect relating to the operation, programming and also applications of T&M equipment from Rohde & Schwarz or Advantest. You can rely on the technical expertise of our personnel.

In cases where an immediate answer is not possible, your time will not be wasted with unnecessary calls but the support center will record your problem and find a competent partner to get back to you.

Try us
Our support center can certainly help you. It is your hotline.

+49 180 512 4242

Your local partner remains
If you are already in contact with Rohde & Schwarz, your local sales office will of course remain the first partner to get in touch with as it is more familiarized with your specific requirements and applications than the support center, and will know right away how to give you the fastest support.

Cabinets, designs

Dimensions

The dimensions of Rohde&Schwarz instruments are specified as follows:

Overall width x height x depth in mm, looking onto the front panel (this also holds for pocket-size instruments). Dimensions generally refer to bench models.

Cabinet designs

Cabinet design must meet all the criteria that mature electronic packaging has to fulfill. Changing requirements regarding technology and environment call for new cabinet designs and systems.

Rohde & Schwarz uses the following two design forms for its products:

- design 2000 (BW2000)
- compact design 90 (KB90)

Rackmounting

Rohde & Schwarz instruments in the above cabinet design can be mounted into 19" racks with the aid of appropriate adapters. It may be necessary to retrofit the racks accordingly.

Design 2000 (BW2000)

Design 2000 is a standardized cabinet system suitable for bench models, for mobile use and for mounting in 19" racks. With only a few basic elements, a variety of cabinets can be implemented from one to six height units and in different widths and depths.

Design 2000 (photo 42980-3)

With the

- iF Product Design Award 1998

and

- iF Ecology Design Award 1998

DESIGN AWARD WINNER 1998
INDUSTRIE FORUM DESIGN HANNOVER

received from Industrie Forum Design Hanover, design 2000 has been attested excellent design that takes account of all environmental and recycling criteria for product design.

Construction
The sturdy construction of design 2000 essentially consists of a chassis, an enclosure, feet and front handles.

The chassis is made up of an aluminium-cast front frame and a sheet-metal module support including rear panel. To enclose the instrument, the enclosure is slid over the chassis from the rear and fixed by means of rear-panel feet with elastic pads. The bottom feet with antislide protection are screwed to the enclosure and serve at the same time as a locking device for stacking units.

Compared to previous designs, design 2000 features further improved shielding. The few interfaces between the cabinet parts can be sealed with braided cords and spring strips where required.

Options
The cabinets can optionally be fitted with side handles and tilt feet. Special shock-absorbing parts for the front and rear panel as well as a swivel carrying handle that can also be used as a stand are available for mobile use.

Cabinets, designs

Compact design 90 (KB 90)

Construction
The design 90 cabinet consists of a self-supporting aluminium-cast frame with front and rear panels and top and bottom covers which make up the panelling. The panelling is fixed and the instrument thus enclosed by screwing two feet (4 screws) to the rear panel. The cabinet is completed by attaching feet at the bottom and on the sides. Depending on the type of equipment, one or two carrying straps fixed on the sides make for portability of the instruments.

The tilt stands at the bottom allow the instrument to be set up in a position for convenient operation.

System compatibility
The compact units of design 90 can be stacked with each other as well as with 19" units of previous designs. The bottom feet serve for stacking the units to form a system.

Transit Cases ZZK-9x

Transit cases made of an aluminium composite material are available for all cabinet sizes of compact design 90. Reinforced rounded corners and edges ensure high stability and protection against knocks. Locks and handles are recessed for safety. The cases are dust-proof and splash-proof to DIN 40050 with IP54 type of protection and are suitable for airfreight and express freight.

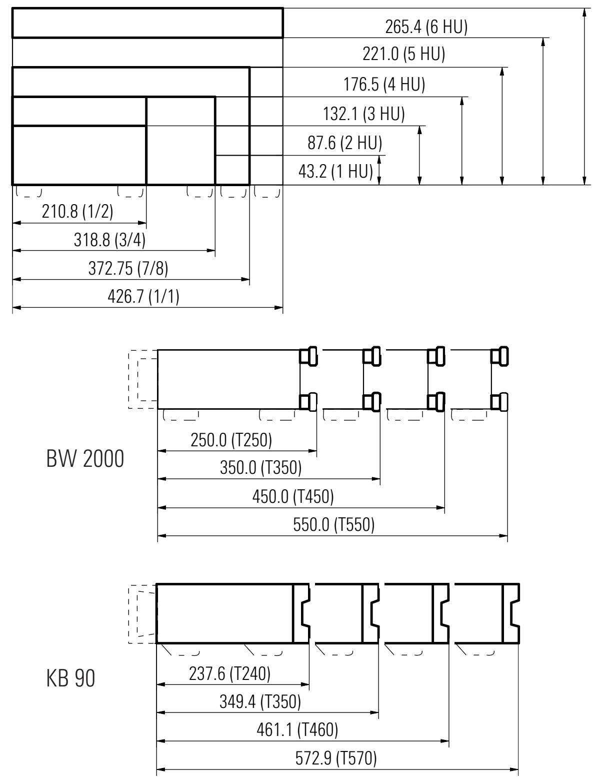
Photo 38536-3

The compact cabinets of design 90 can be stacked not only with one another but also with 19" cabinets of the preceding cabinet designs (photo 35053-4)

Dimensions, ordering information

Instrument size	Inner dimensions of case (mm) (H x W x D)			Weight (kg)	Type R&S ...	Order No.
2HU, 1/2, 350	211	329	507	7.3	ZZK-973	1013.9143.00
2HU, 1/2, 460	211	329	619	8.5	ZZK-974	1013.9150.00
3HU, 1/2, 350	256	329	507	8.0	ZZK-983	1013.9172.00
3HU, 1/2, 460	256	329	619	9.3	ZZK-984	1013.9189.00
4HU, 3/4, 350	300	438	507	10.0	ZZK-993	1013.9237.00
4HU, 3/4, 460	300	438	619	11.6	ZZK-994	1013.9243.00
1HU, 1/1, 350	166	546	507	8.5	ZZK-913	1013.9266.00
1HU, 1/1, 460	166	546	619	9.8	ZZK-914	1013.9272.00
2HU, 1/1, 350	211	546	507	9.2	ZZK-923	1013.9295.00
2HU, 1/1, 460	211	546	619	10.7	ZZK-924	1013.9308.00
2HU, 1/1, 570	211	546	731	12.0	ZZK-925	1013.9314.00
3HU, 1/1, 350	255	546	507	10.0	ZZK-933	1013.9320.00
3HU, 1/1, 460	255	546	619	12.0	ZZK-934	1013.9337.00
3HU, 1/1, 570	255	546	731	13.0	ZZK-935	1013.9343.00
4HU, 1/1, 350	299	549	507	10.8	ZZK-943	1013.9350.00
4HU, 1/1, 460	299	549	619	12.4	ZZK-944	1013.9366.00
4HU, 1/1, 570	299	549	731	14.0	ZZK-945	1013.9372.00
5HU, 1/1, 350	343	549	507	11.6	ZZK-953	1013.9389.00
5HU, 1/1, 460	343	549	619	13.3	ZZK-954	1013.9395.00
5HU, 1/1, 570	343	549	731	14.5	ZZK-955	1013.9408.00
6HU, 1/1, 350	392	558	507	12.4	ZZK-963	1013.8682.00
6HU, 1/1, 460	392	558	619	14.2	ZZK-964	1013.8682.00
6HU, 1/1, 570	392	558	731	15.5	ZZK-965	1013.8682.00

Cabinets, designs



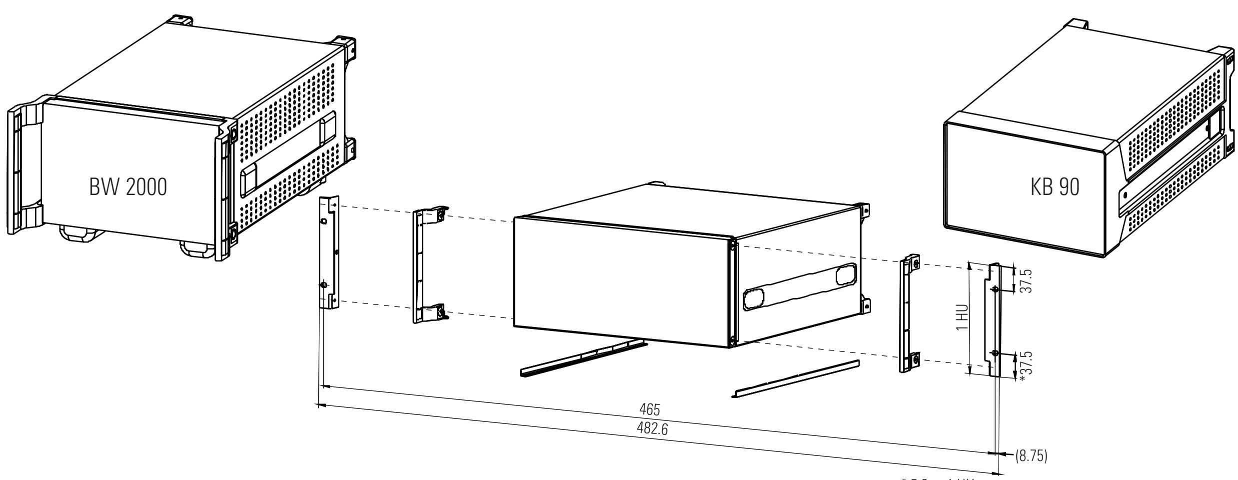
Installation in 19" Racks

Rohde & Schwarz instruments of design 2000 or compact design 90 can be installed in 19" racks with the aid of appropriate adapters. It might be necessary to retrofit the racks accordingly.

With the 19" adapters from Rohde & Schwarz a wide variety of rackmounting combinations can be implemented, even different types of cabinet can be combined (1/2 width).

Additional adapter sets are available for rackmounting by means of telescopic rails. For mounting the appropriate 19" adapter all that is required is to remove a few elements, e.g. the instrument's feet. The scope of supplies includes comprehensive mounting instructions plus the mechanical parts and fixing elements.

19" adapter for 1/1 cabinets

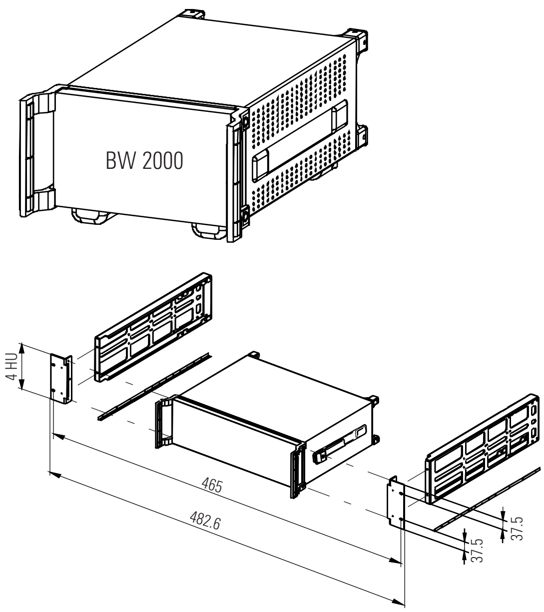


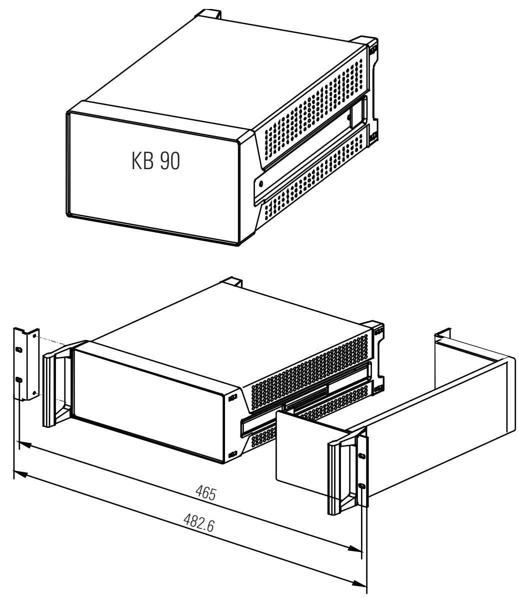
E	19“ adapter BW2000 Type	Order number
1	R&S ZZA-111	1096.3254.00
2	R&S ZZA-211	1096.3260.00
3	R&S ZZA-311	1096.3277.00
4	R&S ZZA-411	1096.3283.00
5	R&S ZZA-511	1096.3290.00

E	19“ adapter KB90 Type	Order number
1	R&S ZZA-91	0396.4870.00
2	R&S ZZA-92	0396.4886.00
3	R&S ZZA-93	0396.4892.00
4	R&S ZZA-94	0396.4905.00
5	R&S ZZA-95	0396.4911.00
6	R&S ZZA-96	0396.4928.00

Cabinets, designs

19" adapter for 3/4 cabinets

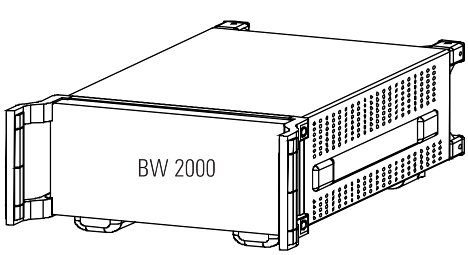


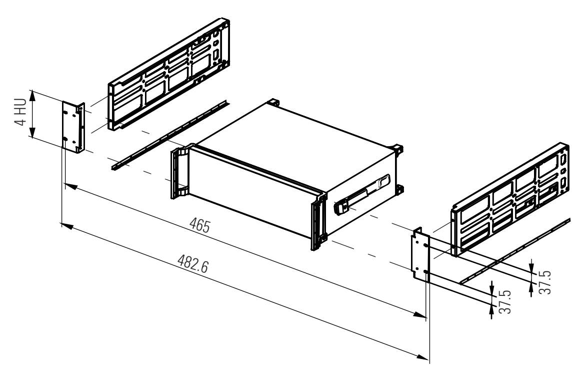


E	19“ adapter BW2000 Type	Order number
3	R&S ZZA-334	1096.3219.00

E	19“ adapter KB90 Type	Order number
4	R&S ZZA-99	0839.5775.00

19" adapter for 7/8 cabinets





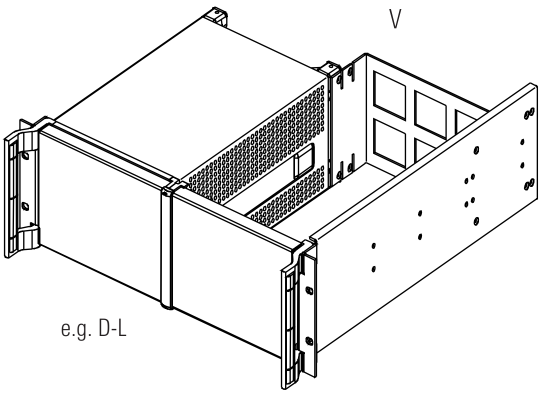
E	19“ adapter BW2000 Type	Order number
4	R&S ZZA-478	1096.3248.00

Cabinets, designs

19" adapter for 1/2 cabinets

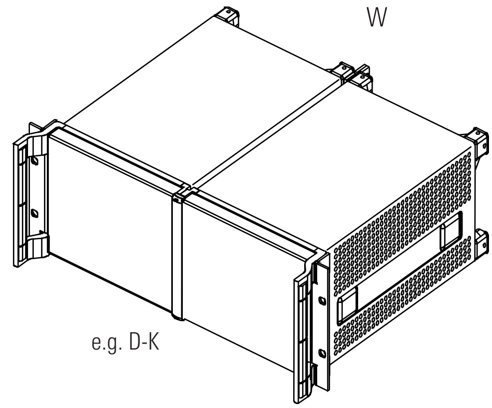
Possible combinations

V



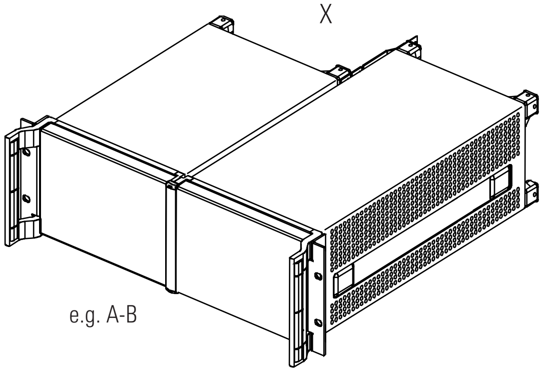
e.g. D-L

W



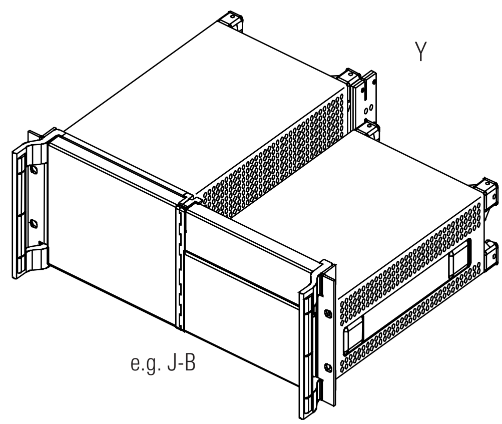
e.g. D-K

X



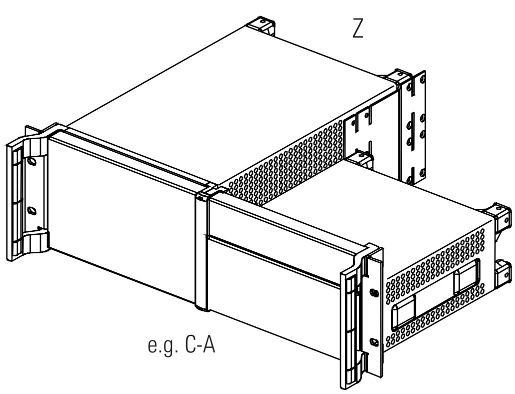
e.g. A-B

Y



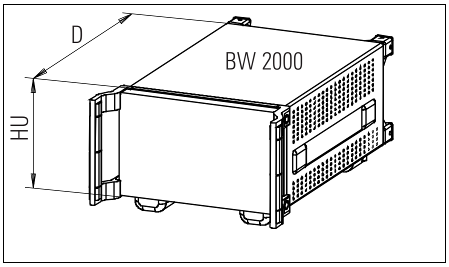
e.g. J-B

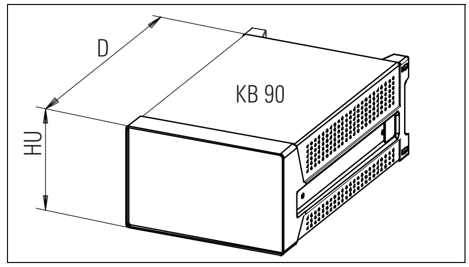
Z

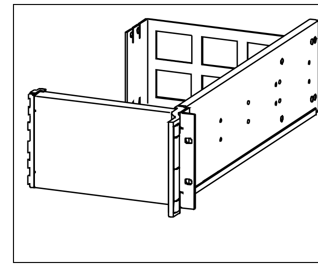


e.g. C-A

Select cabinet combination







Height in mm (HU)	Depth in mm (T)	Cabinet
88 (2 HU)	222 (T250)	A
88 (2 HU)	322 (T350)	B
132 (3 HU)	322 (T350)	C
132 (3 HU)	422 (T450)	D
132 (3 HU)	422 (T460)	E

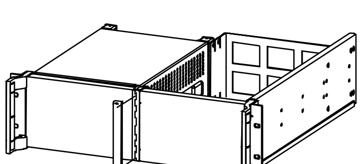
Height in mm (HU)	Depth in mm (T)	Cabinet
88 (2 HU)	209 (T240)	F
88 (2 HU)	321 (T350)	G
88 (2 HU)	433 (T460)	H
132 (3 HU)	321 (T350)	J
132 (3 HU)	432 (T460)	K

	Cabinet
Empty cabinet	L

	A	B	C	D	E	F	G	H	J	K	L
A	**3**	8	17	18	19	5	6	6	21	21	1
B	8	**3**	14	17	20	7	5	6	15	21	1
C	17	14	**4**	12	13	22	16	23	9	10	2
D	18	17	12	**4**	4	22	22	16	11	9	2
E	19	20	13	4	**4**	22	22	16	11	9	2
F	5	7	22	22	22	**24**	24	24	25	25	24
G	6	5	16	22	22	24	**24**	24	25	25	24
H	6	6	23	16	16	24	24	**24**	25	25	24
J	21	15	9	11	11	25	25	25	**25**	25	25
K	21	21	10	9	9	25	25	25	25	**25**	25
L	1	1	2	2	2	24	24	24	25	25	

e.g. combination C-L

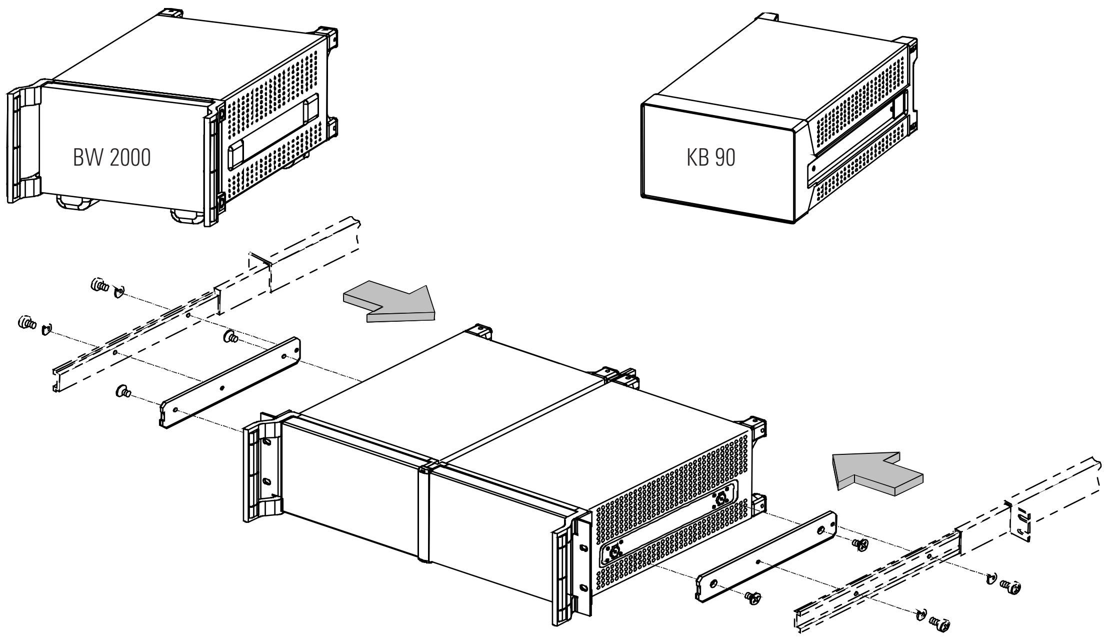
Select #2 from table
(Rohde&Schwarz Order number 1109.4164.00)



#	Rohde&Schwarz Order number	Description	See cabinets on page 518
1	1109.4158.00	19" adapter 1/2 Type 1	V
2	1109.4164.00	19"adapter 1/2 Type 2	V
3	1109.4170.00	19"adapter 1/2 Type 3	W
4	1109.4187.00	19"adapter 1/2 Type 4	W
5	1109.4193.00	19"adapter 1/2 Type 5	W
6	1109.4206.00	19"adapter 1/2 Type 6	X
7	1109.4212.00	19"adapter 1/2 Type 7	X
8	1109.4229.00	19"adapter 1/2 Type 8	X
9	1109.4235.00	19"adapter 1/2 Type 9	W
10	1109.4241.00	19"adapter 1/2 Type 10	X
11	1109.4258.00	19"adapter 1/2 Type 11	X
12	1109.4264.00	19"adapter 1/2 Type 12	X
13	1109.4270.00	19"adapter 1/2 Type 13	X
14	1109.4287.00	19"adapter 1/2 Type 14	Y
15	1109.4293.00	19"adapter 1/2 Type 15	Y
16	1109.4306.00	19"adapter 1/2 Type 16	Y
17	1109.4312.00	19"adapter 1/2 Type 17	Z
18	1109.4329.00	19"adapter 1/2 Type 18	Z
19	1109.4335.00	19"adapter 1/2 Type 19	Z
20	1109.4341.00	19"adapter 1/2 Type 20	Z
21	1109.4358.00	19"adapter 1/2 Type 21	Z
22	1109.4364.00	19"adapter 1/2 Type 22	Z
23	1109.4370.00	19"adapter 1/2 Type 23	Z
24	1109.4527.00	R&S ZZA-97 19" adapter 2E 1/2	V/W/X
25	1109.4533.00	R&S ZZA-98 19" adapter 3E 1/2	V/W/X/Y/Z

Cabinets, designs

Adapter for telescopic rails (only in conjunction with 19" adapter)



Height (HU)	19" adapter BW2000 Depth (T)	Type	Order number
1	T350	R&S ZZA-T13	1109.3739.00
	T450	R&S ZZA-T14	1109.3745.00
2 to 5	T350	R&S ZZA-T35	1109.3768.00
	T450	R&S ZZA-T45	1109.3774.00
	T550	R&S ZZA-T55	1109.3780.00

Height (HU)	19" adapter KB90 Depth (T)	Type	Order number
1	T350	R&S ZZA-913	0396.5430.00
	T460	R&S ZZA-914	0396.5460.00
2 to 6	T350	R&S ZZA-923	0396.5476.00
	T460	R&S ZZA-924	0396.5482.00
	T570	R&S ZZA-925	0396.5499.00

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