Test & Measurement
Catalog 2010/2011

R&S®FSV
Signal and Spectrum Analyzer – sets the benchmark for bandwidth, speed, usability and features.
▷ For more details, see page 26

R&S®FSH4/8
Handheld Spectrum Analyzers

R&S®SMBV100A
Vector Signal Generator

R&S®CMW500
Wideband Radio Communication Tester

ROHDE&SCHWARZ

Test & Measurement
Catalog 2010/2011

Dear customer: This catalog will give you an overview of all Rohde&Schwarz test and measurement products. For detailed information, please refer to our website www.rohde-schwarz.com and enter the type designation of the product as the search term.

Example: R&S®FSV Signal and Spectrum Analyzer
▷ search term = FSV

On our website, you will find this catalog as a PDF file for download. For convenient use, this file has navigation functions as well as hyperlinks for quick access to the corresponding product pages on our website.

For more than 75 years, Rohde & Schwarz has stood for quality, precision and innovation in all fields of wireless communications.

The privately owned company group has a global presence. It develops, produces and markets a wide range of electronic capital goods for industry, infrastructure operators and government agencies.

Rohde & Schwarz numbers among the market leaders in all of its business fields, including wireless communications and RF test and measurement, terrestrial TV broadcasting and technologies relating to the interception and analysis of radio signals.

Numerous subsidiaries and representatives not only ensure quick and competent on-site support anywhere in the world, but also safeguard customer investments with comprehensive service and support offerings.

Our business fields

Test and measurement

T&M instruments and systems for wireless communications, electronics and microwave applications

Secure communications

(Radio) systems providing encrypted communications for police, armed forces, government agencies and industry

Radiomonitoring and radiolocation

Spectrum monitoring systems and radiomonitoring equipment for public safety and national security

Broadcasting

Sound and TV broadcasting and measuring equipment

Test and measurement

Rohde&Schwarz is one of the world's largest manufacturers of electronic test and measurement equipment. Our products set standards in research, development, production and service. We are a key partner of industry and network operators for all T&M tasks in radiocommunications.

In the past year, Rohde&Schwarz launched many new product highlights, again providing its innovative strength in RF test and measurement. In the extremely high frequency range, the introduction of products for network analysis in the millimeter-wave range marked the entry in the terahertz technology of the future. On the wireless market, the company strengthened its leading position as a supplier of T&M solutions for next-generation technologies such as LTE, WiMAX™ and MIMO.

Our test and measurement portfolio

- Instruments and systems for testing mobile radio and wireless technologies
  - Wireless device testers
  - Infrastructure testers
  - Protocol testers
  - Conformance/preconformance testers
  - Test systems and accessories
- Spectrum and signal analyzers
- Signal generators
- Network analyzers
- Coverage measurement systems
- EMC and field strength test solutions
- Modular instruments
- Power meters and voltmeters
- Audio analyzers
- Video and TV generators and analyzers
- Modulation analyzers
- Power supplies
- RF and microwave accessories
- Industrial PCs

Test and measurement.

Broadcasting

TV viewers and radio listeners in more than 80 countries receive their programs via transmitters from Rohde&Schwarz. Our unique product portfolio including both broadcasting and measuring equipment acts as a catalyst for the worldwide development of digital broadcasting. The company's market leadership in terrestrial TV transmitters, including for mobile TV, was further enhanced in the past year by the installation of Rohde&Schwarz equipment in all regions of the world. One of the primary success factors was the introduction of a new generation of transmitters featuring significantly lower power consumption.

At the bottom end of the transmission power scale, a new family of gap fillers and transposers for TV and DAB now provides cost-effective, seamless coverage even of areas with difficult topography.

To producers of consumer electronics, Rohde&Schwarz supplies all necessary test equipment for the development and production of satellite receivers, TV sets and other user equipment, including for the new high definition formats. The large variety of broadcast and video technologies is covered by the multistandard platforms from Rohde&Schwarz, which allow very flexible use at all stages of the value added chain.

Secure communications

Radiocommunications systems Security organizations and armed forces must be able to exchange information efficiently and securely – also in multinational operations. To ensure the rapid coordination of civil, governmental and military forces in times of crisis, Rohde&Schwarz supplies powerful, interoperable communications systems. Due to their modern encryption methods, the company's solutions fulfill the highest requirements of national and international security standards. Software defined radios ensure the greatest possible flexibility and are in use around the globe. Civil air traffic control agencies in 80 countries and at more than 200 locations – both airports and ATC centers – use Rohde&Schwarz radio systems.

Professional mobile radio (PMR) TETRA radio networks have already been put into operation in more than 30 countries by the Rohde&Schwarz Professional Mobile Radio GmbH subsidiary – for example in the Moscow Metro, at the Panama Canal, in a nationwide network in Malaysia and at major sporting events such as the Asian Games in Qatar.

Communications security Rohde&Schwarz SIT GmbH develops highly secure crypto products and systems for private industry, government agencies and the military. A highlight is the ELCRODAT 4-2 encryption unit, which has been approved for maximum levels of classification and is being used by the German armed forces and NATO.

Our broadcasting portfolio

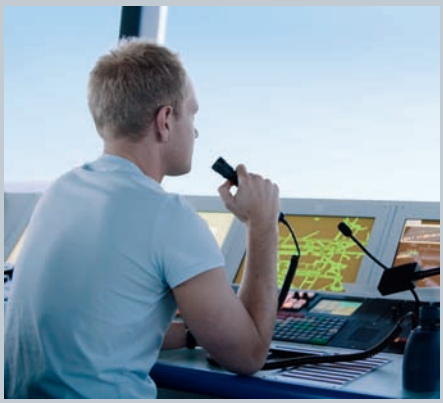
- Digital and analog TV transmitters for all power classes and all conventional standards worldwide, including mobile TV
- Digital and analog sound broadcast transmitters
- Broadcast and video test instruments and systems

Our secure communications portfolio

- Integrated communications systems for the following
  - Civil and military air traffic control (ATC)
  - Army
  - Navy
  - Air force
- Encryption technology

Broadcasting.

Secure communications.



Radiomonitoring and radiolocation

The need for mobile, wireless exchange of information is increasing drastically, but the usable frequency spectrum for radiocommunications is limited. Therefore, Rohde&Schwarz develops and produces stationary and mobile systems for detecting, locating and analyzing radiocommunications signals. These systems allow efficient monitoring and allocation of the limited radio frequencies. Its receivers, direction finders, signal analyzers, antennas and customized systems have made Rohde&Schwarz a reliable partner for its customers for many decades. Applications include public safety and national security, radiomonitoring by regulatory agencies and frequency management.

Services

Rohde&Schwarz operates a global service network in order to safeguard the investments of its customers.

The following on-site services are offered worldwide:
- Calibration
- Maintenance and repair
- Product updates and upgrades

By cooperating with the regional Rohde&Schwarz service centers as well as the plants and specialized subsidiaries, the company can provide a wide range of additional services:
- System integration
- System support
- Installation and commissioning
- Application support
- Development of customized modules, instruments and systems
- Software development
- Mechanical and electrical design
- Manufacturing to order
- Technical documentation and logistics

Our radiomonitoring and radiolocation portfolio

- Radio intelligence systems
- Spectrum monitoring systems
- Signal analysis systems
- Receivers
- Direction finders
- Antennas
- Antenna calibration test site

Service you can rely on
- Worldwide
- Local and personalized
- Customized and flexible
- Uncompromising quality
- Long-term dependability

Radiomonitoring and radiolocation.

Services.

Chapter 1
Wireless Communications Testers and Systems

To keep the evolution of mobile radio technology running, innovative mobile devices need to be efficiently developed and manufactured. For the complex measurements involved, Rohde&Schwarz offers a wide range of instruments and systems such as wireless device RF and protocol testers for R&D, conformance and operator acceptance tests.

Type	Designation	Description	Page
Wireless device testers			
R&S®CMW270	WiMAX™ Communication Tester	All-in-one solution for testing WiMAX™ equipment	7
R&S®CMW500	Wideband Radio Communication Tester	All-in-one test platform for wireless devices	8
R&S®CMW-Z10/-Z11	RF Shielding Box and Antenna Coupler	Excellent shielding effectiveness and superior coupling characteristics	8
R&S®CMU200	Universal Radio Communication Tester	Multitechnology tester for mobile radio devices	9
R&S®CRTU-W/G	Protocol Test Platform	Family of protocol testers for GSM and WCDMA mobile radio standards	9
R&S®CMS54/57	Radiocommunication Service Monitors	Radio testers for service, production and development	10
R&S®CBT/CBT32	Bluetooth® Testers	Fast and comprehensive RF and audio measurements for development, production, and verification	11
Protocol testers			
R&S®PTW70	WLAN Protocol Tester	IEEE 802.11 multimode protocol tester for development, integration and verification	11
Conformance and preconformance testers			
R&S®TS895xG/W	GSM/GPRS/EDGE/WCDMA RF Test System Family	Development, precompliance and conformance testing of mobile phones	12
R&S®TS8970	Mobile WiMAX™ Radio Conformance Test System	RX/TX test system in line with WiMAX™ MRCT test specification	13
R&S®TS8975	Mobile WiMAX™ RF Preconformance Test System	RX/TX RF tester	14
R&S®TS8980	LTE RF Test System	Test platform for development through to conformance testing	15
R&S®TS8991	OTA Performance Test System	Perfect characterization of wireless products over the air interface	16
R&S®TS8996	RSE Test System	Fully automatic emission measurements on wireless communications equipment required for R&D and quality assurance	17
System accessories			
R&S®TS712x	Shielded RF Test Chambers	Reliable RF tests on devices with radio interface	18
R&S®R-Line	Compact Test Chamber	Measurement accuracy as high as that of an anechoic chamber	19

R&S®CMW270
WiMAX™ Communication Tester

All-in-one solution for testing WiMAX™ equipment fast and accurately in line with IEEE 802.16e

- Best in scalability, test speed, measurement repeatability and accuracy
- Continuous frequency range up to 6 GHz
- Realtime signaling to verify network entry and functional performance, plus a message logger
- Vector signal analyzer (VSA) for transmitter measurements and verification
- Vector signal generator (VSG) for receiver measurements with arbitrary waveform functionality
- R&S®Smart Alignment and R&S®Multi-Evaluation concept to reduce test times significantly
- Easy connection to WiMAX™ devices using the RF interface with integrated switching to eliminate external hardware
- Dual tester concept for real parallel test saves money, time and valuable floor space

Specifications in brief

Frequency range	70 MHz to 6 GHz
Max. frequency drift, base unit	$\pm 1 \times 10^{-6}$
With R&S®CMW-B690A option (OCXO extension)	$\pm 5 \times 10^{-8}$
With R&S®CMW-B690B option (highly stable OCXO extension)	$\pm 5 \times 10^{-9}$
RF output level range CW, RF1 OUT, WiMAX™ band 1	–130 dBm to +8 dBm
Level uncertainty, +20 °C to +35 °C, no overranging, level > –120 dBm	< 0.6 dB (calibration interval 1 year)
IF bandwidth	70 MHz
RF input level range CW, RF1 COM, RF2 COM	–84 dBm to +34 dBm
Level uncertainty, +20 °C to +35 °C	< 0.5 dB (calibration interval 1 year)
IF bandwidth	40 MHz
Arbitrary waveform generator	option
Arbitrary waveform files	max. length of 256 Msample
Sample rate	max. 100 MHz
Memory size	1 Gbyte
WiMAX™ parameters	
Digital standard	IEEE 802.16e
Physical layer mode	OFDMA, TDD
Bandwidths	3.5/5/7/8.75/10 MHz
Frame duration	5 ms
FFT size	512, 1024
Modulation and coding rates	BPSK, QPSK 1/2, QPSK 3/4, 16QAM 1/2, 16QAM 3/4, 64QAM 1/2, 64QAM 2/3, 64QAM 3/4, 64QAM 5/6
MAC support	IEEE 802.16e, BS emulation

R&S®CMW500
Wideband Radio Communication Tester

All-in-one test platform for wireless devices

- Just one 19" box for all technologies
- Support of cellular and non-cellular wireless technologies as well as of broadcast technologies
- (Inter-RAT) handover scenarios with only one tester
- Just one 19" box for RF, protocol and application tests
- Increased test depth owing to combination of protocol and RF measurements
- Just one 19" box for all product development and production phases
- Consistent measurement results in development, conformance test and production
- Shorter time-to-market due to reuse of test scripts and signaling tests
- Just one scalable hardware
- Scalable RF resources
- Configurable baseband and signaling units

Models	
R&S®CMW500	All-in-one test platform
R&S®CMW280	Compact RF tester for production
R&S®CMW270	WiMAX™ and non-cellular expert
R&S®CMWPC	R&S®CMW tool set for PC

Specifications in brief	
Frequency range	
Base model	70 MHz to 3.3 GHz
With R&S®CMW-KB036 option	70 MHz to 6 GHz
Output level range	
RF1 COM, RF2 COM	100 MHz to 3300 MHz
Continuous wave (CW)	–130 dBm to –5 dBm
Peak envelope power (PEP)	up to –5 dBm
Overranging (PEP)	up to 0 dBm
RF1 OUT	100 MHz to 3300 MHz
Continuous wave (CW)	–120 dBm to +8 dBm
Peak envelope power (PEP)	up to +8 dBm
Overranging (PEP)	up to +13 dBm
Output level uncertainty (+20 °C to +35 °C, no overranging)	
RF1/RF2 COM, 100 MHz to 3.3 GHz, output level > –120 dBm	< 0.6 dB
RF1 OUT, 100 MHz to 3.3 GHz, output level > –110 dBm	< 0.8 dB
RF power meter	
Expected nominal power setting range RF1/RF2 COM, 100 MHz to 3.3 GHz	–47 dBm to +34 dBm
Level uncertainty (+20 °C to +35 °C) RF1/RF2 COM, 100 MHz to 3.3 GHz	< 0.5 dB
Supported technologies LTE FDD, LTE TDD (TD-LTE), Mobile WIMAX™, CDMA2000® 1xRTT, CDMA2000® 1xEV-DO, TD-SCDMA, WCDMA/HSPA+, GSM/GPRS/EDGE/EDGE Evolution, GPS, Bluetooth®, WLAN a/b/g/n, DVB-T, T-DMB, MediaFLO™, CMMB, FM stereo	

R&S®CMW-Z10/-Z11
RF Shielding Box and Antenna Coupler

Excellent shielding effectiveness and superior coupling characteristics

The R&S®CMW-Z10 RF shielding box and the R&S®CMW-Z11 antenna coupler offer excellent shielding effectiveness and superior coupling characteristics. Both devices can be used for frequencies up to 6 GHz. These outstanding features combine with a modular options concept to make the R&S®CMW-Z10 and R&S®CMW-Z11 indispensable for any radiocommunications tester.

- Frequency range up to 6 GHz
- Excellent shielding characteristics
- Ultra-low reflections
- Broadband spiral antenna allowing a wide variety of applications
- Optimized antenna structure for extremely good RF coupling
- Designed for harsh, continuous duty and ergonomic operation
- Modular options concept and flexible assignment of modules
- Large area for optimum positioning, even large DUTs

Specifications in brief	
Shielding effectiveness (including R&S®CMW-Z11, R&S®CMW-Z12, R&S®CMW-Z13, R&S®CMW-Z14)	
0.4 GHz to 4 GHz	> 80 dB
4 GHz to 6 GHz	> 60 dB
Weight	9 kg (19.8 lb)
Outer dimensions (W × H × D)	320.9 mm × 267.5 mm × 527.7mm (12.6 in × 10.5 in × 20.8 in)

R&S®CMU200
Universal Radio Communication Tester

Multitechnology tester for mobile radio devices

- Extremely high-speed testing
- Highly accurate measurements
- Modular future-ready design
- Comprehensive spectrum analyzer
- Fast switching between networks
- R&S®CMU200V02 for mobile phone testing with network emulation – the signaling specialist
- R&S®CMU200V10 for high-end servicing of mobile phones – the service tester specialist
- R&S®CMU200V30 for non-signaling production testing of mobile phones – the calibration specialist

Specifications in brief

RF generator	
Frequency range	100 kHz to 2.7 GHz
Frequency resolution	0.1 Hz
Output level range	
RF2, 100 kHz to 2.2 GHz	–130 dBm to –10 dBm
RF2, 2.2 GHz to 2.7 GHz	–130 dBm to –16 dBm
Output level uncertainty (output level ≥ –106 dBm, +20°C to +35°C)	
RF1/2, < 2.2 GHz	< 0.6 dB
Output level resolution	0.1 dB
RF analyzer	
VSWR (RF1/2, 10 MHz to 2.2 GHz)	< 1.2
Power meter (wideband)	
Frequency range	100 kHz to 2.7 GHz
Level range, continuous power, 10 MHz to 2.2 GHz	
RF1, 50 W	+6 dBm to +47 dBm
RF2, 2 W	–8 dBm to +33 dBm
Level uncertainty (input level +6 dBm to +33 dBm, +5°C to +20°C or +35°C)	
RF2, 50 MHz to 2.7 GHz	< 0.5 dB
Supported technologies: CDMA2000® 1xRTT, CDMA2000® 1xEV-DO, WCDMA/HSPA, GSM/GPRS/EDGE, GPS, Bluetooth®	

R&S®CRTU-W/G Protocol Test Platform

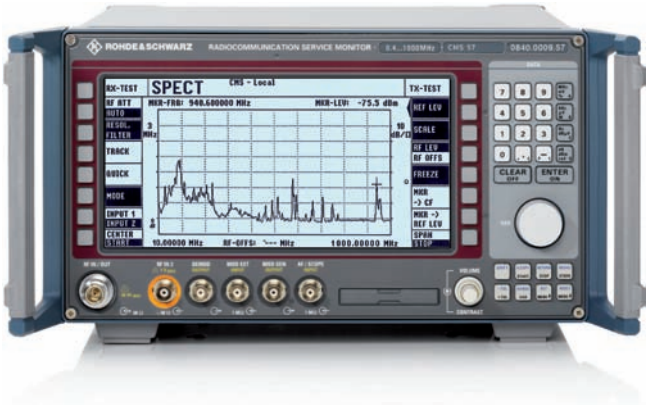
Family of protocol testers for GSM and WCDMA mobile radio standards

The R&S®CRTU-W/G is the unique signaling and protocol test solution for GSM/WCDMA multimode terminals. It provides a maximum level of flexibility from early design and development through to comprehensive conformance and certification testing.

Powerful tools enable the user to define and execute test cases in line with 3GPP test specifications TS51.010 and TS34.123 and to visualize the test results. In addition, customer-specific test scenarios can be implemented in TTCN or C++. Two independent RF channels allow the simulation of two independent cells at the same or at different RF frequencies, which is an indispensable prerequisite for performing WCDMA handovers.

- Protocol analyzer and system simulator for (E)GPRS/GSM/ HSPA/WCDMA FDD
- Support of all specified frequency bands
- Use in protocol stack R&D and conformance testing
- Complete and convenient tool chain covering test generation through to result analysis
- Detailed signaling analysis
- Full test case coverage for mobile certification according to GCF and PTCRB
- Fully automatic test cycles
- Channel extension to up to ten physical channels
- Ciphering available
- Windows operating system
- Upgradeable to RRM and RF conformance test systems

R&S®CMS54/57
Radiocommunication Service Monitors



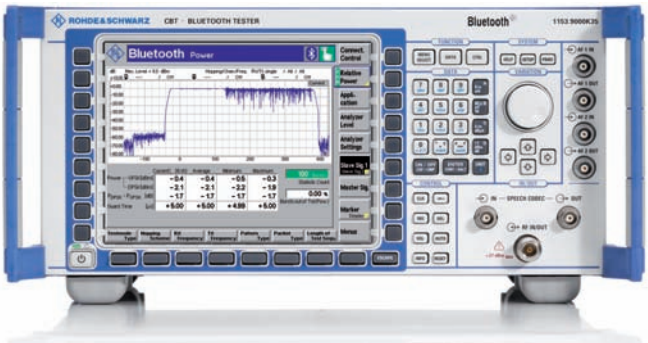
Radio testers for service, production and development

- Frequency range from 400 kHz to 1 GHz
- Radio tester family including two models to cover all measurement requirements
- Suitable for every type of radio equipment using AM, FM, φM as well as SSB
- Transmitter, receiver and duplex measurements on mobile radio equipment, base stations and RF modules
- Analog signaling
- Simultaneous display of settings and results
- Manual and automatic measurements
- Tracking generator
- Spectrum monitor
- Stationary and mobile use
- Cable fault finder

Specifications in brief

Basic RF data	
Frequency range	(30 kHz) 1 MHz to 1 GHz
Max. input power	50 W, optionally 100 W
RF generator	
Output level, RF I/O port	–134 dBm to 0 dBm
Level accuracy, up to 1 GHz	±3 dB
FM deviation accuracy	5%
FM deviation range	0 to 100 kHz
FM modulation frequency	20 Hz to 20 kHz
AM depth range	0% to 99%
AM modulation frequency	0 Hz to 10 kHz
AM accuracy	5%
SSB phase noise	–105 dBc (1 Hz) at 10 kHz
Spectrum analyzer	
Accuracy	±3 dB
Dynamic range	> 65 dB
Broadband power measurement	
Range, RF I/O	5 mW to 100 W
Accuracy	0.45 dB
Analyzer	
FM demodulation range	0 to 100 kHz
FM demodulation accuracy	±5%
AM demodulation range	0 to 99%
AM demodulation accuracy	±7%
Distortion measurement	
Range	0.1% to 50%
Accuracy	±5%
Input level	0.1 V
SINAD meter	
Frequency	100 Hz to 5 kHz
Input level range	100 mV to 30 V
Accuracy	< 1 dB

R&S®CBT/CBT32 Bluetooth® Testers



Fast and comprehensive RF and audio measurements for development, production and verification

- Highly flexible troubleshooting in R&D
- Very short measurement times for high throughput in production
- Integrated spectrum measurements
- R&S®CBTGo software supporting 18 Bluetooth® RF test cases
- Bluetooth® audio profiles (handsfree, headset and A2DP profiles)
- Dual-channel audio generator and analyzer

Specifications in brief

RF generator	
Frequency range	
RF menu	2398 MHz to 2499 MHz
Bluetooth® menu	2402 MHz to 2495 MHz
Bluetooth® LE menu	2402 MHz to 2480 MHz
Frequency offset range	±250 kHz
Output level range, RF IN/OUT	
For basic rate packets and for Bluetooth® low energy packets	–90 dBm to +0 dBm
For EDR packets (2-DHx, 3-DHx)	–90 dBm to –3 dBm
GFSK modulation	
GFSK bit rate, DHx packet types	1 Mbps, B × T = 0.5
Modulation index range, frequency deviation 100 kHz to 220 kHz	0.20 to 0.44
DPSK modulation	
π/4DQPSK bit rate, 2-DHx packet types	2 Mbps
8DPSK bit rate, 3-DHx packet types	3 Mbps
Power meter	
Level range, RF IN/OUT	
Continuous power	–40 dBm to +22 dBm
Peak envelope power (PEP)	+26 dBm (400 mW)
Modulation analyzer	
Total measurement range for frequency offset and frequency deviation (GFSK, frequency offset < maximum deviation)	
Bluetooth® menu	–250 kHz to +250 kHz
Bluetooth® LE menu	–350 kHz to +350 kHz
Frequency resolution (GFSK/DPSK)	
Manual mode	1 kHz
Remote control mode	1 Hz

R&S®PTW70 WLAN Protocol Tester

IEEE 802.11 multimode protocol tester for development, integration and verification

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

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

The modular design allows flexible tester configurations specific to a given measurement task – from the single-channel model to versions networking several R&S®PTW70 testers. Its powerful hardware platform makes the tester a future-ready investment.

- Simulates a wireless LAN access point or a station
- Records data communications in wireless LAN cells
- Multichoice operating concept features graphical and programmable user interfaces
- Online analysis tools provide reliable data
- Analyzes protocol sequences in detail in all operating modes
- Measurement unit detached from the controller, can be remotely driven from different workstations
- Predefined set of applications tailored to specific user groups

R&S®TS895xG/W GSM/GPRS/EDGE/ WCDMA RF Test System Family

Development, precompliance and conformance testing of mobile phones

The R&S®TS89xx family consists of a full range of highly configurable RF test systems for user equipment (UE) and mobile phones. The R&S®TS8950 and R&S®TS8970 represent the top end of the new, third generation of RF test systems from Rohde&Schwarz that fulfills all requirements for RF conformance tests on 2G, 2.5G, 3G and WiMAX™ devices.

Customized and standard solutions for R&D, development and precompliance testing are available with the R&S®TS8955x test solutions, i.e. the R&S®TS8955G, R&S®TS8955W and R&S®TS8955GW in various configurations depending on the required functionalities. The R&S®TS8955 uses the same application software as the R&S®TS8950.

The R&S®TS8950 systems feature fully automatic path calibration routines that run with minimum manual intervention and without the need for any external equipment.

The R&S®TS89xx family

- R&S®TS8950G: GSM RF full conformance tests
- R&S®TS8950W: WCDMA RF full conformance tests
- R&S®TS8950GW: dual-mode GSM/WCDMA RF full conformance tests
- R&S®TS8952G: GSM RF receiver conformance tests
- R&S®TS8952W: WCDMA RF receiver conformance tests
- R&S®TS8952GW: dual-mode GSM/WCDMA RF receiver conformance tests
- R&S®TS8955G: GSM RF precompliance/R&D tests
- R&S®TS8955GW: WCDMA RF precompliance/R&D tests
- R&S®TS8970: WiMAX™ radio conformance tests (RCTT)

Upgrades among these systems are possible at any time with only small add-ons, because the R&S®TS895x platform is nearly identical for GSM and WCDMA applications.

Test applications for RF test

- R&S®TS8950G: GSM, GPRS, AMR, DARP and EGPRS in line with 3G TS 51.010-1 (formerly GSM 11.10); sections 12/13/14/16/18/21
- R&S®TS8950W: WCDMA FDD 1, 2, 5, 6 in line with 3G TS 34.121, HSDPA, Rel. 5; sections 5/6/7/9
- R&S®TS8955G: GSM, GPRS, AMR, DARP and EGPRS in line with 3G TS 51.010-1; sections 12/13/14/21
- R&S® TS8955W: WCDMA FDD 1, 2, 5, 6 in line with 3G TS 34.121, HSDPA, Rel. 5; sections 5/6/7/9

Radio resource management tests, section 8, are available in a separate test setup or as an extension to the R&S®TS8950W or R&S®TS8950GW. All test cases are implemented based on test methods. The test methods are generic test applications with parameter sets that can be edited via an intuitive Windows user interface.

RF tests for the development of GERAN and UTRAN mobile phones and user equipment

- User-configurable test scenarios based on supplied test methods
- Different system configurations available depending on customer requirements
- Support of customer climatic chambers to run tests under different temperature conditions
- Conformance tests
  - Using sets of validated test cases
  - Using a validated test platform
- Precompliance tests
  - Testing against modified conformance tests
  - Testing against custom tests based on the Rohde&Schwarz test methods
- R&D tests
  - Margin testing, e.g. absolute sensitivity of receiver
- Quality assurance
  - Sample test

R&S®TS8970 Mobile WiMAX™ Radio Conformance Test System

Reference tool of choice for the RF characterization of Mobile WiMAX™ products

The R&S®TS8970 is the reference tool of choice for the RF characterization of Mobile WiMAX™ products. Many of the WiMAX Forum® Designated Certification Labs (WFDCL) successfully rely on the R&S®TS8970 in their certification work. The test system has also become a lab favorite in the precertification of products at manufacturers of WiMAX™ infrastructure and mobile stations. Owing to the complexity of the simulation of MIMO channels, the R&S®TS8970 is also frequently used in the WiMAX™ R&D lab.

The R&S®TS8970 enables users to test either a Mobile WiMAX™ base station (BS), a Mobile WiMAX™ mobile station (MS) or a combined system with BS/MS switch-over. The test cases offered reflect the current version of the WiMAX Forum® WiMAX™ Mobile Radio Conformance Test (MRCT) specification. As test requirements and specifications get adapted, the latest versions of the test cases are provided online for the R&S®TS8970. After the first year, they are made available by concluding an optional maintenance contract.

The R&S®PASS user interface is already familiar to many test engineers because an identical form of it is implemented in the widely used R&S®TS8950 certification system for GSM and WCDMA.

- The R&S®TS8970 was developed in response to a request for proposals from the WiMAX Forum®
- Frequency range from 400 MHz to 6 GHz, prepared for future Mobile WiMAX™ profiles
- BS and MS test cases can be run using the same system
- Unsurpassed measurement accuracy and highly detailed result reports
- Minimization of downtime owing to two-year calibration interval for the system and its components

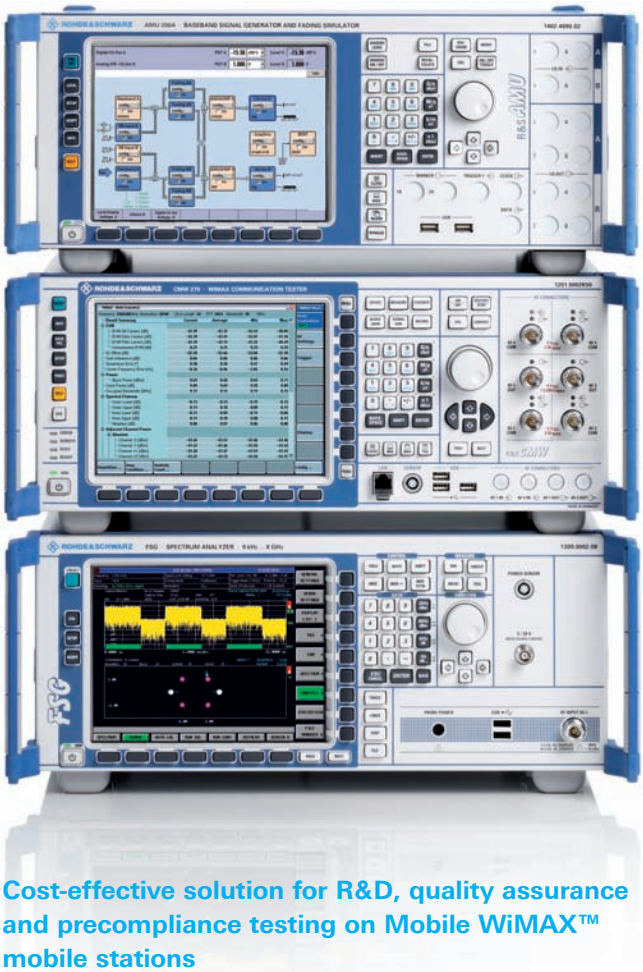
Combining the features of market-leading products from Rohde&Schwarz

- R&S®AMU200A baseband signal generator and fading simulator
- R&S®SMU200A vector signal generator
- R&S®FSL spectrum analyzer
- R&S®FSQ vector signal analyzer
- R&S®NRP power meter
- R&S®PASS user interface
- R&S®TS-EX-IQ2 baseband digital combiner unit

Future-ready concept

- Orthogonal frequency division multiple access (OFDMA) methods
- Multi-antenna transmission and/or reception (MIMO technology)
- Smart antenna arrays/beamforming
- Upgradeable to cover 3GPP Long Term Evolution (LTE)

R&S®TS8975 Mobile WiMAX™ RF Preconformance Test System



Cost-effective solution for R&D, quality assurance and precompliance testing on Mobile WiMAX™ mobile stations

The R&S®TS8975 is the ideal RX/TX RF tester in R&D, quality assurance and precompliance when it comes to the testing of mobile stations in line with the Mobile WiMAX™ test specification.

The R&S®TS8975 enables high-precision RF characterization of Mobile WiMAX™ mobile stations in line with the WiMAX™ Mobile Radio Conformance Test specification. In many aspects, the system is similar to the highly successful R&S®TS8970 used by many of the WiMAX Forum® Designated Certification Labs (WFDCL).

The test cases offered for Mobile WiMAX™ mobile stations (MS) are traceable to those provided on the R&S®TS8970 and follow the MRCT V2.2.1 (WiMAX™ Mobile Radio Conformance Test) specification. Unlike on the R&S®TS8970, the test cases on the R&S®TS8975 are not periodically revalidated, yielding significant cost savings for customers.

Many test engineers are already familiar with the R&S®PASS user interface because an identical form of it is implemented in the widely used R&S®TS8950 certification system for GSM/WCDMA and in the R&S®TS8970 for Mobile WiMAX™.

- Frequency range from 2 GHz up to 6 GHz (optional: from 400 kHz), enabling customers to test all band class profiles defined by the WiMAX Forum® as well as future profiles
- Based on the R&S®CMW270, which allows a multitude of debugging features and more flexibility than earlier pre-RCT systems
- Scalable from the compact two-box benchtop setup up to the 19" rack system, the R&S®TS8975 can be expanded to meet increasing test depth requirements
- Even in the system's basic configuration, approx. 60 % of the MS MRCT V2.2.1 test cases are covered
- High measurement accuracy due to full path compensation yields more reliable results than can be obtained by standard lab setups
- Very detailed measurement reporting that corresponds to the R&S®TS8970 RCT output
- Realistic mobile station tests in full signaling mode

Strong support for achieving RCT first time pass

- All necessary test methods traceable to WiMAX Forum® CWG radio conformance test platform RCT 1.1
- Test methods approved and kept up to date at regular intervals
- Individual or sequential execution of tests possible

Automated data logging, report generation and user-configurable PASS/FAIL output

- Full access to measurement result output
- All PASS/FAIL criteria can be edited
- Graphical output of measurement results versus tolerance criteria
- Easy evaluation of test results

Scalable future-safe test platform

- Basic platform can be upgraded from a compact benchtop setup with channel emulation up to a full R&S®TS8975 rack configuration with extended test case coverage supporting the simulation of 2x2 MIMO scenarios as specified in the MRCT specification
- Can be upgraded to the R&S®TS8970 radio conformance test system with full test case coverage
- Can be upgraded to the R&S®TS8980 LTE RF test system

R&S®TS8980 LTE RF Test System

Test platform for development through to conformance testing

The R&S®TS8980 is a modular and fully automated test system for RF transmitter and receiver measurements on LTE mobile stations. The R&S®TS8980 is a future-oriented tool that allows developers of UMTS long term evolution (LTE) mobile stations to avoid having to develop their own test system solution so they can concentrate on their real work instead.

- Flexible combination of LTE radio access network simulation including fading, simulation of different faded interfering signals, power measurements, spectrum measurements and modulation analysis
- Test applications for development of LTE mobile stations
- Open programming interfaces for adaptation of test applications
- Frequency range from 400 MHz to 3 GHz
- Fully automated path calibration for high accuracy

Consistent RF tests

The hardware can be expanded to create a conformance test system. This, together with the uniform tester software, ensures optimal results in applications ranging from development through to final testing.

Early LTE development requirements met [1)]

- Development-oriented test cases
- Adaptation to incomplete DUT protocol functionality

Reduced development times

- Efficient tools
- Individual definition of tests
- Test methods included
- Individual or sequential execution of tests
- Easy evaluation of tests

Precise, reproducible measurement results

The fully automated path calibration used in the R&S®TS8980 LTE RF test system and high-speed self-test mechanisms deliver maximum accuracy and reproducibility of measurement results.

Low cost of ownership

Scalable configurations starting with a standard R&S®CMW500 plus the R&S®CONTEST test environment ensure an optimum match of budget and functionality. The instruments used in the system require calibration only every 24 months. Between calibrations, the automatic path calibration ensures optimum measurement accuracy. The use of digital baseband connections for fading reduces RF switching as well as possible interference effects due to I/Q imbalance.

Efficient use of the test system through automation

RF tests can be fully automated if required. This makes it possible to use the system continuously, independent of working hours. An optional extension further increases the level of automation by allowing sequential testing of multiple devices under test (DUTs) on one system.

A secure investment and a well-qualified partner

The R&S®TS8980 test system is ready to handle future features such as MIMO and scenarios involving multiple radio cells. Rohde&Schwarz continually implements functional extensions that are made available to users in the form of upgrades. As an active participant in standardization bodies, Rohde&Schwarz helps promote the development of LTE. This knowledge and experience are then immediately incorporated into the company's products.

[1)] The 3GPP-Rel-8 mobile radio standard is still under development. The functionality provided by the R&S®TS8980 LTE RF test system is undergoing continuous development to keep pace with standardization progress and industry requirements. The range of functions available with the R&S®TS8980 LTE RF test system will be communicated upon request.

R&S®TS8991
OTA Performance Test System

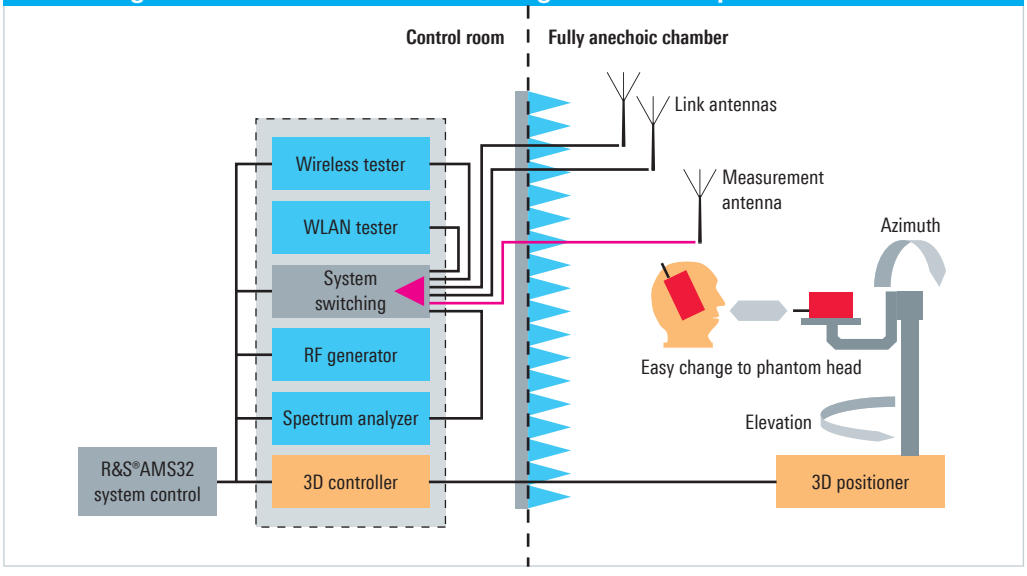
Perfect characterization of wireless products over the air interface

The R&S®TS8991 OTA performance test system measures the spatial radiation and sensitivity characteristic of wireless equipment.Network operators and also various standards prescribe these measurements as important quality parameters defining the behavior of a device in the wireless network. The test system sets up a connection to the EUT over the air interface and then measures both the radiated power and the limit sensitivity in different channels and wireless services (by means of the bit, frame or packet error ratio) in all spatial directions. This yields the relevant parameters such as total radiated power (TRP) and total isotropic sensitivity (TIS), while the 3D radiation diagrams directly show the spatial distributions. Parameters and diagrams together conclusively describe the RF characteristic of the wireless application.

The R&S®TS8991 supports the positioner of the R&S®R-Line compact test chamber and the R&S®TS-MAPD standalone 3D positioner.

- Measurement of over-the-air (OTA) performance in line with CTIA, CWG, PTCRB standards and test cases and WiMAX™ Forum®
- For all important wireless technologies
- Reliable and reproducible measurement results
- Time-optimized, configurable test sequences for qualification and development, based on R&S®AMS32 system software
- Efficient due to automatic test sequences and integrated evaluation and report
- Can be combined with radiated spurious emission and EMC test systems
- Two different test methods: great circle and conical cut

Block diagram of the R&S®TS8991 – configuration example



R&S®TS8996 RSE Test System

R&S®TS8996 RSE test system with filter bank R&S®OSP-F7x, compact RF chamber R&S®R-Line or separate R&S®TS-MAPD positioner

Fully automatic emission measurements on wireless communications equipment required for R&D and quality assurance

The R&S®TS8996 RSE test system is used for EMI and spurious emission measurements on wireless communications equipment during EMC and type approval testing. Typical DUTs are mobile phones, base stations, radio sets and short-range devices.

The relevant standards stipulate a wide variety of measurements in a very wide frequency range, all of which can be covered with the R&S®TS8996. For some radiocommunications systems (i.e. short-range devices), higher frequency limits (i.e. 40 GHz) are already stipulated for spurious emission measurements. The R&S®TS8996 can be easily adapted to customer requirements.

The modular design of the filter unit R&S®OSP-F7x for suppression of the carrier frequencies allows flexible configuration and easy extension of frequency bands. For the measurement of radiated spurious emissions from radiocommunications equipment filter configurations of following technologies are prepaired: GSM, Bluetooth®, WLAN, WiMAX™ and WCDMA (UMTS). Others on request.

- Frequency range from 30 MHz to 18 (40) GHz
- Radiated measurements in line with ETSI EN 301489, FCC part 15 and 3GPP TS51.010 standards
- Conducted spurious emission measurements from 100 kHz to 12.75 GHz on antenna connector of DUT
- Measurement of spurious emissions from radiocommunications equipment

System Software

The R&S®EMC32 software enables fully automatic simple testing. It offers special features by the R&S®EMC32-K2 option:

- Automatic setup and control of wireless link
- Control of different 3D EUT manipulators
- ERP/EIRP measurement
- Automatic suppression of carrier signal by R&S®T8996 filter unit

The predefined test sequences allow a high degree of automation. Users are thus freed from tedious extra works, and incorrect settings or signal connections can be avoided right from the start. Our product managers give support in selecting options and exact configuration the system.

R&S®TS712x Shielded RF Test Chambers

Reliable RF tests on devices with radio interface

The R&S®TS712x family of RF test chambers has been designed to meet the requirements of automatic production lines. These include long service life, rugged design and automatic opening and closing of the RF chamber. Featuring high shielding effectiveness over a wide frequency range, the RF test chambers perform tests on modules and devices with a radio interface in accordance with a wide variety of standards such as ISM, GSM/CDMA2000®/WCDMA, WLAN, Bluetooth®, Zigbee, WiMAX™ and LTE.

- Rugged design for long service life
- High shielding effectiveness up to 14 GHz
- Low reflection due to use of absorbent material
- Integrated RF connectors and filter feedthroughs
- Automatic and manual version
- Exchangeable connector plate for application specific modifications
- Varity of options to support application-specific configurations

R&S®TS7121A and R&S®TS7123M

The R&S®TS712x product family includes two base models that differ mainly in width. Plus, an automatic and a manual version of each model is available. The automatic R&S®TS712xA RF test chamber is mainly used in production. The R&S®TS712xM manual version is particularly suited for applications in service, quality assurance and development.

The automatic and manual versions R&S®TS712xA and R&S®TS712xM of the RF test chambers have the same basic design, ensuring the same test functionality for both versions in development, production and service. The exchangeable connector plate allows the user to add application-specific feedthroughs without having to modify the RF test chamber.

A number of options such as antenna couplers, absorber and USB filter feedthrough significantly simplify the configuration of the RF test chamber:

- Wideband antenna coupler (300 MHz to 6 GHz) for R&S®TS7123
- Antenna couplers, e.g. for GSM/CDMA2000®/WCDMA, WLAN, Bluetooth® and ISM
- Feedthrough filter for USB up to 2.0
- Elevated cover, e.g. for integrating CCD cameras and keyboard stimulators above the DUT

This allows the user to focus on the DUT and test specific modifications of the RF test chamber.

R&S®TS712x rear view.

R&S®R-Line Compact Test Chamber

Measurement accuracy as high as that of an anechoic chamber

The R&S®R-Line compact test chamber is used to eliminate emission problems and optimize the overall RF performance of wireless terminals already in the initial phases of product development. This helps to avoid costly and time-consuming modifications to a large number of prototypes at a later stage, thus optimizing time to market and return on investment.

The R&S®R-Line compact RF chamber performs measurements in the critical frequency range from 800 MHz to 18 GHz with an accuracy as high as that of an anechoic chamber ten times larger. It easily fits into any R&D lab, which reduces investments for infrastructure and instrumentation.

The SVSWR validation requirements in line with CISPR 16-1-4:2007 are not only met but even considerably exceeded.

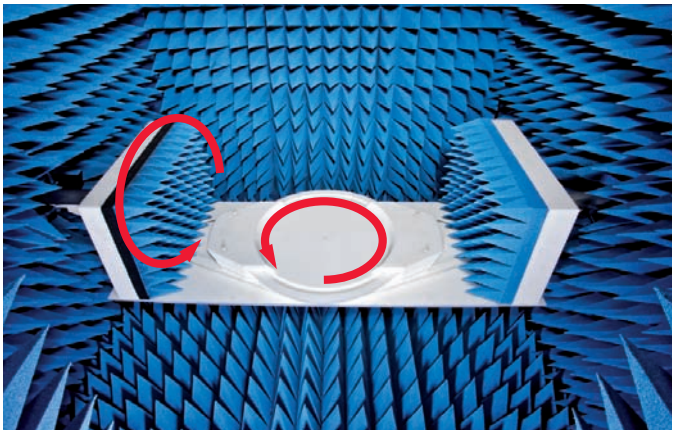
The high measurement accuracy is obtained through an optimized measurement geometry and absorber layout combined with a 3D positioner made of low-permittivity material throughout.

Optimum utilization of resources through comprehensive, automated test systems

Optimizing radiated spurious emissions and over-the-air (OTA) performance poses a permanent challenge. These two R&S®R-Line applications are automatically performed by the R&S®AMS32 test software together with Rohde&Schwarz turnkey test system solutions:

- R&S®TS8991 over-the-air (OTA) performance test system
- R&S®TS8996 radiated spurious emissions (RSE) test system

The R&S®R-Line identifies radiated harmonics and spurious emissions at an early stage – i.e. during development. This avoids complex and costly reengineering during the final conformance tests. As a result, time to market and related costs are reduced.



Internal 3D positioner.

Specifications in brief	
RF specifications/measurement range	
Frequency range	800 MHz to 18 GHz
Polarization	horizontal and vertical through R&S®HL024A1 cross-polarized antenna
Field uniformity site	VSWR, typ. 2 dB in line with CISPR 16-1-4:2007
Communications antenna	800 MHz to 6 GHz, circularly polarized
Shielding effectiveness	> 95 dB, 800 MHz to 6 GHz
	> 70 dB, 6 GHz to 18 GHz
Mechanical data	
Dimensions (W × H × D)	1700 mm × 2250 mm × 1640 mm (66.93 in × 88.58 in × 64.57 in)
Door size (W × H)	500 mm × 1000 mm (19.68 in × 39.37 in)
Size of EUT (Ø × H)	max. 330 mm × 240 mm (max. 12.99 in × 9.45 in)
Weight	562 kg (1239 lb)
Weight of EUT	max. 1 kg (max. 2.2 lb)
RF feedthroughs for calibration or connecting the EUT	2 × N (female), 2 × SMA (female)

Chapter 2
Signal and Spectrum Analyzers

Since 1986 Rohde&Schwarz has been standing for innovative test equipment for signal and spectrum measurements. Customers from all over the world rely on the accuracy of spectrum analyzers, signal analyzers or vector signal analyzers from Rohde&Schwarz.

Type	Designation	Frequency range	Description	Page
Spectrum analyzers				
R&S®FSH3/6/18	Handheld Spectrum Analyzers	100 kHz to 3/6 GHz 10 MHz to 18 GHz	Compact, flexible, professional and economically priced solutions	21
R&S®FSH4/8	Handheld Spectrum Analyzers	9 kHz to 3.6/8 GHz	Where mobility counts	22
R&S®FSC	Spectrum Analyzer	9 kHz to 3/6 GHz	Compact, cost-efficient solution	23
R&S®FSL	Spectrum Analyzer	9 kHz to 3/6/18 GHz	High-end functions in a lightweight, compact package	23
R&S®FSV	Signal and Spectrum Analyzer	9 kHz to 3.6/7/13.6/30/40 GHz	Signal analysis at its best	24
R&S®FSU	Spectrum Analyzer	20 Hz to 3.6/8/26.5/43/46/50/67 GHz	High-end spectrum analyzer with unrivaled dynamic range	25
R&S®FSG	Spectrum Analyzer	9 kHz to 8/13.6 GHz	Spectrum analysis for wideband communications technologies	26
Signal analyzers				
R&S®FSQ	Signal Analyzer	20 Hz to 3.6/8/26.5/40 GHz	Signal and pectrum analysis in a single unit	26
R&S®FSUP	Signal Source Analyzer	20 Hz to 8/26.5/50 GHz	Phase noise tester, high-end signal and spectrum analyzer	27
R&S®FMU36	Baseband Signal Analyzer	36 MHz I/Q bandwidth	Universal analyzer for baseband signals	27
R&S®FSMR	Measuring Receiver	20 Hz to 3.6/26.5/43/50 GHz	One-box solution for calibrating generators and attenuators	28
Accessories for R&S®FSx analyzers				
R&S®FS-Z10	Coherence Unit	100 MHz to 6 GHz	Phase-coherent RF measurements with two analyzers	29
R&S®FS-Zxxx	External Mixers	40 GHz to 110 GHz	Spectrum analysis in the waveguide bands above 40 GHz	29
Application firmware				
Application firmware packages for R&S®FSx analyzers: see overview on page 30 and description on page 31				
Modulation analyzers				
R&S®FSV/L-K7	Measurement Demodulator	Application firmware	AM/FM/φM analysis for the R&S®FSV and R&S®FSL	31
R&S®FSV-K7S	FM Stereo Measurement	Application firmware	Complete FM stereo analysis for the R&S®FSV	31
R&S®FS-K15	VOR/ILS Demodulator	Application firmware	VOR/ILS analysis for the R&S®FSU, R&S®FSMR and R&S®FSQ	40
R&S®EVS300	VOR/ILS Analyzer	70 MHz to 350 MHz	Precision level and modulation analysis	40
R&S®FMAx	Modulation Analyzers	50 kHz to 1.36 GHz	Fast and accurate analysis of analog modulated signals	41

R&S®FSH3/6/18
Handheld Spectrum Analyzers

Compact, flexible, professional and economically priced solutions

The R&S®FSH3/FSH6/FSH18 are rugged, handheld spectrum analyzers designed for measurement tasks in the field. The R&S®FSH6 and the R&S®FSH18 cover the WLAN frequency range. The functionality of the analyzers matches that of conventional lab instruments.

- Frequency range up to 3/6/18 GHz
- Easy operation, low weight and rugged design for field use
- Channel power measurements, burst power measurements in time domain
- RMS detector
- Quasi-peak detector
- AM/FM audio demodulator
- Tracking generator
- Distance-to-fault measurements
- VSWR measurements and Smith chart
- S_{11} and S_{21} phase measurements
- Group delay measurements
- Receiver mode
- Terminating power sensors up to 18 GHz
- Directional power sensors up to 4 GHz
- Test system for EMF measurements (R&S®TS-EMF)
- Code domain power measurements on 3GPP base stations

Specifications in brief

Spectrum analysis	**R&S®FSH3**	**R&S®FSH6**	**R&S®FSH18**
Frequency range	100 kHz to 3 GHz	100 kHz to 6 GHz	10 MHz to 18 GHz
Resolution bandwidths	100 Hz to 1 MHz		
Video bandwidths	10 Hz to 1 MHz		
Displayed average noise level (DANL)	typ. –135 dBm (100 Hz)		typ. –128 dBm (100 Hz)
TOI	typ. 13 dBm		typ. 7 dBm
SSB phase noise at 100 kHz carrier offset	< –100 dBc (1 Hz)		≤ –90 dBc (1 Hz)
Detectors	sample, max peak, min peak, auto peak, RMS, average, quasi-peak		
Level measurement uncertainty	< 1.5 dB, typ. 0.5 dB		< 1.5 dB up to 6 GHz
			< 2.5 dB up to 16 GHz
			< 3 dB up to 18 GHz
Dimensions	170 mm × 120 mm × 270 mm (6.7 in × 4.2 in × 10.6 in)		
Weight	2.5 kg (5.5 lb)		

R&S®FSH4/8
Handheld Spectrum Analyzers

Where mobility counts

The R&S®FSH4/FSH8 are rugged and handy spectrum analyzers designed for use in the field. Their low weight, their simple, well-conceived operation and the large number of measurement functions make them indispensable tools for anyone who needs efficient measuring instruments for outdoor work.

- Frequency range up to 3.6/8 GHz
- High sensitivity (< –141 dBm (1 Hz), with preamplifier < –161 dBm (1 Hz))
- Low measurement uncertainty (< 1 dB)
- Measurement functions for all important measurement tasks during startup and maintenance of transmitter systems
- Internal tracking generator and VSWR bridge with built-in DC voltage supply (bias)
- Two-port network analyzer
- Easy-to-replace Li-ion battery for up to 4.5 h of operation
- Rugged, splash-proof housing for use in the field
- Easy handling due to low weight (3 kg with battery) and easy-to-reach function keys
- Measurement results saved to SD card
- LAN and USB interface for remote control and transfer of measurement data
- R&S®FSH4View software for simple documentation of measurement results

Specifications in brief

Spectrum analysis	**R&S®FSH4**	**R&S®FSH8**
Frequency range, model .04/.14 or model .08/.18	9 kHz to 3.6 GHz	9 kHz to 8 GHz
Frequency range, model .24 or model .28	100 kHz to 3.6 GHz	100 kHz to 8 GHz
Phase noise (f = 500 MHz)	–95 dBc (1 Hz) at 30 kHz carrier offset	
Resolution bandwidths	1 Hz to 3 MHz	
DANL (f = 2 GHz), without preamplifier	< –141 dBm, typ. –146 dBm	
DANL (f = 2 GHz), with preamplifier	< –161 dBm, typ. –65 dBm	
TOI, 300 MHz to 3.6 GHz	> +10 dBm, typ. +15 dBm	> +10 dBm, typ. +15 dBm
TOI, 3.6 GHz to 8 GHz	–	> +3 dBm, typ. +10 dBm
Total measurement uncertainty, 10 MHz to 3.6 GHz	< 1 dB, typ. 0.5 dB	< 1 dB, typ. 0.5 dB
Total measurement uncertainty, 3.6 GHz to 8 GHz	–	< 1.5 dB, typ. 1 dB
Detectors	sample, max peak, min peak, auto peak, RMS	
Vector network analysis	**model .24 only**	**model .28 only**
Frequency range	300 kHz to 3.6 GHz	300 kHz to 8 GHz
Reflection measurement (S_{11}, S_{22})		
Directivity (f = 3 GHz)	> 43 dB	
Display modes	magnitude, phase, magnitude and phase, Smith chart, VSWR, return loss (dB), reflection coefficient, mp	
Transmission measurement (S_{21}, S_{12})		
Dynamic range (f = 3 GHz)	typ. 100 dB	
Display modes	magnitude (loss, gain), phase, magnitude + phase	
Battery operating time (without tracking generator)	up to 4.5 h	
Weight	3 kg (6.6 lb)	

R&S®FSC Spectrum Analyzer

Compact, cost-efficient solution

The R&S®FSC is a compact, cost-efficient solution that offers all essential features of a professional spectrum analyzer with Rohde&Schwarz quality. It covers a wide range of applications from simple development tasks to production, or can be used for training RF professionals. Moreover, it is ideal for applications in service or maintenance.

- Frequency range 9 kHz to 3 GHz or 6 GHz
- Resolution bandwidths 10 Hz to 3 MHz
- High sensitivity < –141 dBm (1 Hz), with optional preamplifier < –161 dBm (1 Hz)
- Low measurement uncertainty < 1 dB
- Internal tracking generator (model .13/.16)
- Storage of measurement results on USB stick
- Compact dimensions
- Low power consumption (12 W)
- Remote control via LAN and USB interface
- R&S ®FSCView software for simple documentation of measurement results

Specifications in brief	
Frequency range	9 kHz to 3 GHz/6 GHz
Resolution bandwidth	10 Hz to 3 MHz
DANL at 1 GHz (RBW = 1 Hz)	
Without preamplifier	< –141 dBm, typ. –146 dBm
With R&S®FSC-B22 preamplifier option	< –161 dBm, typ. –165 dBm
IP3 (1 GHz)	typ. 15 dBm
Phase noise (500 MHz, 30 kHz carrier offset)	< –95 dBc (1 Hz)
Detectors	sample, max./min. peak, auto peak, RMS
Level measurement uncertainty (10 MHz < f ≤ 3.6 GHz)	< 1 dB, typ. 0.5 dB
Tracking generator (model .13/.16)	
Frequency range	100 kHz to 3 GHz/6 GHz
Output power	0 dBm (nominal)
Dynamic range (transmission, 300 kHz < f < 6 GHz)	> 70 dB, typ. 90 dB

R&S®FSL Spectrum Analyzer

Best performance in its class

The R&S®FSL is a lightweight and compact spectrum analyzer for cost-conscious users who want the functionality of high-end instruments.

- Continuous RF frequency range from 9 kHz to 18 GHz
- Signal analysis bandwidth of 28 MHz
- Low measurement uncertainty, even in microwave range

Fast and versatile in production

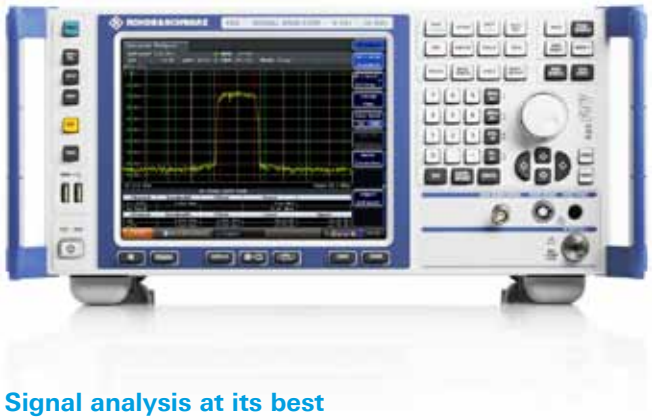
- Higher throughput owing to high measurement speed and optimized measurement routines
- Remote control via LAN or IEC/IEEE bus in line with SCPI

The universal tool for every developer

- Excellent price/performance ratio
- General-purpose signal analysis
- Large selection of options for the various mobile radio and communications standards
- General measurement applications, e.g. spectrogram
- Lightweight and compact for on-site installation, maintenance and service
- On-site plug&play installation of options without opening the instrument

Specifications in brief	
Frequency range	9 kHz to 3/6/18 GHz
Phase noise (10 kHz carrier offset)	–103 dBc (1 Hz)
Resolution bandwidths	300 Hz to 10 MHz, additionally 20 MHz in zero span, optionally 1 Hz to 100 Hz, channel filters, EMI filters
DANL at 1 GHz (300 Hz RBW)	–117 dBm
TOI	typ. +18 dBm
Total measurement uncertainty	< 0.5 dB (up to 3 GHz)
Weight (with battery option)	< 8 kg (17.6 lb)

R&S®FSV Signal and Spectrum Analyzer



Signal analysis at its best

The R&S®FSV is a fast and versatile signal and spectrum analyzer for performance-oriented, cost-conscious users working in the development, production, installation and servicing of RF systems.

- Frequency range 9 kHz to 3.6/7/13.6/30/40 GHz
- 40 MHz analysis bandwidth
- 0.4 dB level measurement uncertainty up to 7 GHz
- Analysis software for GSM/EDGE/EDGE Evolution, WCDMA/HSPA, LTE, WiMAX™, WLAN, analog modulation modes, general-purpose vector signal analysis
- Support of power sensors from the R&S®NRP family along with extensive power measurement functions
- Easy on-site upgrading with options
- Phase noise –110 dBc (1 Hz) at 10 kHz frequency offset
- Third-order intercept (TOI) +15 dBm
- DANL in 1 Hz bandwidth:
  –155 dBm at 1 GHz, –147 dBm at 30 GHz
- Removable hard drive for security critical applications
- Up to five times faster than other signal and spectrum analyzers
- Easy, intuitive operation
  - Touch screen operation
  - Hotkeys for fast access to all important functions
- Easy transition due to remote-control compatibility with the R&S®FSP and R&S®FSU

Specifications in brief

Frequency	
Frequency ranges	9 kHz to 3.6/7/13.6/30/40 GHz
Phase noise (1 GHz, 10 kHz carrier offset)	–106 dBc (1 Hz), typ. –110 dBc (1 Hz)
Resolution bandwidths	
Standard sweep	1 Hz to 10 MHz
Standard sweep, zero span	1 Hz to 10 MHz, 20 MHz, 28 MHz, optionally 40 MHz
FFT sweep	1 Hz to 300 kHz
Channel filters	100 Hz to 5 MHz
EMI filters	200 Hz, 9 kHz, 120 kHz, 1 MHz
Video filter	1 Hz to 10 MHz, 20 MHz, 28 MHz, 40 MHz
Signal analysis bandwidth	28 MHz, optionally 40 MHz
DANL (1 Hz bandwidth)	
1 GHz	–152 dBm, typ. –155 dBm
3 GHz	–150 dBm, typ. –153 dBm
7 GHz	–146 dBm, typ. –149 dBm
13.6 GHz	–148 dBm, typ. –151 dBm
30 GHz	–144 dBm, typ. –147 dBm
40 GHz	–136 dBm, typ. –139 dBm
TOI	
f < 3.6 GHz	+13 dBm, typ. +16 dBm
3.6 GHz to 40 GHz	+15 dBm, typ. +18 dBm
Total measurement uncertainty	
3.6 GHz	0.29 dB
7 GHz	0.39 dB
13.6 GHz	1 dB
30 GHz	1.32 dB
40 GHz	1.65 dB

R&S®FSU Spectrum Analyzer

First spectrum analyzer with full span sweep of 67 GHz

The R&S®FSU is a first-rate spectrum analyzer that meets any challenge in RF analysis – in aerospace and defense or for general microwave applications up to 67 GHz.

- Frequency range 20 Hz to 3.6/8/26.5/43/46/50/67 GHz
- Excellent RF performance:
  - Low phase noise –128 dBc (1 Hz), typ. –133 dBc (1 Hz) at 10 kHz carrier offset
  - DANL –158 dBm (1 Hz)
  - Third-order intercept (TOI) typ. +25 dBm
- Resolution bandwidth 1 Hz to 50 MHz
- Highest dynamic range, e.g. up to 84 dB for 3GPP ACLR measurements
- DANL with preamplifier (R&S®FSU-B24)
  - typ. –168 dBm (1 Hz) at 20 GHz
  - typ. –155 dBm (1 Hz) at 50 GHz
- Standard-specific firmware packages for base station tests in development or production
  - GSM/EDGE/EDGE Evolution
  - Wireless Bluetooth® connections
  - TD-SCDMA (BTS/MS)
  - WCDMA NodeB and UE, HSDPA
  - CDMA2000®, CDMA2000® 1×EV-DO (BTS/MS)
  - TETRA Release 2/TEDS

Wide selection of firmware options

- R&S®FS-K30 for easily measuring noise figure and gain on amplifiers or frequency-converting devices under test (DUTs) throughout the entire frequency range of the R&S®FSU
- Phase noise measurements (R&S®FS-K40)
- Modulation analysis for AM, FM or φM (R&S®FS-K7), e.g. to measure frequency deviation or to determine the frequency settling of oscillators
- High-precision power measurements (R&S®FS-K9)
- VOR/ILS measurements (R&S®FS-K15)
- General vector signal analysis (R&S®FSU-B73)
- Separate preamplifier up to 26 GHz for measuring even the smallest noise figures

Specifications in brief	
Frequency range	20 Hz to 3.6/8/26.5/43/46/50/67 GHz
Phase noise	typ. –128 dBc (1 Hz)
At 10 kHz carrier offset	typ. –133 dBc (1 Hz)
Resolution bandwidths	10 Hz to 50 MHz
FFT filters	1 Hz to 30 kHz
Channel filters	39, from 100 Hz to 5 MHz
EMI bandwidths	200 Hz, 9 kHz, 120 kHz, 1 MHz
DANL at 1 GHz (RBW 10 Hz)	
R&S®FSU3/FSU8	typ. –148 dBm
R&S®FSU26/FSU43/FSU46/FSU50	typ. –146 dBm
R&S®FSU67	typ. –142 dBm
TOI (300 MHz to 3.6 GHz)	typ. 27 dBm
Total measurement uncertainty (f < 3.6 GHz)	0.3 dB

R&S®FSG Spectrum Analyzer

Spectrum analysis for wideband communications technologies

The R&S®FSG supports frequencies up to 13.6 GHz and excels due to its high measurement speed and its performance, which is optimized for applications in mobile radio and wireless communications.

- 28 MHz I/Q demodulation bandwidth
- 4 Msample I and Q memory
- I/Q data extraction
- Fast vector signal analysis

- Spectrum and code domain power measurements for 3GPP FDD/HSPA/HSPA+, CDMA2000® 1xRTT, CDMA2000® 1xEV-DV, CDMA2000® 1xEV-DO, TD-SCDMA
- Spectrum and modulation measurements for GSM/EDGE/EDGE Evolution, Bluetooth®, WLAN IEEE 802.11a/b/g/j/n, WiMAX™, 3GPP LTE; support of MIMO measurements
- Dynamic range of a high-end spectrum analyzer
  - Third-order intercept (TOI) of typ. +25 dBm
  - 1 dB compression of +13 dBm
  - 84 dB ACLR/3GPP with noise correction

Specifications in brief	
Frequency range	9 kHz to 8/13.6 GHz
Phase noise (f = 1 GHz, 10 kHz carrier offset)	typ. –114 dBc (1 Hz)
Resolution bandwidths	1 Hz to 10 MHz
DANL (1 GHz, 1 Hz RBW)	typ. –155 dBm
DANL (1 GHz, 1 Hz RBW, PREAMP ON)	typ. –162 dBm
TOI (DC to 20 MHz)	typ. 25 dBm
Total measurement uncertainty	0.3 dB
Signal analysis bandwidth	28 MHz

R&S®FSQ Signal Analyzer

Signal and spectrum analysis in one instrument

The R&S®FSQ is a solution for all areas in development and production. It offers very low phase noise, an unsurpassed low residual EVM, a high dynamic range as well as above-average accuracy.

- Outstanding RF characteristics
  - TOI of typ. +25 dBm
  - 1 dB compression of +13 dBm
  - 84 dB ACLR/3GPP with noise correction
- 28 MHz signal analysis bandwidth, optionally 120 MHz
- Analysis in the analog and digital baseband (optional)

- Numerous and standard-specific modulation and code domain power measurements
- General vector signal analysis and OFDM vector signal analysis
- Exceptional spectrum analyzer characteristics and functionality
- Ideal for applications in development and production, e.g. WLAN, WiMAX™, 3GPP, LTE
- Comprehensive analysis functions, e.g. time domain power, TOI marker, noise/phase noise marker

Specifications in brief	
Frequency range	20 Hz to 3.6/8/26.5/40 GHz
Phase noise (at 10 kHz carrier offset)	typ. –133 dBc (1 Hz)
Resolution bandwidths	10 Hz to 50 MHz
FFT filter	1 Hz to 30 kHz
Channel filters	32, from 100 Hz to 5 MHz
EMI bandwidths	200 Hz, 9 kHz, 120 kHz
DANL at 1 GHz (RBW 10 Hz)	
R&S®FSQ3/FSQ8	typ. –148 dBm
R&S®FSQ26/FSQ40	typ. –146 dBm
TOI (300 MHz to 3.6 GHz)	typ. 27 dBm
Total measurement uncertainty	0.3 dB (f < 3.6 GHz)
I/Q memory depth	16 Msamples (optionally 705 Msamples)

R&S®FSUP Signal Source Analyzer

Highly flexible phase noise tester with versatile measurement capabilities

The R&S®FSUP combines the scope of functions of a high-end signal and spectrum analyzer with the benefits of a phase-noise-only tester.

- Unique combination of phase noise tester and spectrum analyzer
  - Noise figure measurements
  - Typical spectrum measurements such as ACP or interference search
- Maximum dynamic range through cross-correlation
  - Sensitivity improved by up to 20 dB
  - Cross-correlation up to 50 GHz in a single box
- Analysis in time domain
  - Transient response of oscillators
- Automatic setting of all important parameters
- Detection, suppression and listing of interference
- Residual phase noise measurements
- AM noise measurements
- Low-noise source for supply and tuning voltages
- Analysis of signals with digital and analog modulation

Specifications in brief	
Frequency range	
Signal and spectrum analyzer	20 Hz to 8/26.5/50 GHz
Signal source analyzer	1 MHz to 8/26.5/50 GHz
Phase noise measurement with	
Spectrum analyzer	10 MHz to 50 GHz
Phase detector (PD)	1 MHz to 50 GHz
PD with cross-correlation	1 MHz to 50 GHz
Phase noise sensitivity at 1 GHz	
At 10 kHz offset	–143 dBc
At 10 MHz offset	–172 dBc
Measurement uncertainty	< 1 dB
Offset frequency range	10 mHz to 30 MHz
Residual phase noise measurement	
With internal detector	1 MHz to 8 GHz
With external detector	frequency range depending on detector
AM noise measurement	frequency range depending on detector

R&S®FMU36 Baseband Signal Analyzer

Analysis of signal and spectrum quality of baseband signals

The R&S®FMU36 is an all-purpose analyzer for analog and digital baseband signals. Moreover, the FFT-based structure enables users to analyze extremely weak signals at low frequencies where analyzers with superheterodyne structure exhibit lower sensitivity.

- FFT-based spectrum analyzer with 36 MHz I and Q bandwidth
- Analog baseband input: balanced/unbalanced, 50 Ω/1 MΩ
- Digital I/Q interface (optional)
- Time domain analyzer
- Efficient vector signal analyzer for all-purpose demodulation and analysis of digital signals
- Spectrum analyzer functions (ACP, TOI, trace, etc.)
- High sensitivity also at low frequencies

Specifications in brief	
Frequency range	DC to 36 MHz
Phase noise (f = 10 MHz, at 1 kHz carrier offset)	135 dBc (1 Hz)
Resolution bandwidths (FFT filter)	0.5 Hz to 20 MHz
Signal-to-noise ratio	typ. > 143 dB (1 Hz)
TOI (DC to 20 MHz)	< –70 dBc
Total measurement uncertainty	< 0.25 dB at 1 MHz (fullscale)
I/Q imbalance	< 0.1 dB

R&S®FSMR Measuring Receiver

Combines the functions of multiple instruments

The R&S®FSMR measuring receiver has been specially designed to handle the measurement tasks involved in the calibration of signal generators and fixed or adjustable attenuators.

- High-end spectrum analyzer
- High-precision level calibration tool
- Modulation analyzer for AM/FM/φM
- Audio analyzer with total harmonic distortion (THD) and SINAD measurement functionality
- Power meter for connecting power sensors from the R&S®NRP family
- Frequency range up to 3.6/26.5/43/50 GHz
- High level linearity 0.005 dB per 10 dB step for precise calibration of level and attenuation
- Wide level measurement range from +30 dBm to 130 dBm
- Measurement of modulation depth, frequency deviation and phase deviation with < 1 % measurement uncertainty
- Fast RF frequency counter with 0.01 Hz resolution
- Separate audio input

Level calibration – precise, repeatable and easy to operate

- Functions and characteristics adapted to the needs of the calibration lab
- Exceptionally high linearity and level stability across an extended time and temperature range enable high-precision measurements across a longer period of time
- Automatic VSWR correction when a power sensor with a power splitter is used
- Traceability to national standards, R&S®FSMR-Z2 attenuation calibration kit for verifying the linearity of the R&S®FSMR

Specifications in brief	
Frequency range	100 kHz to 3.6/26.5/43/50 GHz
Relative level measurement, linearity (per 10 dB step)	0.01 dB + 0.005 dB
Measurement uncertainty	
Level measurement (with R&S®NRP-Z27/37 power sensor)	0.083 dB
Modulation depth	1 %
Frequency deviation	1 %
Spectrum analysis data	see R&S®FSU

R&S®FS-Z10 Coherence Unit

Phase-coherent RF measurements

The R&S®FS-Z10 coherence unit in combination with two Rohde&Schwarz R&S®FSQ or R&S®FSG signal and spectrum analyzers enables phase-coherent RF measurements such as measuring the phase, timing and gain differences of two RF signals.

Moreover, it can compensate the phase, timing and gain difference of the digitized RF signal for further calculations. The R&S®FS-Z10 focuses on measurements on multi-antenna systems in aerospace and defense as well as in mobile communications, for instance MIMO beamforming.

- High-performance signal analyzers with excellent RF performance
- Signal analysis bandwidth up to 120 MHz with low EVM
- Frequency range 100 MHz to 6 GHz
- Phase-coherent two RF channel operation
- Design, test and calibration of multi-antenna systems
- Measurement of phase, timing and amplitude difference of RF signals
- Compensation of phase, timing and amplitude differences based on the I/Q data for further analysis

Spectrum analysis in the waveguide bands above 40 GHz

Frequencies in the high GHz range still require the use of external harmonics mixers. Such mixers can be connected to an R&S®FSUP26/50, R&S®FSP40, R&S®FSV30/40, R&S®FSU26/43/46/50/67 or R&S®FSQ26/40 provided that these are equipped with the R&S®FSx-B21 LO/IF ports option for external mixers. Mixers available from Rohde&Schwarz cover the frequency range up to 110 GHz. If other suitable mixers are used, up to 1.1 THz is possible.

Overview of external mixers

	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
Mixer type	balanced dual-diode mixer, no biasing			
Conversion loss	typ. 18 dB	typ. 25 dB	typ. 34 dB	typ. 32 dB
LO frequency range	9.81 GHz to 15.19 GHz	8.61 GHz to 12.62 GHz	8.61 GHz to 12.62 GHz	9.4 GHz to 14 GHz
Number of harmonics	4	6	6	8

LO/IF ports option

	R&S®FSV30/40 with R&S®FSV-B21 R&S®FSP40 with R&S®FSP-B21	R&S®FSU26/46/50 R&S®FSQ26/40 with R&S®FSU-B21 R&S®FSUP26/50 with R&S®FSUP-B21
LO frequency range	7 GHz to 13.2 GHz	7 GHz to 15.5 GHz
LO level	+15 dBm	+15 dBm
IF	404.4 MHz	404.4 MHz

Application-specific solutions

The tables provide an overview of the application firmware/PC software packages offered and show the wide range of applications covered by the signal and spectrum analyzers from Rohde&Schwarz.

[1] Standard.
[2] Base station only.
[3] See R&S®FSH data sheets.
[4] WiBro only.

General measurement applications

Firmware or PC software R&S®FSx		R&S®FSU	R&S®FSQ	R&S®FSG	R&S®FSV	R&S®FSP	R&S®FSL	R&S®FSMR	R&S®FSUP	R&S®FMU36	R&S®FSH	Page
-K7	Modulation analysis for AM/FM/φM including THD and SINAD measurements	•	•	•	•	•	•	•	• [1]	•	–	31
-K7S	FM stereo modulation analysis	–	–	–	•	–	–	–	–	–	–	31
-K9	Measurement with power sensors	•	•	•	•	•	•	•	•	–	• [1]	–
-K14	Spectrogram measurements	–	–	–	•	–	•	–	–	–	• [1]	32
-K15	VOR/ILS measurements	•	•	–	–	–	–	•	–	–	–	40
-K20	Cable TV measurements, analog and digital	–	–	–	–	–	•	–	–	–	–	–
-K30	Noise figure and gain measurements	•	•	•	•	•	•	•	•	–	–	33
-K40	Phase noise measurements	•	•	•	•	•	–	•	• [1]	–	–	33
-K70	General vector signal analysis	•	•	•	•	–	–	•	•	• [1]	–	34

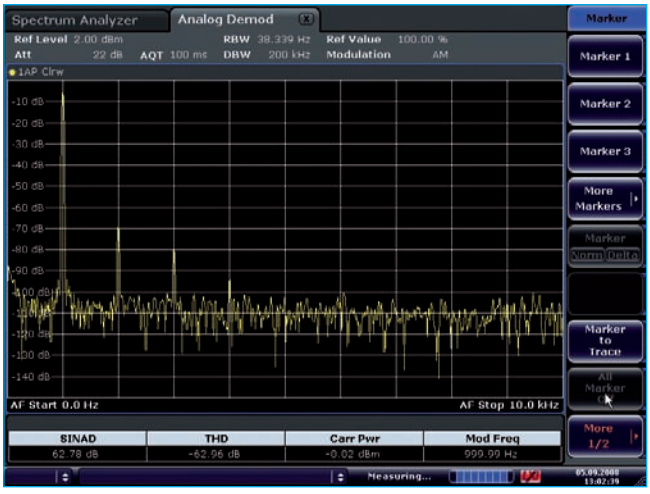
Measurements in line with mobile radio standards

Firmware R&S®FSx		R&S®FSU	R&S®FSQ	R&S®FSG	R&S®FSV	R&S®FSP	R&S®FSL	R&S®FSMR	R&S®FSUP	R&S®FMU36	R&S®FSH	Page
-K10	GSM/EDGE	•	•	•	•	•	–	•	•	•	• [1] [3]	35
-K10	EDGE Evolution	–	•	•	•	–	–	–	–	–	–	35
-K72	3GPP WCDMA	•	•	•	•	•	• [2]	•	•	•	• [2] [3]	36
-K73/74	3GPP WCDMA HSDPA	•	•	•	•	•	•	•	•	•	–	36
-K73+/74+	3GPP WCDMA HSPA+	•	•	•	•	•	–	–	–	•	–	36
-K82/84	CDMA2000® 1xEV-DV	•	•	•	• [2]	•	• [2]	•	•	•	–	37
-K83/85	CDMA2000® 1xEV-DO	•	•	•	–	•	–	•	•	•	–	37
-K76/77	3GPP TD-SCDMA	•	•	•	•	•	–	•	•	•	–	36
-K100/101	3GPP LTE	–	•	•	•	–	–	–	–	–	–	39
-K104/105	3GPP LTE TDD	–	•	•	•	–	–	–	–	–	–	39
-K102	3GPP LTE MIMO	–	•	•	•	–	–	–	–	–	–	39
-K110	TETRA Release 2/TEDS	•	•	–	–	–	–	–	–	–	–	39

Other wireless applications

Firmware or PC software R&S®FSx		R&S®FSU	R&S®FSQ	R&S®FSG	R&S®FSV	R&S®FSP	R&S®FSL	R&S®FSMR	R&S®FSUP	R&S®FMU36	R&S®FSH	Page
-K92/93	IEEE 802.16e-2005 WiMAX™	–	•	•	•	• [4]	•	–	–	•	–	38
-K94	IEEE 802.16 WiMAX™ MIMO	–	•	•	–	–	–	–	–	–	–	38
-K91	IEEE 802.11 a/b/g/j WLAN	•	•	•	•		•	–	–	•	–	38
-K91n	IEEE 802.11 n WLAN	•	•	•	•	–	•	–	–	–	–	38
-K8	IEEE 802.15.1 Bluetooth® EDR	•	•	•	–	•	•	•	•	•	–	32
-K96	General OFDM vector signal analysis	–	•	–	–	–	–	–	–	–	–	35

R&S®FS-K7/FSV-K7/FSL-K7 AM/FM/φM Measurement Demodulator



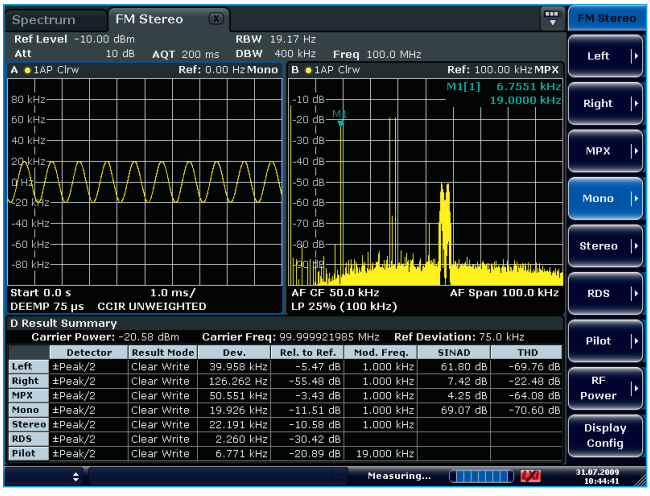
THD measurement on an amplitude-modulated signal. The first harmonic of the modulation signal is well suppressed by 69 dB. This corresponds to a THD (D2) of less than 0.1 %.

Analog signal measurement

The R&S®FS/FSV/FSL-K7 AM/FM/φM measurement demodulator application firmware converts the R&S®FSV/R&S®FSL into an analog modulation analyzer for amplitude-, frequency- or phase-modulated signals. The following display and analysis alternatives are available:

- Modulation signal versus time
- Spectrum of modulation signal (FFT)
- RF signal power versus time
- Spectrum of RF signal
- Table with numeric display of
  - Deviation or modulation factor, RMS weighted, +Peak, –Peak, ±Peak/2
  - Modulation frequency
  - Carrier frequency offset
  - Carrier power
  - Total harmonic distortion (THD) and SINAD

R&S®FSV-K7S FM Stereo Measurement



The result summary clearly displays the measurement results of all the channels; switchover is not required. Additional displays such as the mono signal or the MPX spectrum display support in-depth analysis.

Comprehensive measurement functions for complete FM stereo analysis

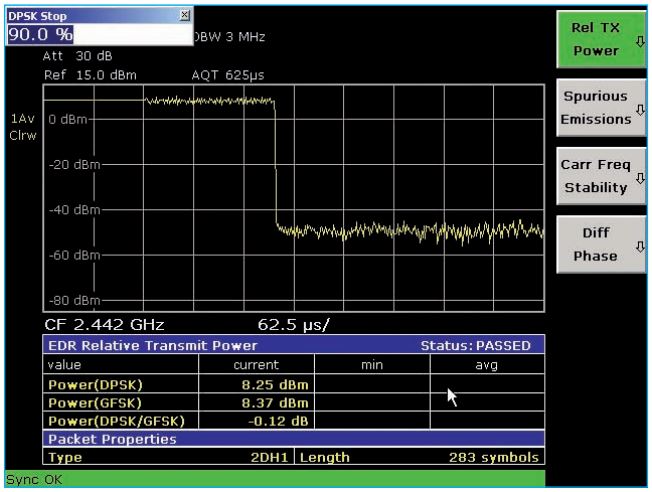
The R&S®FSV-K7S application firmware expands the functionality of the R&S®FSV-K7 application firmware with measurements on FM stereo transmitters.

- Frequency deviation measurement in channels MPX, L, R, M, S and frequency deviation measurement of pilot and RDS carrier
- Carrier power and carrier frequency measurement
- Audio frequency measurement
- Absolute and relative deviation measurement for easy-to-perform S/N ratio and crosstalk attenuation measurement
- AF spectrum display and display per channel
- Up to 4 measurement windows

A variety of audio filters and detectors for standard-compliant measurements

- CCIR filter, weighted and unweighted
- Highpass filters 20 Hz, 50 Hz, 300 Hz and lowpass filters 3 kHz, 15 kHz, 23 kHz and 150 kHz
- Selectable deemphasis 50 µs, 75 µs, 750 µs
- Detectors: ±peak/2, +peak, –peak, RMS, RMS × SQR2, quasi-peak (in line with CCIR 468) and quasi-peak × SQR2

R&S®FS/FSL-K8 Transmitter Measurements for Bluetooth® V2.0 and EDR



Relative transmit power: The EDR relative transmit power determines the power of the GFSK-modulated and the DPSK-modulated part and the power difference.

The R&S®FS/FSL-K8 application firmware enhances the range of applications of the R&S®FSL/FSP/FSU/FSQ spectrum analyzers to include measurements on Bluetooth® transmitters. All measurements are carried out in line with the Bluetooth® RF Test Specification (Bluetooth® SIG) Rev. 2.0+EDR and cover basic rate as well as EDR. Integrated limit value monitoring is provided for all measurements and allows analysis of the results in the development and production of Bluetooth® modules.

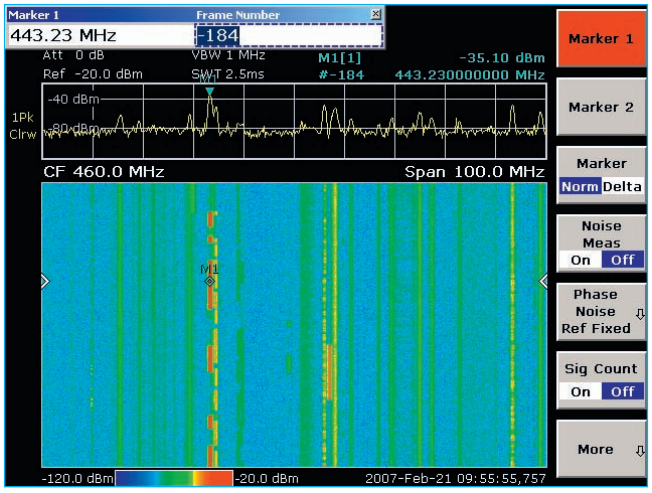
Basic rate measurements

- Output power
- ACP over up to 79 channels
- Modulation characteristics
- Initial carrier frequency tolerance
- Carrier frequency drift

EDR measurements

- Output power and relative transmit power
- In-band spurious emissions, gated
- Carrier frequency stability and modulation accuracy (DEVM)
- Differential phase encoding

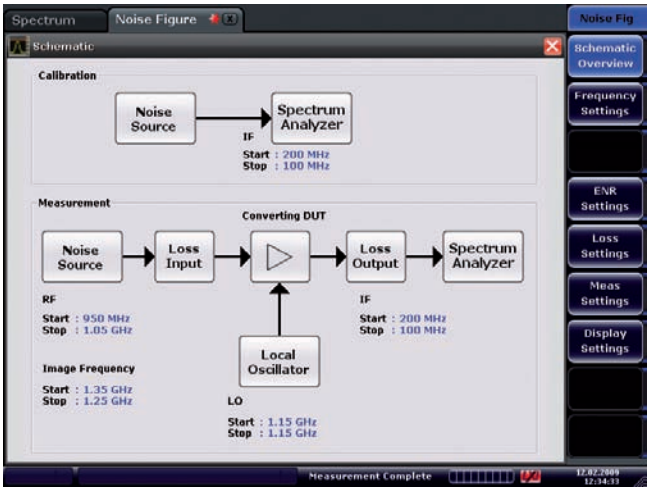
R&S®FSL-K14 Spectrogram Measurement



The R&S®FSL-K14 application firmware adds a spectrogram display and trace recording to the R&S®FSL. The spectrogram view shows a history of the spectrum and helps to analyze intermittent problems or variations in frequency and level versus time. It also adds a new trigger, i.e. a time trigger that makes it possible to record a trace at a regular time interval.

- Recording of up to 20000 traces: approx. 5.5 h continuous monitoring with repetition interval set to 1 s
- Time trigger, 100 ms to 5000 s repetition interval: allows unattended continuous monitoring
- Scrolling through recorded traces with markers: replay and repeatedly analyze the recorded data

R&S®FS/FSV/FSL-K30
Noise Figure and Gain Measurement



The schematic view of the test setup simplifies measurements on frequency-converting DUTs.

Wide variety of RF measurements

The R&S®FS/FSV/FSL-K30 application firmware expands the R&S®FS/FSV/FSL signal and spectrum analyzers by adding measurement functionality otherwise only provided by special noise measurement analyzers. The following parameters can be measured at a specified frequency or in a selectable frequency range:

- Noise figure in dB
- Noise temperature in K
- Gain in dB

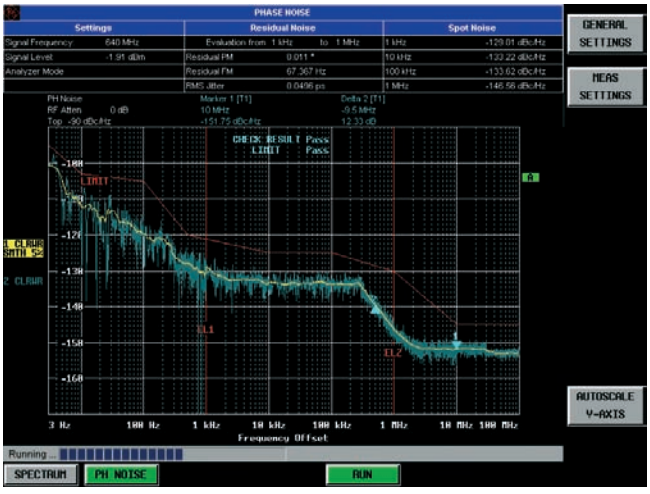
Noise measurements

- Measurement range 0 dB to 35 dB
- Resolution 0.01 dB
- Device measurement uncertainty 0.05 dB

Gain measurements

- Measurement range –20 dB to +60 dB
- Resolution 0.01 dB
- Measurement accuracy ±0.2 dB

R&S®FS/FSV-K40
Phase Noise Measurement



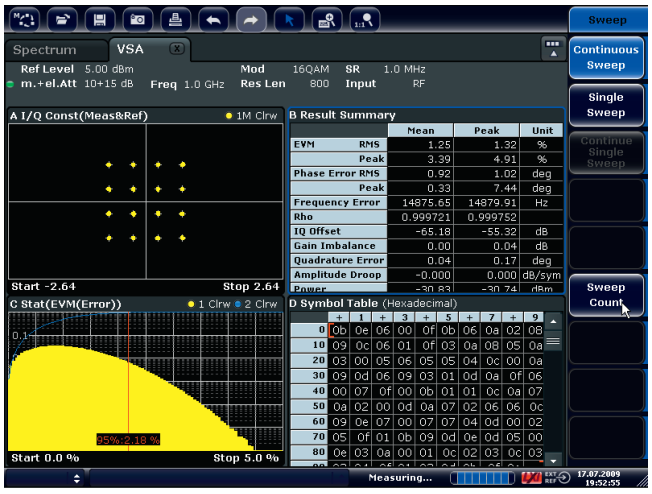
Phase noise measurement of a signal source: blue trace: original trace; yellow trace: trace with a smoothing factor of 5%. The red trace is a LIMIT. The measurement result (pass in this example) is displayed directly in the diagram. The vertical red lines mark the range limits for residual FM/φM measurements. Results are displayed in the top center of the screen under residual noise.

Fast and easy phase noise measurements

The R&S®FS/FSV-K40 application firmware enables the R&S®FSQ/G/FSU/FSMR/FSV signal and spectrum analyzers to perform fast and easy phase noise measurements in development and production.

- Carrier offset frequency range selectable from 1 Hz to 1 GHz in 1/3/10 sequence (1 Hz, 3 Hz, 10 Hz, 30 Hz, etc.)
- Number of averages, sweep mode and filter bandwidth for every measurement subrange can be individually selected to optimize the measurement speed
- Fast results for the subranges are obtained by starting the measurement at the maximum carrier offset
- Verification of carrier frequency and power prior to each measurement avoids incorrect measurements
- Improvement of dynamic range by measuring the thermal inherent noise in a reference trace and performing noise correction
- Tabular display of residual FM, residual φM and RMS jitter in addition to measurement trace
- Limit lines with PASS/FAIL indication

R&S®FSV-K70 Vector Signal Analysis



16QAM with four screens.

Flexible modulation analysis from MSK to 64QAM

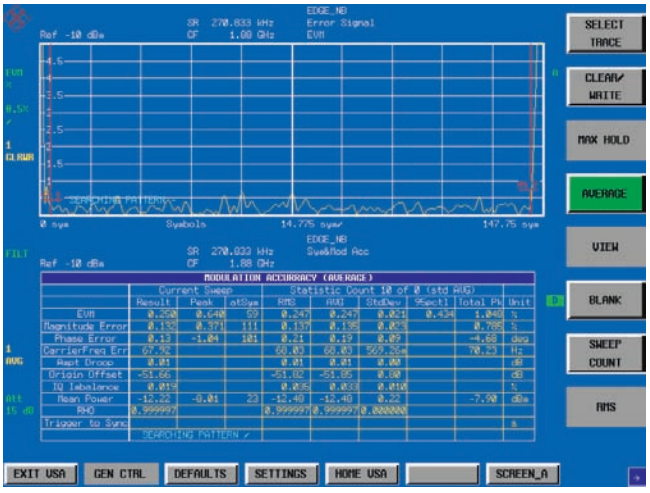
The R&S®FSV-K70 application firmware enables users to flexibly set the analysis of digitally modulated single carriers down to the bit level using the R&S®FSV. The clear-cut operating concept simplifies measurements, despite the wide range of analysis tools.

- Modulation formats
  MSK, DMSK, BPSK, QPSK, 8PSK, DQPSK, D8PSK, π/4-DQPSK, 3π/8-D8PSK, 16QAM to 64QAM
- Symbol rate up to 32 MHz
- Analysis length up to 50000 symbols
- Signal analysis bandwidth 28 MHz, optionally 40 MHz

Numerous standard-specific default settings

- GSM, GSM/EDGE, WCDMA, TETRA
- Display choices for amplitude, frequency, phase, I/Q, eye diagram, amplitude, phase, or frequency error, constellation or vector diagram

R&S®FSQ-K70 Vector Signal Analysis



Modulation error measurements on EDGE signals.

Universal demodulation, analysis and documentation of digital radio signals

The R&S®FSQ-K70 application firmware enables users to analyze digitally modulated carriers down to the bit level using the signal and spectrum analyzers R&S®FSQ/FSU/FSMR/FSUP/FSG and the R&S®FMU baseband analyzer.

For all major mobile radio communication standards

- GSM and EDGE
- WCDMA-QPSK, CDMA2000®-QPSK
- Bluetooth®, TETRA, PDC, PHS, DECT, NADC

For all common digital modulation modes

- BPSK, QPSK, OQPSK, π/4-DQPSK
- 8PSK, D8PSK, 3π/8-8PSK, (G)MSK, 2/4/(G)FSK
- 16, 32, 64, 128, 256 (D)QAM, 8VSB
- 25 MHz symbol rate expandable up to 81.6 MHz
- 28 MHz I/Q demodulation bandwidth expandable up to 120 MHz (R&S®FSQ only)

Optimum representation of results

- In-phase and quadrature signals versus time
- Magnitude and phase versus time
- Eye/vector/constellation diagrams
- Table with modulation errors
- Demodulated bit stream
- Statistical evaluation of modulation parameters
- Spectral evaluation
- Amplifier distortion measurements

R&S®FSQ-K96
OFDM Vector Signal Analysis

The upper part of the display shows the recorded signal in the time domain. The lower part shows the constellation diagram.

The R&S®FSQ-K96 PC software expands the R&S®FSQ/FSUP signal analyzers to feature modulation measurements on general OFDM signals. The OFDM demodulator is user-configurable and standard-independent.

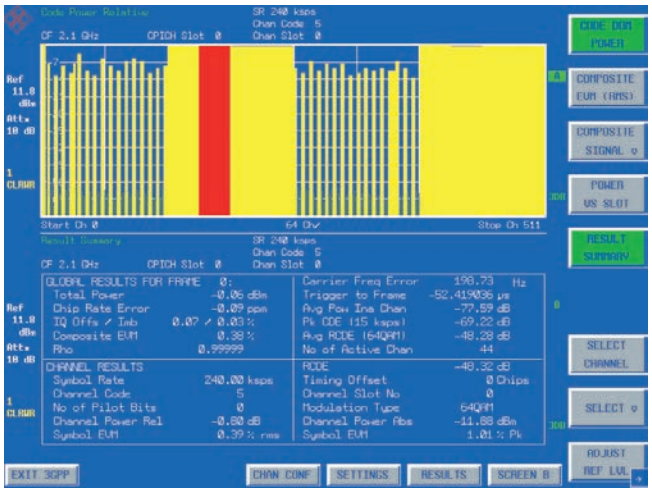
- Support of OFDM and OFDMA
- Support of any PSK or QAM modulation format
- Frequency range 50 MHz to 3/8/26.5/40 GHz, depending on the R&S®FSQ model
- Very low residual EVM of below –51 dB for DVB-T, 2k mode
- RF measurement or I/Q baseband measurement (optional)
- Numerous measurements for the analysis of OFDM signals

R&S®FS/FSV-K10
GSM/EDGE/EDGE Evolution Analysis

The R&S®FS/FSV-K10 measurement application firmware enables transmitter tests on mobile stations and base stations. It provides all the functionality needed for GSM/EDGE and EDGE Evolution.

- Power measurement in time domain including carrier power
- Modulation quality
  - EVM
  - Phase/frequency error
  - Origin offset suppression
- Spectrum measurements
  - Modulation spectrum
  - Transient spectrum
  - Spurious emissions

R&S®FS-K72/-K73/-K73+/-K74/-K74+ WCDMA 3GPP Measurements



Code domain power measurement on a signal with 44 active codes.

Code domain power measurements (3GPP FDD)

The application firmware adds measurement functions in line with the 3GPP specifications for the FDD mode to the Rohde&Schwarz signal and spectrum analyzers.

- Measurement of modulation quality: EVM, peak code domain error and relative code domain error
- Automatic detection of active channels and their data rate
- Scrambling code search
- Automatic detection of modulation formats in HSDPA and HSPA+ (R&S®FS-K72)
- Provides the functionality needed for base station testing

R&S®FS-K72/R&S®FS-K73

- Provides all the functionality for testing base stations (R&S®FS-K72) or user equipment (R&S®FS-K73) in line with WCDMA Release 99, HSPDA and HSPA+

R&S®FS-K73/R&S®FS-K74

- Extends the capabilities of R&S®FS-K72 to encompass HSPA (high speed packet access) for base station testing (R&S®FS-K74) and user equipment testing (R&S®FS-K73)

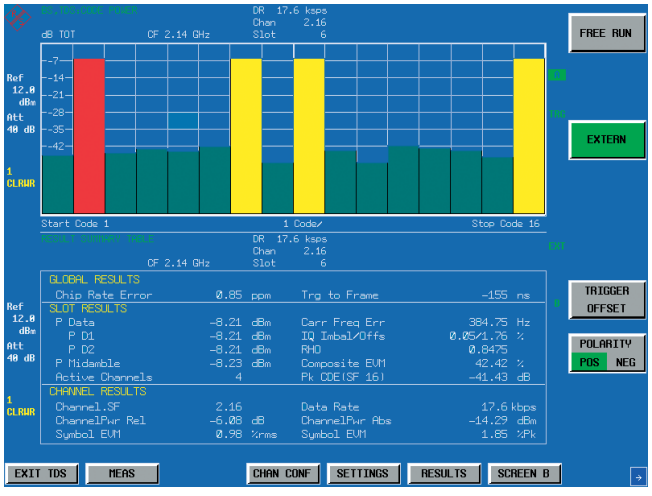
R&S®FS-K73+

- Adds HSPA+ capabilities to the R&S®FS-K73

R&S®FS-K74+

- Provides additional functionality for HSPA+ testing in line with 3GPP Release 7

R&S®FS-K76/-K77 TD-SCDMA Test



Code domain power measurement on a signal with four active channels: Active and inactive channels are displayed; inactive channels (noise, interference) are displayed with a spreading factor of 16. The table also shows the main parameters of the total signal at a glance, e.g. total power, pilot power, frequency error and error of chip rate, as well as the parameters of the marked code channel such as code power and EVM.

Base station and mobile station tests on TD-SCDMA with the R&S®FSQ/FSU/FSP and R&S®FSMR

The R&S®FS-K76/-K77 application firmware adds measurement functions in line with 3GPP as well as China Wireless Telecommunication Standard Group (CWTS) specifications to the R&S®FSQ/FSU/FSP analyzers. It enhances the range of applications to include code domain power and modulation measurements on TD-SCDMA base stations.

- Code domain power measurement
- Easy measurement of modulation quality
- Automatic detection of active channels
- Spectrum emission mask
- Remote control

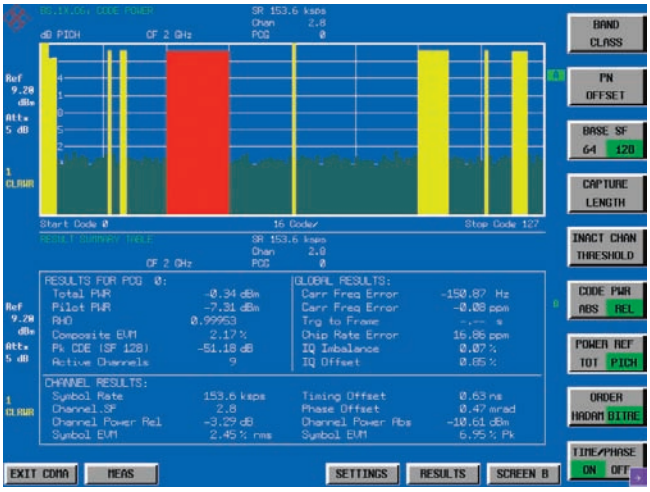
R&S®FS-K76

- Provides the functionality needed for base station testing

R&S®FS-K77

- Provides user equipment (UE) functionality

R&S®FS-K82/-K84 Base Station Test



Code domain power measurement on a signal with nine active channels: Active and inactive channels are displayed in bit-reversed order; inactive channels (noise, interference) are displayed with the base spreading factor. The table also shows the main parameters of the total signal at a glance, as well as the parameters of the marked code channel.

CDMA2000®/IS-95 base station test (R&S®FS-K82)

The R&S®FS-K82 application firmware enhances the range of applications to include code domain power and modulation measurements on CDMA2000® signals for radio configurations 1 to 5 and radio configuration 10. cdmaOne base station signals can be analyzed by using radio configuration 1 or 2.

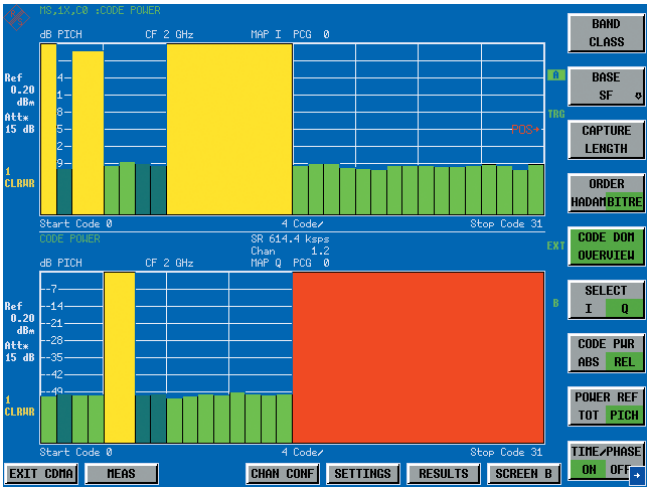
1xEV-DO base station test (R&S®FS-K84)

The R&S®FS-K84 application firmware adds the capability to measure code domain power modulation accuracy on all four channel types (pilot, preamble, MAC and DATA) of a 1xEV-DO base station signal.

Measurement parameters

- Code domain power (code domain analyzer)
- Code domain power versus time (R&S®FS-K82)
- Rho
- Error vector magnitude (EVM)
- Peak code domain error
- Power versus symbol
- Symbol constellation
- Channel table
- Code domain error power

R&S®FS-K83/-K85 Mobile Station Test



Code domain power measurement on a signal with high data rate transmission: Active and inactive channels are displayed in bit-reversed order; inactive channels (noise, interference) are displayed with the base spreading factor. The upper half shows the inphase part of the signal, the lower half the quadrature part.

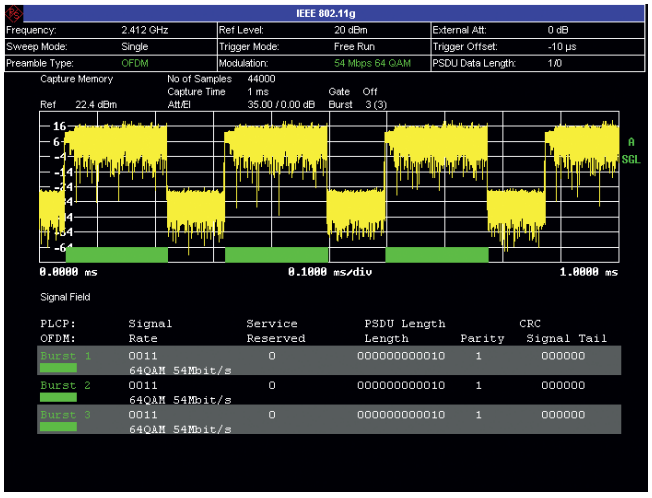
Transmitter measurements on 3GPP2 signals with R&S®FSQ/FSU/FSP/FSMR analyzers

The R&S®FS-K83 application firmware enhances the range of applications to include code domain power and modulation measurements on CDMA2000® signals for radio configurations 3 and 4. 1xEV-DV reverse link channels of release C are also supported. The R&S®FS-K85 application firmware adds the capability to measure code domain power modulation accuracy on all five channel types (PICH, RRI, DATA, ACK and DRC) as well as TRAFFIC and ACCESS operating modes of an access terminal.

Measurement parameters

- Code domain power
- 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
- Power versus chip (R&S®FS-K85)

R&S®FSx-K91/-K91n WLAN TX Measurements



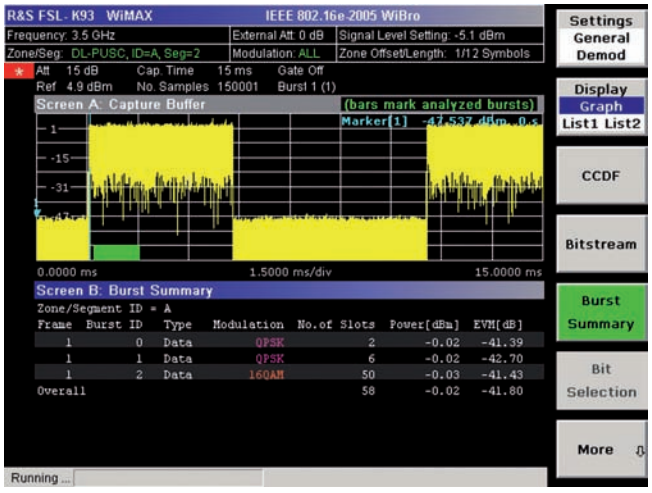
The signal field content is used for automatic modulation setting and can be displayed for further evaluation.

WLAN TX measurements with analyzers from Rohde & Schwarz

The R&S®FSx-K91/-K91n application firmware expands the application range of the R&S®FSQ/FSG/FSV/FSL and R&S®FMU signal and spectrum analyzers by the capability to perform spectrum and modulation measurements on signals in line with the WLAN IEEE 802.11a/b/g/j/n standard.

- Analysis at the RF or in the analog/digital baseband (optional for the R&S®FSQ)
- Demodulation bandwidth of 28 MHz/40 MHz/120 MHz
- Modulation formats for IEEE 802.11a/g/j/n: BPSK, QPSK, 16QAM, 64QAM
- Modulation formats for IEEE 802.11b: DBPSK, DQPSK, CCK, short PLCP, long PLCP
- Very low residual EVM of –44/–46 dB (0.7 % at 2.4 GHz)
- Legacy/mixed/Greenfield mode of IEEE 802.11n signals
- Provides complex WLAN measurements at a keystroke (automatic setting of modulation format)
- Allows remote control of all functions via IEC/IEEE bus or LAN

R&S®FSx-K92/-K93, R&S®FSQ-K94 WiMAX™/MIMO TX Measurements



The subranges of the WiMAX™ signal in the time domain (highlighted in green) are demodulated. The burst summary provides information about the bursts of the analyzed zone, e.g. modulation mode and EVM. The raw data bit stream can be displayed for all bursts, including the FCH field.

The R&S®FSx-K92 and R&S®FSx-K93 application firmware allows TX measurements on OFDM and OFDMA signals in line with the WiMAX™ IEEE 802.16-2004 and IEEE 802.16e-2005 standards. The R&S®FSQ-K94 application firmware enhances the capability of R&S®FSQ-K93 to include analysis of WiMAX™ MIMO signals for the R&S®FSQ and R&S®FSG.

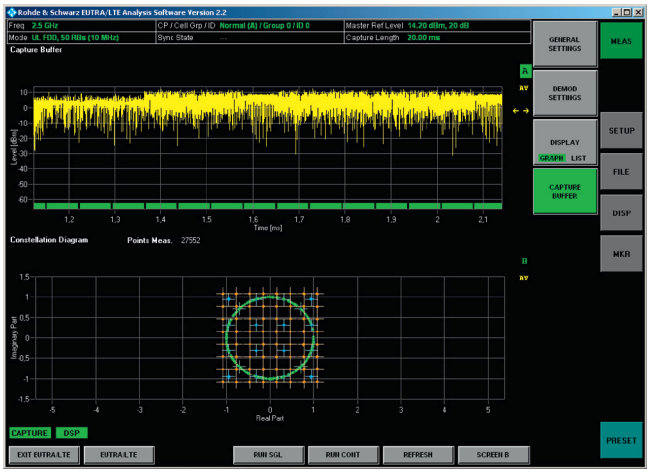
R&S®FSx-K92/-K93

- Enhances the R&S®FSQ/FMU/FSL/FSV and R&S®FSG analyzers by adding the capability to perform spectrum and modulation measurements on signals in line with the IEEE 802.16-2004 and IEEE 802.16e-2005 standards
- Supports OFDM and OFDMA
- Complex WiMAX™ measurements at a keystroke
- Measurements in the RF/IF range and in the baseband
- Remote control of all functions via IEC/IEEE bus or LAN

R&S®FSQ-K94

- Enhances the R&S®FSQ and R&S®FSG spectrum analyzers (when equipped with the R&S®FSQ-K93 application firmware) by adding the capability to perform spectrum and modulation measurements on WiMAX™ MIMO signals

R&S®FSQ-K100/101/102/104/105 EUTRA/LTE Signal Analysis



The most important measurement results are listed in a table to provide a quick overview of the performance of the transmitter.

- Error vector magnitude (EVM) of all carriers
- EVM physical channel
- EVM physical signal
- Frequency error
- Sampling error
- Modulation parameters: I/Q error, gain imbalance, quadrature error
- Power
- Crest factor

For advanced analysis, a number of graphical displays is available.

Transmitter measurements on LTE signals

The software analyzes the modulation quality, e.g. EVM or I/Q imbalance, of 3GPP EUTRA FDD and TDD signals in both uplink and downlink. When combining two or up to four signal analyzers, these tasks can even be performed on MIMO transmitters.

Designation	Type
EUTRA/LTE Downlink FDD Software	R&S®FSQ-K100
EUTRA/LTE Uplink FDD Software	R&S®FSQ-K101
EUTRA/LTE Downlink MIMO Software (requires R&S®FSQ-K100 or R&S®FSQ-K104)	R&S®FSQ-K102
EUTRA/LTE Downlink TDD Software	R&S®FSQ-K104
EUTRA/LTE Uplink TDD Software	R&S®FSQ-K105

R&S®FS-K110 TETRA Release 2 Analysis

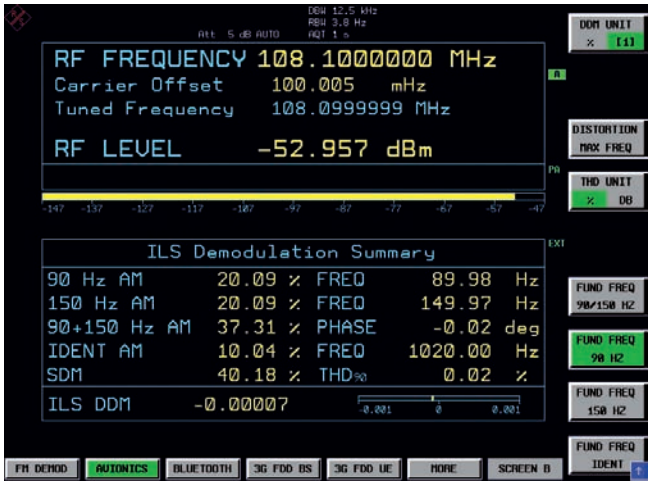
Adjacent channel power (ACP) measurement: The bandwidth of the TX channel depends on the number of carriers; the power in the adjacent channels is determined by means of a TETRA filter.

Transmitter measurements on TETRA signals

R&S®FS-K110 analyzes uplink and downlink signals in line with the EN 300 392-2 and EN 300 394-1 standards. It measures the modulation quality (e.g. EVM, I/Q imbalance, frequency error) and spectrum parameters such as ACP on continuous and burst signals.

- Supports 25 kHz, 50 kHz, 100 kHz, 150 kHz channels
- Supports 4QAM,16QAM and 64QAM data symbols
- Measurements:
  - Error vector magnitude (EVM)
  - Power versus time (PvT)
  - Adjacent channel power (ACP) due to modulation and transients
  - Constellation diagram, selectable per carrier and per symbol type
  - Bit stream
  - Phase and magnitude error
- Capture length up to 108 slots

R&S®FS-K15 VOR/ILS Demodulator



Precise VOR and ILS modulation analysis for calibration, development, production and service

The R&S®FS-K15 application firmware adds VOR/ILS analysis capability to the R&S®FSMR, R&S®FSU and R&S®FSQ. In the R&S®FSMR measuring receiver, the option enables the calibration of VOR/ILS signal generators and communications/navigation testers.

Using the R&S®FSMR and R&S®FS-K15 these instruments can be calibrated by a single box without any additional VOR/ILS tester. In the R&S®FSU/FSQ, R&S®FS-K15 is the ideal toolbox for development, verification, production testing, monitoring of operation and maintenance of ground infrastructure.

The R&S®FS-K15 is designed to replace the R&S®FMAV. It provides the same function set for VOR/ILS analysis and meets the uncertainty specifications of the R&S®FMAV.

- Low measurement uncertainty for
  - ILS DDM (difference in depth of modulation)
  - VOR phase
  - Modulation parameters of single signal components such as 90/150 Hz tones, 30 Hz/9.96 kHz subcarrier
- All measurement parameters at one glance in an easy-to-read table
- Selective distortion measurements for the 30 Hz, 90 Hz, 150 Hz, 1020 Hz components
- Analysis from RF or – in the R&S®FSMR – audio input
- Easy to operate: user simply has to select between VOR and ILS

R&S®EVS300 VOR/ILS Analyzer

Precision level and modulation analysis for ground and flight inspection

The R&S®EVS300 is a portable level and modulation analyzer designed especially for starting up, checking and maintaining ILS, VOR and marker beacon systems.

The integrated rechargeable battery and robust design make it the ideal choice for mobile, mains-independent measurements in the field. Due to the high measurement speed and the trigger/synchronization functions, the R&S®EVS300 is also tailor-made for deployment with flight inspection systems.

- Extremely fast (100 measurements per second)
- Synchronization via GPS, trigger and remote interfaces
- Digital separation of course and clearance signals using only one signal processing channel (R&S®EVS-K3 option)
- Expandable to support a second signal processing channel for simultaneous localizer and glideslope measurements (R&S®EVS-B1 option)
- Support for R&S®NRP and R&S®NRT power sensors from Rohde&Schwarz (R&S®EVS-K5 option)

R&S®FMAx Modulation Analyzers

Fast and accurate analysis of all parameters of analog modulated signals

The R&S®FMAx modulation analyzers combine the functionalities of several measuring instruments in a single box (RF counter, power meter, voltmeter, psophometer, distortion meter, FM stereo decoder). The R&S®FMAx modulation analyzers are suitable for measurements in the field of broadcasting (e.g. on AM and FM transmitters) and radiotelephony as well as in the calibration of signal generators. They can be upgraded to perform many other measurement tasks.

- AM, FM, φM demodulation
- 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
- Extremely high accuracy
- High-precision power measurement (typ. error < 0.5 dB)
- Stereo decoder
- Audio generator for single and dual tones, stereo MPX

Specifications in brief	
Frequency range	
R&S®FMA/FMAB	50 kHz to 1.36 GHz
R&S®FMAS	5 MHz to 1 (1.36) GHz
RF power measurement	0.18 µW to 1 W (–37.5 dBm to +30 dBm)
AM measurement frequency range	10 Hz to 200 kHz
FM measurement frequency range	10 Hz to 200 kHz
Max. measurable deviation for f_{in}	
50 kHz to 300 kHz	f_{in}/10
0.3 MHz to 10 MHz	150 kHz
≥ 10 MHz	700 kHz
φM measurement frequency range	200 Hz to 200 kHz
Max. measurable deviation	
300 kHz to 10 MHz	150 rad
≥ 10 MHz	700 rad
DC voltage measurement range	±10 µV to 20 V
AC voltage measurement range	30 µV to 20 V
Frequency range	10 Hz to 300 kHz
AF detectors	±peak, RMS, QP (R&S®FMA-B1)
Weighting filters	
Highpass filters	10/20/300 Hz (2nd/3rd/2nd order)
Lowpass filters: 3/23 kHz (4th order), combined with 20 Hz highpass filter in line with ITU-R 468-4, unweighted; 100 kHz (4th order)	
Filter option R&S®FMA-B1: ITU-R 468-4 (weighted); ITU-T P53, 5 Hz lowpass, 30 kHz and 120 kHz; Bessel lowpass of 4th order, 4.2 kHz; Cauer lowpass; special φM filter	
AF frequency counter	5 digits
Frequency range, resolution	10 Hz to 300 kHz, 1 mHz to 10 Hz

Functions of individual models, options	R&S®FMA	R&S®FMAB	R&S®FMAS
AM/FM/φM	•	•	•
Weighting filters (ITU-T, ITU-R): lowpass filter 5 Hz, 4.2 kHz (high skirt selectivity), 30 kHz, 120 kHz (Bessel), special φM filter	R&S®FMA-B1	•	•
DIST/SINAD meter: 10 Hz to 100 kHz, distortion measurable down to typ. < 0.005%	R&S®FMA-B2	•	•
Stereo decoder: RDS demodulator with external evaluation facility	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, generation of stereo multiplex signals	R&S®FMA-B4	R&S®FMA-B4	R&S®FMA-B4
Selective AF analysis up to 150 kHz: selective distortion, intermodulation, selective modulation and voltage measurement	R&S®FMA-B8	R&S®FMA-B8	•
RF/IF selection: 5 MHz to 1 GHz, connectible, tracking four-section preselection, selectable IF filters	–	–	•
Reference oscillator (1×10^{-7}/year)	R&S®FMA-B10	R&S®FMA-B10	R&S®FMA-B10

• = Standard – = not available

Chapter 3
Signal Generators

Rohde&Schwarz offers analog and digital signal generators with a variety of frequencies, standards, modulations and functions.

Type	Designation	Frequency range	Description	Page
RF vector signal generators				
R&S®SMU200A	Vector Signal Generator	100 kHz to 2.2/3/4/6 GHz	The art of signal generation	43
R&S®SMATE200A	Vector Signal Generator	100 kHz to 3 GHz/6 GHz	Production solution based on the R&S®SMU200A	43
R&S®SMJ100A	Vector Signal Generator	100 kHz to 3 GHz/6 GHz	Versatility in signal generation	44
R&S®SMBV100A	Vector Signal Generator	9 kHz to 3.2 GHz/6 GHz	Generating signals for today and tomorrow	44
RF analog signal generators				
R&S®SMA100A	Signal Generator	9 kHz to 3 GHz/6 GHz	The new standard of excellence in the analog signal generator class	45
R&S®SMB100A	Signal Generator	9 kHz to 1.1/2.2/3.2/6 GHz	Setting standards in the mid-range	45
R&S®SMC100A	Signal Generator	9 kHz to 1.1 GHz/3.2 GHz	Flexible and universal all-purpose signal generator	46
Microwave signal generators				
R&S®SMF100A	Microwave Signal Generator	100 kHz to 43.5 GHz	Signal generation redefined	46
R&S®SMR20/27/30/40	Microwave Signal Generators	10 MHz to 20/27/30/40 GHz	High performance, cost-effectiveness and reliability up to 40 GHz	47
R&S®SMR50/60	Microwave Signal Generators	10 MHz to 50 GHz/60 GHz	High performance, cost-effectiveness and reliability up to 60 GHz	47
Baseband signal generators				
R&S®AMU200A	Baseband Signal Generator and Fading Simulator		Versatile realtime I/Q source and cost-effective baseband fading simulator in a single unit	48
R&S®AFQ100A	I/Q Modulation Generator		Meeting new challenges in baseband signal generation, e.g. for aerospace and defense applications	48
R&S®AFQ100B	UWB Signal and I/Q Modulation Generator		High-performance baseband signals tailored to UWB applications	49
R&S®EX-IQ-BOX	Digital Signal Interface Module		Bidirectional digital I/Q interface for Rohde&Schwarz signal generators, analyzers and communications testers	49

R&S®SMU200A Vector Signal Generator

The art of signal generation

- First RF path from 100 kHz to 2.2/3/4/6 GHz
- Optional second RF path from 100 kHz to 2.2/3 GHz
- Up to two complete baseband paths
- Support of 3GPP LTE FDD and TDD, 3GPP FDD/HSPA/HSPA+, GSM/EDGE/EDGE Evolution, TD-SCDMA, WiMAX™ and all other important digital standards
- 2×2 MIMO with realtime fading possible
- Two instruments combinable for 2×4 or 4×2 MIMO
- Optional fading simulator with up to 40 fading paths
- I/Q modulator with 200 MHz RF bandwidth
- Optional baseband generator with realtime coder and arbitrary waveform generator
- Outstanding RF performance (SSB phase noise, wideband noise and level repeatability)
- I/Q modulator with 200 MHz RF bandwidth

Specifications in brief

Frequency	
Frequency range	100 kHz to 2.2/3/4/6 GHz
Setting time	< 2 ms, typ. 1.5 ms
Setting time in List mode	< 450 µs, typ. 300 µs
Level	
Level range	
Standard	–145 dBm to +13 dBm (PEP)
With option	–145 dBm to +19 dBm (PEP)
Setting time	< 2 ms, typ. 1.5 ms
Setting time in List mode	< 450 µs, typ. 300 µs
Spectral purity (at f = 1 GHz)	
Nonharmonics	
Standard, carrier offset > 850 kHz	< –86 dBc
Optional, carrier offset > 10 kHz	< –90 dBc
SSB phase noise (20 kHz carrier offset, 1 Hz measurement bandwidth)	
Standard	< –131 dBc, typ. –135 dBc
With option	< –136 dBc, typ. –139 dBc
Wideband noise (carrier offset > 10 MHz, 1 Hz measurement bandwidth)	
CW	< –150 dBc, typ. –153 dBc
I/Q modulation	
RF modulation bandwidth	
Using external I/Q inputs	200 MHz
Using internal baseband section	80 MHz
Supported standards and digital systems (depending on options)	
3GPP LTE FDD and TDD, 3GPP FDD/HSPA/HSPA+, TD-SCDMA, GSM/EDGE/EDGE Evolution, cdmaOne, CDMA2000®, 1xEV-DO, WiMAX™, IEEE 802.11a/b/g/n, TETRA, Bluetooth®, AWGN, user-defined multicarrier CW, GPS, DVB-H/T, DAB/T-DMB, XM Radio™, Sirius, HD Radio™	

R&S®SMATE200A Vector Signal Generator

Production solution based on the R&S®SMU200A

- Up to two independent signal generators in one unit
- 3 GHz or 6 GHz frequency options in one or two paths
- Very short setting times for frequency and level (frequency changes < 1 ms over GPIB and < 400 µs in List mode)
- Fast Hop mode offering flexibly addressable frequency/level pairs; as fast as normal List mode
- Multisegment waveform function enabling fast switching between different test signals in waveform generator
- Up to two independent baseband sources that not only support realtime signal generation but also offer arbitrary waveform generation with up to 128 Msamples each

Specifications in brief

Frequency range	100 kHz to 3 GHz or 6 GHz
Setting time	< 1 ms
Setting time in List mode	< 400 µs
Level range	
Standard	–145 dBm to +13 dBm (PEP)
With option	–145 dBm to +19 dBm (PEP)
Setting time	< 1 ms, typ. 1.5 ms
Setting time in List mode	< 450 µs, typ. 300 µs
Spectral purity (at f = 1 GHz)	see R&S®SMU200A
I/Q modulation	
RF modulation bandwidth	
Using external I/Q inputs	200 MHz
Using internal baseband section	80 MHz
Supported standards and digital systems (depending on options)	
3GPP LTE FDD and TDD, 3GPP FDD/HSPA/HSPA+, TD-SCDMA, GSM/EDGE/EDGE Evolution, cdmaOne, CDMA2000®, 1xEV-DO, WiMAX™, IEEE 802.11a/b/g/n, TETRA, Bluetooth®, AWGN, user-defined multicarrier CW, GPS, DVB-H/T, DAB/T-DMB	

R&S®SMJ100A Vector Signal Generator

Versatility in signal generation

- Frequency options from 100 kHz to 3 GHz/6 GHz
- Support of 3GPP LTE FDD and TDD, 3GPP FDD/HSPA/HSPA+, GSM/EDGE/EDGE Evolution, TD-SCDMA, WiMAX™ and all other important digital standards
- I/Q modulator with 200 MHz RF bandwidth
- Optional baseband generator with realtime coder and arbitrary waveform generator for maximum flexibility
- Optional ARB-only baseband generator as cost-saving alternative
- Excellent RF performance (SSB phase noise, wideband noise and level repeatability)

Specifications in brief	
Frequency	
Frequency range	100 kHz to 3 GHz/6 GHz
Setting time	< 2 ms, typ. 1.5 ms
Setting time in List mode	< 450 µs, typ. 300 µs
Level	
Level range	–145 dBm to +13 dBm (PEP)
Setting time	< 2 ms, typ. 1.5 ms
Setting time in List mode	< 450 µs, typ. 300 µs
Spectral purity (at f = 1 GHz)	
Nonharmonics (carrier offset > 850 kHz)	< –86 dBc
SSB phase noise (20 kHz carrier offset, 1 Hz measurement bandwidth)	< –129 dBc, typ. –133 dBc
Wideband noise (carrier offset >10 MHz, 1 Hz measurement bandwidth, CW)	< –150 dBc, typ. –153 dBc
I/Q modulation	
RF modulation bandwidth	
Using external I/Q inputs	200 MHz
Using internal baseband section	80 MHz
Supported standards and digital systems (depending on options)	
3GPP LTE FDD and TDD, 3GPP FDD/HSPA/HSPA+, TD-SCDMA, GSM/EDGE/EDGE Evolution, cdmaOne, CDMA2000®, 1xEV-DO, WiMAX™ , IEEE 802.11a/b/g/n, TETRA, Bluetooth®, AWGN, user-defined multicarrier CW, GPS, DVB-H/T, DAB/T-DMB, XM Radio™, Sirius, HD Radio™	

R&S®SMBV100A Vector Signal Generator

Generating signals for today and tomorrow

- Frequency options from 9 kHz to 3.2 GHz/6 GHz
- Low cost of ownership due to simple service concept
- Support of 3GPP LTE FDD/TDD, 3GPP FDD/HSPA/HSPA+, GSM/EDGE/EDGE Evolution, TD-SCDMA, WiMAX™ and all other important digital standards
- I/Q modulator with 528 MHz RF bandwidth
- Optional baseband generator with realtime coder and arbitrary waveform generator for maximum flexibility
- Optional ARB-only baseband generators as cost-saving alternatives
- Optimized for high production throughput
- Prepared for aerospace and defense applications

Specifications in brief	
Frequency	
Frequency range	9 kHz to 3.2 GHz/6 GHz
Setting time	< 3 ms, < 7 ms (I/Q modulation ON)
Setting time in List mode	< 1 ms
Level	
Level range	– 145 dBm to +18 dBm (PEP)
Setting time	< 2.5 ms, < 7 ms (I/Q modul. ON)
Setting time in List mode	< 1 ms
Spectral purity (at f = 1 GHz)	
Nonharmonics (carrier offset >10 kHz)	< –70 dBc
SSB phase noise (20 kHz carrier offset, 1 Hz measurement bandwidth)	< –122 dBc, typ. –128 dBc
Wideband noise (carrier offset > 10 MHz, 1 Hz measurement bandwidth, CW)	< –142 dBc, typ. –152 dBc
I/Q modulation	
RF modulation bandwidth	
Using external I/Q inputs	528 MHz
Using internal baseband section	120 MHz
Supported standards and digital systems (depending on options)	see R&S®SMJ100A

R&S®SMA100A Signal Generator

The new standard of excellence in the analog signal generator class

- Very low SSB phase noise
- Very short frequency/level setting times
- Very high level accuracy and repeatability
- High output power electronic attenuator with built-in overvoltage protection over entire frequency range
- Pulse modulator with excellent characteristics
- Optional operating altitude up to 4600 m
- Optional removable mass storage
- Selectable control language (SCPI or remote control emulation of various signal generators)

Specifications in brief	
Frequency range	9 kHz to 3 GHz/6 GHz
Setting time	< 2 ms
Level range	–145 dBm to +18 dBm (up to +28 dBm in overrange)
Setting time	< 1.5 ms
Setting time in List mode/Fast Hopping mode	< 450 µs
Spectral purity (at f = 1 GHz)	
Nonharmonics (carrier offset > 10 kHz, f ≤ 1500 MHz)	
Standard	< –80 dBc (typ. –90 dBc)
With R&S®SMA-B22 option	< –90 dBc (typ. –100 dBc)
SSB phase noise (20 kHz carrier offset, 1 Hz measurement bandwidth)	
Standard	< –131 dBc (typ. –135 dBc)
With R&S®SMA-B22 option	< –136 dBc (typ. –139 dBc)
Wideband noise (carrier offset > 10 MHz, 1 Hz measurement bandwidth)	
750 MHz < f ≤ 1500 MHz)	< –153 dBc (typ. –160 dBc)
Supported modulation modes	
AM, pulse	standard
FM/φM, chirped pulses, VOR/ILS, DME	depending on options
Clock synthesis	
Frequency range	100 kHz to 1.5 GHz (with R&S®SMA-B29 option)

R&S®SMB100A Signal Generator

Setting standards in the mid-range

- Frequency options from 9 kHz to 1.1/2.2/3.2/6 GHz
- High output power as standard
- On-site servicing as convenient alternative
- Best signal quality in the mid-range (SSB phase noise, wideband noise and nonharmonics)
- Very low SSB phase noise even at low output frequencies (new DDS synthesizer from 9 kHz to 23.4375 MHz used instead of downconverter)
- Excellent pulse modulation capabilities
- Testing of FM stereo and RDS receivers (optional)
- AM, FM/φM included as standard

Specifications in brief	
Frequency range	9 kHz to 1.1/2.2/3.2/6 GHz
Setting time	< 3 ms, typ. 1.6 ms
Setting time in List mode	< 1 ms
Level range	–145 dBm to +18 dBm (PEP)
Setting time	< 2.5 ms, typ. 1.2 ms
Setting time in List mode	< 1 ms
Spectral purity (at f = 1 GHz)	
Nonharmonics (carrier offset > 10 kHz)	< –70 dBc
SSB phase noise (20 kHz carrier offset, 1 Hz measurement bandwidth)	< –122 dBc, typ. –128 dBc
Wideband noise (carrier offset > 10 MHz, 1 Hz measurement bandwidth, CW)	< –142 dBc, typ. –152 dBc
Analog modulation	
Pulse	optional (R&S®SMB-K22)
Rise/fall time	< 20 ns, typ. 10 ns
Minimum pulse width	20 ns (R&S®SMB-K23 option)
AM depth	0% to 100%
Maximum FM deviation	16 MHz (f > 3 GHz)
Maximum φM deviation	160 rad (f > 3 GHz)

R&S®SMC100A Signal Generator

Flexible and universal all-purpose signal generator

- Smallest size and best price/performance ratio in its class
- Frequency range from 9 kHz to 1.1 GHz/3.2 GHz
- Maximum output level of typ. > +17 dBm
- Optional high-stability reference oscillator
- Analog modulation modes (AM/FM/φM/pulse) integrated as standard
- Integrated overvoltage protection
- Wear-free electronic attenuator
- Minimized total cost of ownership

Specifications in brief	
Frequency range	
R&S®SMC-B101 frequency option	9 kHz to 1.1 GHz
R&S®SMC-B103 frequency option	9 kHz to 3.2 GHz
Frequency setting time, SCPI mode	< 5 ms
Level	
Maximum output power	
f = 200 kHz to 3.2 GHz	> +13 dBm
f ≥ 500 kHz	typ. > +17 dBm in overrange
Level uncertainty (f = 200 kHz to 3.2 GHz, ALC ON, AUTO mode, T = +18 °C to +33 °C)	< 0.9 dB
Spectral purity	
SSB phase noise (f = 1 GHz, 20 kHz carrier offset, 1 Hz measurement bandwidth)	< –105 dBc (typ. –111 dBc)
Wideband noise (f > 1 MHz, level > 5 dBm, carrier offset > 10 MHz, 1 Hz measurement bandwidth)	< –138 dBc (typ. –148 dBc)
Supported modulation modes	
AM/FM/φM	standard
Maximum FM deviation	4 MHz (f > 1.6 GHz)
Maximum φM deviation	40 rad (f > 1.6 GHz)
Pulse	standard
Rise/fall time	< 500 ns (typ. 100 ns)
Minimum pulse width, with integrated pulse generator	1 µs
ON/OFF ratio	> 80 dB

R&S®SMF100A Microwave Signal Generator

Signal generation redefined

- Max. frequency range from 100 kHz to 22/43.5 GHz
- Excellent SSB phase noise of typ. –120 dBc (at 10 GHz; 10 kHz carrier offset)
- Very high output power of typ. +25 dBm
- Optional pulse modulator with excellent data: > 80 dB ON/OFF ratio, < 10 ns rise/fall time, < 20 ns pulse width
- Optional pulse generator
- Optional removable compact flash disk to meet high security requirements
- Connector for R&S®NRP-Zx power sensors for precise power measurement
- Usable for scalar network analysis with R&S®-NRP-Zx power sensor connected
- Remote control via GPIB, Ethernet or USB

Specifications in brief	
Frequency	
Frequency range	100 kHz to 43.5 GHz
Setting time	< 4 ms
Setting time in List mode	typ. < 700 µs
Level	
Setting range	–130 dBm to +30 dBm
Setting time	< 3 ms
Setting time in List mode	< 700 µs
Spectral purity	
SSB phase noise (f = 10 GHz, 10 kHz carrier offset, 1 Hz measurement bandwidth)	< –115 dBc (typ. –120 dBc)
Supported modulation modes	
With R&S®SMF-B20 option	AM/FM/φM/LOG AM
With R&S®SMF-K3 option	pulse modulation

R&S®SMR20/27/30/40 Microwave Signal Generators

High performance, cost-effectiveness and reliability up to 40 GHz

- Frequency range from 10 MHz up to 40 GHz
- Standard version: CW generator with pulse modulation and digital frequency sweep
- Easy upgrading to AM/FM signal generator and synthesized sweep generator with analog ramp sweep owing to flexible options concept
- Optional pulse generator for radar and EMC applications
- Optional IF input for upconversion of digitally modulated IF signals
- Compact, lightweight, user-friendly: ideal for lab and field applications

Specifications in brief	
Frequency range	10 MHz to 20/27/30/40 GHz
Setting time (to within < 1 × 10^{-6}) after IEC/IEEE-bus delimiter	< 10 ms + 2 ms/GHz
Level range	–130 dBm to +13 dBm (depending on frequency and options)
Setting time after IEC/IEEE-bus delimiter	
With R&S®SMR-B15/-B17 option	< 10 ms
With switching in attenuator	< 25 ms
SSB phase noise	
f = 10 GHz, 10 kHz carrier offset, 1 Hz bandwidth, CW, FM OFF	< –83 dBc
Supported modulation modes	pulse modulation
With R&S®SMR-B5 option	lin/log AM, FM

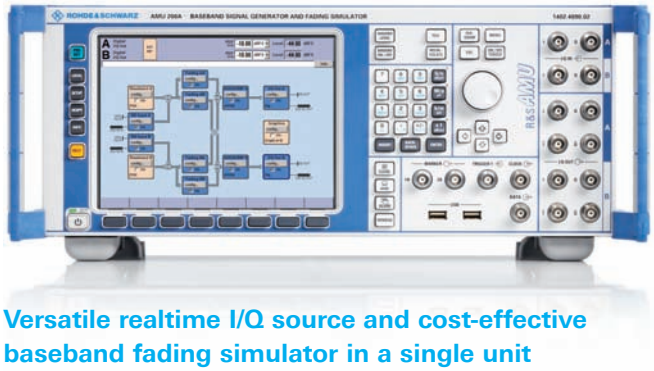
R&S®SMR50/60 Microwave Signal Generators

High performance, cost-effectiveness and reliability up to 60 GHz

- Frequency range from 10 MHz up to 60 GHz
- CW generator with pulse modulation and digital frequency sweep
- Fast quasi-analog ramp sweep
- Level sweep with a minimum step time of 1 ms
- Easy upgrading to AM/FM signal generator and synthesized sweep generator with analog ramp sweep owing to flexible options concept
- Optional pulse generator for radar and EMC applications
- Compact, lightweight, user-friendly: ideal for lab and field applications

Specifications in brief	
Frequency range	10 MHz to 50 GHz/60 GHz
Setting time (to within < 1 × 10^{-6}) after IEC/IEEE-bus delimiter	< 10 ms + 2 ms/GHz
Level range	–110 dBm to +11 dBm (depending on frequency and options)
Setting time after IEC/IEEE-bus delimiter	
With R&S®SMR-B15/-B17 option	< 10 ms
With switching in attenuator	< 25 ms
SSB phase noise	
f = 10 GHz, 10 kHz carrier offset, 1 Hz bandwidth, CW, FM OFF	< –83 dBc
Supported modulation modes	pulse modulation
With R&S®SMR-B5 option	lin/log AM, FM

R&S®AMU200A Baseband Signal Generator and Fading Simulator



Versatile realtime I/Q source and cost-effective baseband fading simulator in a single unit

- Single-path or dual-path instrument
- Up to two complete baseband paths
- Configuration as a fading simulator, an I/Q source, or an all-in-one instrument offering fading simulation and signal generation
- Baseband generators with universal coders for realtime signal generation
- Arbitrary waveform generators with 16 Msample, 64 Msample, or 128 Msample memory depth
- Analog single-ended, analog differential, and digital baseband outputs
- Lossless combination of up to four baseband signals in the digital domain (e.g. for testing multistandard base stations)

Specifications in brief

Baseband generator	
Waveform memory	16/64/128 Msample
Sampling rate	100 MHz
Baseband bandwidth	40 MHz
Fading simulator	
Fading bandwidth	80/50/30 MHz (RF)
Predefined fading scenarios	
Standard	CDMA2000®, GSM, NADC, PCN, TETRA, HiperLAN
With R&S®AMU-K71 option	3GPP FDD, moving delay, birth-death
With R&S®AMU-K72 option	SUI1 to SUI6, ITU OIP-A, ITU OIP-B, ITU V-A, DABRA, DAB-TU, DAB-SFN
MIMO fading	depending on options
Using one R&S®AMU200A	1×2, 2×1 and 2×2 MIMO fading
By combining two R&S®AMU200A	1×3, 1×4, 2×3, 2×4, 3×1, 4×1, 3×2 and 4×2 MIMO fading
Signal quality of analog I/Q outputs	
Frequency response up to 40 MHz	typ. 0.03 dB
SFDR (sine wave) up to 20 MHz	typ. 60 dB
Phase noise for 10 MHz sine wave at 20 kHz offset	typ. –150 dBc
Wideband noise for 10 MHz sine wave at 1 MHz offset	typ. –155 dBc

R&S®AFQ100A I/Q Modulation Generator

Meeting new challenges in baseband signal generation, e.g. for aerospace and defense applications

- Outstanding signal quality
- Tailored to digital communications systems
  - Variable memory clock rate (1 kHz to 300 MHz) can optimally be adjusted to the useful signal
  - RF bandwidth of 200 MHz, e.g. for compensating higher-order nonlinearities of multicarrier power amplifiers (MCPA)
  - Long signal duration of up to 1 Gsample (R&S®AFQ-B11 option); long signals are needed e.g. for bit error ratio (BER) measurements
  - R&S®WinIQSIM2™ options for communications standards such as WiMAX™, LTE, HSPA, etc.

Specifications in brief

Output memory	
Memory clock	1 kHz to 300 MHz
Waveform length (data and markers)	
Waveform memory (R&S®AFQ-B10)	up to 256 Msample
Waveform memory (R&S®AFQ-B11)	up to 1 Gsample
Amplitude resolution of data words	16 bit, analog and digital
System bandwidth (RF)	200 MHz
Signal output	
Number of outputs	2 (I and Q)
Output (unbalanced)	1 V (V_{pp})
Level range	0 V to 1.5 V (V_{pp})
Resolution	14 bit
Frequency response	±0.1 dB up to 100 MHz
Output (balanced)	2 V (V_{pp})
Level range	0 V to 3 V (V_{pp})
Resolution	14 bit
Frequency response	±0.1 dB up to 100 MHz
Spurious-free dynamic range	typ. 83 dBc

R&S®AFQ100B
UWB Signal and I/Q Modulation Generator

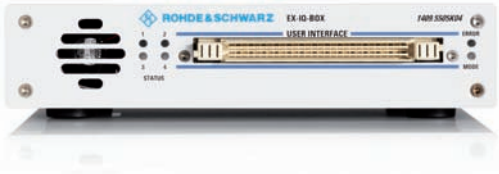
High-performance baseband signals tailored to wideband applications

- Memory clock rate:
  - Standard mode (mode 1): Variable clock rate (1 kHz to 300 MHz) can optimally be adjusted to the useful signal
  - Broadband mode (mode 2): 600 MHz
- 200 MHz RF bandwidth in standard mode
- 528 MHz RF bandwidth in broadband mode
- Long signal duration of up to 1 Gsample (option)
- R&S®WinIQSIM2™ option for flexible UWB (ECMA-368) signal generation (R&S®AFQ-K264)
- Almost all R&S®AFQ100A features included

Specifications in brief

Output memory	
Memory clock	
Mode 1	1 kHz to 300 MHz
Mode 2	600 MHz
Waveform length (data and markers)	
Waveform memory (R&S®AFQ-B11)	up to 1 Gsample
Waveform memory (R&S®AFQ-B12)	up to 512 Msample
Amplitude resolution of data words	16 bit analog and digital
System bandwidth (RF)	
Mode 1	200 MHz
Mode 2	528 MHz
Signal output	
Number of outputs	2 (I and Q)
Output (unbalanced)	1 V (V_{pp})
Level range	0 V to 1.5 V (V_{pp})
Resolution	14 bit
Frequency response	±0.1 dB up to 100 MHz
Output (balanced)	1 V (V_{pp})
Level range	0 V to 1.4 V (V_{pp})
Resolution	14 bit
Frequency response	±2.5 dB up to 264 MHz
Spurious-free dynamic range	typ. 78 dBc

R&S®EX-IQ-BOX
Digital Signal Interface Module



Bidirectional digital I/Q interface for Rohde&Schwarz signal generators, analyzers and communications testers

- Conversion of digital I/Q signals to and from the device under test
- Flexible user-defined digital I/Q interface settings (I/Q format, bit alignment, clock rate, logic levels, etc.)
- Two breakout boards included (single-ended, differential connectors) for connection of the device under test
- Easy interface configuration via enclosed R&S®DigIConf software
- Transient recorder in R&S®DigIConf for visual control of generated digital signals (I/Q diagram, vector diagram, CCDF, spectrum)
- Future-ready concept enabling extension to cover standardized interface protocols (e.g. CPRI, OBSAI, DigRF 3G/4G) and user-defined interface protocols via additional breakout boards (R&S®EX-IQ-BOX, model .04)

Specifications in brief

User defined digital interface protocol	
I/Q format	parallel, serial
Sample rate	1 kHz to 100 MHz
Resampling	automatically performed by Rohde&Schwarz instrument if required
Word size	4 to 18 bit (depending on Rohde&Schwarz instrument)
Logic level	LVTTL, CMOS, LVDS
Max. clock rate	100 MHz (parallel)/400 MHz (serial)
CPRI™ digital interface protocol (optional)	
Supported mobile standards	3GPP FDD (incl. HSDPA, HSUPA, HSPA+), CDMA2000®, LTE, WiMAX™
I/Q payload input	realtime via attached instrument; PN16 or 20 bit pattern via internal test generator; internal waveform memory (optional)
I/Q payload output	one selectable I/Q signal inside received CPRI frame in realtime via attached instrument
Control and management	fast C&M (Ethernet), slow C&M (HDLC), vendor-specific data
Visualization	graphical display of CPRI™ basic frame configuration
CPRI™ specific breakout board	support of SFP modules for optical link

Chapter 4
Network Analyzers

Vector network analysis (VNA) is one of the most essential RF/microwave measurement techniques. As a leading manufacturer of T&M equipment, Rohde&Schwarz offers a wide range of high-performance network analyzers.

Type	Designation	Frequency range	Description	Page
Network analyzers				
R&S®ZVA8 R&S®ZVA24/40/50/67	Vector Network Analyzers	300 kHz to 8 GHz 10 MHz to 24/40/50/67 GHz	High-end VNA with up to four sources for sophisticated measurements up to 67 GHz	51
R&S®ZVT8	Multiport Vector Network Analyzer	300 kHz to 8 GHz	Network analysis with two to eight test ports	52
R&S®ZVT20	Multiport Vector Network Analyzer	10 MHz to 20 GHz	Network analysis with two to six test ports	52
R&S®ZVB4/8 R&S®ZVB14/20	Vector Network Analyzers	300 kHz to 4/8 GHz 10 MHz to 14/20 GHz	High measurement speed with two or four test ports	53
R&S®ZVL	Vector Network Analyzer	9 kHz to 3/6/13.6 GHz	Cost-efficient compact class in network analysis (two test ports)	54
Converters				
R&S®ZVA-Z75	Millimeter-Wave Converter	50 GHz to 75 GHz	Network analysis up to 75 GHz	55
R&S®ZVA-Z90E	Millimeter-Wave Converter	60 GHz to 90 GHz	Network analysis up to 90 GHz	55
R&S®ZVA-Z110/110E	Millimeter-Wave Converters	75 GHz to 110 GHz	Network analysis up to 110 GHz	55
R&S®ZVA-Z325	Millimeter-Wave Converter	220 GHz to 325 GHz	Network analysis up to 325 GHz	55
Accessories for network analysis				
R&S®ZVAX24	Extension Unit	10 MHz to 24 GHz	Measurements on active devices made easy	55
R&S®ZV-Z81/-Z82	Switch Matrix	50 MHz to 24 GHz	Two or four VNA ports, up to nine test ports	55
R&S®ZV-Z5x	Calibration Units	300 kHz to 50 GHz	Automatic calibration of vector network analyzers (two, four, six, eight ports)	55
R&S®ZV-Z52/54/55/59	Automatic Calibration Units	10 MHz to 20/40/50 GHz	Automatic calibration of vector network analyzers	55
R&S®ZCAN	Calibration Kits	0 Hz to 3 GHz	Manual calibration kits (coaxial)	55
R&S®ZV-WRxx	Manual Waveguide Calibration Kits	50 GHz up to 325 GHz	Manual calibration kits (coaxial)	55
R&S®ZV-Z121/132	Manual Calibration Kits	0 Hz to 8 GHz/13 GHz	Manual calibration of vector network analyzers (economy)	55
R&S®ZV-Z2xx	Manual Calibration Kits	0 Hz to 67 GHz	Manual calibration of vector network analyzers (precision)	55

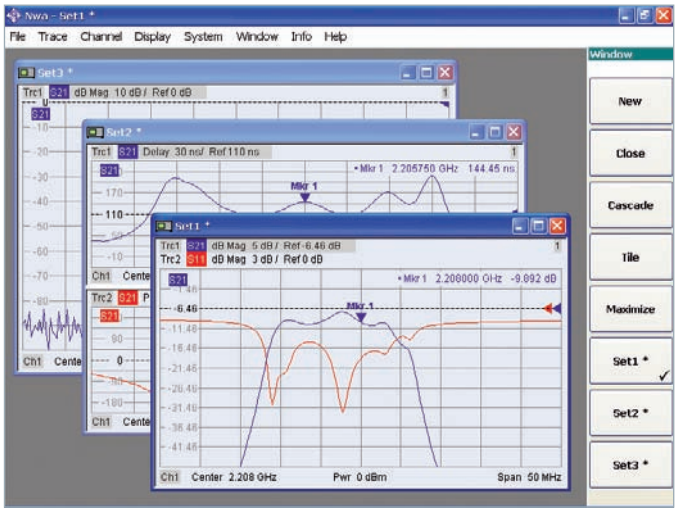
R&S®ZVA Vector Network Analyzer

High-end VNA with up to four sources for sophisticated measurements up to 67 GHz

The R&S®ZVA series is an ideal choice for demanding measurements on active and passive components and modules, which require high performance and wide versatility. All instruments support scalar and vector measurements on mixers and converters (linear and nonlinear) and noise measurements on amplifiers as well as pulsed measurements for aerospace and defense applications. The frequency range of the high-frequency models can be extended to more than 0.3 THz.

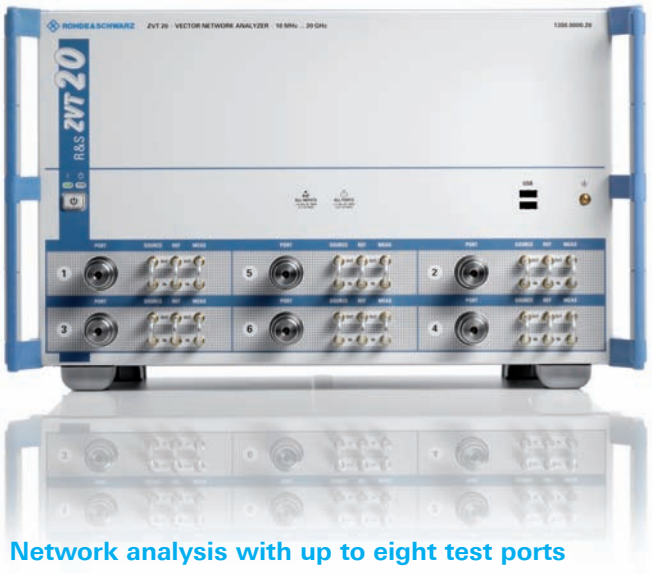
- First VNA
  - With four internal sources up to 67 GHz for fast two-tone measurements on amplifiers and mixers
  - Up to 67 GHz and generating phase-coherent signals
  - With IF bandwidths up to 30 MHz for pulsed measurements on amplifiers and mixers
- Phase and group delay measurements of conversion loss on mixers with and without LO access
- Harmonic, compression, intermodulation and hot S_{22} measurements on amplifiers and mixers
- New method for noise figure definition without noise source
- Point-in-pulse, average pulse and pulse profile measurements
- Two internal pulse generators
- Internal pulse modulators and combiner by means of the R&S®ZVAX24
- Embedding/deembedding impedance matching using virtual networks
- True differential measurements to characterize nonlinear effects of balanced devices
- Versatile calibration techniques: TOSM, TRL/LRL, TOM, TRM, TNA, UOSM and AutoCal

Specifications in brief	
Number of test ports	2 or 4
Frequency range	
R&S®ZVA8	300 kHz to 8 GHz
R&S®ZVA24/40/50/67	10 MHz to 24/40/50/67 (70) GHz
Measurement time per test point	< 3.5 µs
Measurement time, 201 test points	4.7 ms
Data transfer time, 201 test points	
Via IEC/IEEE bus	< 2.9 ms
Via VX11 over 100 Mbit/s LAN	< 1.3 ms
Via RSIB over 100 Mbit/s LAN	< 0.7 ms
Switching time	
Between channels	< 1 ms
Between instrument setups	< 10 ms
Max. dynamic range at 10 Hz measurement bandwidth	
Between test ports	
R&S®ZVA8	130 dB, typ. > 140 dB
R&S®ZVA24	130 dB, typ. > 135 dB
R&S®ZVA40	130 dB, typ. > 140 dB
R&S®ZVA50	130 dB, typ. > 140 dB
R&S®ZVA67	125 dB, typ. > 135 dB
With direct receiver access	
R&S®ZVA8	typ. > 150 dB
R&S®ZVA24	typ. > 150 dB
R&S®ZVA40	typ. > 150 dB
R&S®ZVA50	typ. > 150 dB
R&S®ZVA67	typ. > 145 dB
Output power at test port	
R&S®ZVA8	> 13 dBm, typ. 15 dBm
R&S®ZVA24	> 13 dBm, typ. 18 dBm
R&S®ZVA40	> 13 dBm, typ. 18 dBm
R&S®ZVA50	> 13 dBm, typ. 18 dBm
R&S®ZVA67	> 13 dBm, typ. 18 dBm
Power sweep range	> 40 dB, typ. 50 dB
IF bandwidths	1 Hz to 30 MHz
Channels, diagrams, traces	> 100
Test points per trace	1 to 60001
Operating system	Windows XP Embedded



Switching between setups at the click of a mouse.

R&S®ZVT
Multiport Vector Network Analyzer



Network analysis with up to eight test ports from 300 kHz to 20 GHz

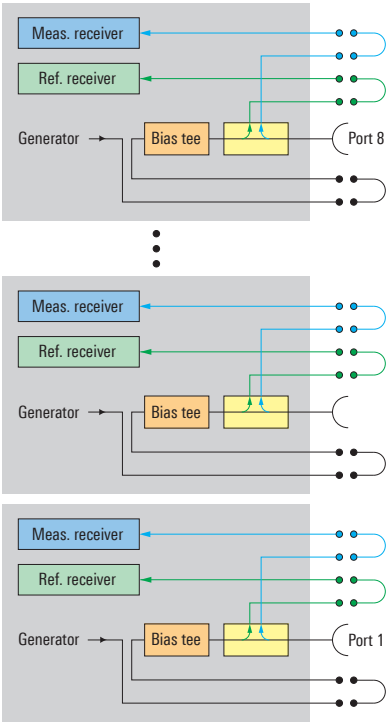
The R&S®ZVT8 contains up to four internal generators and up to 16 receivers. The R&S®ZVT20 includes up to three internal generators and up to 12 receivers. This unique concept with one generator per two test ports makes the R&S®ZVT ideal for intermodulation measurements, even on mixers, (true) differential balanced measurements, multireceiver measurements with antennas or high throughput and efficiency in production.

Hardware options such as direct generator/receiver access for the individual ports enable versatile test set configuration. Based on this concept, the R&S®ZVT multiport vector network analyzers provide solutions for even the most demanding measurement tasks.

The R&S®ZVT provides all functions of the R&S®ZVA, plus features based upon multichannel and multireceiver capability

- Arbitrary frequency conversion measurements
- Multiport measurements, avoiding any time loss due to matrix control
- Flexible configuration of test ports for balanced and single-ended measurements
- True differential measurements, coherence mode
- Multiple-signal measurements, e.g. intermodulation measurements on mixers or double-converting DUTs, requiring only a single unit and extremely short run times
- Enhanced performance by parallel measurements on several DUTs
- Multichannel receiver with simultaneous sampling of channels, e.g. for phase measurements on antenna arrays
- Automatic calibration units
- Point-in-pulse and pulse profile measurements with up to 16 receivers

R&S®ZVT with direct generator/receiver access



Specifications in brief

	R&S®ZVT8	R&S®ZVT20
Number of test ports [1]	2 to 8	2 to 6
Frequency range	300 kHz to 8 GHz	10 MHz to 20 GHz
Measurement time (201 points)	5 ms	5 ms
Data transfer time (201 points)		
Via IEC/IEEE bus	< 2.9 ms	< 2.9 ms
Via VX11 (100 Mbit/s LAN)	< 1.3 ms	< 1.3 ms
Via RSIB (100 Mbit/s LAN)	< 0.7 ms	< 0.7 ms
Switching time		
Between channels	< 1 ms	< 1 ms
Between instrument setups of up to 2001 points	< 10 ms	< 10 ms
Electronic power sweep range	> 50 dB	> 40 dB
Dynamic range (at test ports)	120 dB	120 dB
Output level	+13 dBm	+10 dBm
Sensitivity at 10 Hz measurement bandwidth	–110 dBm	–105 dBm
IF bandwidths	1 Hz to 1 MHz [2]	1 Hz to 1 MHz [2]
Number of channels and traces	> 100 [3]	> 100 [3]
Number of points per trace	60001	60001
Operating system	Windows XP Embedded	

[1] Depending on installed options.
[2] With options up to 30 MHz.
[3] Limited by available RAM capacity.
[4] Typical; max. number depends on number of channels and data points.

R&S®ZVB Vector Network Analyzer

- Multiport measurements
- Balanced measurements
- Mixer and harmonics measurements
- Response power calibration and power measurements
- Filter measurements and adjustments
- Measurements on active components
- Integrated embedding/deembedding function
- Integrated PC with Windows XP for automated procedures and data management
- Optimization of test and production sequences

High measurement speed up to 20 GHz with two or four test ports

The R&S®ZVB combines excellent performance with low weight and compact design. Intelligent and user-friendly functions offer maximum ease of operation. They allow the large number of measured quantities involved in multiport and balanced measurements to be handled easily, and also offer a variety of ways to optimize production sequences – a smart solution that satisfies even the most challenging demands.

High-speed parallel measurements can be achieved because the generator signal can be output to multiple test ports simultaneously, plus data can be captured at multiple ports simultaneously and all displayed at the same time. For example, the R&S®ZVB four-port version makes it possible to measure two two-port DUTs simultaneously, which doubles performance.

It is also possible to measure and display the four reflection parameters S_{11} to S_{44} simultaneously on a four-port DUT (provided that DUT ports are uncoupled). This reduces measurement time by a factor of 4 compared with instruments featuring just one generator and a conventional switching technique.

Specifications in brief	
Frequency range (R&S®ZVB4/8)	300 kHz to 4 GHz/8 GHz
Frequency range (R&S®ZVB14/20)	10 MHz to 14 GHz/20 GHz
Measurement time per point (CW mode, at 500 kHz IF bandwidth)	< 4.5 µs
Measurement time (including any data transfer time) [1]	< 4.5 ms
Data transfer time	data transfer simultaneous with measurement
Dynamic range (at 10 Hz IF bandwidth)	> 123 dB
Inherent noise	< –110 dBm
Power sweep range [2]	–40 dBm to +13 dBm
IF bandwidths	1 Hz to 500 kHz
Number of measurement points per trace	1 to 60001
Number of test ports	2 or 4
Number of measurement and reference receivers	one measurement and one reference receiver per test port
Number of integrated generators	one generator per test port pair
Calibration techniques	TOSM, UOSM, TRL/LRL, TOM, TRM, TNA, automatic calibration unit
Operating system and internal PC	Windows XP
Number of traces, diagrams, independent channels, setups that can be simultaneously loaded into RAM	> 100 [3], traces can be assigned to diagrams as required

[1] Specification valid for 201 measurement points, measurement bandwidth 500 kHz, display OFF, ALC OFF, at 5 GHz, narrow span.
[2] Power level that can be electronically swept.
[3] Number limited only by internal memory.

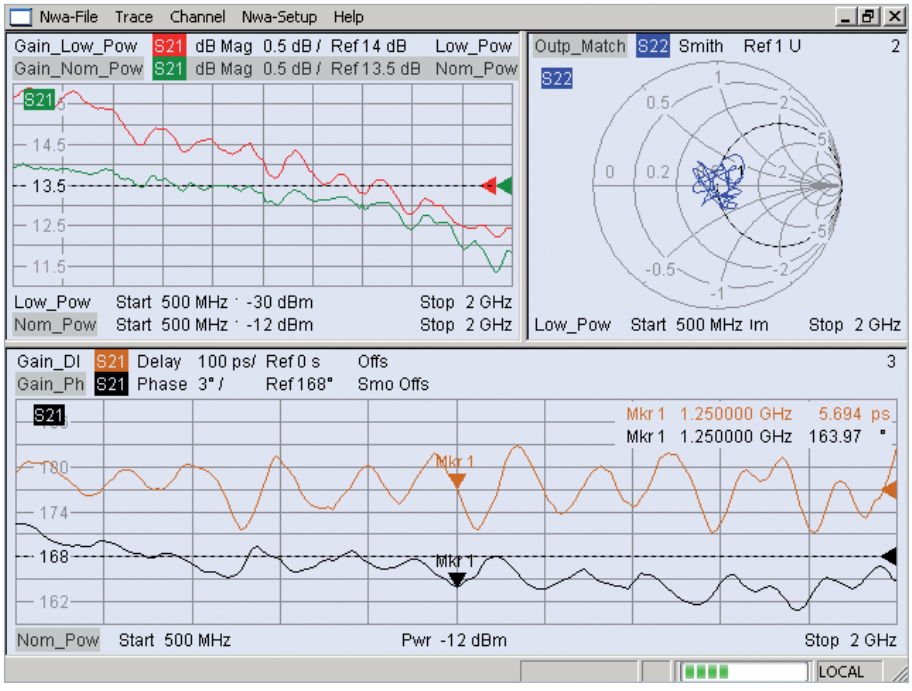
R&S®ZVL Vector Network Analyzer

The cost-efficient compact class in network analysis

- Network analyzer, spectrum analyzer and power meter in a single box
- Digital communications standards
- Bidirectional test set for displaying all four S-parameters
- R&S®ZVL3-75: 75 Ω vector network analyzer for TV and CATV measurements
- Multitrace display for displaying all relevant parameters
- Distance-to-fault measurement for detecting cable faults
- Time domain analysis
- Operation with mouse or hardkeys/softkeys – convenient user interface with wizards and context menus
- Undo/Redo softkey for reversing up to six preceding operating steps
- USB connector for R&S®NRP-Z power sensor series for precise power measurements
- DVI-D connector for external monitor
- Internal battery and 12 V DC operation
- Small, compact, lightweight and portable (< 7 kg)

Specifications in brief

Frequency range	
R&S®ZVL3/6/13, specified	9 kHz to 3 GHz/6 GHz/13.6 GHz
R&S®ZVL3/6/13, unspecified	5 kHz to 3 GHz/6 GHz/15 GHz
Network analysis	
Measurement time (201 measurement points, full two-port-calibrated)	< 75 ms
Data transfer (201 measurement points)	1.5 ms (via RSIB over 100 Mbit/s LAN)
Dynamic range at 10 Hz measurement bandwidth	> 115 dB, typ. 123 dB
Output power	> 0 dBm, typ. +10 dBm
Measurement bandwidths	10 Hz to 500 kHz in 1/2/5 steps
Weight (without battery)	< 7 kg (15.43 lb)
Channels, diagrams and traces	> 100
Measurement points per trace	2 to 4001
Operating system	Windows XP
Spectrum analysis	
Resolution bandwidths	
Standard	300 Hz to 10 MHz in 1/3 steps, 20 MHz at zero span
With R&S®FSL-B7 option	(1 Hz) 10 Hz to 10 MHz in 1/3 steps
Video bandwidths	10 Hz to 10 MHz
I/Q demodulation bandwidth	20 MHz
SSB phase noise at 500 MHz	typ. –103 dBc (1 Hz), 10 kHz carrier offset
Displayed average noise level	
Without preamplifier at 1 GHz	< –140 dBm (1 Hz)
With preamplifier at 1 GHz	< –156 dBm (1 Hz), typ. –163 dBm
IP3	> +5 dBm, typ. +12 dBm
Detectors	max/min peak, auto peak, RMS, quasi-peak, average, sample
Level measurement uncertainty (95 % confidence level)	< 0.5 dB



Multitrace display for faster DUT characterization.

Accessories for network analysis

R&S®ZVA-Z75/-Z90E/-Z110/-Z110E/-Z140/-Z325 Millimeter-Wave Converters

Network analysis up to 325 GHz
Featuring a high dynamic range, the Rohde&Schwarz converters offer high operating convenience and allow fast measurements. For a two-port measurement, a four-port network analyzer and two converters are necessary; no external generator is required. When using a two-port network analyzer, an external generator is necessary to supply the LO signals. Different models are available for the V (WR15)/E (WR12)/W (WR10)/F (WR08) and J (WR03) band.

R&S®ZVAX24 Extension Unit

Measurements on active devices made easy
The R&S®ZVAX24 extension unit for the R&S®ZVA simplifies harmonic, intermodulation, high-power and pulsed measurements on active devices such as amplifiers. Depending on the measurement tasks, it can be configured with combiners, harmonic filters, pulse modulators or high-power couplers.

It is directly controlled by the R&S®ZVA via a graphical user interface. The combination of an R&S®ZVA and the R&S®ZVAX24 behaves like a fully integrated single box. However, if multiple R&S®ZVA analyzers are being used in a lab, they can share the extension unit. This helps ensure optimum investment utilization.

R&S®ZV-Z81/-Z82 Switch Matrix

Two or four VNA ports, up to nine test ports
- Frequency range: 50 MHz to 24 GHz
- Impedance: 50 Ω
- Port connector: type K (2.92 mm), female
- Damage level: +23 dBm
- Damage DC voltage: 12 V
- Isolation
  - 50 MHz to 8 GHz: > 90 dB
  - 8 GHz to 24 GHz: > 80 dB
- Switching time
  - USB: 10 ms, nominal
  - LAN: 12 ms, nominal
  - RS-232-C: 8 ms, nominal
- Remote control: USB, LAN, RS-232-C

R&S®ZV-WRxx Manual Waveguide Calibration Kits

Designation	Type (models with/without sliding match)	Frequency range
Calibration kit WR03	R&S®ZV-WR03	220 GHz to 325 GHz
Calibration kit WR05	R&S®ZV-WR05	140 GHz to 220 GHz
Calibration kit WR06	R&S®ZV-WR06	110 GHz to 170 GHz
Calibration kit WR08	R&S®ZV-WR08	90 GHz to 140 GHz
Calibration kit WR10	R&S®ZV-WR10	75 GHz to 110 GHz
Calibration kit WR12	R&S®ZV-WR12	60 GHz to 90 GHz
Calibration kit WR15	R&S®ZV-WR15	50 GHz to 75 GHz

R&S®ZCAN/ZV-Z121/-Z132/-Z2xx Manual Calibration Kits (coaxial)

Type, connector	Description
R&S®ZCAN, type N, 75 Ω	TOSM, 3 GHz
R&S®ZCAN, type N, 50 Ω	TOSM, 3 GHz
R&S®ZV-Z121, type N, male/female	Combination, 8 GHz
R&S®ZV-Z270, 3.5 mm, male/female	TOSM, fixed matches, 18 GHz
R&S®ZV-Z132, 3.5 mm, male/female	Combination, 13 GHz
R&S®ZV-Z235, 3.5 mm	TOSM, fixed matches, 26 GHz
R&S®ZV-Z229, 2.92 mm, male/female	TOSM, fixed matches, 40 GHz
R&S®ZV-Z224, 2.4 mm, male/female	TOSM, fixed matches, 50 GHz
R&S®ZV-Z218, 1.85 mm, male/female	TOSM, fixed matches, 67 GHz

R&S®ZV-Z5x Automatic Calibration Units

Type, connector	Frequency range, ports
R&S®ZV-Z53, N female	300 kHz to 3 GHz, 2 ports, 75 Ω
R&S®ZV-Z53, N female	300 kHz to 18 GHz, 2 ports, 50 Ω
R&S®ZV-Z51, N female	300 kHz to 8 GHz, 4 ports
R&S®ZV-Z58, N female	300 kHz to 8 GHz, 8 ports
R&S®ZV-Z53, 3.5 mm female	300 kHz to 24 GHz, 2 ports
R&S®ZV-Z51, 3.5 mm female	300 kHz to 8 GHz, 4 ports
R&S®ZV-Z52, 3.5 mm female	10 MHz to 24 GHz, 4 ports
R&S®ZV-Z58, 3.5 mm female	300 kHz to 8 GHz, 8 ports
R&S®ZV-Z59, 3.5 mm female	10 MHz to 20 GHz, 6 ports
R&S®ZV-Z54, 2.92 mm female	10 MHz to 40 GHz, 2 ports
R&S®ZV-Z55, 2.4 mm female	10 MHz to 50 GHz, 2 ports

Chapter 5
Drive Test Tools

The number of mobile networks as well as new technologies are steadily increasing. Rohde&Schwarz drive test systems are available in various designs that are always tailored to meet your specific needs and optimize your benefits.

Type	Designation	Description	Page
Hardware			
R&S®TSMW	Universal Radio Network Analyzer	Scanner for drive tests and I/Q streaming	57
R&S®TSMQ	Radio Network Analyzer	Just one drive test covers all standards	57
R&S®TSMU	Radio Network Analyzer	Flexible drive test solution	57
R&S®TSML	Radio Network Analyzer	Technology-specific drive test solution	57
R&S®TSM-DVB	DVB-T/DVB-H Diversity Test Receiver	Compact drive test receiver for DVB-T and DVB-H	58
R&S®TSMX-PPS	GPS Module	GPS receiver module with PPS output	58
Software			
R&S®ROMES4	Drive Test Software	Mobile coverage and QoS measurements in wireless communications	59
R&S®ROMES2GO	3GPP Walk Test Solution	QoS assurance made simple	59
Systems			
R&S®TS51GA30	Coverage Suitcase System	Compact case system for outdoor measurements	60
R&S®TS9955	High-Performance Drive Test System	Drive test platform for accurate and fast coverage measurements in mobile radio and broadcasting networks	60
R&S®TSMU-Z3	Coverage Backpack	Lightweight backpack solution for indoor and outdoor coverage measurements	61

R&S®TSMW
Universal Radio Network Analyzer

Scanner for drive tests and I/Q streaming

The R&S®TSMW universal radio network analyzer is a high-end platform for optimizing all conventional mobile radio networks. Two highly sensitive 20 MHz frontends for any input frequency from 30 MHz to 6 GHz, a dual-channel preselection and an FPGA-based software-defined architecture offer unsurpassed performance while providing maximum flexibility and operational readiness. In addition to functioning as a scanner for wireless communications networks, the R&S®TSMW is also an ideal digital I/Q baseband receiver for customer-specific applications.

- User-definable input frequency range from 30 MHz to 6 GHz
- Two independent RF and signal processing paths, each with a bandwidth of 20 MHz
- Integrated preselection for high intermodulation suppression with wide dynamic range
- Support of LTE FDD and TD-LTE measurements together with the R&S®ROMES drive test software
- Parallel measurements in GSM, WCDMA, CDMA2000® 1xEV-DO, WiMAX™, TETRA and LTE networks
- I/Q baseband streaming with Gigabit interface
- Integrated GPS

R&S®TSMx Radio Network Analyzers

Powerful scanner family for mobile applications

The R&S®TSML, R&S®TSMU and R&S®TSMQ form a family of radio network analyzers with scanner functionality. Their compact size and low power consumption make them ideal for mobile applications. Even a fully equipped backpack solution can easily be implemented in order to perform indoor measurements, for example.

When combined with the R&S®ROMES4 drive test software, the scanners provide their full-range functionality and maximum performance. Interference measurements, automatic neighborhood measurements or fast spectrum measurements can be performed in virtually no time. The software has been designed for multicore CPUs to enable simultaneous multiple measurements.

- No band limiting – support of all frequencies from 80 MHz to 3 GHz or 6 GHz (R&S®TSML-CW)
- Decoding of all broadcast information
- Small weight and low power consumption
- Suitable for GSM, WCDMA, CDMA2000® 1xEV-DO, spectrum, CW
- High measurement speed in all technologies

Device	GSM	WCDMA	CDMA2000® 1×EV-DO	CW
R&S®TSML-G	•	–	–	–
R&S®TSML-W	–	•	–	–
R&S®TSML-C	–	–	•	–
R&S®TSML-CW	–	–	–	•
R&S®TSML-GW	•	•	–	–
R&S®TSMU	•	•	•	•
R&S®TSMQ	•	•	•	•

Simultaneous or single measurement possible.

R&S®TSM-DVB
DVB-T/DVB-H Diversity Test Receiver

Flexible drive test receiver for DVB-T and DVB-H

For survey tests in DVB-T/DVB-H networks, operators usually perform measurements in line with the ETSI DVB-T and DVB-H standards:

- ETSI EN 50083-9
- ETSI EN 300 744 including annex F

Stationary measurements are performed with directional antennas raised to 10 m above the surface. These measurements require tremendous investments in specialized measurement vehicles.

Furthermore, these kind of coverage measurements take a lot of time. Finally, the coverage information is collected only for smaller areas, not in the broad field.

Digital broadcasting technologies (such as DVB-T/DVB-H) are generating a demand for new coverage measurement methods that do more than the traditional procedure mentioned above. These new methods must work in mobile scenarios, i.e. during driving.

The R&S®TSM-DVB DVB-T/DVB-H diversity test receiver has been designed for mobile measurements in DVB-T/DVB-H networks, even at very high driving speed (up to 100 km/h). Its concept helps ensure reliable and fast measurements.

- Fast DVB-T and DVB-H measurements for drive test applications
- Indoor and outdoor coverage measurements possible
- Fully software-supported application via R&S®ROMES
- VHF (channels 5 to 12)
- UHF (channels 21 to 69)
- User-selectable IF bandwidths of 5/6/7/8 MHz
- Low power consumption of 12 V DC/12 W
- Secured measurements due to antenna diversity
- Two ASI outputs for two MPEG transport streams

R&S®TSMX-PPS GPS Module

GPS receiver module with PPS output

- SuperSense GPS receiver
- Pulses per second (PPS) output
- 16 channels
- Activation interval of 4 Hz
- Compact, light and versatile

High sensitivity

- May also be used in buildings
- High accuracy

PPS output

- Precise synchronization of an R&S®TSMx scanner

Fast update rate

- Local resolution higher than with conventional GPS receivers

Supported instruments

The R&S®TSMX-PPS with PPS pulses can be used in combination with one of the following instruments:

- R&S®TSMQ
- R&S®TSML-C
- R&S®TSML-G
- R&S®TSML-W
- R&S®TSML-GW
- R&S®TSMU with R&S®TSMU-K11/-K12/-K13

R&S®ROMES4 Drive Test Software

Mobile coverage and QoS measurements

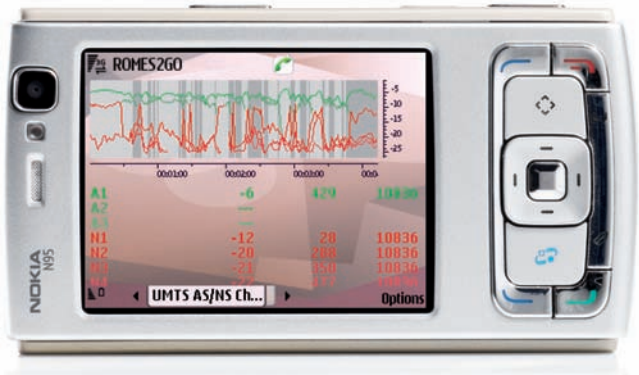
R&S®ROMES4 is a test platform for mobile measurements in all modern radio networks. In combination with scanners and test mobile phones, it forms a complete system for coverage and quality of service (QoS) measurements.

Besides pure recording and visualization of test parameters, data is processed instantly and statistics are calculated in realtime.

Currently, the following technologies are supported: GSM/EDGE, WCDMA/HSPA, CDMA2000® 1xEV-DO Rev. A, WLAN (IEEE 802.11b, g), WiMAX™ (IEEE 802.16e), TETRA, LTE, DAB, DVB-T and DVB-H. Standard-compliant RF level measurements can be time- and route-triggered over a very wide frequency range (9 kHz to 7 GHz).

- One software solution for all technologies: "all under one roof"
- Flexible handling of licenses reduces startup costs
- Parallel measurements with up to 16 mobile phones per software license; this saves time, allowing existing resources to be utilized more effectively: reduction of operating expenses (OPEX)
- Use of highly accurate, fast RF test and measurement equipment (Rohde & Schwarz scanners): many reliable measured values and results
- Automatic evaluation after completion of measurement by means of the integrated replay function or R&S®ROMES4NPA network problem analyzer, which considerably reduces OPEX
- Automatic identification of GSM interferences: considerable OPEX reduction

R&S®ROMES2GO 3GPP Walk Test Solution



QoS assurance made simple

The R&S®ROMES2GO autonomous walk test solution records and stores quality of service (QoS) and performance data in 3GPP mobile radio networks. The measurement results are displayed both alphanumerically and graphically. All of them, including past error events such as dropped calls, are saved to the memory card in the test mobile phone.

The scanner mode provides a quick overview of network activities. The results are based on the Nokia mobile phones N95, N6120, N6121, N85, N96 and N6720.

- Autonomous 3GPP walk test solution for indoor and outdoor applications
- Use of indoor floor plans for walk tests
- With external (Bluetooth®) or built-in GPS
- Low investment costs (CAPEX); additional control software for standard test mobile phones
- Easy operation (measurement ON, measurement OFF)
- Available in different languages: German, English, Spanish, Chinese
- Flexible handling of task files (GSM, GPRS, EDGE, WCDMA, HSDPA, HSUPA and scanning)
- Storage of measurement data on the test mobile phone as well as data transmission to an FTP server or via USB
- Tooltips inform the user about the most important parameters
- Measurement files can be downloaded and converted to the *.rscmd R&S®ROMES data format for further evaluation using the R&S®ROMES replay function
- Files can be analyzed by means of compatible planning and analysis programs

R&S®TS51GA30 Coverage Suitcase System

Compact case system for outdoor measurements

The R&S®TS51GA30 coverage suitcase system integrates the latest drive test technology in a compact, portable suitcase. Four test mobile phones allow measurements using different standards at the same time so that measurements can be carried out on several networks simultaneously. This solution is ideal for portable coverage measurements and offers maximum flexibility.

- High-end R&S®TSMx radio network analyzer
- Up to four mobile phones
- Supported mobile phones (Nokia, Qualcomm)
- GPS receiver with PPS output
- High-performance notebook with Windows XP and R&S®ROMES software
- Battery buffer for the R&S®TSMx
- Ruggedized suitcase with connectors for external antennas and power supply

R&S®TS9955 High-Performance Drive Test System

Drive test platform for accurate and fast coverage measurements in mobile radio and broadcasting networks

The R&S®TS9955 provides high-performance measurement data needed for the planning, installation, optimization and quality monitoring of radio networks. This custom-designed system supports high-precision and fast field strength measurements.

In the appropriate configuration, the drive test system can deliver immediate results from comprehensive realtime interference analysis. Further time-consuming post-processing is not required. This is a unique system design offered only by Rohde&Schwarz.

- Extremely flexible system concept for perfectly customized solution
- Numerous types of high-quality Rohde&Schwarz receivers available for various applications, including
  - Broadcasting (FM, TV, DAB, DVB-T)
  - CW measurements from 9 kHz to 7 GHz
  - GSM, GPRS, EDGE, WCDMA, CDMA2000® 1xEV-DO
  - EMC
- Easy means of competitive analysis (benchmarking), e.g. for four or more network operators in one drive
- Measurements in accordance with the Lee criterion (distance-triggered)
- Quality of service (QoS) measurement
- Interference and pilot pollution analysis
- Realtime handover analysis
- Missing neighbor analysis
- Channel impulse response analysis

R&S®TSMU-Z3 Coverage Backpack

Lightweight backpack solution for indoor and outdoor coverage measurements

The R&S®TSMU-Z3 coverage backpack is a compact and lightweight solution for GSM, WCDMA, CDMA2000® 1xEV-DO and CW parameter- and network-specific quality measurements. The R&S®TSMU-Z3 is ideal for portable coverage measurements for indoor and outdoor (e.g. in shopping malls, railway stations, airports and pedestrian zones).

- Up to two mobile phones
- Supported mobile phones (Nokia, Qualcomm)
- Portable size: 43 cm × 30 cm × 12 cm (16.93 in × 11.81 in × 4.72 in)
- Backpack > 6 kg (13.2 lb, including battery pack)
- Approximately 4 h continuous operation with battery pack
- Spare battery pack
- AC charger included

Chapter 6
EMC and Field Strength Test Solutions

EMI and EMS test equipment and systems from Rohde&Schwarz determine the causes and effects of electromagnetic interference. Decades of experience in the field of EMC measurements has made us the world's market leader.

Type	Designation	Description	Page
EMI precompliance/compliance			
R&S®ESU	EMI Test Receiver, 20 Hz to 8/26.5/40 GHz	Maximum-precision, standard-compliant EMI measurements at high speed	68
R&S®ESCI	EMI Test Receiver, 9 kHz to 3/7 GHz	For full compliance tests meeting all commercial standards	69
R&S®ESPI	Test Receiver, 9 kHz to 3/7 GHz	The reference instrument for the EMI precompliance class	70
R&S®ESL	EMI Test Receiver, 9 kHz to 3/6 GHz	The EMC expert for every lab bench	71
R&S®TS9975	EMI Test System	Tests in line with commercial, wireless, automotive and MIL standards	72
EMS measurements			
R&S®TS9980	EMS Test System Audio and Video and TV-Monitoring	EMS measurements on sound broadcast and TV receivers, satellite receivers and DVB receivers	73
R&S®TS9982	EMS Test System	Radiated and conducted EMS measurements in line with commercial, wireless, automotive and MIL standards	74
EMF measurements			
R&S®TS-EMF	Portable EMF Measurement System	Simple, frequency-selective measurement of EMF emssions	75
R&S®EMF-M	EMF Monitor	Autonomous test station for automated EMF long-term measurements	76
EMC software			
R&S®ES-SCAN	EMI Measurement Software	User-friendly software for EMI measurements	77
R&S®EMC32	EMC Measurement Software Platform	For use in development, for compliance and batch testing	78

Type	Designation	Description	Page
EMC accessories			
Disturbance voltage measurements			
	R&S®ENV216/4200, R&S®ESH2-Z5, R&S®ESH3-Z6	V-networks for EMC measurements on power supply networks	79
	R&S®ENY21/ENY41/ENY81, R&S®ENY81-CA6	Coupling networks for EMC measurements on telecommunications ports	80
	R&S®EZ-12, R&S®EZ-25	Antenna impedance converter, 150 kHz highpass filter	81
	R&S®ESH2-Z2/-Z3, R&S®ESH2-Z31, R&S®ESH3-Z2	Voltage probes, attenuator, pulse limiter	81
Disturbance current measurements			
	R&S®EZ-17, R&S®ESV-Z1	Current probes for disturbance current measurements on cables	82
Disturbance power measurements			
	R&S®EZ-24, R&S®MDS-21	Absorbing clamps for EMC measurements on cables	83
Field strength measurements			
	R&S®HZ-10, R&S®HZ-11/14/15/16, R&S®HZ-12/13	Pickup coil, E and H near-field probe sets, halfwave dipole sets	85, 84
	R&S®HFH2-Z1/-Z2/-Z4/-Z6, R&S®HZ-9	Rod antenna, loop antenna, inductive probe, power supply	85, 86
	R&S®HL033/HL040/HL046(E)/HL050/HL223, R&S®HM020	Log-periodic antennas, triple-loop antenna	87, 88
	R&S®HK5000, R&S®HK116, R&S®HF907, R&S®HL562	EMS broadband dipole, biconical antenna, double-ridged waveguide horn antenna, ULTRALOG	88, 89
	R&S®HE202/HE302	Active receiving dipoles	89

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 early in the design phase. In line with the definition, EMC is subdivided into electromagnetic interference (EMI) and electromagnetic susceptibility (EMS). Legislation prescribes compliance with maximum values for EMI and minimum values for EMS. The relevant limits, 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, e.g. by the CE conformity mark required in the entire European Economic Area.

EMI measurements

For measuring electromagnetic disturbance, the disturbance sink, which in the commercial sector is always the radio listener or TV 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 detector to show the human perception of disturbance as a measured value. Disturbance measurements higher than 1 GHz use peak, CISPR average and RMS average weighting.

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

Disturbance is emitted by the equipment under test in various ways of coupling. Therefore, the EMC standards contain procedures for coupling the test receiver to the equipment under test as well as for the environment of the EUT and its operation.

EMS measurements

For measuring electromagnetic susceptibility, the different disturbance 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

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

For computer-controlled EMC measurements, two different software tools are available: The R&S®ES-SCAN EMI diagnostics software is used to quickly and easily collect, evaluate, and document RFI voltage, power and field strength data. The R&S®EMC32 software platform includes various modules for electromagnetic interference (EMI) and electromagnetic susceptibility (EMS) measurements. Due to its flexible structure the software can be optimally adapted to the requirements of almost any commercial or military EMC application.

These tools 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®ESU, R&S®ESCI, R&S®ESPI and R&S®ESL series. They allow fully automatic time-saving measurements without an external controller, so that very compact test setups can be implemented.

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 at hand. Rohde&Schwarz can offer everything from small systems through to the complete equipment of test houses with shielded anechoic chamber and the complete infrastructure required, covering all major standards in the commercial, automotive, wireless and military range.

EMC standards in the European Economic Area

The number of standards published in the Official Journals is steadily increasing. The different types of standards include "generic standards", which can be applied in all cases that 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.

Generic standards – emission

- **EN 61000-6-3:** Residential, commercial and light industry environment
- **EN 61000-6-4:** Industrial environment

Generic standards – immunity

- **EN 61000-6-1:** 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 3-2: Limits for harmonics up to 16 A
- **EN 61000-3-3:** EMC Part 3-3: Limits for voltage fluctuations and flicker up to 16 A
- **EN 61000-3-11, -12:** Limits for harmonic currents and voltage variations up to 75 A

Product family standards for high-frequency emission

- **EN 55011:** ISM equipment
- **EN 55012:** Vehicles, internal combustion engines
- **EN 55013:** Sound and TV broadcast receivers
- **EN 55014-1:** Household appliances and electric tools
- **EN 55015:** Lighting equipment
- **EN 55022:** Information technology equipment
- **EN 55025:** Vehicles, boats, combustion engines
- **EN 55103-1:** Audio and video equipment

Product standards for immunity

- **EN 55014-2:** Household appliances, tools and similar apparatus
- **EN 61547:** Lighting equipment
- **EN 55020:** Sound and TV broadcast receivers
- **EN 55024:** Information technology equipment
- **EN 55103-2:** Audio and video equipment

Special standards for signal transmission in low-voltage installations

- **EN 50065-1:** Signaling on low-voltage electrical installations, Part 1: General requirements, frequency bands and electromagnetic disturbances
- **EN 50065-2-x:** Immunity

Product standards containing EMC requirements

- **EN 50083-2:** Cabled networks for TV and sound signals
- **EN 50090-2-2:** Electronic systems for home and buildings
- **EN 50091-2:** Uninterruptible power systems
- **EN 50130-4:** Alarm systems
- **EN 50148:** Electronic taximeters
- **EN 50199, EN 60974-10:** Arc welding equipment
- **EN 50263:** Measuring relays
- **EN 50270:** Gas sensors
- **EN 50293:** Traffic signal systems
- **EN 50295, EN 60439-1, EN 60947-x-x:** Low-voltage switchgear and control gear
- **EN 50370-1, -2:** Machine tools
- **EN 60034-1:** Rotating electrical machines
- **EN 60204-31:** Sewing machines
- **EN 60521, EN 60687, EN 61036, EN 61037, EN 61038, EN 61268, EN 62052-x, EN 62053-x, EN 62054-x:** Several AC watt-hour meters
- **EN 60601-1-2:** Medical electrical apparatus: General safety requirements – EMC requirements and tests
- **EN 50428, EN 60669-2-x, EN 61204-3:** Switches for household and similar fixed electrical installations
- **EN 60730-x-x:** Automatic electric controls for household and similar use
- **EN 60870-2-1:** Telecontrol equipment and systems
- **EN 60945:** Maritime navigational equipment
- **EN 61008-1, EN 61009-1, EN 61543:** Residual current circuit breakers
- **EN 61037:** Electronic ripple control receivers for tariff and load control
- **EN 61038:** Time switches for tariff and load control
- **EN 61131-2:** Programmable controllers
- **EN 61326:** Electrical equipment for measurement and test, control and laboratory use
- **EN 61800-3:** Adjustable speed electrical power drive systems
- **EN 61812-1:** Time relays for industrial applications
- **EN 617, EN 618, EN 619, EN 620:** Continuous handling equipment
- **EN 12015, EN 12016:** Elevators and escalators
- **EN 12895:** Industrial trucks
- **EN 13241:** Doors and gates
- **EN 13309:** Machines with electrical power supply
- **EN 14010:** Safety of machinery
- **EN ISO 14982:** Agricultural and forestry machines
- **EN 300386:** Telecommunications network equipment

Equipment required for EMI measurements to specific standards

Group of equipment

Standards		International Europe + Germany Japan USA	Industrial, scientific and medical equipment CISPR 11; EN 55011 VDE 0875 Part 11 EACL Sect. 2 FCC Part 18, Subpart C	Vehicles with combustion engines, remote/built-in RFI suppression CISPR 12/CISPR 25; ECE 10; DIR 95/54/EC; DIR 2004/104/EC EN 55012, VDE 0879 Part 1, 2, 3 JASO D001-82; SAE J 551, J 1113	Sound and TV broadcast receivers CISPR 13; EN 55013 VDE 0872 Part 13 EACL Sect. 3&8 –	Electrical devices, household appliances and tools CISPR 14-1; EN 55014-1 VDE 0875 Part 14 EACL Sect. 5 –	Fluorescent lamps and luminaires CISPR 15; EN 55015 VDE 0875 Part 2/15-1 EACL Sect. 6&7 –	Information technology equipment (ITE) CISPR 22 EN 55022 EACL Sect. 4 FCC Part 15, Subpart B	Military equipment and systems VG 95370, 95373 – MIL-STD-461 (CE/RE) DEF-STAN 59-41 (UK)	Generic emission standards EN 61000-6-3/4	Mains signaling equipment EN 50065-1	Cabled distribution systems TV/sound EN 50083-2	Uninterruptible power systems (UPS) EN 50091-2	Professional audio/video equipment prEN 55103-1	Electric railways prEN 50121	Medical electrical apparatus EN 60601-1-2	Maritime navigation equipment EN 60945	Low-voltage switchgear and control gear EN 60947-x-x
Frequency range	Test receiver	Accessories and extras																			
From 20 Hz	R&S®ESU	R&S®EZ-17 Current Probe							●												
		R&S®HZ-10 H-Field Coil							●								●				
From 9 kHz	R&S®ESL [10] R&S®ESCI R&S®ESPI [1] R&S®ESU	R&S®EZ-17 Current Probe	○	○	○	○	○	●	●		○	○									
		R&S®ESV-Z1 Current Probe	○	○	○	○	○	●	●		○	○									
		R&S®HZ-10 H-Field Coil							● [4]								●				
		R&S®HFU-Z Tripod	●						● [5]									●		●	
		R&S®HFH2-Z2 Loop-Antenna	●						● [5]									●		●	
		R&S®HZ-1 Tripod		●					●												
		R&S®HFH2-Z6 Rod Antenna		●					●												
		R&S®ESH2-Z5 V-Network	●		●	●	●	●	● [6]	●	● [9]	●	●	●	●	●	●	●	●	●	●
		R&S®ENV216 V-Network	●		●	●	●	●	● [6]	●	● [9]	●	●	●	●	●	●	●	●	●	●
		R&S®ENV4200 V-Network	●		●	●	●	●	● [6]	●	● [9]	●	●	●	●	●	●	●	●	●	●
		R&S®ESH3-Z6 V-Network		●					●												
		R&S®ESH2-Z2 Voltage Probe	●		●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●
		R&S®ESH2-Z3 Voltage Probe	●		●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●
		R&S®EZ-12 Antenna Impedance Converter		●																	
		R&S®EZ-25 Highpass									●										
		R&S®HZ-11 Probe Set	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
		R&S®HZ-14 Probe Set	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
		R&S®HM020 Triple-Loop Antenna	○				●													○	
		R&S®HZ-3/HZ-4 RF Cable	○		○	○	○	○	○												
from 30 MHz	R&S®ESL [10] R&S®ESCI R&S®ESPI [1] R&S®ESU	R&S®EZ-17 Current Probe	○	○	○		○	○	●	●	○		○								
		R&S®ESV-Z1 Current Probe	○	○	○		○	○	●	○	○										
		R&S®MDS-21/22 Absorbing Clamp	●	●	○	●		○		●	●	●		●							
		R&S®HZ-11 Probe Set	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
		R&S®HZ-14 Probe Set	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
		R&S®HZ-15 Probe Set	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
		R&S®HFU-Z Tripod	●	●	●		●	●		●	●		●	●		●	●	●	●	●	
		R&S®HUF-Z1 Broadband Dipole	●	●	●		●	●		●	●		●	●		●	●	●	●	●	●
		R&S®HL023A1 Log-Periodic Antenna	●	●			●	●		●	●		●	●		●	●	●	●	●	●
		R&S®HK116 Biconical Antenna	●	●	●		●	●	●	●	●		●	●		●	●	●	●	●	●
		R&S®HL223 Log-Periodic Antenna	●	●	●		●	●	● [7]	●	●		●	●		●	●	●	●	●	●
		R&S®HUF-Z4 Conical Log Spiral Antenna							● [8]												
		R&S®HZ-1 Tripod							●												
		R&S®HFU2-Z4/-Z5 RF Cable	●	●	●		●	●		●	●		●	●		●	●	●	●	●	●
		R&S®HL562 ULTRALOG Antenna	●	●	●			●		●			●			●	●	●	●	●	
From 1 GHz	R&S®ESL [10] R&S®ESCI R&S®ESPI [1] R&S®ESU	R&S®HL050, R&S®HF907Antennas further antennas on request	●		●				● [2]	●			●								
From 2 GHz	R&S®ESU	R&S®HL050, R&S®HF907 antennas further antennas on request	●		●				● [3]	●			●								
From 5 GHz	R&S®ESU	R&S®HL050, R&S®HF907 antennas further antennas on request	●						●	●			●								
From 10 GHz	R&S®ESU26 R&S®ESU40	R&S®HL050, R&S®HF907 antennas further antennas on request	●						●	●			●								
18 GHz to 40 GHz	R&S®ESU26 R&S®ESU40	R&S®HL050 antenna further antennas on request								●			●								

[1] R&S®ESPI has limited compliance with CISPR 16-1-1. [2] FCC: clock frequency < 200 MHz. [3] FCC: clock frequency < 500 MHz. [4] VG up to 200 kHz. [5] VG. [6] VG, MIL.

Telecom systems of large dimensions	Short range devices (SRD) 9 kHz to 40 GHz	PMR equipment DECT equipment	Generic EMC standard for radio equipment	ERMES paging receivers	GSM 900 MHz, GSM 1800 MHz	Fixed radio links	Equipment of telecommunication networks	Wireless microphones and similar equipment	Second-generation cordless telephones (CT2)	VHF FM broadcasting transmitters	VSAT, SNG and TES equipment	CB radio and ancillary equipment	On-site and wide-area paging equipment	Commercially available amateur radio equipment	Analog cellular radio comm. equipment	2.6 GHz wideband transmission and HIPERLAN	TETRA and ancillary equipment	VHF maritime mobile radio telephone	1.5 GHz maritime MES with LBRDC for GMDSS	1.5 GHz receive-only MES for data comm.	1.5/2/2.5 GHz MES for satellite GSM	< 1 GHz MES with LBRDC using LEOs	
EN 300127	EN 300220, 330, 440 EN 301489-3	EN 301489-5 EN 301489-6	EN 300339 EN 301489-1	ETS 300340	EN 301489-7 EN 302018-2	EN 300385 EN 301489-4	ETS 300386-1 EN 300386-2	EN 301489-9	EN 301489-10	EN 301489-11 ETS 300384/447	EN 301489-12	EN 301489-13	EN 300 741 EN 301489-2	EN 301489-15 EN 301783-2	EN 301489-16	EN 301489-17	EN 301489-18	EN 301843-2	EN 300829	EN 301489-19	EN 300 831 EN 301489-20	EN 300 832 EN 301721	**Legend** ● necessary accessory ○ recommended extra * 10 GHz = upper frequency limit to GAM-EG 13 ** 18 GHz = upper frequency limit to CISPR 11, VG standards and DEF-STAN 59-41 *** 40 GHz = upper frequency limit to ANSI C 63.2, C 63.4 and MIL-STD-461 Further European standards see page 65
																							Current probe 20 Hz to 100 MHz
																							Shielded, calibrated field coil 5 Hz to 10 MHz
	●																						Current probe 20 Hz to 100 MHz
	●																						Current probe 9 kHz to 300 MHz (cal. up to 600 MHz)
																							Shielded, calibrated field coil 5 Hz to 10 MHz
	●																	●	●				Tripod for R&S®HFH2-Z2 loop antenna
	●																	●	●				Active loop antenna 9 kHz to 30 MHz
																							Tripod for R&S®HFH2-Z6 rod antenna
																							Active rod antenna 9 kHz to 30 MHz
	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	V-network up to 25 A (70 A), four-line LISN
	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	V-network up to 16 A, two-line LISN
	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	V-network up to 200 A, four-line LISN
		●	●		●	●		●		●	●		●	●	●								V-network up to 150 A (500 A), single-phase LISN
	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Active probe for RFI voltage measurement
	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Passive probe for RFI voltage measurement
																							Antenna impedance converter 9 kHz to 30 MHz
																							150-kHz Highpass (R&S®EZ-25)
	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	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
	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	Near-field probe set 30 MHz to 3 GHz
●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Broadband dipole 20 MHz to 80 MHz
●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Log-periodic antenna 80 MHz to 1300 MHz
●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Biconical antenna 30 MHz to 300 MHz
●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Log-periodic antenna 200 MHz to 1300 MHz
																							Conical log spiral antenna 200 MHz to 1000 MHz
																							Tripod for R&S®HK116, R&S®HL223 and R&S®HUF-Z4
●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	RF connecting cable 12 m/7 m, common-mode suppr.
	○	○	○	○	○			○	○			○	○	○	○								Shielded TEM Line, 0.15 MHz to 1000 MHz (2 models)
	●													●									Directional antenna 1 to 18 GHz, e.g. log-periodic antenna or double-ridged waveguide horn antennas
	●													●									Directional antenna 1 GHz to 18 GHz, e.g. log-periodic antenna or double-ridged waveguide horn antennas
	●													●									Directional antenna 1 GHz to 18 GHz, e.g. log-periodic antenna or double-ridged waveguide horn antennas
	●													●									Directional antenna 1 GHz to 18 GHz, e.g. log-periodic antenna or double-ridged waveguide horn antennas
	●													●									Double-ridged waveguide horn antenna or log-periodic antenna

[7] VG, DEF-STAN. [8] MIL-STD-461 C. [9] see R&S®EZ-25. [10] Precompliance.

R&S®ESU EMI Test Receiver

Maximum-precision, standard-compliant EMI measurements at unparalleled measurement speed

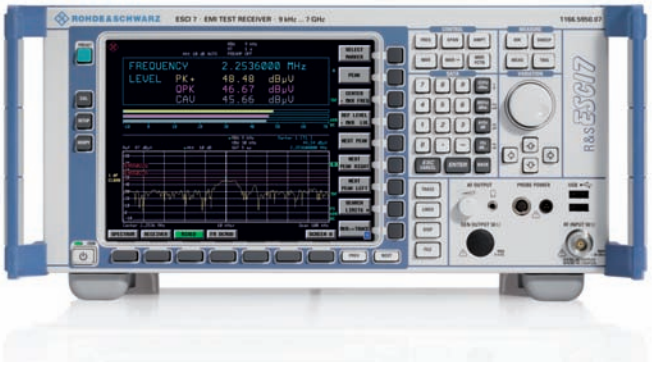
The R&S®ESU family of CISPR16-1-1-compliant EMI test receivers meets all commercial and military standards for electromagnetic disturbance measurements. The R&S®ESU-K53 FFT-based time-domain scan option allows users to perform overview measurements up to 1000 times faster than on previous EMI test receivers. The R&S®ESU also features automatic and interactive measurement functions, parallel IF analysis and up to three detectors in parallel, including the new RMS-average detector.

- Combination of standard-compliant EMI test receiver and high-end spectrum analyzer
- Excellent RF characteristics
- Very low measurement uncertainty
- Full compliance with CISPR 16-1-1 standard
- High-speed time-domain scan (FFT) option
- Receiver mode with parallel IF analysis
- All commercial and military standards met
- Internal preselection (can be switched off in analyzer mode)
- Integrated 20 dB preamplifier up to 3.6 GHz as standard
- Wide choice of detectors incl. CISPR-average and RMS-average
- CISPR- and MIL-STD-compliant measurement bandwidths
- User-programmable scan tables (max. 10 subranges)
- Frequency scan with max. three detectors in parallel (max. 2 million test points/trace)
- Second RF input (max. 1 GHz, pulse-protected)
- Time-domain analysis for evaluation of timing behavior of disturbances (e.g. click-rate analysis)
- Fully and partially automatic measurements (preview measurement, data reduction, final measurement)
- Automatic consideration of coupling devices such as line impedance stabilization networks, probes, cables and antennas using transducer factors and sets
- Simultaneous measurement of multiple traces for parallel evaluation
- Continuous bargraph display and marker functions for precise measurements
- Automatic disturbance voltage measurements using remote-controllable line impedance stabilization networks (LISN) from Rohde&Schwarz
- Predefined transducer factors
- Library of limit lines for commercial standards
- Integrated report generator
- Optional preamplifiers up to 8/26.5/40 GHz (R&S®ESU-B24)

Specifications in brief

Frequency	**R&S®ESU8**	**R&S®ESU26**	**R&S®ESU40**
Frequency range, RF input 1	20 Hz to 8 GHz	20 Hz to 26.5 GHz	20 Hz to 40 GHz
Frequency range, RF input 2	20 Hz to 1 GHz	20 Hz to 1 GHz	20 Hz to 1 GHz
Reference frequency	aging 1 × 10^{-7}/year, optionally 2 × 10^{-9}/year (R&S®FSU-B4)		
Spectral purity	< –128 dBc (1 Hz), typ. –133 dBc (1 Hz) at 10 kHz		
Preselection	12 preselection filters in the range from 20 Hz to 3.6 GHz, can be switched off in analyzer mode		
Preamplifier	can be switched between preselection and 1st mixer, 20 dB gain, frequency range 1 kHz to 3.6 GHz		
IF filter			
3 dB bandwidths	10 Hz to 10 MHz in steps of 1/2/3/5		
6 dB bandwidths	10 Hz, 100 Hz, 200 Hz, 1 kHz, 9 kHz, 10 kHz, 100 kHz, 120 kHz, 1 MHz		
FFT filters (–3 dB, analyzer mode)	1 Hz to 30 kHz in 1/3 sequences		
Channel filters	44 bandwidths, 100 Hz to 5 MHz		
Detectors (receiver mode)	min peak, max. peak, quasi-peak, RMS, average, CISPR-average, RMS-average		
Display range	DANL up to +30 dBm		
Intermodulation			
Third-order intercept (TOI), without preselection	> +17 dBm	> +17 dBm	> +17 dBm
1 dB compression of input mixer (< 3.6 GHz)	+13 dBm, nominal		

R&S®ESCI EMI Test Receiver



For full compliance tests meeting all commercial standards

The R&S®ESCI/ESCI7 EMI test receivers are standard-compliant measuring receivers for EMC certification measurements in line with commercial standards in the frequency range from 9 kHz to 3/7 GHz. The receivers conform to the latest version of the CISPR 16-1-1 basic standard. At the same time, they function as full-featured and powerful spectrum analyzers for lab applications.

- Combination of standard-compliant EMI test receiver and high-quality spectrum analyzer
- Integrated preselection with selectable 20 dB preamplifier
- Frequency range from 9 kHz to 3/7 GHz; usable for all commercial EMC standards
- Effective analysis of the disturbance spectrum through simultaneous graphical presentation of the disturbance level and emission spectrum around the receive frequency ("mixed-mode")
- Time-domain analysis for evaluation of timing behavior of disturbances (e.g. click-rate analysis)
- Automatic consideration of coupling devices such as line impedance stabilization networks, probes, cables and antennas using transducer factors and sets
- SCAN settings in tabular format (max. 10 subranges)
- Simultaneous measurement of multiple traces for parallel evaluation
- Fast, reliable measurements using automatic and interactive test routines
- Continuous bargraph display and marker functions for precise measurements
- Automatic disturbance voltage measurements using remote-controllable line impedance stabilization networks (LISN) from Rohde&Schwarz
- Predefined transducer factors
- Library of limit lines for commercial standards

Specifications in brief

Frequency range	
R&S®ESCI	9 kHz to 3 GHz
R&S®ESCI7	9 kHz to 7 GHz
Scan	max. 10 partial ranges with different settings
Measurement time per frequency	50 ms to 100 s
Sweep (analyzer mode)	
In time range, span = 0 Hz	1 µs to 16 000 s, resolution 125 ns
In frequency range, span ≥10 Hz	2.5 ms to 16 000 s
Resolution bandwidth	
Sweep filter	
3 dB bandwidths	10 Hz to 3 MHz in 1/3 sequences
EMI filters (–6 dB, pulse bandwidth)	200 Hz, 9 kHz, 120 kHz, 1 MHz
Video bandwidths (analyzer mode)	1 Hz to 10 MHz in 1/3 sequences
FFT filters (–3 dB, analyzer mode)	1 Hz to 30 kHz in 1/3 sequences
Channel filters	44 bandwidths, 100 Hz to 5 MHz
Preselection (switchable)	11 preselection filters
Preamplifier (switchable)	20 dB
Max. input level	
RF attenuation ≥ 10 dB	
DC voltage	0 V DC; 50 V AC
CW RF power	30 dBm
Max. pulse voltage (10 µs)	150 V
Max. pulse energy (20 µs)	10 mWs
Pulse spectral density	97 dBmV/MHz
Intermodulation	
1 dB compression of input mixer (f > 200 MHz, 0 dB RF attenuation, preselection OFF, preamplifier OFF)	5 dBm (nominal)
TOI, 200 MHz to 3 GHz, level 2 × –30 dBm, Δf > 5 × IF bandwidth or resolution bandwidth, or > 10 kHz)	
Preselection OFF	> 7 dBm, typ. 10 dBm
Preselection ON, preamplifier OFF	> 2 dBm, typ. 5 dBm
Preselection on, preamplifier ON	> –18 dBm, typ. –15 dBm
Displayed noise floor (analyzer mode)	
0 dB RF attenuation, RBW = 10 Hz, VBW = 1 Hz, span = 0 Hz, 20 averages, trace average, 50 Ω termination, 10 MHz to 1 GHz	
Preselection OFF (AC/DC coupling)	< –142 dBm, typ. –145 dBm
Preselection OFF, preamplifier ON	< –142 dBm, typ. –145 dBm
Preselection ON, preamplifier ON	< –152 dBm, typ. –155 dBm
Displayed noise floor (receiver mode)	
AV display, 30 MHz to 1 GHz, bandwidth = 120 kHz	
Preamplifier OFF	< 6 dBµV, typ. 3 dBµV
Preamplifier ON	< –16 dBµV, typ. –19 dBµV
Level measurement accuracy	
Total error	
Preselection OFF, preamplifier OFF	0.5 dB
Preselection ON, preamplifier ON	1 dB
Quasi-peak display	in line with CISPR 16-1

R&S®ESPI Test Receivers

The R&S®ESPI3 and R&S®ESPI7 have been specially designed for precompliance measurements in development for all commercial EMI standards to CISPR, EN, ETS, FCC, ANSI C63.4, VCCI and VDE

Excellent test receiver features

- Peak, quasi-peak, RMS, RMS-average, CAV and AV (max. 3 detectors simultaneously)
- EMI bandwidths 200 Hz, 9 kHz, 120 kHz, 1 MHz
- Correct pulse weighting to CISPR 16-1-1 from PRF of 10 Hz
- ETS, FCC, ANSI C63.4, VCCI and VDE
- Preselector and 20 dB preamplifier (R&S®ESPI-B2 option)

Spectrum analyzer

- Resolution bandwidths from 10 Hz to 10 MHz
- RMS detector for digitally modulated signals
- Channel filter bandwidths from 100 Hz to 5 MHz
- Test routines for determining TOI, ACPR, OBW, amplitude statistics

Outstanding performance features

- Total measurement uncertainty
  - Spectrum analyzer mode: 0.5 dB (without preselection)
  - Receiver mode: < 1.5 dB
- DANL –155 dBm (1 Hz), f < 1 GHz
- User-programmable scan tables
- Correction values for cable loss, coupling networks and antennas included as transducer factor
- Bargraph display for different types of detectors
- Automatic overload indication
- Built-in AF demodulation
- External trigger function for measuring field strength profiles (R&S®ESPI-K50 option) including additional channel filters from 5.6 MHz to 8 MHz (ISDB-T, ATSC, DVB-T, DVB-T2)

Specifications in brief

Frequency	**R&S®ESPI3**	**R&S®ESPI7**
Frequency range	9 kHz to 3 GHz	9 kHz to 7 GHz
Frequency display (receiver mode)	numeric display	
Spectral purity (dBc (1 Hz)) SSB phase noise, f = 500 MHz, carrier offset 10 MHz	typ. –145 dBc (1 Hz)	
Residual FM, f = 500 MHz, RBW 1 kHz, sweep time 100 ms	typ. 3 Hz	
Frequency scan (receiver mode)	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	
Span ≥ 10 Hz	2.5 ms to 16000 s	
IF bandwidths (receiver and analyzer mode)		
Bandwidths (–3 dB)	10 Hz to 10 MHz	
EMI bandwidths (CISPR)	200 Hz, 9 kHz, 120 kHz (–6 dB) 1 MHz (pulse bandwidth)	
Video bandwidths (analyzer mode)	1 Hz to 10 MHz	
FFT filters (–3 dB, analyzer mode)	1 Hz to 10 MHz	
Channel filters	44 bandwidths, 100 Hz to 5 MHz	
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	
3rd-order intermodulation (TOI)		
Intermodulation-free dynamic range, level 2 × –30 dBm, Δf > 5 × RBW or 10 kHz, whichever is greater		
20 MHz to 200 MHz	> 70 dBc, TOI > 5 dBm	
200 MHz to 3 GHz	> 74 dBc, TOI > 7 dBm (typ. 10 dBm)	
3 GHz to 7 GHz	–	> 80 dBc, TOI > 10 dBm (typ. 15 dBm)
Displayed average noise level		
0 dB RF attenuation, RBW = 10 Hz, VBW = 1 Hz, 20 averages, trace average, zero span, 50 Ω termination		
10 MHz to 1 GHz	< –142 dBm, typ. –145 dBm	< –140 dBm, typ. –145 dBm
Level display (receiver mode)		
Spectrum	level axis 10 dB to 200 dB in 10 dB steps, user-selectable frequency axis, linear or logarithmic	
Detectors (3 detectors can be switched on simultaneously)	AV, RMS, min./max./quasi peak, CISPR-average, RMS-average	
Measurement time	100 µs to 100 s, selectable	
Level display (analyzer mode)		
Traces	max. 3 per diagram	
Trace detectors	min./max./auto peak, sample, RMS, AV, QP	
Trace functions	Clear/Write, min./max. hold, AV	
Quasi-peak display (with R&S®ESPI-B2 option)	in line with CISPR 16-1-1, ≥ 10 Hz pulse repetition frequency	
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, output	AM, FM, loudspeaker, headphone	

R&S®ESL EMI Test Receiver

Compact, cost-effective measuring receiver

The R&S®ESL EMI test receiver combines two instruments in one, measuring EMC disturbances in accordance with the latest standards and also serving as a full-featured spectrum analyzer for diverse lab applications. The R&S®ESL is designed to meet the needs of cost-conscious users who want to perform diagnostic and precompliance EMI measurements up to 3 GHz or 6 GHz.

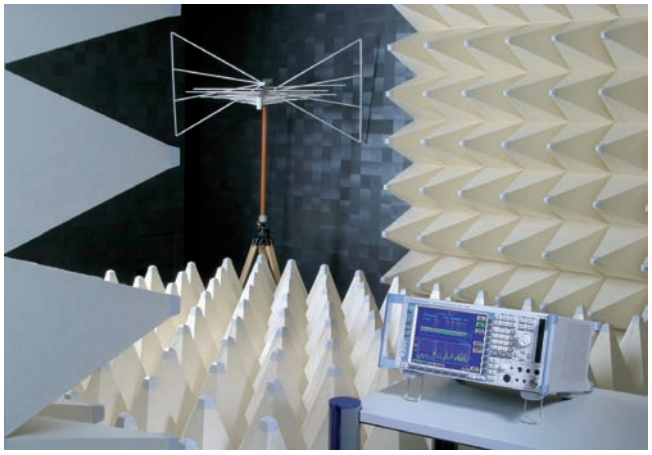
The combination of very good RF characteristics and all of the important functions needed for fast, precise measurement and evaluation of the EMC of a device under test in accordance with commercial standards is unmatched in this class of instrument. The diverse analysis capabilities, high measurement speed and time-saving automated test routines make the R&S®ESL the obvious choice for any development lab that needs to prepare for EMC certification tests.

- Frequency range from 9 kHz to 3 GHz/6 GHz covering almost all commercial EMC standards
- First-ever combination of an EMI test receiver and spectrum analyzer in the entry-level class
- All major functions of an advanced EMI test receiver, including fully automated test sequences
- Weighting detectors: min./max. peak, average, RMS, quasi-peak as well as average with meter time constant (CAV) and RMS-average in accordance with the latest version of CISPR 16-1-1
- Compact, lightweight instrument, can be battery-powered for mobile applications

Specifications in brief

	R&S®ESL3, model .03	R&S®ESL3, model .13	R&S®ESL6, model .06	R&S®ESL6, model .16
Frequency range	9 kHz to 3 GHz	9 kHz to 3 GHz	9 kHz to 6 GHz	9 kHz to 6 GHz
Frequency accuracy (standard)	1×10^{-6}			
With R&S®FSL-B4 (OCXO)	1×10^{-7}			
Measurement time				
Receiver mode/scan (per frequency step)	selectable from 100 µs to 100 s			
Analyzer mode/sweep time	selectable from 2.5 ms to 16000 s, zero span 1 µs to 16000 s			
Resolution bandwidth (–3 dB)	10 Hz to 10 MHz in 1/3 sequence			
Resolution bandwidth (–6 dB)	200 Hz, 9 kHz, 120 kHz, 1 MHz (impulse)			
Video bandwidth	1 Hz to 10 MHz in 1/3 sequence			
Level				
Max. RF level (input attenuation ≥ 10 dB)	+30 dBm (= 1 W)			
Max. pulse energy	10 mWs			
Max. pulse voltage	150 V			
Third-order intercept (TOI)	typ. +18 dBm			
1 dB compression	+5 dBm			
Displayed average noise level (with RBW = 1 Hz FFT filter RBW and R&S®FSL-B22 preamplifier option)				
9 kHz < f < 3 MHz	typ. –115 dBm			
f = 500 MHz	typ. –162 dBm			
f = 3 GHz	typ. –158 dBm			
Detectors	pos./neg. peak, auto peak, quasi-peak, RMS, average, sample, average with meter time constant (CISPR-average), RMS-average (CISPR RMS)			
Level measurement uncertainty	f < 3 GHz (< 0.5 dB) f < 6 GHz (< 0.8 dB)			
Tracking generator	no	yes	no	yes
Frequency range	–	1 MHz to 3 GHz	–	1 MHz to 6 GHz
Output level	–	–20 dBm to 0 dBm	–	–20 dBm to 0 dBm

R&S®TS9975 EMI Test System



Tests in line with commercial, wireless, automotive and MIL standards

The R&S®TS9975 is the base system for conducted and radiated EMI measurements. Due to its modular design, it covers a wide range of applications and can be very easily adapted to the measurement task at hand. Any configuration is possible – from conducted measurements and the small precompliance system with a compact test cell to the accredited test system for complete motor vehicles. Combinations of different applications or incremental expansion do not present a problem either.

All test systems are controlled by the R&S®EMC32 EMC test software.

The test receiver forms the core of the system. It evaluates and displays emissions in line with the relevant standards.

From system design and implementation to installation and training, these turnkey systems and the EMC experts from Rohde&Schwarz provide everything from a single source, enabling the customer to concentrate on testing. A design only for conducted or radiated measurements is possible.

Covered standards (examples)

This test system covers the main standards for EMI measurements for the different ranges of applications.

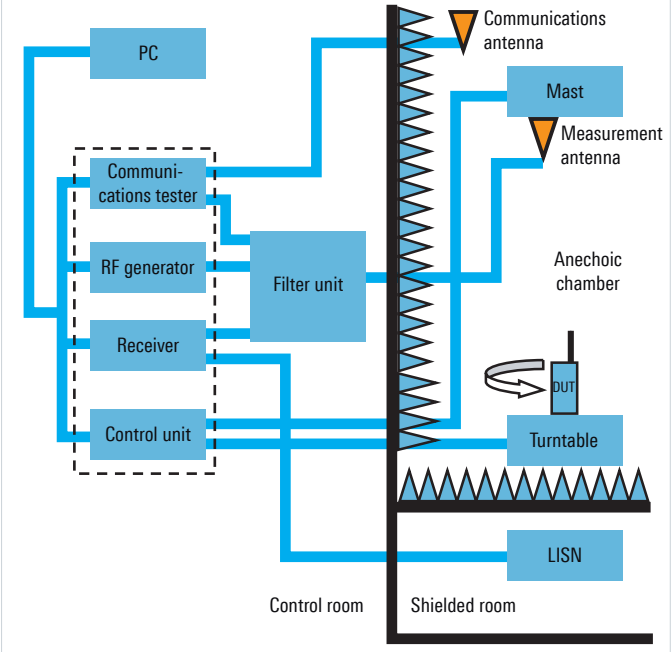
Commercial tests
- CISPR 11–22
- EN 55011–55022
- VDE 0872–0879
- ANSI-C 63.4
- CFR 47 FCC part 15, 18
- 3GPP TS 51.010
- ETSI EN 301908-1
- ETSI EN 300328-1

Wireless tests
- ETSI EN 301489 for all major technologies (e.g. CDMA, GSM, UMTS, WLAN, WiMAX™)

Automotive tests
- CISPR 12
- CISRP 25

MIL tests
- VG 95370–95377
- DEF-STAN 49–41
- GAM-EG 13
- MIL-STD-461/462

R&S®TS9975 block diagram



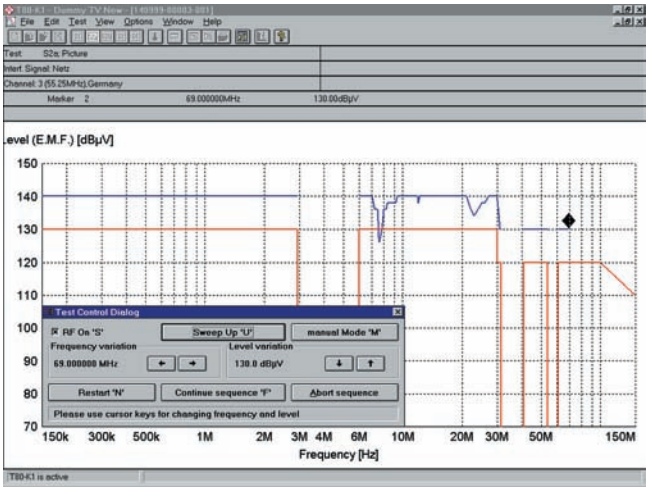
R&S®TS9980 EMS Test System for Audio and Video and TV Monitoring

Measuring the electromagnetic susceptibility (EMS) of sound and TV broadcast receivers, satellite and DVB/DAB receivers

Automatic measurements to
- EN 55020:2001
- CISPR 20:2002, edition 5

The growth in communications via terrestrial and satellite links and the frequency crowding in cable networks may affect reception quality. Comprehensive EMS tests are used to verify the capability of receivers to operate satisfactorily even under adverse conditions. These tests include the following measurements:
- Immunity to input interference (S1)
- Immunity to RFI voltages (S2a)
- Immunity to RFI currents (S2b)
- Immunity to radiated interference (S3)
- Shielding effectiveness (S4)
- Keyed carrier (S5)
- Immunity against radiated RFI for large EUTs (S6)

Since these tests are highly complex and involve a large number of single measurements, they are carried out with automatic test systems. The R&S®TS9980 test system is available in three versions to cater for different products and applications:
- **R&S®TS9980 audio**
  - FM: VHF (mono/stereo)
  - AM: LF/MF/HF (mono)
- **R&S®TS9980 AV multistandard**
  - PAL: B/G, I, D/K
  - SECAM: D/K, L/L'
  - NTSC: M/N
- **R&S®TS9980 DVB multistandard**
  - DVB-C QAM (quadrature amplitude modulation) to ETS 300429
  - DVB-S QPSK (quadrature phase shift keying) to ETS 300421
  - DVB-T OFDM (orthogonal frequency division multiplex) to ETS 300744
  - ATSC 8VSB (vestigial sideband) to ATSC Doc. A/53
  - DAB ODFM to ETS 300401



R&S®T80-K1 System Software

The powerful R&S®T80-K1 software package is the basis for automatic control and monitoring of the R&S®TS9980 test system as well as for data collection and analysis. Effective and economically efficient use of the R&S®TS9980 test system is only possible through automation. Further benefits are:
- Improved reproducibility and higher accuracy of measurement results
- Automatic generation of comprehensive test reports
- Permanent system monitoring
- Improved data management through integrated database
- Automatic calibration and correction of frequency-dependent parameters

Software options
- R&S®T80-K5 (video upgrade)
- R&S®T80-K6 (audio upgrade)
- R&S®T80-K7 (DVB upgrade)
- R&S®T80-K8 (DAB upgrade)
- R&S®T80-K13 (S4 option)
- R&S®T80-K14 (S5 option)
- R&S®T80-K15 (S6 option)

R&S®TS9982 EMS Test System

Radiated and conducted EMS measurements in line with commercial, wireless, automotive and MIL standards

The R&S®TS9982 is the base system for conducted and radiated EMS measurements. Due to its modular design, it covers a wide range of applications and can be very easily adapted to the measurement task at hand. Any configuration is possible – from conducted measurements and the small precompliance system with a compact test cell to the accredited test system for complete motor vehicles with 200 V/m. Combinations of different applications or incremental expansion do not present a problem either.

All test systems are controlled by the R&S®EMC32 EMC test software with its various capabilities such as extensive EUT and system monitoring. From system design and implementation to installation and training, these turnkey systems and our EMC experts provide everything from a single source, enabling the customer to concentrate on testing. A design only for conducted or radiated measurements is possible.

Covered standards (examples)

This test system covers all relevant standards for radiated and conducted commercial measurements for the different ranges of applications.

Commercial tests
- IEC/EN 61000-4-3 and -6
- IEC/EN 61000-4-20
- EN 61000-6-1
- EN 61000-6-2
- CISPR 24/EN 55024
- EN 60601-1-2

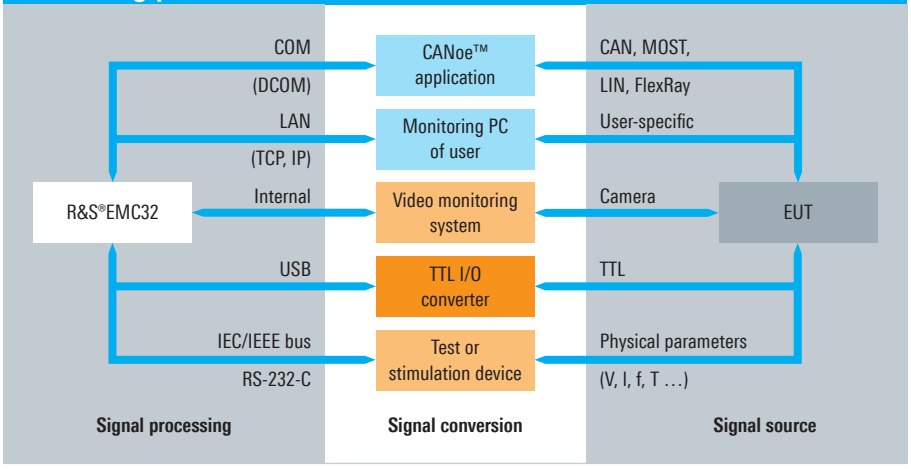
Wireless tests
- ETSI EN 301489 for all major technologies (e.g. CDMA, GSM, UMTS, WLAN, WiMAX™)

Automotive tests – components
- ISO 11452-2
- ISO 11452-3
- ISO 11452-4
- ISO 11452-5
- 2004/104/EC

Automotive tests – vehicles
- ISO 11451
- 2004/104/EC
- Customer-specific requirements

MIL tests
- MIL-STD-461D/462D
- MIL-STD-461E/F
- Customer-specific requirements

Monitoring possibilities with R&S®EMC32 EMC measurement software



R&S®TS-EMF
Portable EMF Measurement System

Simple, frequency-selective measurement of EMF emmissions

In combination with Rohde&Schwarz spectrum analyzers, the R&S®TS-EMF measurement system detects high-frequency electromagnetic fields in the environment (EMF). The isotropic antenna, together with the software, which has been specifically designed for EMF measurements, allows simple and precise evaluation of total and individual emissions on site.

- Automated EMF measurements
- Precise measurements of even complex scenarios and RF signals
- Wide frequency range from 9 kHz to 6 GHz using isotropic antennas
- Isotropic antenna for detecting fields independent of direction and polarization
- Combined use possible with various Rohde&Schwarz spectrum analyzers and test receivers

Safety based on exact measurements for reproducible and reliable results

- Evaluation of total emissions, individual radio services or individual frequencies
- Measurements in line with all common EMF standards and measurement methods
- Correct evaluation even of complex scenarios or RF signals
- Excellent reproducibility using automated measurements

Efficient on-site measurements

- Fast, simple measurements owing to predefined test routines
- On-site interpretation of results using integrated report generation
- Easy adaptation to local conditions
- Versatile use due to the compact one-box solution with the R&S®FSL spectrum analyzer

Suitable for a wide range of applications

- Investigation of specific problems or radio signals by directly setting individual measurement parameters
- Additional manual measurements using a full-featured spectrum analyzer
- Optional storage of raw measurement data for further in-depth result evaluation
- Precise extrapolation for WCDMA using CPICH demodulation

Future-oriented

- Coverage of the complete frequency range from 9 kHz to 6 GHz, extendable up to 40 GHz, using additional antennas
- Measurements of advanced radio services with wide bandwidths and high crest factors

R&S®EMF-M EMF-Monitor Station

Fully automatic EMF measurement station

Automated EMF long-term measurements expand snapshot measurements associated with risk communications

Conventional on-site measurements only cover the situation at the moment. Signal weighting is also difficult because some radio signals are only transmitted for a short time and because advanced technologies make use of adaptive power and radiation pattern control.

Such problems are solved by automatically and continuously monitoring typical or critical measurement points, which yield conclusive results. This approach involves standard-compliant monitoring over the entire frequency range, where the individual electromagnetic emissions are allocated to exact frequencies. This solution allows the evaluation of both short-term and long-term fluctuations, e.g. due to new technologies, and provides reliable data for risk communications and research.

- Automated EMF long-term measurements
- Frequency range 9 kHz to 3 GHz, optionally 6 GHz
- Accurate and reliable detection of each emission
- Automatic wireless data transmission and remote configuration via GSM
- Ruggedized design for outdoor use
- Easy transport

Main components

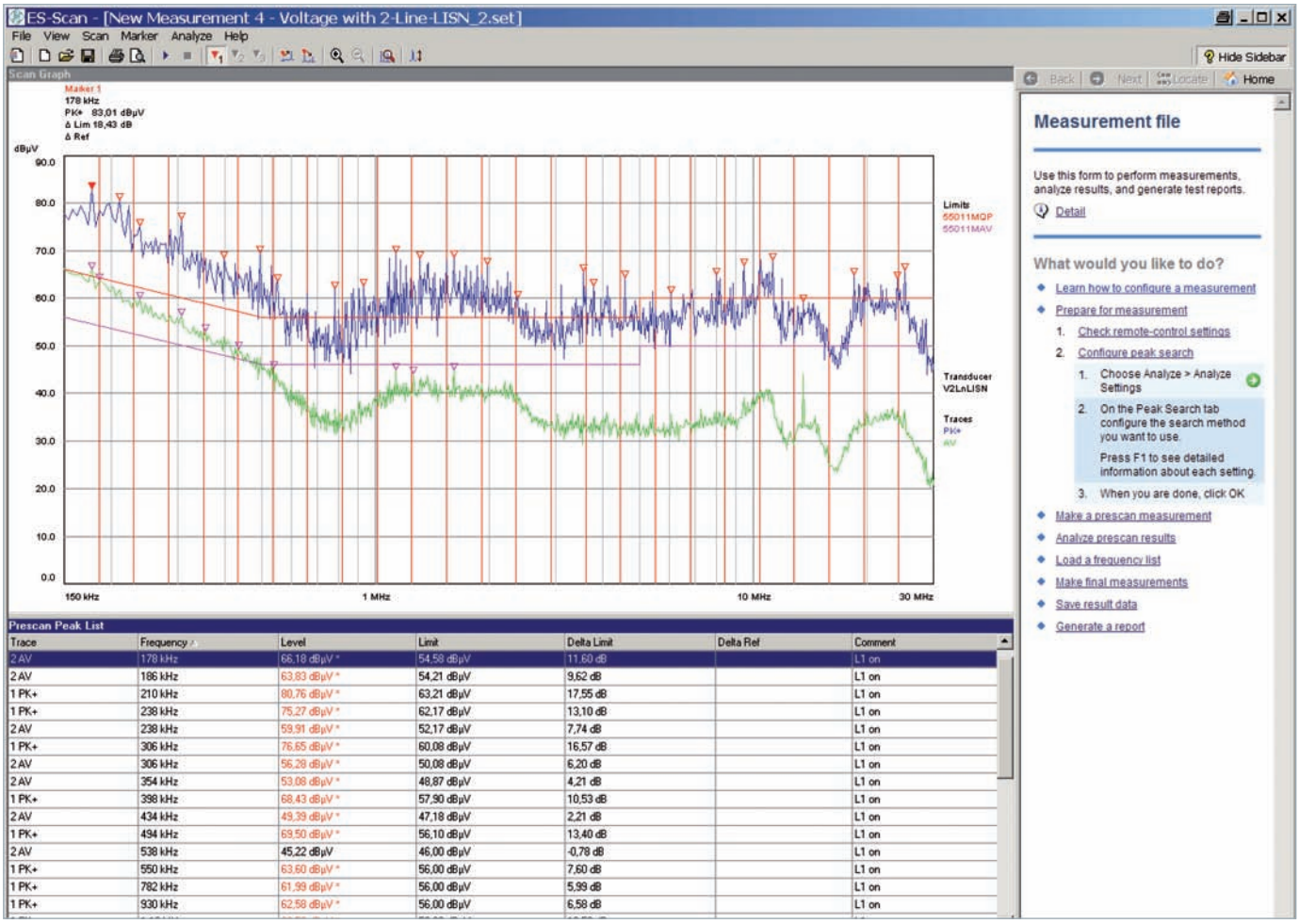
- Radome with measurement antennas, thermo hygro sensor and GPRS antenna
- Protective cover (housing GPS antenna)
- R&S®ESPI test receiver
- System controller with measurement software and watchdog
- Temperature management with display
- Interface for external monitor for local configuration
- Foldable, detachable base

As an autonomous test station, the R&S®EMF-M precisely and seamlessly detects electromagnetic emissions in the frequency range from 9 kHz to 3 GHz or 6 GHz specified by many EMF standards.

The wide dynamic range covers both strong and weak signals. The frequency-selective field strength measurement is not dependent on the angle of incidence and polarization and covers everything from analog modulated signals up to digital, pulsed wideband or radar signals.

Measurement and signal analysis are controlled by the tried-and-tested R&S®RFEX EMF measurement software. This software allows the exact detection, allocation and evaluation of electromagnetic emissions. The measurement results are automatically transmitted to a server and – in Germany, for example – made available to the public via the Internet.

R&S®ES-SCAN
EMI Measurement Software



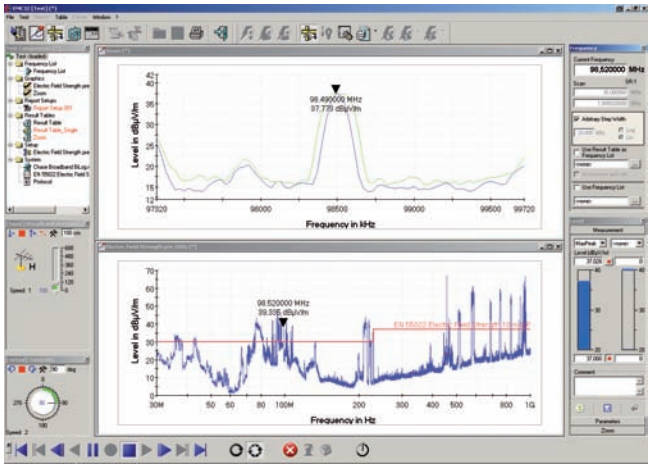
User-friendly software for EMI measurements

R&S®ES-SCAN is a cost-efficient and user-friendly 32-bit Windows software application that has been developed for Rohde&Schwarz test receivers and spectrum analyzers. The main requirements of EMI measurements in accordance with commercial standards have been combined in an easy-to-use application: measurement settings and storage, scan data acquisition and display with automatic data reduction, peak search with acceptance limit and selection of sub-ranges, final measurement with worst-case selection, report generation, and measurement data storage.

R&S®ES-SCAN offers all the advantages of a state-of-the-art software tool, including operation via keyboard and mouse, table editor, configurable report generation, and printout of reports on any Windows printer. An assistant supports the user of the R&S®ES-SCAN EMI software at any stage of operation. Online help texts explain all software functions; an operating manual is therefore not required.

- Menu-controlled configuration of test receiver and storage of settings on controller, including limit lines and transducer factors
- Reliable acquisition, evaluation and documentation of measurement data
- Graphical display of scan data with automatic data reduction
- Marker function, including "Marker to Peak" and "Tune Receiver to Marker Frequency"
- Automatic peak search with selectable acceptance limit and selectable subranges
- Editable frequency list for automatic or semi-automatic final measurements
- "Fine Tuning" function for fast detection of local maxima
- Flexible configuration of report generation for different report layouts

R&S®EMC32
EMC Measurement Software Platform



R&S®EMC32 as virtual instrument: e.g. user interface for manual measurement of disturbance field strength.

For use in development, for compliance and batch testing

The R&S®EMC32 EMC measurement software can be used for all electromagnetic interference (EMI) and electromagnetic susceptibility (EMS) measurements. The software is a modern and powerful tool for controlling and monitoring Rohde&Schwarz devices as well as third party equipment. Thanks to its comprehensive and modular configuration capabilities and its open software structure, it ensures reliable collection, evaluation and documentation of measurement results.

- Cost-efficient
- Flexible and scalable
- Future-ready
- Modular concept allows flexible adaptation to customer needs
- Predefined hardware setups to support easy generation of test setups
- Support of measurements enabling all major standards in the commercial, wireless, automotive and military range
- Manual and automatic EMI and EMS measurements
- Fully automatic and interactive sequences
- Customer- or EUT-specific data handling
- Extensive EUT monitoring capabilities and user-specific actions
- Interface to lab management system

Options

R&S®EMC32-EB	Basic EMI measurement software
R&S®EMC32-S	Basic EMS measurement software
R&S®EMC32-K1	EMS measurements in line with automotive standards and MIL-STD-461
R&S®EMC32-K2	EMC measurements in line with wireless standards.
R&S®EMC32-K3	EMS measurements in reverberation chambers
R&S®EMC32-K4	Automatic EMS test sequences
R&S®EMC32-K6	EMS measurements in line with MIL-STD-461E, CS 103, 104, 105
R&S®EMC32-K7	Generic driver for generators, power meters and oscilloscopes
R&S®EMC32-K8	Database interface for lab management system
R&S®EMC32-K10	EMI auto test
R&S®EMC32-K11	Sequencer for EMC measurements
R&S®EMC32-K21	Application interface for customer-specific RF measurements
R&S®EMC32-K22	Measurement of antenna characteristic (azimuth chart)
R&S®EMC32-K51	EMI measurement reports in line with GMW 3091/3097

Application overview (examples)

Application	Standards (examples) EMS	Standards (examples) EMI
Industrial and household products (commercial)	IEC/EN 61000-4-3, -6	CISPR 11/EN 55011 CISPR 14-1/EN 55014-1 ANSI-C 63.4 FCC 15, 18
Information technology (commercial)	CISPR 24/EN 55024 IEC/EN 61000-4-3, -6	CISPR 22/EN 55022 ANSI-C 63.4 FCC 15, 18
Medical devices (commercial)	EN 60601-1-2 EN 60601-2-x	EN 60601-1-2 CISPR 11/EN 55011
Wireless devices (commercial)	ETSI EN 301498-x ETSI EN 300826	ETSI EN 301489-x 3GPP TS 51.010 ETSI EN 301908-1 ETSI EN 300328-1 FCC part 15
Automotive	ISO 11451, ISO 11452, SAE J1113, SAE J551, 2004/104 EC reverberation chamber (mode-tuned)	2004/104/EC CISPR 12, SAE J551/2 CISPR 25, SAE J1113/41
Military/avionics	MIL-STD-461E, CS 114 and RS 103, MIL-STD-461E, CS 103, CS 104, CS 105 RTCA/DO-160	MIL-STD-461E, CE 101, CE 102, CE 106, RE 101, RE 102, RE 103 RTCA/DO-160 VG 95370-95377 DEF-STAN 49-41 GAM-EG 13
Consumer products radio/TV receivers (commercial)		CISPR 13/EN 55013

EMC accessories for disturbance voltage/current/power and field strength measurements

EMC accessories for disturbance voltage measurements

R&S®ENV216 Two-Line V-Network

Disturbance voltage measurements on single-phase EUTs
- Several models for Germany, United Kingdom, France, China/Australia, USA
- Air-core design and artificial hand
- Switch-selectable highpass filter of 150 kHz
- Built-in 10 dB attenuator pad
- Built-in pulse limiter (can be switched off)
- Remote control with TTL levels (compatible with Rohde&Schwarz EMI test receivers)
- Compact, low weight

Specifications in brief
- Frequency range: 9 kHz to 30 MHz
- Power-handling capacity:16 A, constant current
- Simulated impedance: (50 µH + 5 Ω) || 50 Ω in line with CISPR 16-1-2 Amd. 2:2006
- V-network in line with CISPR, EN, VDE, ANSI, FCC Part 15 and MIL-STD-461D, E and F
- Calibrated in line with CISPR 16-1-2 and ANSI C63.4

R&S®ENV4200 200 A Four-Line V-Network

RFI voltage measurements at high currents
The R&S®ENV4200 V-network meets the requirements of CISPR 16-1-2, EN 55016-1-2, and ANSIC 63.4 for V-networks with the impedance in the 150 kHz to 30 MHz frequency range. CISPR 16-1-2 specifies two types of V-networks for the 150 kHz to 30 MHz frequency range. They have the following impedance:

- **Type 1:** 50 µH || 50 Ω
- **Type 2:** (50 µH + 5 Ω) || 50 Ω

Type 2 is also suitable for the frequency range from 9 kHz to 150 kHz, but not for very high currents since it requires an isolating choke of 250 µH.

The R&S®ENV4200 V-network corresponds to type 1. The maximum attainable current of the V-network is limited by the voltage drop at the standardized inductances (CISPR 16-1-2 limits the voltage drop to 5% of the AC supply voltage) and by unavoidable heat losses.

Specifications in brief
- Frequency range: 150 kHz to 30 MHz
- Impedance: 50 µH || 50 Ω (magnitude and phase) in line with CISPR 16 -1-2 Amd. 2: 2006
- Artificial hand
- Continuous current up to 4 × 200 A
- Air-core design
- Built-in pulse limiter (can be switched off)
- Remote control with TTL levels (compatible with Rohde&Schwarz EMI test receivers)

R&S®ESH2-Z5 25 A Four-Line V-Network

Disturbance measurements on DC- or AC-powered loads
The R&S®ESH2-Z5 four-line V-network is used to measure RFI voltages on supply connections of EUTs and is based on air-core inductances. It contains an artificial hand as well as a PE simulating network that can be bypassed.

Specifications in brief
- Frequency range: 9 kHz to 30 MHz
- V-network in line with CISPR, EN, VDE, ANSI
- Impedance: (50 µH + 5 Ω) || 50 Ω (magnitude and phase) in line with CISPR16-1-2 2006
- Continuous current up to 4 × 25 A
- Short-time current (max. 2 min) up to 4 × 50 A
- Artificial hand and PE simulation network
- Air-core design
- Remote control via TTL levels (compatible with Rohde&Schwarz EMI test receivers)
- Calibrated to CISPR 16-1-2 and ANSI C63.4

R&S®ESH3-Z6 150 A Single-Line V-Network

For measurements of RFI voltage and immunity to RFI in low-impedance power supply networks
The R&S®ESH3-Z6 is a single-phase V-network with an equivalent circuit of (5 µH + 1 Ω) || 50 Ω for the 100 kHz to 200 MHz frequency range. The R&S®ESH3-Z6 is rated for a continuous current of up to 150 A and can handle surges of up to 500 A for a maximum time of 30 s. Its screw terminals ensure a low-impedance connection of the test device and the power supply.

Specifications in brief
- Frequency range: 0.1 MHz to 200 MHz
- Continuous current of up to 150 A
- Impedance: (5 µH + 1 Ω) || 50 Ω
- In line with
  - CISPR 25 (onboard power supply systems)
  - CISPR 16-1-2 and EN 55016-1-2 (low-impedance power supplies)
  - MIL-I-6181D, MIL-I-16910C, MIL-E-55301
  - DEF-STAN 59-411 and DO-160

EMC accessories for disturbance voltage measurements

R&S®ENY21 Two-Wire Coupling Network

Radio disturbance and immunity measurements on unshielded, symmetrical telecommunications ports

- Radio disturbance measurements in line with CISPR 22: 2005 and EN 55022: 2006 (150 kHz to 30 MHz)
- Immunity measurements in line with CISPR 24 and EN 55024 (150 kHz to 80 MHz)
- CISPR 16-1-2 complied with
- Adapter sets to meet standardized LCL requirements (55 dB and 65 dB) and to accommodate various telecommunications interfaces
- High transmission bandwidth for wanted signal (100 MHz)

Specifications in brief

- Frequency range
  - Radio disturbance: 150 kHz to 30 MHz
  - Immunity: 150 kHz to 80 MHz
- Asymmetrical impedance
  - Imped. (0.15 MHz to 30 MHz): 150 Ω ± 20 Ω
  - Phase angle (0.15 MHz to 30 MHz): 0° ± 20°
  - Imped. (> 30 MHz to 80 MHz): 150 Ω ± 40 Ω
- Voltage division factor in asymmetrical circuit
  - 150 kHz to 80 MHz: typ. 10 dB ± 1 dB
- Maximum permissible values
  - Max. RF input voltage: < 15 V
  - Max. DC voltage between line/ground: 100 V
  - Max. AC voltage between line/ground: 63 V
  - Max. DC current: 400 mA (current on each individual wire of one pair or on different pairs)

R&S®ENY41 Four-Wire Coupling Network

Radio disturbance and immunity measurements on unshielded, symmetrical telecommunications ports

- Radio disturbance measurements in line with CISPR 22: 2005 and EN 55022: 2006 (150 kHz to 30 MHz)
- Immunity measurements in line with CISPR 24 and EN 55024 (150 kHz to 80 MHz)
- CISPR 16-1-2 complied with
- Adapter sets to meet standardized LCL requirements (55 dB and 65 dB) and to accommodate various telecommunications interfaces
- High transmission bandwidth for wanted signal (100 MHz)

Specifications in brief

- Frequency range
  - Radio disturbance: 150 kHz to 30 MHz
  - Immunity: 150 kHz to 80 MHz
- Asymmetrical impedance
  - Imped. (0.15 MHz to 30 MHz): 150 Ω ± 20 Ω
  - Phase angle (0.15 MHz to 30 MHz): 0° ± 20°
  - Imped. (> 30 MHz to 80 MHz): 150 Ω ± 40 Ω
- Voltage division factor in asymmetrical circuit
  - 150 kHz to 80 MHz: typ. 10 dB ± 1 dB
- Maximum permissible values
  - Max. RF input voltage: < 15 V
  - Max. DC voltage between line/ground: 100 V
  - Max. AC voltage between line/ground: 63 V
  - Max. DC current: 400 mA (current on each individual wire of one pair or on different pairs)

R&S®ENY81 Eight-Wire Coupling Network

Radio disturbance measurements on unshielded, symmetrical telecommunications ports

- Radio disturbance measurements in line with CISPR 22: 2005 and EN 55022: 2006 (150 kHz to 30 MHz)
- CISPR 16-1-2 complied with
- Adapter sets to meet standardized LCL requirements (55 dB and 65 dB) and to accommodate various telecommunications interfaces
- High transmission bandwidth for wanted signal (100 MHz)

Specifications in brief

- Frequency range: 150 kHz to 30 MHz
- Asymmetrical impedance
  - Imped. (0.15 MHz to 30 MHz): 150 Ω ± 20 Ω
  - Phase angle (0.15 MHz to 30 MHz): 0° ± 20°
- Voltage division factor in asymmetrical circuit
  - 150 kHz to 30 MHz: typ. 10 dB ± 1 dB
- Maximum permissible values
  - Max. RF input voltage: < 15 V
  - Max. DC voltage between line/ground: 100 V
  - Max. AC voltage between line/ground: 63 V
  - Max. DC current: 400 mA (current on each individual wire of one pair or on different pairs)

R&S®ENY81-CA6 Eight-Wire Coupling Network for cable category CAT 6

Radio disturbance measurements on unshielded, symmetrical telecommunications ports

- Radio disturbance measurements in line with CISPR 22: 2005 and EN 55022: 2006
- Immunity measurements in line with CISPR 24 and EN 55024 (150 kHz to 80 MHz)
- CISPR 16-1-2 complied with
- 75 dB longitudinal conversion loss (LCL)
- High transmission bandwidth for wanted signal (250 MHz)

Specifications in brief

- Frequency range
  - Radio disturbance: 150 kHz to 30 MHz
  - Immunity: 150 kHz to 80 MHz
- Asymmetrical impedance
  - Imped. (0.15 MHz to 30 MHz): 150 Ω ± 20 Ω
  - Phase angle (0.15 MHz to 30 MHz): 0 ° ± 20°
  - Imped. (> 30 MHz to 80 MHz): 150 Ω ± 40 Ω
- Voltage division factor in asymmetrical circuit
  - 150 kHz to 30 MHz: typ. 9.5 dB ± 1 dB
- Maximum permissible values
  - Max. RF input voltage: < 15 V
  - Max. DC voltage between line/ground: 100 V
  - Max. AC voltage between line/ground: 63 V
  - Max. DC current: 400 mA (current on each individual wire of one pair or on different pairs)

EMC accessories for disturbance voltage measurements

R&S®EZ-12 Antenna Impedance Converter

Broadband matching unit for test receivers and spectrum analyzers with low-impedance inputs
The R&S®EZ-12 is used for high-impedance measurements of interference voltage at the feed-point of a vehicle-mounted antenna in the long-, medium-, shortwave and FM bands to VDE 0879 Part 2 and CISPR 25. For measurements in the VHF-FM range, the antenna signal can be switched to a separate 50 Ω input.

- Flat frequency response
- High sensitivity and overload capacity
- Calibration in line with CISPR 25: 2008
- Remote-controlled FM range switch

Specifications in brief
- Frequency range: 150 kHz to 30 MHz (120 MHz)
- RF input: SO 10599-1
- Input impedance: > 100 kΩ, < 10 pF (at 1 MHz)
- Gain factor for direct input to antenna connector: +11.2 dB ±1 dB
- Correction factor (nominal gain to CISPR 25 is 10 dB): 10 dB
- VSWR: ≤ 1.4
- Noise voltage at output (input terminated with antenna simulator; AVG, bandwidth = 10 kHz)
  - f > 150 kHz: < –5 dBµV
  - f > 500 kHz: < –7 dBµV
- 1 dB compression point: > 107 dBµV

R&S®EZ-25 150 kHz Highpass

Conducted emission measurements in the presence of longwave mains disturbance signals
For the measurement of equipment that requires higher selectivity at the transition between 130 kHz and 150 kHz as shown in figure 2 of CISPR 16-1-1 (e.g. signaling equipment as defined in EN 50065-1), a highpass filter may be added in front of the measuring receiver to improve the selectivity and achieve the values stipulated in EN 50065 Part 1 without impairing the passband of the measuring receiver.

- Conducted emission measurements to EN 50065 Part 1
- Very steep slope in line with CISPR 16-1-1
- 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 LISN
- High pulse energy capability (50 mWs)
- Calibrated response

Specifications in brief
- Passband: 150 kHz to 30 MHz
- Insertion loss in passband: 9.5 dB to 11.5 dB
- VSWR in passband: < 1.2
- Stopband: below 130 kHz
- Minimum attenuation in stopband: 60 dB
- Attenuation in transition region:
  - 146 kHz: < 12 dB
  - 145 kHz: > 12 dB
  - 140 kHz: > 24 dB
  - 130 kHz: > 60 dB
- Max. input voltage (continuous): 137 dBµV
- Max. impulse energy (50 µs): 50 mWs
- Dimensions (L × W × H): 145 mm × 95 mm × 52 mm (5.7 in × 3.74 in × 2.05 in)
- Weight: 500 g (1.1 lb)

R&S®ESH2-Z2/-Z3 Voltage Probes, R&S®ESH2-Z31 Attenuator

R&S®ESH2-Z2 Active Voltage Probe
The active voltage probe is used for measuring RFI voltages on lines that do not carry AC supply voltage.

R&S®ESH2-Z3 Passive Voltage Probe
The passive voltage probe is suitable for measuring RFI voltages (on AC supply lines) in line with CISPR 16-2-1 and EN 55016-2-1.

R&S®ESH2-Z31 Attenuator
For checking the interference source impedance in line with EN 55016-2-1 and CISPR 16-2-1

Specifications in brief (R&S®ESH2-Z2/-Z3)
- Frequency range: 9 kHz to 30 MHz
- Measurement range (AVG, IF bandwidth 200 Hz with Rohde&Schwarz test receivers): –20 dBµV to +120 dBµV, +10 dBµV to +150 dBµV
- Attenuation, uncertainty of calibration: 10 dB, 0.5 dB/30 dB, 0.5 dB
- Input impedance: 118 kΩ ± 5 % || 8 pF/1.5 kΩ ± 5 % || 8 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

R&S®ESH3-Z2 Pulse Limiter

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. The R&S®ESH3-Z2 pulse limiter limits and reduces the interference level.

Specifications in brief
- Frequency range: 0 Hz to 30 MHz
- Insertion loss: 10 dB ±0.3 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
- Pulse power-handling capacity: E = 0.1 Ws (6 ms)
- Dimensions (L × W × H): 94 mm × 25 mm × 25 mm (3.70 in × 0.98 in × 0.98 in)
- Weight: 120 g (0.26 lb)

EMC accessories for disturbance current measurements

R&S®EZ-17 Current Probe

Emission and susceptibility measurements
The R&S®EZ-17 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).

- Model .02 for emission measurements
- Model .03 for emission and susceptibility measurements
- High sensitivity and overload capability
- Wide frequency range
- High load capacity for DC and AC current
- Small dimensions in spite of large inner diameter (30 mm)
- Simple clamping thanks to spring-loaded mechanism

Specifications in brief
- Frequency range: 20 Hz to 100 MHz
- Range with constant transducer factor (–3 dB): 1 MHz/2 MHz to 100 MHz
- Transducer factor reduced by 20 dB/decade in range 20 Hz to 1 MHz/2 MHz
- 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)
  - Max. RF current (RMS): 2 A (f > 1 MHz)/1 A (f > 1 MHz)
- Load capacity model .03 (EMS measurement)
  - Max. power at RF connector: 10 W (f > 1 MHz)

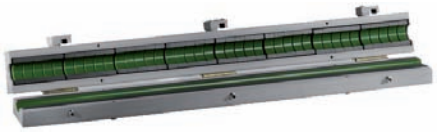
R&S®ESV-Z1 VHF Current Probe

The R&S®ESV-Z1 current probe is used for selective or broadband measurements of very small or very large RF currents in electric lines. It is shielded against electrostatic effects and complies with CISPR 16-1-2 and VDE 0876.

Specifications in brief
- Frequency range: 9 kHz to 600 MHz
- Measurement range (AVG, IF bandwidth 7.5 kHz): –33 dBµA to +117 dBµA
- Transfer admittance (Y_t = Iin/V_{out}): 0.1 S (20 MHz to 600 MHz)
- Transducer factor (k = 20 log (Y_t/s): –20 dB (20 MHz to 600 MHz)
- Max. current (superimposed on RF current or peak AC current): 50 A
- Max. diameter of conductor: 13.5 mm (0.53 in)
- Dimensions (Ø × height): 55 mm × 20 mm (2.17 in × 0.79 in)
- Weight: 130 g (0.29 lb)

EMC accessories for disturbance power measurements

R&S®EZ-24 Ferrite Clamp



The R&S®EZ-24 ferrite clamp is used to improve the reproducibility of disturbance field strength measurements and the measurements of disturbance power and screening effectiveness.

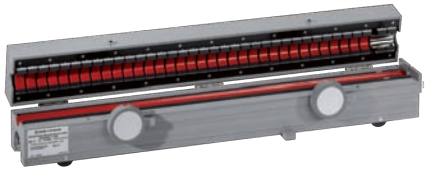
In a 50 Ω circuit, the clamp produces decoupling attenuation of more than 15 dB in the range from 30 MHz to 1 GHz. The ferrite clamp can be opened to insert the cable to be loaded.

Drafts on the measurement of radiated emission call for ferrite absorbers to load cables in order to improve the reproducibility of disturbance field strength measurements. Ferrite absorbers also help to improve the measurements of disturbance power and screening effectiveness.

Specifications in brief

- Frequency range: 1 MHz to 1 GHz
- High reproducibility of disturbance field strength measurements
- Calibrated in line with CISPR 16-1-3
- Maximum diameter of cable: 22 mm (0.87 in)

R&S®MDS-21 Absorbing Clamp



The R&S®MDS-21 absorbing clamp can be used in conjunction with EMI test receivers to measure the disturbance power on cables in line with CISPR 13 or EN 55013, CISPR 14-1 or EN 55014-1, as well as EN 50083-2. In conjunction with two-port measurement devices, it allows the shielding effectiveness of cables to be measured in line with DIN 47250 Part 6, IEC 96-1 and EN 50083-2.

It can also be used for measuring the efficiency of disturbance suppression devices for high-voltage ignition systems in line with CISPR 12 or EN 55012.

High-energy pulses are coupled out and taken to the measuring receiver. This means that measuring receiver inputs must be thoroughly protected.

The R&S®MDS-21 clamps are also suitable for use as coupling clamps in order to test the immunity of electronic devices.

Specifications in brief

- Frequency range: 30 MHz to 1000 MHz
- Calibrated in line with CISPR 16-1-3
- Ball bearing rollers for continuous use in automatic measurements
- Maximum diameter of cable: 20 mm (0.79 in)

EMC accessories for field strength measurements

R&S®HZ-10 Shielded, Calibrated Magnetic Field Pickup Coil (MIL)

Measurement of magnetic field strengths to relevant standards
The R&S®HZ-10 shielded and individually calibrated magnetic field pickup coil allows magnetic field strengths in the frequency range from 20 Hz to 200 kHz to be measured in line with the commercial and military MIL-STD-461/462, DEF-STAN 59-61, GAM-EG 13, VG 95377 Part 13 and EN 55103-1 standards. These standards specify 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.

Specifications in brief
- Frequency range: 5 Hz to 10 MHz
- Antenna factor: calibration certificate supplied with coil
- Coil
  - Diameter: 133 mm (5.23 in)
  - Number of turns: 36
  - Type of wire: 7-41, litz wire
  - Resistance: 10 Ω
  - Inductance: 415 µH
- Connector: Twinax female
- Dimensions (W × H × D):
  142 mm × 178 mm × 29 mm
  (5.59 in × 7.01 in × 1.14 in)
- Weight: 260 g (0.57 lb)

R&S®HZ-11 E Near-Field Probe Set

Diagnostic tools for solving EMC problems and for RFID measurements
The R&S®HZ-11 near-field probe set can be used in conjunction with test receivers, spectrum analyzers or oscilloscopes to determine electromagnetic emissions of any type. The main application is the diagnosis of emissions from printed boards, cables and leakage spots in shielded enclosures. The passive probes can be used for a local susceptibility test. The R&S®HZ-11 probe set is for qualitative analysis. It comes in a handy transit case.

Equipment supplied
- Three passive H-field probes
- Two passive E-field probes
- One probe extension
- One preamplifier
- One power supply

Specifications in brief
- Probe type, measurement of E-/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
    35 dB/38 dB/39 dB
  - 1 GHz/2 GHz/3 GHz
    33 dB/26 dB/14 dB
- Noise figure at 500 MHz: typ. 3.5 dB
- Saturated output level at 100 MHz:
  typ. 12 dBm
- 1 dB compression point at 100 MHz:
  typ. 8 dBm

R&S®HZ-14 H Near-Field Probe Set

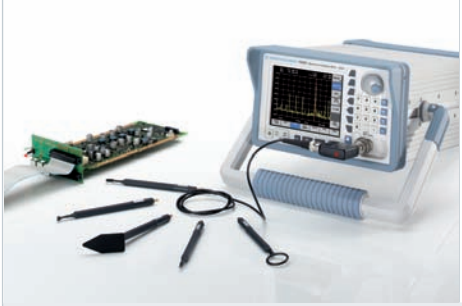
Diagnostic tools for detecting EMC trouble spots
The R&S®HZ-14 near-field probe set can be used in conjunction with test receivers, spectrum analyzers or oscilloscopes to determine electromagnetic emissions of any type. The main application is the diagnosis of emissions from printed boards, cables and leakage spots in shielded enclosures. The two passive H-field probes can be used for a local susceptibility test. The R&S®HZ-14 probe set is for quantitative analysis. It comes in a handy transit case.

Equipment supplied
- 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 functional testing of 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
- H-field probes
  - 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
  - Frequency range: 9 kHz to 1 GHz
  - Gain: 30 dB ± 2 dB (typ. ±1 dB)
  - Noise figure: typ. < 4 dB
  - 1 dB compression point: typ. 0 dBm
  - Input/output: BNC female/N male
  - Impedance: 50 Ω
  - VSWR: < 2
  - DC powering: 10 V ± 0.1 V, < 100 mA
  - DC connector: LEMO

EMC accessories for field strength measurements

R&S®HZ-15 Probe Set for E and H Near-Field Emission Measurements



The R&S®HZ-15 probe set contains special probes from 30 MHz to 3 GHz for near-field emission measurements on electronic modules for use in conjunction with test receivers and spectrum analyzers. Inserting the R&S®HZ-16 preamplifier between the near-field probe and the spectrum analyzer makes it easier to measure very weak high-frequency fields of up to 3 GHz.

- Five probes for easy diagnostic measurements
- Special, electrically shielded magnetic field probes
- Probe tips adapted to near-field measurement
- High-resolution measurements
- Easy-to-determine magnetic field orientation
- Easy operation and handling

Specifications in brief (R&S®HZ-16)
- Frequency range: 100 kHz to 3 GHz
- Gain: 20 dB (from 1.5 GHz decreasing to 17 dB)
- Noise figure: 4.5 dB
- Max. input power: +13 dBm
- Operating voltage: 12 V
- Plug-in power supply: 100 V to 240 V, 50 Hz/60 Hz, Euro connector (2 mm × 4 mm), adapter for USA and Japan

R&S®HZ-12 Precision Halfwave Dipole Set

Maximum precision for antenna calibration, field strength measurements and test site attenuation measurements
Tunable halfwave dipoles are used for calibrating VHF/UHF broadband antennas, which have advantages in practical use but whose characteristics cannot be strictly calculated.

Halfwave dipoles are the only tools for checking reference sites used for antenna calibration in line with CISPR 16-1-5 and ANSI C63.5. They are also used for checking semi-anechoic chamber test sites.

Specifications in brief
- Frequency range: 30 MHz to 300 MHz
- Power attenuation of dipole pair (closely coupled):
  - 20 dB (calibration curve supplied with set)
- Antenna factor:
  - 7.5 dB to 27.6 dB (proportional to f)
- VSWR: < 1.1

R&S®HZ-13 Precision Halfwave Dipole Set

Maximum precision for antenna calibration, field strength measurements and test site attenuation measurements
Tunable halfwave dipoles are used for calibrating VHF/UHF broadband antennas, which have advantages in practical use but whose characteristics cannot be strictly calculated.

Halfwave dipoles are the only tools for checking reference sites used for antenna calibration in line with CISPR 16-1-5 and ANSI C63.5. They are also used for checking semi-anechoic chamber test sites.

Specifications in brief
- Frequency range: 300 MHz to 1000 MHz
- Power attenuation of dipole pair (closely coupled):
  - 20 dB (calibration curve supplied with set)
- Antenna factor:
  - 27.4 dB to 38 dB (proportional to f)
- VSWR:
  - < 1.2 (300 MHz to 800 MHz)
  - < 1.3 (800 MHz to 1 GHz)

R&S®HFH2-Z1 Rod Antenna

Broadband active rod antenna for use as a general-purpose receiving antenna and for measuring the electrical field strength, preferably in open-area measurements
- Frequency range: 9 kHz to 30 MHz
- Antenna factor k, referred to 1/m: 10/20 dB, selectable
- Accuracy: 1 dB
- Measurement range (IF bandwidth 200 Hz, AV ind.)
  - Lower limit, frequency-dependent: +15 dB(µV/m) to –10 dB(µV/m)
  - Upper limit: 140 dB(µV/m), 130 dB(µV/m) with k = 10 dB
- Connectors
  - RF: BNC female, 50 Ω
  - Supply and coding (antenna factor): 12-contact Tuchel female
  - Length of connecting cables: 10 m (393.70 in)
- Current drain (±10 V): < 40 mA
- Dimensions
  - Counterpoise Ø: 2510 mm (98.82 in)
  - Rod height: 1092 mm (42.99 in)
- Weight in transit case, without cable: 8 kg (17.64 lb)

EMC accessories for field strength measurements

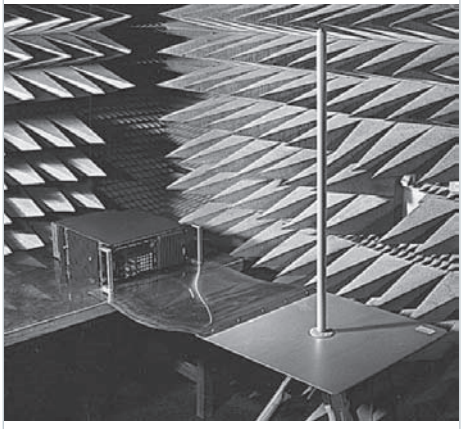
R&S®HFH2-Z2 Loop Antenna

Broadband active loop antenna for measuring the magnetic field strength
- Frequency range: 9 kHz to 30 MHz
- Antenna factor k, referred to 1/m: 20 dB (E-field)
- Accuracy: 1 dB
- Measurement range (IF bandwidth 200 Hz, AV ind.)
  - Lower limit, frequency-dependent, 9 kHz to 1 MHz: +40 dB(µV/m) to +10 dB(µV/m)
  - Lower limit, frequency-dependent, 1 MHz to 30 MHz: +10 dB(µV/m) to +5 dB(µV/m)
  - Upper limit: 140 dB(µV/m)
- Connectors
  - RF: BNC female, 50 Ω
  - Supply and coding (antenna factor): 12-contact Tuchel female
  - Length of connecting cables: 10 m (393.70 in)
- Current drain (±10 V): < 40 mA
- Dimensions (loop Ø): 590 mm (23.23 in)
- Weight in transit case, without cable: 12 kg (26.46 lb)

R&S®HFH2-Z4 Inductive Probe

Inductive probe for assessing the magnetic field strength
- Frequency range: 100 kHz to 30 MHz
- Antenna factor k, referred to 1/m: 80 dB (E-field)
- Accuracy: 6 dB
- Measurement range (IF bandwidth 200 Hz, AV ind.)
  - Lower limit, frequency-dependent: 50 dB(µV/m) (≈0 dB(µA/m))
  - Upper limit: > 190 dB(µV/m) (≈140 dB(µA/m)
- Connectors
  - RF: BNC male, 50 Ω
  - Supply and coding (antenna factor): 12-contact Tuchel female
  - Length of connecting cables: 1 m (39.37 in)
- Dimensions
  - Outer Ø: 50 mm (1.97 in)
  - Height: 20 mm (0.79 in)
- Weight with cable: 0.3 kg (0.66 lb)

R&S®HFH2-Z6 Rod Antenna



Broadband active rod antenna for measuring the electrical component of radiated EMI in test setups to MIL-STD-461/462 and similar MIL standards and CISPR 25
- Frequency range: 9 kHz to 30 MHz
- Antenna factor k, referred to 1/m: 10/20 dB, selectable
- Accuracy: 1 dB
- Measurement range (IF bandwidth 200 Hz, AV ind.)
  - Lower limit, frequency-dependent: +15 dB(µV/m) to –18 dB(µV/m)
  - Upper limit: 140 dB(µV/m), 130 dB(µV/m) with k = 10 dB
- Connectors
  - RF: BNC female, 50 Ω
  - Supply and coding (antenna factor): 12-contact Tuchel female
  - Length of connecting cables: 10 m (393.70 in)
- Current drain (±10 V): < 45 mA
- Dimensions
  - Counterpoise: 600 mm × 600 mm (23.62 in × 23.62 in)
  - Rod height: 1000 mm (39.37 in)
- Weight without cable: 5 kg (11.02 lb)

R&S®HZ-9 Power Supply

Power supply for feeding the active R&S®HFH2-Z1/-Z2/-Z6 antennas, if these antennas cannot be powered from the test receiver
Output voltages: ±10 V ± 0.5%
Max. current load: 100 mA
DC connector: 12-contact Tuchel female
AC supply: 100 V to 240 V, –15/+10%
Dimensions (W × H × D): 125 mm × 70 mm × 188 mm (4.92 in × 2.76 in × 7.40 in)
Weight: 1.5 kg (3.31 lb)

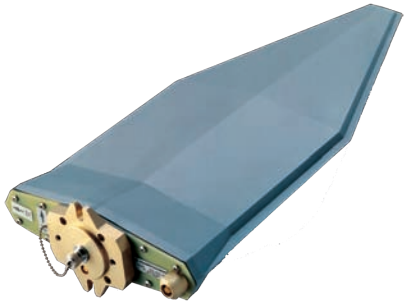
EMC accessories for field strength measurements

R&S®HL033 Log-Periodic Broadband Antenna

Detection and measurement of RF signals
- Extremely broadband
- Only one antenna required to cover a wide frequency range
- Low frequency dependence of radiation patterns and input impedance
- Can be used as transmit antenna
- Metal parts electrically connected to mast flange for protection against electric charges and lightning
- Highly weatherproof
- Stable installation due to optional center bracket
- Individual calibration in line with ANSI C63.5

Specifications in brief
- Frequency range: 80 MHz to 2 GHz
- Polarization: linear
- Input impedance: 50 Ω
- VSWR: ≤ 2
- Max. input power (T_A = +30 °C)
  - 80 MHz: 460 W + 100 % AM to
  - 2 GHz: 120 W + 100 % AM
- Gain: typ. 6.5 dBi
- Max. wind speed (without ice deposit): 150 km/h
- Dimensions (L × W): approx. 1800 mm × 1960 mm (70.87 in × 77.17 in)
- Weight: approx. 5 kg (11.02 lb)

R&S®HL040 Log-Periodic Broadband Antenna



For broadband transmission and reception under open-field and laboratory conditions
- Wide bandwidth
- High symmetry and low frequency dependence of radiation patterns
- Coverage of various mobile radio frequency ranges
- Suitable for field strength and EMC measurements due to high precision
- Individual calibration in line with ANSIC 63.5/DIN 45003
- Compact and sturdy design
- Can be used in the lab and for open-field applications
- Individual calibration certificate

Specifications in brief
- Frequency range: 400 MHz to 3 GHz
- Polarization: linear
- Input impedance: 50 Ω
- VSWR: < 2.5, typ. < 2.0
- Max. input power: 150 W to 50 W CW
- Gain: 5 dBi to 7 dBi
- Front-to-back ratio
  - 400 MHz to 450 MHz: > 10 dB
  - 450 MHz to 3 GHz: > 15 dB
- Polarization isolation: > 20 dB
- Max. wind speed (without ice deposit): 200 km/h
- Dimensions (H × W × L): approx. 130 mm × 300 mm × 680 mm (5.1 in × 11.8 in × 26.8 in)
- Weight: approx. 2.8 kg (6.17 lb)

R&S®HL046 Log-Periodic Broadband Antenna

Antenna for EMS measurements
- Consists of two log-periodic antennas arranged in a V-shape and connected in parallel
- Almost rotation-symmetrical radiation patterns
- High antenna gain, i.e. low amplifier power required
- Wide frequency range
- High selectivity in H plane
- Uniform object irradiation due to optimized radiation patterns
- Reduced influence of test chamber
- Wall mounting possible
- Small size, suitable for use in test chambers

Specifications in brief
- Frequency range: 80 MHz to 1.3 GHz
- Gain: typ. > 7 dBi
- Max. input power
  - 80 MHz: 1000 W + 100 % AM to
  - 1 GHz: 300 W + 100 % AM
- Front-to-back ratio: typ. > 20 dB
- Input impedance: 50 Ω
- VSWR: < 2
- Polarization: linear
- Trolley as an option
  - Height continuously adjustable between approx. 1 m and 1.75 m above ground
  - Pneumatic actuators as an option

R&S®HL046E High Gain Log-Periodic Antenna

Antenna for EMS measurements
- High antenna gain, i.e. low amplifier power required
- No change of antennas needed over wide frequency range
- Uniform object irradiation due to optimized radiation patterns
- Small size, suitable for use in test chambers
- Reduced influence of test chamber
- Antenna gain approximately constant over the entire frequency range
- Wall mounting possible

Specifications in brief
- Frequency range: 80 MHz to 3 GHz
- Polarization: linear
- Input impedance: 50 Ω
- VSWR: < 2 (< 2.5 GHz), < 2.5 (≥ 2.5 GHz)
- Practical gain: typ. > 8 dBi
- Max. input power
  - 80 MHz: 1400 W + 100 % AM to
  - 3 GHz: 250 W + 100 % AM
- Trolley as an option
  - Height continuously adjustable between approx. 1 m and 1.75 m above ground
  - Pneumatic actuators as an option

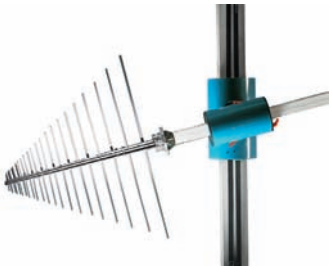
EMC accessories for field strength measurements

R&S®HL050 Log-Periodic Antenna

Log-periodic directional antenna for linear polarization
- Extremely wide frequency range
- Rotation-symmetrical radiation patterns
- High gain due to V-shaped configuration of antenna elements
- Can be used in the lab and for open-field applications
- Can be used as a separate antenna or as a feed for microwave directional antennas

Specifications in brief
- Frequency range: 850 MHz to 26.5 GHz
- Polarization: linear
- Input impedance: 50 Ω
- VSWR: ≤ 2.5
- Max. input power: 10 W to 2 W
- Gain: typ. 8.5 dBi
- Max. wind speed (without ice deposit): 180 km/h
- Dimensions (diameter × height, with radome): approx. 210 mm × 300 mm (8.27 in × 11.81 in)
- Weight: approx. 0.7 kg (1.54 lb)

R&S®HL223 Log-Periodic Antenna



For measurement, monitoring and transmission
Owing to its broadband characteristics and the virtually frequency-independent radiation patterns, the R&S®HL223 covers a very wide frequency range. The sturdy construction makes the antenna suitable for stationary and mobile applications. Each antenna is supplied with an individual calibration certificate so that measurements can be performed in addition to monitoring and transmitting.

Specifications in brief
- Frequency range: 200 MHz to 1.3 GHz
- Polarization: linear
- Input impedance: 50 Ω
- VSWR: ≤ 2 (typ. 1.6)
- Max. input power: 1500 W to 600 W CW
- Gain: > 6 dBi
- Max. wind speed (without ice deposit): 200 km/h
- Dimensions (L × W): approx. 710 mm × 765 mm (27.95 in × 30.12 in)
- Weight: approx. 2 kg (4.41 lb)

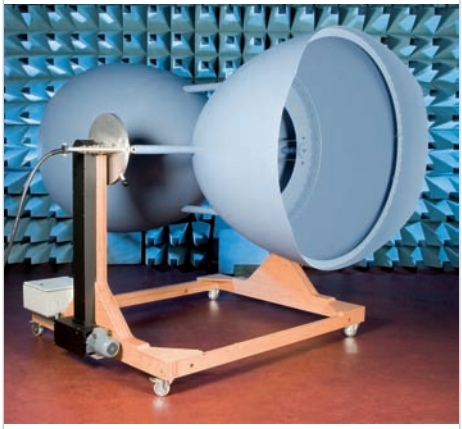
R&S®HM020 Triple-Loop Antenna

Large loop antenna system
The R&S®HM020 is a large loop antenna system in line with CISPR 16-1-4, for electric lighting equipment in line with CISPR 15 and for induction sources in line with CISPR 11.

- 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 × H × D); weight
- Loops set up, normal mode
  2.49 m × 2.57 m × 2.07 m; 45 kg
  (98.03 in × 101.18 in × 81.50 in; 99.21 lb)
- Loops set up, reduced height
  2.49 m × 2.09 m × 2.07 m
  (98.03 in × 82.28 in × 81.50 in)
- Transport crate: 2.68 m × 2.32 m × 0.57 m
  (105.51 in × 91.34 in × 22.44 in)
- R&S®HM020Z1 basic pedestal
  0.9 m × 1 m × 0.9 m; 40 kg
  (35.43 in × 39.37 in × 35.43 in; 88.18 lb)
- R&S®HM020Z2 adapter pedestal
  0.9 m × max. 0.5 m × 0.9 m; 30 kg
  (35.43 in × max. 19.69 in × 35.43 in; 66.14 lb)

R&S®HK5000 EMS Broadband Dipole



High-power transmitting antenna specially designed for EMS operation in test chambers
- Generation of high field strength
- High power capability
- No tuning necessary
- Compact size
- Easy mounting and demounting

Specifications in brief
- Frequency range: 20 MHz to 100 MHz
- Polarization: linear
- Input impedance: 50 Ω
- VSWR: < 2 (under free-space conditions)
- Gain: > 2 dBi (under free-space conditions)
- Max. input power
  - With EIA 1 $^{5}/_{8}$" connector: 10 kW CW
  - With 13-30 connector (in line with IEC 169-5): 5 kW CW
- Generated field strength: > 200 V/m RMS at a distance of 1 m and 5 kW CW input power
- Dimensions (L × W × H)
  - Vertically polarized:
    approx. 1.8 m × 2.95 m × 2.2 m
    (70.9 in × 116.1 in × 86.6 in)
  - Horizontally polarized:
    approx. 2.9 m × 2.4 m × 2.2 m
    (114.2 in × 94.5 in × 86.6 in)
- Weight
  - Antenna: approx. 150 kg (330.7 lb)
  - Holder with motor: approx. 120 kg (264.6 lb)

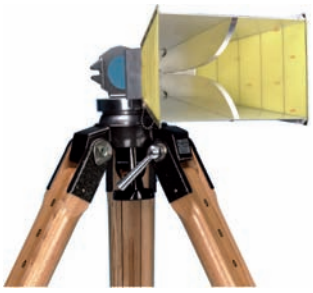
EMC accessories for field strength measurements

R&S®HK116 Biconical Antenna

For radiated emission measurements
- Wide frequency range
- Radiation patterns virtually independent of frequency
- Individual calibration in line with ANSI C63.5 (free-space calibration) and ARP 958
- Low weight

Specifications in brief
- Frequency range: 20 MHz to 300 MHz
- Polarization: linear
- Input impedance: 50 Ω
- VSWR: typ. 2.5
- Permissible input power: 75 W CW
- Dimensions (L × W × H): approx. 1380 mm × 530 mm × 720 mm (54.3 in × 20.9 in × 28.3 in)
- Weight: approx. 3 kg (6.61 lb)

R&S®HF907 Double-Ridged Waveguide Horn Antenna



Broadband directional antenna, ideal for EMC measurements
- Wide frequency range
- High gain and low VSWR for measurement of weak signals and generation of high field strengths without any significant return loss
- Radiation pattern contains only one main lobe over the entire frequency range
- Ideal for use in EMC laboratories
- Compact size, low weight
- Each antenna is calibrated individually in line with ANSI C63.5 and SAE ARP 958

Specifications in brief
- Frequency range: 800 MHz to 18 GHz
- Polarization: linear
- Polarization decoupling: > 25 dB (typ. > 30 dB)
- Input impedance: 50 Ω
- VSWR: ≤ 3.0 (f < 1.5 GHz), < 2.0 (f ≥ 1.5 GHz)
- Max. input power: 300 W CW/500 W PEP
- Gain: 5 dBi to 14 dBi (typ.)
- Dimensions (L × W × H):
  approx. 305 mm × 280 mm × 226 mm
  (12.0 in × 11.0 in × 8.9 in)
- Weight: approx. 1.9 kg (4.2 lb)

R&S®HL562 ULTRALOG

EMI and EMS measurements in an extremely wide frequency range
- Combines the characteristics of a biconical and a log-periodic antenna
- Only one antenna required to cover a wide frequency range
- Selectable polarization plane
- V-shaped log-periodic part of the antenna for high system sensitivity
- Suitable for EMS measurements with high field strengths (10 V/m or higher)
- Gain increase at high frequencies
- Compact size
- Individual calibration (ANSI C63.5 and DIN 45003)

Specifications in brief
- Frequency range: 30 MHz to 3 GHz
- Polarization: linear
- Cross-polar suppression: > 20 dB (in line with CISPR 16-1-4)
- Nominal impedance: 50 Ω
- VSWR: typ. < 2
- 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: typ. 8 dBi from 200 MHz

R&S®HE202 Active Receiving Dipole

Optimized for very small dimensions
- 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
- Linear polarization

Specifications in brief
- Frequency range: 200 MHz to 1 GHz
- VSWR: < 2.5
- Electronic gain: 5 dB to 9 dB
- Practical gain: 7 dB to 11 dB
- Directivity: 2 dB average
- Noise figure: 6 dB (200 MHz), 7 dB (1 GHz)
- 2nd order intercept point: > 55 dBm
- 3rd order intercept point: > 30 dBm
- Dimensions (L × H):
  approx. 512 mm × 238 mm (20.16 in × 9.37 in)
- Weight: 2.1 kg (4.63 lb)

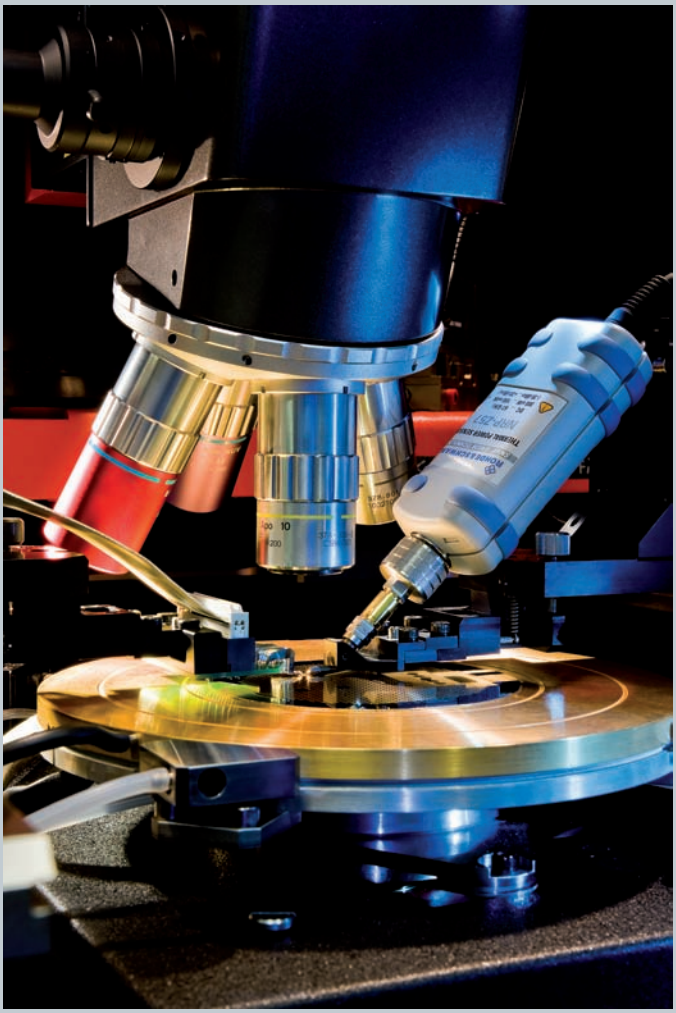
R&S®HE302 Active Receiving Dipole

Optimized for very small dimensions
- 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
- Linear polarization

Specifications in brief
- Frequency range: 20 MHz to 500 MHz
- VSWR: < 2.5
- Electronic gain: –11 dB to +8 dB
- Practical gain: –9 dB to +10 dB
- Directivity: 2 dB average
- Noise figure: 28 dB (20 MHz), 9 dB (500 MHz)
- 2nd order intercept point: > 60 dBm
- 3rd order intercept point: > 30 dBm
- Dimensions (L × H):
  approx. 1 m × 240 mm (39.37 in × 9.45 in)
- Weight: 2.5 kg (5.51 lb)

Chapter 7
Power Meters and Voltmeters

Power meters, directional power meters, voltmeters and sensors from Rohde & Schwarz provide extremely high versatility. Rohde & Schwarz power sensors are intelligent standalone instruments specially designed for use with the company's signal generators and spectrum analyzers.



R&S®NRP Power Meter Family

The ultimate solution for power measurements

R&S®NRP base unit
- Small, lightweight and ruggedized base unit for production, laboratory and mobile applications
- Simple operation due to window-based graphical user interface
- Presets for fast, standard-compliant measurements
- Simultaneous operation of up to four sensors
- Remote operation via Ethernet (R&S®NRP-B4 option), GPIB or USB
- Sensor check source (R&S®NRP-B1 option)

R&S®NRP-Z11/-Z2x/-Z31 universal power sensors
- True universal power sensors for a vast number of applications
- Innovative three-path diode power sensor with enhanced inter-range performance
- 90 dB dynamic range for CW und modulated signals
- Continuous average, burst average, timeslot average, time gating and trace mode supported (video bandwidth 100 kHz)
- Automatic burst detection and acquisition
- Up to 1500 measurements/s (buffered mode)
- Low sensitivity to harmonics

R&S®NRP-Z5x thermal power sensors
- Suitable for very demanding reference applications
- Industry-proven DC-coupled thermoelectric test cell
- Highly accurate continuous average power measurements
- Linearity uncertainty < 0.02 dB

R&S®NRP-Z9x average power sensors
- Specially designed for EMC applications
- Measurement of continuous average power
- 90 dB dynamic range for CW and modulated signals
- Low sensitivity to harmonics

R&S®NRP-Z81 wideband power sensor
- Peak power measurements of radar and mobile communications signals with up to 30 MHz RF video bandwidth; sensor rise time < 13 ns
- Automatic burst detection and acquisition
- Ultra-fast statistical analysis (one-million point CCDF within < 25 ms)
- Accurate continuous power measurements on modulated and unmodulated signals in the range from –60 dBm to +20 dBm
- High measurement repeatability due to very low zero drift of < 150 nW for single-shot events and statistics, < 2 nW for repetitive measurements

R&S®NRP-Z23 sensor.

R&S®NRP-Z55 sensor.

R&S®NRP-Z91 sensor.

R&S®NRP-Z81 sensor.

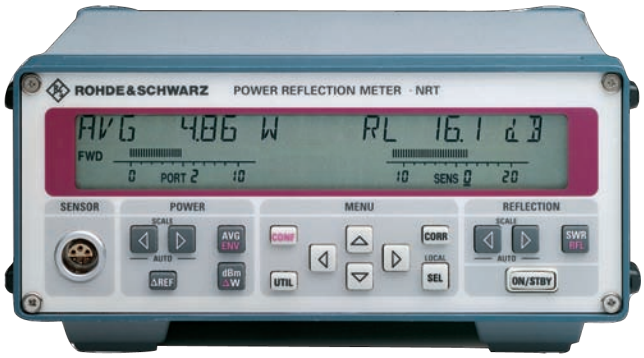
R&S®NRP-Zxx sensor overview

Sensor connector	Frequency range	Power range; max. average power/peak envelope power	Impedance matching	SWR	Rise time, video BW	Accuracy
Universal power sensors						
R&S®NRP-Z11 N connector	10 MHz to 8 GHz	200 pW to 200 mW (–67 dBm to +23 dBm); max. 400 mW (AVG), 1 W (PK, 10 µs)	10 MHz to 2.4 GHz > 2.4 GHz to 8.0 GHz	< 1.13 < 1.20	< 8 µs, > 50 kHz	0.058 dB
R&S®NRP-Z21 N connector	10 MHz to 18 GHz	200 pW to 200 mW (–67 dBm to +23 dBm); max. 400 mW (AVG), 1 W (PK, 10 µs)	10 MHz to 2.4 GHz > 2.4 GHz to 8.0 GHz > 8.0 GHz to 18.0 GHz	< 1.13 < 1.20 < 1.25	< 8 µs, > 50 kHz	0.058 dB
R&S®NRP-Z31 3.5 mm connector	10 MHz to 33 GHz	200 pW to 200 mW (–67 dBm to +23 dBm); max. 400 mW (AVG), 1 W (PK, 10 µs)	10 MHz to 2.4 GHz > 2.4 GHz to 8.0 GHz > 8.0 GHz to 18.0 GHz > 18.0 GHz to 26.5 GHz > 26.5 GHz to 33.0 GHz	< 1.13 < 1.20 < 1.25 < 1.30 < 1.35	< 8 µs, > 50 kHz	0.149 dB
R&S®NRP-Z22 N connector	10 MHz to 18 GHz	2 nW to 2 W (–57 dBm to +33 dBm); max. 3 W (AVG), 10 W (PK, 10 µs)	10 MHz to 2.4 GHz > 2.4 GHz to 8.0 GHz > 8.0 GHz to 12.4 GHz > 12.4 GHz to 18.0 GHz	< 1.14 < 1.20 < 1.25 < 1.30	< 8 µs, > 50 kHz	0.085 dB
R&S®NRP-Z23 N connector	10 MHz to 18 GHz	20 nW to 15 W (–47 dBm to +42 dBm); max. 18 W (AVG), 100 W (PK, 10 µs)	10 MHz to 2.4 GHz > 2.4 GHz to 8.0 GHz > 8.0 GHz to 12.4 GHz > 12.4 GHz to 18.0 GHz	< 1.14 < 1.25 < 1.30 < 1.41	< 8 µs, > 50 kHz	0.087 dB
R&S®NRP-Z24 N connector	10 MHz to 18 GHz	60 nW to 30 W (–42 dBm to +45 dBm); max. 36 W (AVG), 300 W (PK, 10 µs)	10 MHz to 2.4 GHz > 2.4 GHz to 8.0 GHz > 8.0 GHz to 12.4 GHz > 12.4 GHz to 18.0 GHz	< 1.14 < 1.25 < 1.30 < 1.41	< 8 µs, > 50 kHz	0.088 dB
Wideband power sensors						
R&S®NRP-Z81 N connector	50 MHz to 18 GHz	1 nW to 100 mW (–60 dBm to +20 dBm); max. 200 mW (AVG), 1 W (PK, 1 µs)	50 MHz to 2.4 GHz > 2.4 GHz to 8.0 GHz > 8.0 GHz to 18.0 GHz	< 1.16 < 1.20 < 1.25	< 13 ns, up to 30 MHz	0.13 dB
Average power sensors						
R&S®NRP-Z91 N connector	9 kHz to 6 GHz	200 pW to 200 mW (–67 dBm to +23 dBm); max. 400 mW (AVG), 1 W (PK, 10 µs)	9 kHz to 2.4 GHz > 2.4 GHz to 6.0 GHz	< 1.13 < 1.20	–	0.058 dB
R&S®NRP-Z92 N connector	9 kHz to 6 GHz	2 nW to 2 W (–57 dBm to +33 dBm); max. 3 W (AVG), 10 W (PK, 10 µs)	9 kHz to 2.4 GHz > 2.4 GHz to 6.0 GHz	< 1.14 < 1.20	–	0.085 dB
Thermal power sensors						
R&S®NRP-Z51 N connector	DC to 18 GHz	1 µW to 100 mW (–30 dBm to +20 dBm); max. 300 mW (AVG), 10 W (PK, 1 µs)	DC to 2.4 GHz > 2.4 GHz to 12.4 GHz > 12.4 GHz to 18.0 GHz	< 1.10 < 1.15 < 1.20	–	0.061 dB
R&S®NRP-Z52 3.5 mm connector	DC to 18 GHz	1 µW to 100 mW (–30 dBm to +20 dBm); max. 300 mW (AVG), 10 W (PK, 1 µs)	DC to 2.4 GHz > 2.4 GHz to 12.4 GHz > 12.4 GHz to 18.0 GHz	< 1.10 < 1.15 < 1.20	–	0.068 dB
R&S®NRP-Z55 2.92 mm connector	DC to 40 GHz	1 µW to 100 mW (–30 dBm to +20 dBm); max. 300 mW (AVG), 10 W (PK, 1 µs)	DC to 2.4 GHz > 2.4 GHz to 12.4 GHz > 12.4 GHz to 18.0 GHz > 18.0 GHz to 26.5 GHz > 26.5 GHz to 40.0 GHz	< 1.10 < 1.15 < 1.20 < 1.25 < 1.30	–	0.068 dB
R&S®NRP-Z56 2.40 mm connector	DC to 50 GHz	300 nW to 100 mW (–35 dBm to +20 dBm); max. 300 mW (AVG), 10 W (PK, 1 µs)	DC to 100 MHz > 100 MHz to 2.4 GHz > 2.4 GHz to 12.4 GHz > 12.4 GHz to 18.0 GHz > 18.0 GHz to 26.5 GHz > 26.5 GHz to 40.0 GHz > 40.0 GHz to 50.0 GHz	< 1.03 < 1.06 < 1.13 < 1.16 < 1.22 < 1.28 < 1.30	–	0.055 dB
R&S®NRP-Z57 1.85 mm connector	DC to 67 GHz	300 nW to 100 mW (–35 dBm to +20 dBm); max. 300 mW (AVG), 10 W (PK, 1 µs)	DC to 100 MHz > 100 MHz to 2.4 GHz > 2.4 GHz to 12.4 GHz > 12.4 GHz to 18.0 GHz > 18.0 GHz to 26.5 GHz > 26.5 GHz to 40.0 GHz > 40.0 GHz to 50.0 GHz > 50.0 GHz to 67.5 GHz	< 1.03 < 1.06 < 1.13 < 1.16 < 1.22 < 1.28 < 1.30 < 1.35	–	0.055 dB

R&S®NRP-Zxx sensor overview

Sensor connector	Frequency range	Power range; max. average power/peak envelope power	Impedance matching	SWR	Rise time, video BW	Accuracy
Level control sensors						
R&S®NRP-Z28 N connector	10 MHz to 18 GHz	200 pW to 100 mW (–67 dBm to +20 dBm); max. 700 mW (AVG), > 4 W (PK, 10 µs)	10 MHz to 2.4 GHz > 2.4 GHz to 4.0 GHz > 4.0 GHz to 8.0 GHz > 8.0 GHz to 18.0 GHz	< 1.11 < 1.15 < 1.22 < 1.30	< 8 µs, > 50 kHz	0.058 dB
R&S®NRP-Z98 N connector	9 kHz to 6 GHz	200 pW to 100 mW (–67 dBm to +20 dBm); max. 700 mW (AVG), > 4 W (PK, 10 µs)	9 kHz to 2.4 GHz > 2.4 GHz to 4.0 GHz > 4.0 GHz to 6.0 GHz	< 1.11 < 1.15 < 1.22	–	0.058 dB
Power sensor modules (for use with the R&S®FSMR)						
R&S®NRP-Z27 N connector	DC to 18 GHz	4 µW to 400 mW (–24 dBm to +26 dBm); max. 500 mW (AVG), 30 W (PK, 1 µs)	DC to 2.0 GHz > 2.0 GHz to 4.2 GHz > 4.3 GHz to 8.0 GHz > 8.0 GHz to 12.4 GHz > 12.4 GHz to 18 GHz	< 1.15 < 1.18 < 1.23 < 1.25 < 1.35	–	0.075 dB
R&S®NRP-Z37 3.5 mm connector	DC to 26.5 GHz	4 µW to 400 mW (–24 dBm to +26 dBm); 500 mW (AVG), 30 W (PK, 1 µs)	DC to 2.0 GHz > 2.0 GHz to 4.2 GHz > 4.3 GHz to 8.0 GHz > 8.0 GHz to 12.4 GHz > 12.4 GHz to 18.0 GHz > 18.0 GHz to 26.5 GHz	< 1.15 < 1.18 < 1.23 < 1.25 < 1.30 < 1.45	–	0.075 dB

R&S®NRT Power Reflection Meter



Power measurement on transmitters, amplifiers, industrial RF and microwave generators

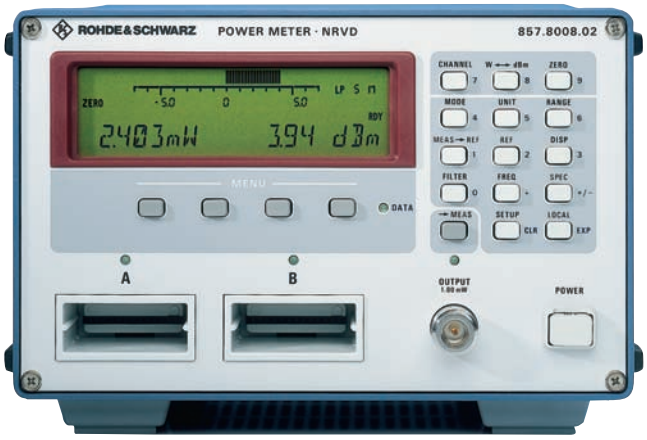
- Simultaneous display of power and reflection
- Measurement of average power irrespective of modulation mode
- Measurement of peak power, crest factor and average burst power
- Compatible with all main digital standards, such as GSM/EDGE, WCDMA, cdmaOne, CDMA2000®, PHS, NADC, PDC, TETRA, DECT, DAB, DVB-T
- Intelligent sensors: simply plug in and go
- Digital interface between sensor and base unit
- Direct connection of sensor to a PC

Specifications in brief (base unit)	
Frequency range	200 kHz to 4 GHz (sensor-dependent)
Power measurement range	0.7 mW to 2 kW (sensor-dependent)
Measurement inputs	1 to 3 (4), one active
For R&S®NRT-Z sensors	one input on front panel, two additional inputs on rear panel (R&S®NRT-B2 option)
For R&S®NAP-Z sensors	one input on rear panel (R&S®NRT-B1 option)
Measurement functions	
Power	forward power and power absorbed by load in W, dBm, dB or % (dB and % referenced to measured value or reference value)
Power parameters [1]	average power, average burst power, peak envelope power, peak-to-average ratio (crest factor), complementary cumulative distribution function
Reflection	SWR, return loss, reflection coefficient, reverse-to-forward power ratio in %, reverse power

R&S®NRT-Z44 directional power sensor.

Specifications in brief (directional power sensors)			
	R&S®NRT-Z14	**R&S®NRT-Z43**	**R&S®NRT-Z44**
Power measurement range	0.006 W to 120 W (average) 300 W (peak)	0.0007 W to 30 W (average) 75 W (peak)	0.003 W to 120 W (average) 300 W (peak)
Frequency range	25 MHz to 1 GHz	400 MHz to 4 GHz	200 MHz to 4 GHz
SWR (referenced to 50 Ω)	max. 1.06	max. 1.07 (from 0.4 GHz to 3 GHz) max. 1.12 (from 3 GHz to 4 GHz)	max. 1.07 (from 0.2 GHz to 3 GHz) max. 1.12 (from 3 GHz to 4 GHz)
Insertion loss	max. 0.06 dB	max. 0.06 dB (from 0.4 GHz to 1.5 GHz) max. 0.09 dB (from 1.5 GHz to 4 GHz)	max. 0.06 dB (from 0.2 GHz to 1.5 GHz) max. 0.09 dB (from 1.5 GHz to 4 GHz)
Directivity	min. 30 dB	min. 30 dB (from 0.4 GHz to 3 GHz) min. 26 dB (from 3 GHz to 4 GHz)	min. 30 dB (from 0.2 GHz to 3 GHz) min. 26 dB (from 3 GHz to 4 GHz)
	R&S®NAP-Z6	**R&S®NAP-Z7**	**R&S®NAP-Z8**
Power measurement range	0.3 W to 1.1 kW	0.05 W to 200 W	0.5 W to 2 kW
Frequency range	25 MHz to 1 GHz	0.4 MHz to 80 MHz	0.2 (0.4) MHz to 80 MHz
SWR (referenced to 50 Ω)	max. 1.07	max. 1.03 (max. 1.02 from 1.5 MHz to 30 MHz)	
Insertion loss			
Up to 0.3 GHz	max. 0.05 dB	–	–
Up to 0.5 GHz	max. 0.10 dB	–	–
Entire frequency range	max. 0.15 dB	max. 0.015 dB	max. 0.015 dB
Directivity	min. 25 dB	min. 35 dB (from 1.5 MHz to 30 MHz)	

R&S®NRVD Dual-Channel Power Meter



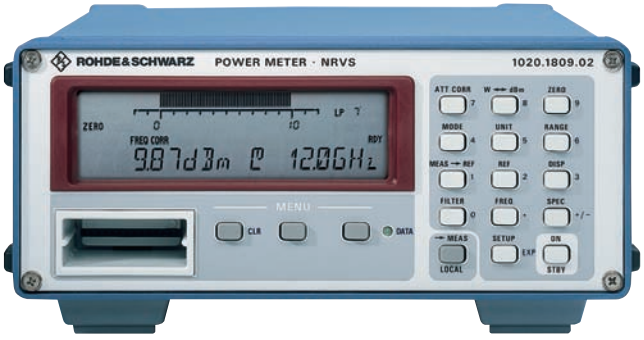
Power, level and voltage measurements from DC to 40 GHz

- Accurate, general-purpose, easy-to-use
- Attenuation and reflection measurements
- Two independent channels measuring simultaneously
- Operating modes: average power, reflection, pulse power, AM, DC
- Manual or automatic range selection
- Intelligent sensors – simply plug in and measure
- Remote control of all functions via IEC/IEEE (SCPI)

Specifications in brief

Measurement functions	unmodulated and modulated power (average power, pulse power, peak envelope power, AM), reflection, DC and AC voltage (depending on sensor)
Frequency and level range	DC to 40 GHz, 100 pW to 30 W (depending on sensor)
Sensors	all R&S®NRV-Z and R&S®URV5-Z voltage and power sensors
Display	LCD for figures, units, user prompting and analog display; adjustable backlighting
Readout	
Absolute	W, dBm, V, dBV, dBµV
Relative	dB, difference, %, ratio, referenced to stored reference value or to second measurement channel; SWR, reflection coefficient, return loss in dB, modulation depth with AM
Averaging filter	over 1 to 512 readings for reducing display noise
Test generator	
Output power	1.00 mW; factory-set to ±0.7 % (traceable to PTB)
Deviation from nominal	1.2 % worst case (0.9 % RSS) at 0 °C to +50 °C for one year
Frequency	50 MHz
SWR	≤ 1.03
RF connector	N female; N male/SMA female adapter for R&S®NRV-Z6/-Z52/-Z15/-Z55 included

R&S®NRVS Power Meter



Power, level and voltage measurements from DC to 40 GHz

- Accurate, general-purpose, easy-to-use
- Intelligent sensors: just plug in and measure
- DC frequency input for tracking frequency response correction
- Analog output
- Remote control of all functions via IEC/IEEE bus

Specifications in brief

Measurement functions	average power, pulse power, max. envelope power, DC and AC voltage (depending on sensor)
Frequency and level range	DC to 40 GHz, 100 pW to 30 W (depending on sensor)
Measuring heads	all R&S®NRV-Z and R&S®URV5-Z voltage and power sensors
Display	LCD for figures, units, user prompting, analog display
Readout	
Absolute	W, dBm, V, dBmV
Relative	dB, %W or %V referenced to stored reference value, numeric readout with or without display of correction frequency
Analog display	automatic or with selectable scale
Resolution of digital display	max. 4½ digits, resolution adjustable in 3 modes: HIGH: 12000 steps or 0.001 dB, MEDIUM: 1200 steps or 0.01 dB, LOW: 120 steps or 0.1 dB
Averaging filter	over 1 to 512 readings for reducing display noise; manual or automatic setting depending on measurement range and resolution
R&S®NRVS-B1 sensor check source (option)	
Frequency	50 MHz, crystal-stabilized
Power	1.00 mW; factory-set to ±0.7 % (traceable to PTB)
Deviation from nominal	max. 1.2 % (0.9 % RSS) at +10 °C to +40 °C or max. 1.6 % (1.2 % RSS) at 0 °C to +50 °C, for 1 year in each case
SWR	1.05
RF connector	N female (at rear panel); N male/SMA female adapter for R&S®NRV-Z6/-Z52/-Z15/-Z55 included

R&S®NRV-Z Power Sensors

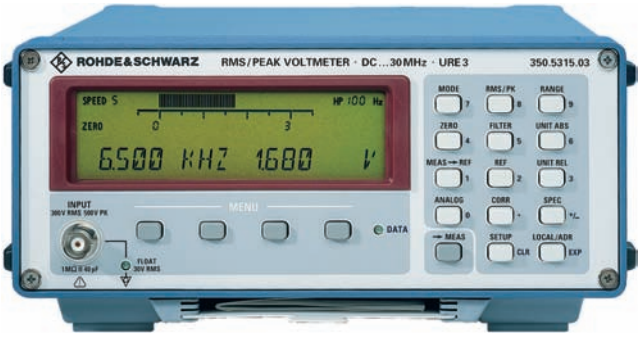
Thermal sensors and diode sensors for high-precision power measurements

- Compatible with R&S®NRVS and R&S®NRVD base units
- Standards: GSM900/1800/1900, DECT, cdmaOne, CDMA2000®, WCDMA, NADC, PDC, DAB, DVB, etc.
- Absolute calibration, simply plug in and measure
- Calibration data memory for sensor-specific parameters
- High long-term stability
- Excellent temperature response

Specifications in brief

Model connector impedance	Frequency range	Power measurement range, max. power	Max. SWR (reflection coefficient)		Zero offset	Display noise	Linearity uncertainty	Power coefficient
R&S®NRV-Z4 N connector 50 Ω	100 kHz to 6 GHz	100 pW to 20 mW 100 mW (AVG) 100 mW (PK)	0.1 MHz to 100 MHz > 0.1 GHz to 2 GHz > 2 GHz to 4 GHz > 4 GHz to 6 GHz	1.05 (0.024) 1.10 (0.048) 1.20 (0.09) 1.35 (0.15)	±50 pW	20 pW	0.03 dB (0.7 %)	0
R&S®NRV-Z6 PC-3.5 connector 50 Ω	50 MHz to 26.5 GHz	400 pW to 20 mW 100 mW (AVG) 100 mW (PK)	0.05 GHz to 4 GHz > 4 GHz to 26.5 GHz	1.15 (0.070) 1.37 (0.157)	±200 pW	80 pW	0.04 dB (1 %)	0
R&S®NRV-Z15 K connector (2.92 mm), 50 Ω	50 MHz to 40 GHz	400 pW to 20 mW 100 mW (AVG) 100 mW (PK)	0.05 GHz to 4 GHz > 4 GHz to 40 GHz	1.15 (0.070) 1.37 (0.157)	±200 pW	80 pW	0.04 dB (1 %)	0
R&S®NRV-Z5 N connector 50 Ω	100 kHz to 6 GHz	10 nW to 500 mW 2 W (AVG) 10 W (PK)	100 kHz to 4 GHz > 4 GHz to 6 GHz	1.05 (0.024) 1.10 (0.048)	±5 nW	2 nW	0.03 dB (0.7 %)	0
R&S®NRV-Z31 N connector 50 Ω	30 MHz to 6 GHz	1 µW to 20 mW 100 mW (AVG) 100 mW (PK)	0.03 GHz to 0.1 GHz > 0.1 GHz to 2 GHz > 2 GHz to 4 GHz > 4 GHz to 6 GHz	1.05 (0.024) 1.10 (0.048) 1.20 (0.09) 1.35 (0.15)	±30 nW	3 nW	included in calibration uncertainty	0

R&S®URE3 RMS/Peak Voltmeter



At the peak of speed and precision

- True RMS measurement for AC and AC+DC
- Peak-value measurement (pos., neg., peak-to-peak)
- Frequency measurement up to 30 MHz
- DC voltage measurement
- Unmatched measuring accuracy through automatic frequency response error correction
- More than 30 measurements/s
- Highpass and lowpass filters
- Digital and analog displays
- Relative measurements, maxima/minima
- Convenient menu operation
- IN/OUT option with dual-channel analog output, ready output, trigger input, TTL frequency counter input
- IEC/IEEE bus for all functions

Specifications in brief

Measurement functions	RMS value, peak value, DC voltage, frequency
Frequency range	
RMS	0.02 Hz to 30 MHz
Peak	10 Hz to 10 MHz
Voltage measurement range	
DC	0 to ±300 V
AC, AC+DC	50 mV to 300 V
Range selection	AUTO, HOLD, FIX
Ranges and resolution	10 mV to 1000 V, 20-dB steps, max. reading 12000 digits, max. resolution 1 mV
RMS measurement	
Voltage meas. range	50 mV to 300 V
Ranges and resolution	1 mV to 300 V, 10 dB steps, max. reading 3800 or 12000 digits, max. resolution 1 mV
Frequency range	
AC coupling	0.02/10/100/1000 Hz to 30 MHz
AC+DC	DC, 0.02/10/100/1000 Hz to 30 MHz
Selectable lowpass filters	20 kHz, 100 kHz Butterworth, 1 MHz Bessel (3 dB cutoff frequency, 40 dB/decade)
Selectable highpass filters	10 Hz, 100 Hz, 1 kHz (lower meas. limit, AC component in AC+DC)
Peak measurement	
Voltage meas. range	0.1 mV to 500 V
Ranges and resolution	3 mV to 1000 V, 10 dB steps, max. reading 1200 or 3800 digits, max. resolution 1 mV
Frequency range	
AC coupling	10/100/1000 Hz to 10 MHz
AC+DC	DC, 0.02 Hz to 10 MHz
Selectable lowpass filters	20 kHz, 100 kHz Butterworth, 1 MHz Bessel (3 dB cutoff frequency, 40 dB/decade)
Selectable highpass filters for AC coupling	10 Hz, 100 Hz, 1 kHz (lower measurement limit)
Frequency measurement	
Frequency range	0.02 Hz to 30 MHz
Display	5 digits, max. resolution 0.1 mHz

Chapter 8
Audio Analyzers

Rohde&Schwarz audio test equipment enjoys an excellent reputation. Versatile audio analyzers and audio switchers enable audio measurements on a large variety of digital and analog interfaces.

Type	Designation	Description	Page
R&S®UPV	Audio Analyzer	Compact instrument for all audio measurements	99
R&S®UPP200/400/800	Audio Analyzers	Audio analyzers for use in production	100
R&S®UPZ	Audio Switcher	Multichannel switcher for audio channel inputs and outputs	101

R&S®UPV Audio Analyzer

Compact instrument for all audio measurements

The R&S®UPV enables users to perform virtually all measurements that are necessary in the audio world: frequency response measurement, total harmonic distortion (THD) displays, spectral displays, analysis of digital interfaces and much more. The generator is just as versatile. It can be used to create any conceivable signal from sinewave and noise signals up to multi-sinewave signals.

- Suitable for all interfaces: analog, digital and combined
- Simultaneous display of multiple measurement functions
- Sampling rate up to 400 kHz
- User-programmable filters for analyzer and generator
- Compact all-in-one instrument with integrated PC
- Slots for future options

All test signals/measurement functions in a single box

- Wide variety of analog and digital (optional) test signals
- Extensive measurement capabilities, on analog and digital (optional) interfaces
- Efficient as well as multichannel FFT analysis with a resolution down to the mHz range
- User-programmable filters can be adapted to the measurement task at hand in only a few seconds
- Everything included; no peripherals required

Largest variety of interfaces in a single instrument

- Analog generator outputs as standard
- Dual-channel analyzer with analog inputs as standard
- Expansion up to 16 measurement channels
- Digital audio interfaces (optional)
- Digital protocol analysis and generation (optional)
- Jitter and interface test (optional)
- Test of audio ICs with I²S interfaces (optional)
- The universal serial interface allows virtually any audio circuit to be adapted (optional)

Options for further applications

- The PESQ® [1] measurement option analyzes speech signals in line with psycho-acoustic methods
- The PEAQ® [2] measurement option analyzes broadband audio signals in line with psycho-acoustic methods
- Standard-compliant measurements of hearing aids
- Acoustic measurements on mobile phones

[1] PESQ® is a registered trademark of OPTICOM Dipl.-Ing. M. Keyhl GmbH, Germany and of Psytechnics Ltd., UK.
[2] PEAQ® is a registered trademark of OPTICOM Dipl.-Ing. M. Keyhl GmbH, Germany.

Specifications in brief

Dual-channel analog analyzer	
Frequency range	DC/10 Hz to 21.76 kHz/40 kHz/80 kHz/250 kHz
Voltage range	0.1 µV to 110 V
Measurement functions (base unit and options)	RMS wideband, RMS selective, peak, quasi-peak, S/N, DC, FFT, THD, THD+N, SINAD, Mod Dist, DFD, DIM, polarity, waveform, frequency, phase, group delay, rub&buzz, 1/n octave analysis, undersample FFT, PESQ®, PEAQ®
Analog generator	
Voltage (balanced, RMS, sine, open circuit)	0.1 mV to 20 V
Output signals (base unit and options)	sine, multisine, sine burst, sine² burst, Mod Dist, DFD, noise, arbitrary waveform, polarity, FM, AM, DC, play WAV files, stereo sine, DIM, square
Digital analyzer/generator	
Digital audio interfaces (optional)	
Audio bits	8 bit to 24 bit
Clock rate	30 kHz to 200 kHz
Format	professional and consumer format in line with AES3 and IEC 60958
I²S interface (optional)	
Audio bits	8 bit to 32 bit
Clock rate	6.75 kHz to 400 kHz
Universal serial interface (optional)	
Data lines	1 to 4
Audio bits	8 bit to 32 bit
Clock rate	0.85 kHz to 400 kHz

R&S®UPP200/400/800 Audio Analyzers

Audio analyzers for use in production

High measurement speed, parallel signal processing in multichannel applications, and high reliability in continuous operation are vital requirements to be met by audio analyzers that are used in production. This is where the R&S®UPP200/400/800 audio analyzer family comes into its own.

Depending on the model, two, four or eight channels are processed in parallel; by cascading multiple instruments, users can simultaneously trigger up to 48 measurement channels.

The R&S®UPP200/400/800 audio analyzer is a compact instrument of low height and comes without front-panel control elements or integrated display. In combination with an external monitor, mouse and keyboard, it becomes a full-featured, manually operable measuring instrument. It has an integrated controller, and the required software is already installed. Users can start taking measurements right away.

When used in test systems, the R&S®UPP200/400/800 can be remote-controlled via LAN, USB or IEC/IEEE bus. Here too, the integrated controller is advantageous: Since the analyses are performed on the instrument's computer, the test system's controller does not have to provide any additional performance. Featuring the same operating philosophy and remote-control commands, the R&S®UPV and R&S®UPP audio analyzers support convenient teamwork – for example, when R&D and production use both Rohde&Schwarz audio analyzer types.

All test signals and measurement functions in a single box

- Generation of a wide variety of analog and – with the R&S®UPP-B2 option – also digital test signals
- Broad scope of measurements on both analog and – with the R&S®UPP-B2 option – digital interfaces
- Powerful as well as multichannel FFT analysis with resolution down to the mHz range
- User-programmable filters that take only seconds to adapt to the individual measurement task
- Integrated controller; manual operation requires only an external monitor and a mouse and keyboard

Large variety of interfaces offered in a single instrument

- Analog generator outputs (two-channel)
- Two-, four- or eight-channel analyzer with analog inputs
- Digital audio interfaces for professional studio operation and for consumer electronics (R&S®UPP-B2 option)
- I²S interfaces for testing audio ICs (R&S®UPP-B2 option)
- Interfaces for generator and analyzer can be set independently of one another and used in any combination

Convenient operation throughout

- State-of-the-art and intuitive user interface makes operation quick and easy to learn
- All measurement results at a glance
- Effective online help

Powerful and fast

- High measurement speed
- Use in production
- Multichannel measurements by means of cascading

Options for further applications

- R&S®UPP-B2 option providing digital audio interfaces in line with AES/EBU and S/P DIF as well as I²S interfaces
- R&S®UPP-K800 cascading software for combining multiple R&S®UPP200/400/800 audio analyzers for parallel measurement of more than eight channels
- XLR/BNC adapter sets
- Connecting cables
- R&S®UPZ audio switcher for switching up to 128 channels at the inputs and outputs

Specifications in brief (R&S®UPP)	
Analog analyzer	
Inputs: XLR female, balanced (unbalanced measurements possible with XLR/BNC adapter), AC/DC coupling selectable	
Frequency range (bandwidth 22 kHz/40 kHz/80 kHz)	DC/10 Hz to 21.76 kHz/40 kHz/ 80 kHz
Voltage range (RMS, sine)	1 µV to 50 V
Input impedance (each pin to ground)	100 kΩ ± 1 % || 220 pF
Crosstalk attenuation (< 20 kHz, 600 Ω)	> 100 dB
Measurement functions: RMS wideband, RMS selective, peak, S/N, DC, FFT, THD, THD+N, SINAD, Mod Dist, DFD, polarity, waveform, frequency, phase, group delay	
Analog generator	
Outputs	XLR male, balanced/unbalanced selectable, short-circuit-proof
Source impedance (balanced)	50 Ω
Source impedance (unbalanced)	25 Ω
Voltage (RMS, sine, open circuit)	0.2 mV to 14 V
Balanced	
Unbalanced	0.1 mV to 7 V
Frequency range	0.1 Hz to 80 kHz
Output signals: sine, stereo sine, multisine, sine burst, Mod Dist, DFD, noise, arbitrary waveform, polarity, DC, play WAV files	
Digital analyzers/generators (R&S®UPP-B2 option)	
Digital audio	
Connectors	
Balanced	D-Sub male, transformer coupling, 110 Ω
Unbalanced	BNC, grounded, 75 Ω
Optical	TOSLINK
Channels	1, 2 or both
Audio bits	8 bit to 24 bit
Clock rate	30 kHz to 200 kHz
Format	professional and consumer format in line with AES3 or IEC 60958
Output signals/measurement functions	same as with analog instrument

I²S interface	
Connector	25-contact D-Sub male
Channels	1, 2 or both
Word length	16 bit/24 bit/32 bit per channel
Audio bits	8 bit to 32 bit
Word clock rate	6.75 kHz to 200 kHz
Output signals/measurement functions	same as with analog instrument
Frequency range	
Digital	DC to 0.5 × sampling rate
Analog (bandwidth 22 kHz/40 kHz/80 kHz)	DC to 22.5 kHz/43.5 kHz/87 kHz
Dynamic range	
Digital, 24 bit	170 dB
Digital, 32 bit	220 dB
Analog	120 dB
Noise floor	
Digital, 24 bit	–170 dB
Digital, 32 bit	–220 dB
Analog	–140 dB
FFT size	512, 1k, 2k, 4k, 8k, 16k, 32k, 64k, 128k, 256k points
Window functions	rectangular, Hann, Blackman-Harris, Rife-Vincent 1-3, Hamming, flat-top
Filters	
Weighting filters A weighting, C weighting, CCIR 1k weighted, CCIR 2k weighted, CCIR unweighted, CCITT, C message, DC noise highpass, deemphasis J.17, 50/15, 50, 75, preemphasis 50/15, 50, 75, IEC tuner, jitter weighted, rumble weighted, rumble unweighted, highpass 22 Hz, 400 Hz, low-pass 22 kHz, 30 kHz, 80 kHz, AES 17	
User-definable filters	
Design parameters: 8th order elliptical type C (for highpass and low-pass filters also 4th order selectable), stopband attenuation selectable up to approx. 120 dB	
Types of filters: highpass, lowpass, bandpass, bandstop, notch, third octave and octave	
File-defined filters: any 8th order filter cascaded from 4 biquads, defined in z plane by poles/zeroes or coefficients	

R&S®UPZ Audio Switcher

Multichannel switcher for audio channel inputs and outputs

As an add-on unit to the Rohde&Schwarz audio analyzers, the R&S®UPZ audio switcher can be used whenever input or output signals have to be switched over to multiple channels or DUTs. Users can directly operate the switcher from the graphical user interface of the R&S®UPV audio analyzer.

Control via any PC is also possible. Up to 16 input switchers plus 16 output switchers can be cascaded, allowing up to 128 input or output channels to be switched.

Specifications in brief	
Signal amplitude [1]	30 V (RMS)/2 A (42 V (peak))
Crosstalk (balanced 600 Ω load) [2]	
20 kHz	typ. –140 dB
100 kHz	typ. –126 dB
Series resistance (per signal pin)	typ. < 0.3 Ω
Shunt capacitance (each signal pin to ground)	typ. < 90 pF

[1] For max. relay life: max. 5 W or 0.2 A.
[2] Between any two channels into 600 Ω.

Chapter 9
Modular Instruments

Production testing is performed in various industries. Testing departments want to flexibly configure required functions in compact units so that future requirements can be covered without large additional investments.

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R&S®CompactTSVP Open Test Platform			
R&S®TS-PCA3	Compact TSVP Test and Measurement Chassis	Open test platform based on CompactPCI and PXI	104
R&S®TS-PWA3	PowerTSVP Switching Application Chassis	Open test platform based on CAN bus	104
System controllers			
R&S®TS-PSC4	System Controller	CompactPCI embedded system controller	105
R&S®TS-PSC4C	System Controller	CompactPCI embedded system controller with enhanced speed and memory	105
R&S®TS-PSC0	System Controller	CompactPCI PCI remote system controller	105
Digital multimeter and in-circuit test			
R&S®TS-PSAM	Analog Source and Measurement Module	Scanning multimeter and data acquisition unit	105
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Signal routing and switching			
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Communications, digital I/O and mixed signal acquisition			
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Type	Designation	Description	Page
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R&S®TS-PCA3 Compact TSVP Test and Measurement Chassis

Open test platform based on CompactPCI and PXI

The R&S®CompactTSVP family of products has been developed for high-performance ATE applications. The chassis contains a mechanical frame, digital backplane, analog backplane, mains switching and filtering, power supply and diagnostic extensions.

For cost-effective peripheral control via CAN bus, the R&S®TS-PSYS1 CAN controller interface is included as a rear I/O module.

The R&S®CompactTSVP is offered as a test and measurement platform (R&S®TS-PCA3) and as a switching application platform (R&S®TS-PWA3). Various measurement modules for industrial use in research, development and production are available.

Specifications in brief	
Modular instrument chassis for CompactPCI and PXI modules	
Enclosure	standard 19" rackmount, 4 HU, suitable for 3 HU CompactPCI
Peripheral slots	14
Control backplane	
Bus systems	▮ CompactPCI/PXI, 32 bit, 33 MHz in line with PICMG 2.0 Rev. 3.0 ▮ rear I/O support IEEE 1101.11-1998 ▮ CAN 2.0b, 1 Mbit ▮ PXI trigger bus, 8 signals

R&S®TS-PWA3 PowerTSVP Switching Application Chassis

Open test platform based on CAN bus

The R&S®TS-PWA3 PowerTSVP chassis was created as a cost-efficient subsystem for switching applications. It can be used to build systems ranging from dedicated switching instruments to complex switching applications in test and measurement systems.

The chassis comprises a mechanical frame, digital backplane, analog backplane, mains switching and filtering, power supply and diagnostic extensions. For cost-effective peripheral control via CAN-bus the R&S®TS-PSYS2 slave interface is included as a rear I/O module.

Various switching and measurement modules controlled by the CAN bus interface from Rohde&Schwarz can be deployed in this chassis.

Specifications in brief	
Modular instrument chassis for dedicated Rohde&Schwarz modules with CAN bus control	
Enclosure	standard 19" rackmount, 4 HU, suitable for 3 HU CompactPCI
Peripheral slots	16
Control backplane	
Bus systems	▮ CAN 2.0b, 1 Mbit ▮ slots 1 to 16, peripheral slots for CAN bus controlled modules

Modules of the R&S®CompactTSVP family: system controllers

R&S®TS-PSC4 System Controller

CompactPCI embedded system controller
Test and measurement computing platform for R&S®CompactTSVP instruments.

The CompactPCI system controller board combines the performance of Intel's Mobile Pentium® M processor with the high integration of the 855GME chipset and the ICH4 I/O controller hub. Legacy interfaces can be accessed on the R&S®CompactTSVP instrument rear via the additional rear I/O module, which is included.

Specifications in brief
- Packaging: 3 U dual-slot processor card
- Processor: Intel Mobile Pentium® 1.6 GHz
- RAM: 512 Mbyte
- HDD: 55.8 Gbyte
- Legacy interfaces:
  - 4 × USB
  - 2 × LAN
  - 2 × RS-232-C
  - 1 × VGA
- Operating system: Windows XP Professional

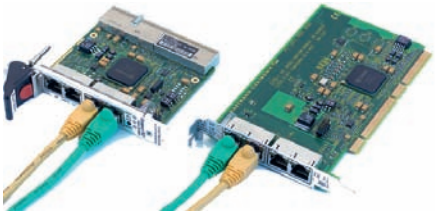
R&S®TS-PSC4C System Controller

CompactPCI embedded system controller with enhanced speed and memory
Test and measurement computing platform for R&S®CompactTSVP instruments.

The CompactPCI system controller board combines the performance of Intel's Mobile Pentium® M processor with the high integration of the 855GME chipset and the ICH4 I/O controller hub. Legacy interfaces can be accessed on the R&S®CompactTSVP instrument rear via the additional rear I/O module, which is included.

Specifications in brief
- Packaging: 3 U dual slot processor card
- Processor: Intel Mobile Pentium® 1.8 GHz
- RAM: 1 Gbyte
- HDD: ≥ 55.8 Gbyte
- Legacy interfaces:
  - 4 × USB
  - 2 × LAN
  - 2 × RS-232-C
  - 1 × VGA
- Operating system: Windows XP Professional

R&S®TS-PSC0 System Controller



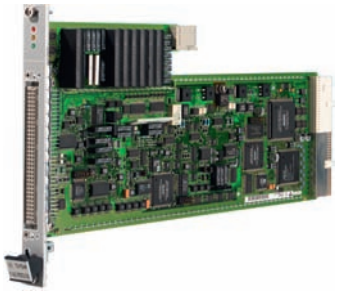
CompactPCI PCI remote system controller
External PC can be used as R&S®CompactTSVP system controller for the R&S®CompactTSVP chassis (R&S®TS-PCA3).

Ideal for solutions where the system design requires the PCI-bus-based hardware to be integrated in the system. The transparent, serial StarFabric interface is ready to run without any software installation and has nearly no influence on the system performance compared to the embedded controller solution.

Specifications in brief
- Remote interface: StarFabric
- External host PC: PCI bus
- Implementation: transparent PCI bridge, serial PCI to CompactPCI link
- Interface location: rear of R&S®CompactTSVP chassis, at controller slot 1

Modules of the R&S®CompactTSVP family: digital multimeter and in-circuit test

R&S®TS-PSAM Analog Source and Measurement Module



Scanning multimeter and data acquisition unit
- Floating measurement of voltage, current (AC/DC) and resistance in 2- und 4-wire mode
- Analog in-circuit-test with short, contact and continuity test
- Test of resistors, diodes, bipolar transistors, jumpers/switches and discharge of capacitors
- Measurement synchronization via PXI clock and trigger

Specifications in brief
- Voltage ranges
  - DC: ±10 mV to ±125 V
  - AC: ±20 mV to ±90 V (V_{RMS})
- Current ranges
  - DC: ±1 µA to ±1 A
  - AC: ±100 µA to ±1 A
- Resistance ranges: 1 Ω to 10 MΩ
- Sample rate: 0.01 sample/s to 200 ksample/s
- DC source: ±5 V, 100 mA, 4-quadrant
- Discharge unit: max. 125 V (DC), 400 mA
- Bus interface: CompactPCI/PXI

Modules of the R&S®CompactTSVP family: digital multimeter and in-circuit test

R&S®TS-PICT In-Circuit Test Extension

Analog ICT in conjunction with the R&S®TS-PSAM

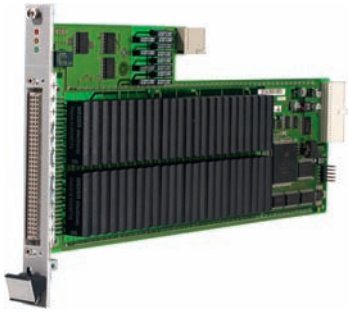
- For guarded measurements in 3-, 4-, 6-wire technology
- Measurement of inductors, capacitors and impedances

Specifications in brief

- AC source: referenced to GND
- Voltage: 0.1 V, 0.2 V, 1.0 V
- Voltage offset: OFF, POS, NEG
- Impedance: 1 Ω, 10 Ω, 1 kΩ, 10 kΩ
- Frequency: DC, 100 Hz, 1 kHz, 10 kHz
- Measurement unit: referenced to GND
- Current ranges: 1 µA to 200 mA
- Sample rate: max. 200 ksample/s
- Working voltage: max. 60 V (DC)
- Bus interface: CompactPCI/PXI

Modules of the R&S®CompactTSVP family: signal routing and switching

R&S®TS-PMB Switch Matrix Module



High-density, 90-channel, full matrix relay-multiplexer module

The R&S®TS-PMB establishes test channels for functional and in-circuit tests. It provides all routing of signals between DUT and measurement modules via R&S®CompactTSVP analog bus.

The general-purpose switch matrix module can handle input signals up to 125 V and up to 1 A. It provides selftest capability and fast switching of signal paths.

Specifications in brief

- Switching: relay, full matrix
- Configuration: 90 channels to 2 × 4 busses
- Deployed as
  - Single matrix 90 pins to 4 bus lines
  - Single matrix 45 pins to 8 bus lines
  - Dual matrix 45 pins to 4 bus lines
- Analog measurement bus access to 8 bus lines
- Voltage: max. 125 V (DC)
- Current: max. 1 A
- Power: max. 10 W
- Switch time: 0.5 ms (incl. bouncing)
- Bus interface: CAN

R&S®TS-PSM1 Power Switching Module

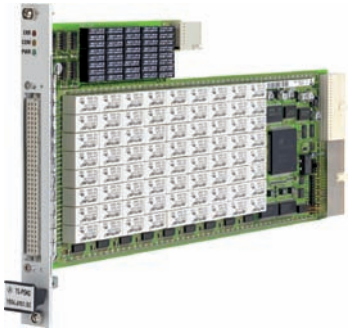
High-power multiplexer and multiple DUT power switching module

- Power switching module for supplies and loads
- Can handle voltages up to 60 V with:
  - 8 high-power channels with max. 16 A
  - 10 power channels with max. 2 A
  - 4 high-power 4-to-1 multiplexer channels with max. 16 A
- Indirect high-current measurements on high-power channels via shunt resistors;- routing of corresponding voltage via analog measurement bus
- Selftest of all relays via analog measurement bus and R&S®TS-PSAM

Specifications in brief

- Switching: high- and medium-power relays
- Configuration MP: 10 × SPST front – front/rear
- Configuration HP
  - 8 × SPST rear – front, shunt
  - 2 × SP 4:1 MUX front – front
  - 2 × SP 4:1 MUX rear – rear
- Voltage: max. 60 V (DC)
- Current MP/HP: max. 2 A/16 A
- Power MP/HP: max. 150 W/480 W
- Switch time MP: 5 ms (incl. bouncing)
- Switch time HP: 10 ms (incl. bouncing)
- Bus interface: CAN

R&S®TS-PSM2 Multiplex and Switch Module



Medium-power multiplexer and switching module

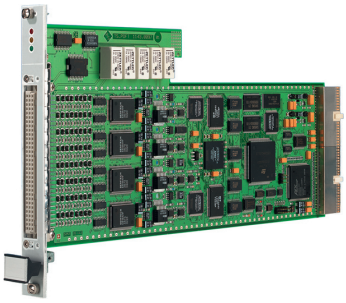
- Medium-power switching module for voltages up to 125 V and 2 A
- Eight independent groups of 3 SPST/1 SPDT relay channels or 4-to-1 DPST relay multiplexers
- Relay multiplexers can be cascaded via local power buses
- Indirect current measurements on each SPxT channel via shunt resistors
- Direct current measurements up to 1 A on all channels via R&S®TSVP analog measurement bus and R&S®TS-PSAM

Specifications in brief

- Switching: 8 independent relay groups
- Configuration
  - 3 × SPST + SPDT, shunt or
  - DP 4:1 MUX
- Voltage: max. 125 V (DC)
- Current: max. 2 A
- Power: max. 60 W
- Switch time: 5 ms (incl. bouncing)
- Bus interface: CAN

Modules of the R&S®CompactTSVP family: communications, digital I/O and mixed signal acquisition

R&S®TS-PDFT Digital Functional Test Module



Programmable 32-bit digital pattern I/O and serial communications interfaces

- 32 digital output channels with pattern acquisition rate up to 20 MHz
- One programmable output level per group
- High output current and short-circuit protection
- Four high-power open drain channels, fully protected and capable of pulse width modulation
- Five relay channels SPST
- 32 digital input channels with two programmable input threshold levels per group for hysteresis or level monitoring

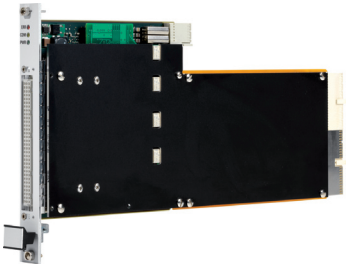
Specifications in brief

- Output channels: 32, in 4 groups
- Voltage/group: –3 V to +10 V, tristate
- Current/channel: 80 mA
- Sample rate: 0.01 sample/s to 20 Msample/s

- Input channels: 32, in 4 groups
- Threshold/group: 0 V to 9.5 V

- Data buffer: 128/64/32 kbyte at 8/16/32 bit
- DUT interfaces: CAN, K-line, RS-232-C, SPI, I^2C
- Bus interface: CompactPCI/PXI

R&S®TS-PHDT High-Speed Digital Test Module



Programmable 32-bit digital high-speed I/O and realtime comparison

- High pattern rate up to 40 MHz
- HIGH and LOW programmable, two thresholds
- Large memory capacity of 1.5 Gbyte
- Independent pattern sets, selectively executable and re-usable without new download
- Tristate at full speed, RTZ clock formatting
- Forbidden-zone detection
- Realtime comparison and results: pass/fail, failed channels, failed pattern
- Timing resolution down to 12.5 ns
- Triggering/synchronization with analog PXI measurement cards

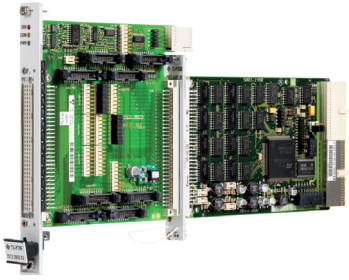
Specifications in brief

- Output channels: 32, in 4 groups
- Voltage/group: –3 V to +10 V, tristate
- Tristate control: bitwise
- Current/channel: 80 mA
- Sample rate: 0.01 sample/s to 40 Msample/s

- Input channels: 32, in 4 groups
- Threshold/group: 0 V to 9.5 V

- Data buffer: 3 × 64 Msample × 64 bit
- Bus interface: CompactPCI/PXI

R&S®TS-PIO3B Digital I/O Module and R&S®TS-PTRF Signal Port and Transmission Module



Digital control and coildriver with power outputs

The R&S®TS-PIO3B is a versatile digital I/O module with 64 channels. It offers eight ports with eight digital I/O lines each that have MOSFET output drivers. The circuitry is designed to drive RF relays with all common control voltages. The high current-carrying capacity makes the module a universal coil driver.

For easily measuring voltages, there are eight analog inputs that can be monitored via a 10-bit A/D converter. An SPI interface offers the capability to control external SPI modules.

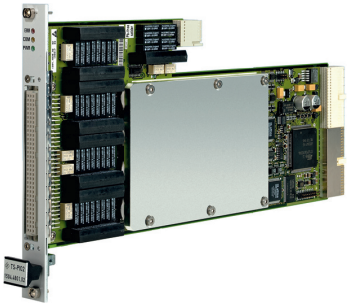
Specifications in brief

- Digital I/O channels: 64, in 8 groups
- Voltage: 0 V to 35 V
- Current output: max. 200 mA per bit, 1 A per port

- Analog inputs: 8
- Level range : 0 V to 5 V
- Resolution: 10 bit
- Accuracy: ±(100 mV + 5 %)

- SPI interface: SPI SCLK
  MOSI 5 V TTL output with 300 Ω series
  MISO 5 V TTL input
- Bus interface: CAN

R&S®TS-PIO2 Analog and Digital I/O Module



Analog and digital 16-channel stimulus and measurement unit for mixed-signal DUT testing

- Analog and digital signal acquisition with high measurement resolution of 24 bits for level ranges up to ±27 V
- Sampling rate of up to 5 ksample/s for inputs and outputs
- Autocorrection feature for all input and output channels
- Analog and digital stimulus outputs, offering static and dynamic signal outputs
- 16-bit resolution, high output level up to ±27 V
- Versatile signal switching and DUT interconnection
- Stimulus and acquisition channels providing floating operation

Specifications in brief

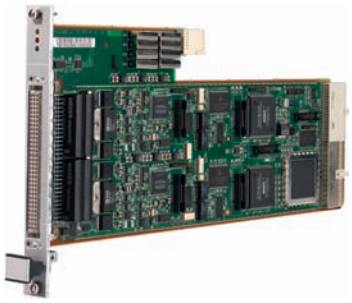
- Output channels: 16, in 4 groups, floating high/low voltage: ±27 V/±27 V (L per group)
- Current/channel: 12 × 15 mA, 4 × 100 mA
- Modes: analog, digital, frequency

- Input channels: 16, in 4 groups, floating
- High/low threshold: ±27 V/±27 V (both per group)

- Data buffer: 4 × 5 ksample (AOUT/DOUT/AIN/DIN)
- Sample rate: 0.01 sample/s to 5 ksample/s
- Bus interface: CAN

Modules of the R&S®CompactTSVP family: arbitrary waveform generator and signal analyzer

R&S®TS-PFG Function Generator Module



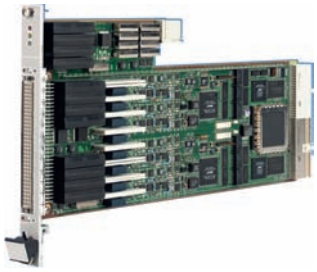
Dual-channel arbitrary waveform generator with isolated outputs

- Arbitrary waveform generator module featuring two floating signal outputs with independent channel isolation
- High output level range up to 40 V (V_{PP})
- High sampling rate of 25 Msample/s per channel
- Output of standard waveforms up to 1 MHz sine, square, triangle, arbitrary waveform
- Sequencing of multiple memory sections and multiple repetitions

Specifications in brief

- Channels: 2, fully independent, floating, cascadable
- Voltage ranges: ±1 V, ±5 V, ±10 V, ±20 V
- Voltage resolution: 16 bit
- Output current: max. 250 mA
- Data buffer: 1 Msample per channel
- Sample rate: 0.01 sample/s to 25 Msample/s
- Standard waveforms: sine wave, triangle, square wave (1 Hz to 1 MHz), DC static
- Pulse: min. 500 ns (1 % to 99 %)
- Output ranges: ±1 V to ±20 V, max. 40 V (V_{PP})
- Output current: max. ±250 mA
- Bus interface: CompactPCI/PXI

R&S®TS-PAM Signal Analyzer Module



Eight-channel digitizer and waveform analyzer

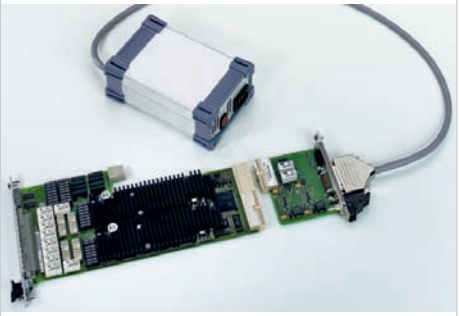
- Digitizer module featuring two fully independent, floating acquisition units
- Acquisition modes with up to eight single-ended or four differential channels
- High sampling rate of 20 Msample/s for each acquisition unit
- Multichannel signal recording for up to eight channels at 5 Msample/s
- Synchronous acquisition of eight programmable comparator signals and PXI trigger
- Wide dynamic range with 14-bit resolution

Specifications in brief

- Acquisition units: 2, fully independent and floating
- Data buffer: 1 Msample per acquisition unit
- Channels per unit: 4
- Voltage ranges: ±0.2 V to 100 V (per channel)
- Resolution: 14 bit
- Sample rate: 0.02 sample/s to 20 Msample/s
- Relay multiplexer: 3:1 per channel
- Bus interface: CompactPCI/PXI

Modules of the R&S®CompactTSVP family: power supplies

R&S®TS-PSU Power Supply and Load Module



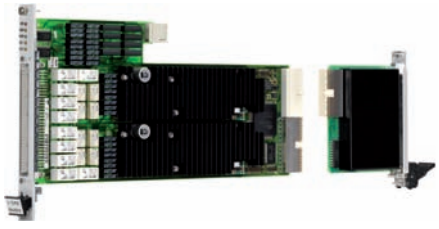
Four-quadrant source with integrated measurement unit

- Two independent, floating channels of four-quadrant sources with separate sensing per channel
- Programmable current and voltage limiting
- Integrated voltage and current measurement unit per channel
- Electronic load simulation of 20 W per channel
- Output and recording of voltage and current profiles
- Protection against overvoltage, overcurrent, overtemperature and short-circuits
- 4-to-1 relay multiplexer for force and sense lines of each channel

Specifications in brief

- Output channels: 2, floating, fully independent, 4 quadrants, cascadable
- Voltage ranges: ±15 V, ±50 V (16 bit)
- Current ranges: 10 mA, 100 mA, 3 A (16 bit)
- Data buffer: 2 × 10 ksample (V_{OUT}/I_{OUT})
- Measurement unit: voltage or current
- Data buffer: 10 ksample
- Sample rate: 0.01 sample/s to 10 ksample/s
- Bus interface: CAN

R&S®TS-PSU12 Power Supply and Load Module



Four-quadrant source with integrated measurement unit

- Two independent, floating channels of four-quadrant sources with separate sensing per channel
- Programmable current and voltage limiting
- Same feature set on the R&S®TS-PSU but R&S®TS-PDC internal primary power supply

Specifications in brief

- Output channels: 2, floating, fully independent, 4 quadrants, cascadable
- Voltage ranges: ±12 V (16 bit)
- Current ranges: 10/100/500 mA (16 bit)
- Data buffer: 2 × 10 ksample (V_{OUT}/I_{OUT})
- Measurement unit: voltage or current
- Data buffer: 10 ksample
- Sample rate: 0.01 sample/s to 10 ksample/s
- Bus interface: CAN

Modules of the R&S®CompactTSVP family: in-system calibration

R&S®TS-ISC In-System Calibration Kit

On-site calibration solution for R&S®CompactTSVP

The R&S®TS-ISC in-system calibration kit contains the fundamental tools for calibrating all modular instruments available for the R&S®CompactTSVP product family.

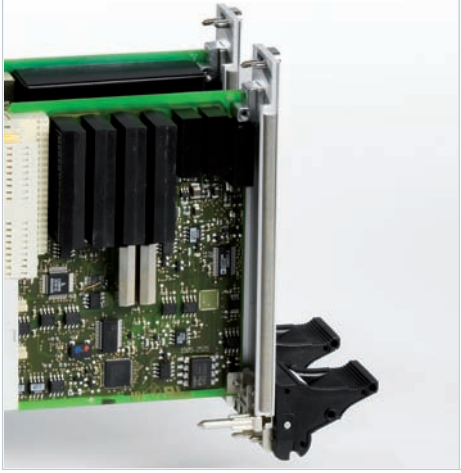
The most important benefit for systems deployed on the factory floor is that all modules that must be calibrated may remain in the instrument chassis slots. Additionally, a dedicated type of highly accurate multimeter is required to achieve a corresponding measuring accuracy during calibration.

Specifications in brief

The R&S®TS-ISC in-system calibration kit consists of the following components:

- R&S®TS-PCAL2 calibration module
- Calibration adapters
  - R&S®TS-PCALA
  - R&S®TS-PCALB
  - R&S®TS-PCALC
- R&S®TS-PKL cable for connecting the adapters to the external multimeter
- R&S®TS-LISC: one software license for in-system calibration; additional licenses are required for each system controller hosting the calibration software

R&S®TS-PCAL2 Calibration Module



On-site calibration module for chassis rear I/O

The R&S®TS-PCAL2 calibration module is used to provide traceable calibration signals. It can be integrated into multiple chassis on the factory floor to prepare each R&S®CompactTSVP instrument for on-site calibration without changing the module configuration.

An on-board relay multiplexer connects the components to the analog bus lines on an R&S®TS-PMB module which has to be installed in front of the R&S®TS-PCAL2 module.

Specifications in brief

The R&S®TS-PCAL2 provides the following functionalities:

- Floating 5 V reference source
- Three reference resistors for resistance measurements
- Ground-referenced current source, adjustable up to 1 A current measurements
- Floating signal generator for dynamic measurements of
  - DC: –40 V to 40 V
  - AC sinusoidal:
    2 V to 80 V (V_{PP}) in frequency range
    20 Hz to 50 kHz
    0.2 V to 2 V (V_{PP}) in frequency range
    50 kHz to 1 MHz

R&S®ATSI100 Infotainment Test System

Fast, comprehensive tests in automobile production

The R&S®ATSI100 system generates every test signal separately in application-specific modules. Each module contains all components needed for signal generation and amplification.

Due to the robust design, the modules meet the rigorous standards in automobile production. The R&S®ATSI100 module frames provide easy slot-in installation and power supply for up to two and up to eleven modules, respectively.

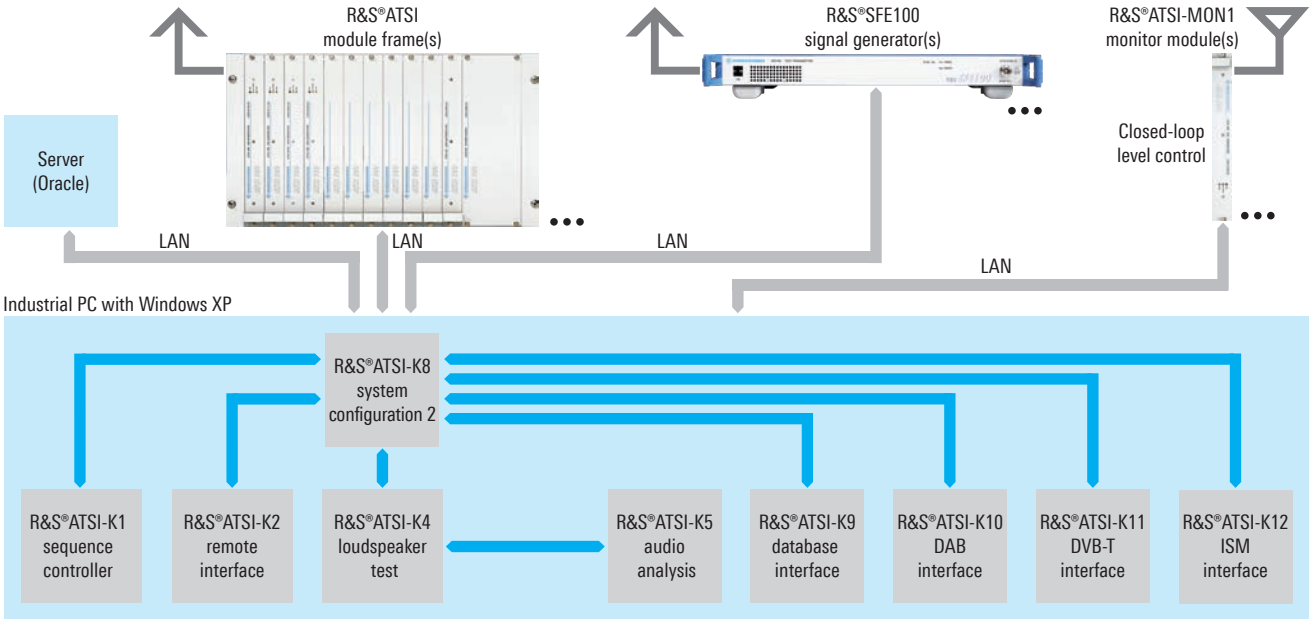
The modular concept allows the installation of the modules close to the test environment (e.g. test cabin, production line). This largely avoids time-consuming and fault-prone laying of RF cables in the production area.

Configuration and control via powerful software application

For easy integration of the R&S®ATSI100 system into the production process control system, the R&S®ATSI-K1 to R&S®ATSI-K12 options offer the appropriate interfaces. These options make it easy for the user to do the following:

- Program automatic test sequences
- Interface the master production computer system in customer-specific versions
- Get a detailed representation of the entire system installed in the production facility
- Evaluate the modules' selftest and monitoring signals, allowing errors to be instantly located
- Notify the system administrator by e-mail if an error occurs
- Analyze complex test scenarios (e.g. loudspeaker and mobile communications test, audio analysis)
- Configure data management for test scenarios and test parameters depending on different vehicle variants
- Connect to a common database for extremely flexible test parameter handling

Block diagram of an R&S®ATSI100 test configuration



Modules of the R&S®ATSI100 infotainment test system: housing

R&S®ATSI-MF Module Frame

19" housing
19" housing with six vertical units for holding the circuit power pack and backplane as well as a variable arrangement for holding a maximum of eleven R&S®ATSI modules.

Specifications in brief
- Circuit power pack for power supply
  - Primary: 100 V to 240 V AC, 50 Hz to 60 Hz
  - Secondary: +5 V, +12 V, –12 V DC
- Backplane for distributing the power supply voltages (+5 V, +12 V, –12 V) to the individual R&S®ATSI modules
- 2 HU, 2-slot model available

Modules of the R&S®ATSI100 infotainment test system: RF generators

R&S®ATSI-AM AM Generator

For AM radio tests
The R&S®ATSI-AM generator enhances the R&S®ATSI100 infotainment test system with the capability to perform AM radio tests. The generator module is simply plugged into the system rack. It is controlled via an Ethernet LAN.

Specifications in brief
- Frequency range: 50 kHz to 30 MHz
- Frequency resolution: 1 Hz
- Level range: –30 dBm to +23 dBm
- Level accuracy better than 1 dB
- Integrated modulation generator: 20 Hz to 20 kHz
- External modulation input

R&S®ATSI-FM FM Generator

For FM radio tests
The R&S®ATSI-FM generator enhances the R&S®ATSI100 infotainment test system with the capability to perform FM radio tests. The generator module is simply plugged into the system rack. It is controlled via an Ethernet LAN.

Specifications in brief
- Frequency range: 76 MHz to 108 MHz
- Output level: –80 dBm to +20 dBm
- Internal modulation generator: 20 Hz to 15 kHz
- External modulation input
- Stereo option
- RDS option

R&S®ATSI-ISM ISM Generator

For tests in ISM bands
The R&S®ATSI-ISM generator enhances the R&S®ATSI100 infotainment test system with the capability to perform tests for different applications in ISM/SRD bands (e.g. centralized door locking, auxiliary heating). The generator module is simply plugged into the system rack. It is controlled via an Ethernet LAN.

Specifications in brief
- Frequency ranges:
  - 310 MHz to 320 MHz
  - 431 MHz to 470 MHz
  - 862 MHz to 920 MHz
- Output power: –60 dBm to +20 dBm
- Modulation and coding: customizable

R&S®ATSI-ATV Analog TV Generator

For analog TV receiver tests
The R&S®ATSI-ATV generator enhances the R&S®ATSI100 infotainment test system with the capability to perform analog TV receiver tests. The generator module is simply plugged into the system rack. It is controlled via an Ethernet LAN.

Specifications in brief
- Frequency range:
  - 174 MHz to 225 MHz
  - 470 MHz to 860 MHz
- Level range: –60 dBm to +20 dBm
- TV standards: PAL B/G, NTSC M
- Internal video generator (color bar)
- External video input
- Internal audio generator
- External audio input
- SD card slot for selectable video patterns

Modules of the R&S®ATSI100 infotainment test system: RF repeaters

R&S®ATSI-GPS1 GPS Repeater

For GPS receiver tests
The R&S®ATSI-GPS1 repeater enhances the R&S®ATSI100 infotainment test system with the capability to perform GPS receiver tests inside buildings by repeating the GPS signal from an outside reference antenna. The repeater module is simply plugged into the system rack. It is controlled via an Ethernet LAN.

Specifications in brief
- Output frequency: 1575.42 MHz
- Overall gain (selectable): up to 80 dB
- Supply voltage for reference antenna (can be switched ON/OFF): 5 V DC
- Overvoltage protection at antenna input

R&S®ATSI-DAB1 DAB Repeater

For digital audio broadcasting tests
The R&S®ATSI-DAB1 repeater enhances the R&S®ATSI100 infotainment test system with the capability to perform digital audio broadcasting tests. The repeater module is simply plugged into the system rack. It is controlled via an Ethernet LAN.

Specifications in brief
- Frequency range:
  - 174 MHz to 240 MHz (band III)
  - 1452 MHz to 1491 MHz (L-band)
- Maximum conversion gain: > 90 dB
- Input sensitivity: better than –70 dBm
- Output level range: –30 dBm to +20 dBm
- Level accuracy: typ. better than 2 dB

R&S®ATSI-DVBT1 DVB-T Repeater

For digital TV tests
The R&S®ATSI-DVBT1 repeater enhances the R&S®ATSI100 infotainment test system with the capability to perform digital TV tests. The repeater module is simply plugged into the system rack. It is controlled via an Ethernet LAN.

Specifications in brief
- Frequency range:
  - 177.5 MHz to 226.5 MHz
  - 474 MHz to 858 MHz
- Input sensitivity: better than –80 dBm
- Output level range: –80 dBm to +20 dBm

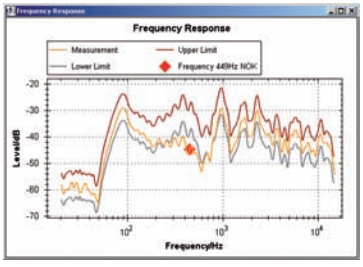
Modules of the R&S®ATSI100 infotainment test system: monitor module

R&S®ATSI-MON1 Monitor Module

Accurate monitoring of transmitted signals
The R&S®ATSI-MON1 monitor module enhances the R&S®ATSI100 infotainment test system with the capability to accurately monitor different transmitted signals. The monitoring module is installed near the transmit antenna(s). It is controlled via an Ethernet LAN.

Specifications in brief
- Frequency range:
  - 50 kHz to 1650 kHz
  - 76 MHz to 108 MHz
  - 170 MHz to 240 MHz
  - 470 MHz to 870 MHz
  - 1.45 GHz to 1.5 GHz
- Resolution bandwidth: adjustable
- Measurement duration: adjustable
- Level range: –90 dBm to +13 dBm
- Level accuracy: better than 1 dB
- 6 RF ports

Modules of the R&S®ATSI100 infotainment test system: software options

R&S®ATSI-K1 Sequence Controller	
Easy generation of test cases	▪ Scheduling of different test cases (e.g. start, a GPS test in parallel with an FM test, followed by an AM test) ▪ Repeatable tests
R&S®ATSI-K2 Remote Interface	
Command exchange with master process control system	▪ Remote commands of major process control system suppliers are interpreted ▪ Complete integration into customer's control system (as a slave) by means of R&S®ATSI-K2
R&S®ATSI-K4 Loudspeaker Test	
Testing the correct installation of loudspeakers	▪ Frequency-selective measurement of sound pressure level (SPL) ▪ Generation of a multisine test signal
R&S®ATSI-K5 Audio Analysis	
Identification of loudspeaker installation errors 	▪ Detection of mechanical defects in acoustic transducers (rub and buzz detection) ▪ Check of the sound system's frequency response ▪ Comparison with reference measurements
R&S®ATSI-K7 System Configuration 1	
Easy system overview	▪ Shortcuts for launching the configuration software of each installed module ▪ Polling and displaying the modules' status information ▪ E-mail notification in case of malfunction (configurable) ▪ Handling of up to three parameters per module
R&S®ATSI-K8 System Configuration 2	
Closed-loop control of all levels (with monitor module installed)	▪ Programmable by R&S®ATSI-K1 (sequence controller) ▪ Controllable by R&S®ATSI-K2 (remote interface) ▪ Handles up to 32 modules and unlimited parameters
R&S®ATSI-K9 Database Interface	
Interface for parameter database (Oracle)	
R&S®ATSI-K10 R&S®SFE100 DAB Interface	
Integration of the R&S®SFE100 as a digital radio signal source	▪ Integration of R&S®SFE100 test transmitter with the R&S®SFE100-K11 T-DMB/DAB option ▪ Digital audio broadcasting signal source
R&S®ATSI-K11 R&S®SFE100 DVB-T Interface	
Integration of the R&S®SFE100 as a digital TV signal source	▪ Integration of R&S®SFE100 test transmitter with the R&S®SFE100-K1 DVB-T/H option ▪ Digital audio broadcasting signal source
R&S®ATSI-K12 ISM Interface	
Testing of keyless entry, auxiliary heater or other ISM/SRD customized applications	▪ Programmable RF-Data telegram including header, user data and CRC block ▪ Selectable modulation (FSK, GFSK, ASK, OOK), coding and data bitrate ▪ Programmable telegram timings (pre- and post-delay), telegram repetition

Chapter 10
Broadcasting Test and Measurement Solutions

Broadcasting systems have different capabilities for distributing audio and/or video signals. Rohde&Schwarz supplies instruments for digital and analog baseband generation, modulation, demodulation and analysis, as well as baseband analysis.

Type	Designation	Description	Page
Video and MPEG TS generators			
R&S®DVSG	Digital Video Signal Generator	Development and quality assurance of TV displays	115
R&S®DV-x	Stream Libraries	Development, production and testing of TV components or devices	115
RF test transmitters			
R&S®SFU	Broadcast Test System	Multistandard test transmitter for R&D	116
R&S®SFE	Broadcast Tester	Compact signal generator for digital and analog TV and audio broadcasting standards	117
R&S®SFE100	Test Transmitter	Powerful broadcast signal generator for production test systems	118
TV analyzers			
R&S®ETH	Handheld TV Analyzer	Portable DVB-T/DVB-H signal analysis up to 3.6 GHz/8 GHz	119
R&S®FSH3-TV	Handheld TV Analyzer	Universal combined TV and spectrum analyzer from 100 kHz to 3 GHz	120
R&S®ETL	TV Analyzer	Universal multistandard platform for the analysis of TV, mobile TV and FM radio signals	120
R&S®EFA	TV Test Receiver Family	Comprehensive analysis/demodulation/monitoring of digital/analog TV signals	121
R&S®EFA-K1	EFA-SCAN Measurement Software	Fast recording and documentation of measurement values for the R&S®EFA digital test receivers	121
Video and MPEG TS analyzers			
R&S®DVMS1	Digital TV Monitoring System	DVB-T/DVB-H and transport stream monitoring and analysis	122
R&S®DVM	Digital Video Measurement System	DTV monitoring and analysis	123
R&S®VSA	Video Measurement System	Video and FFT analyzer, vectorscope and oscilloscope in one unit	125

R&S®DVSG Digital Video Signal Generator

- Digital and analog video and audio output
- HDTV and SDTV formats up to 1080p, PC formats up to WUXGA
- Reference source for moving sequences
- User-selectable variation of interface parameters and signal amplitude
- MPEG-2 transport stream recording and playback

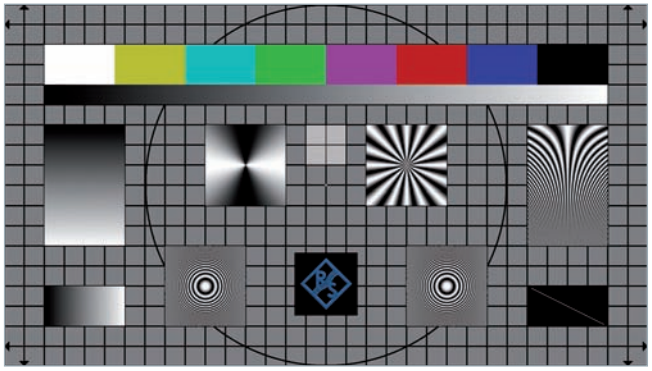
Development and quality assurance of TV displays

The R&S®DVSG digital video signal generator supports the development and quality assurance of latest-generation TV sets and projectors. It is a cost-efficient, one-box solution that generates the audio and video signals required for these tasks.

Specifications in brief

R&S®DVSG-K10 AV signal generator	
Interfaces	HDMI 1.3/DVI, component, composite, SCART, VGA, TS
TV resolutions (SD/HD)	480i, 576i, 480p, 576p, 720p, 1080i, 1080p with flexible timings
VESA resolutions	VGA, SVGA, XGA, WXGA, SXGA, HD Ready 1, WXGA+, UXGA, WSXGA, WUXGA
Supported color spaces	ITU 601/709, sRGB, xvYCC etc. (customizable)
Color depths	up to 12 bit
Audio standards and interfaces	HDMI, AUDIO DIG OUT with PCM audio for up to 8 channels (customizable)
Signal libraries	uncompressed static patterns and sequences for luminance and chromaticity, motion blur, deinterlacing and EMC measurements; supporting EBU, ITU, ANSI, SMPTE standards
R&S®DVSG-K20 TS player and recorder	
Interfaces	ASI, SMPTE, SPI
Supported standards	DVB, ATSC (mobile DTV), ISDB-T(B), DTMB, CMMB, MediaFLO™

R&S®DV-x Stream Libraries



Development, production and testing of TV components or devices

Large variety of applications

- Testing of TV sets, set-top boxes and mobile TV handsets
- EMC testing of TV sets
- Testing of decoders and encoders
- Testing of analog/digital TV networks and transmitters
- Testing of radio receivers

Extensive collection of libraries

- SDTV stream library for DVB and ATSC
- HDTV stream library for DVB and ATSC
- H.264 stream library for DVB and ATSC
- TCM stream library for DVB and ATSC
- DVB-H stream library
- ISDB-T stream libraries for Japanese and Brazilian ISDB-T
- MediaFLO™ stream library
- CMMB stream library
- T-DMB and DAB stream library
- DAB+ stream library
- Analog video signal library

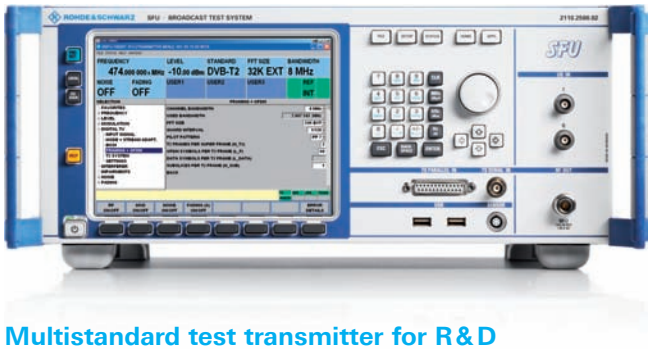
Easy generation of transport streams by the user

- Generation of customer-specific transport streams with the R&S®DV-ASC advanced stream combiner software

Rohde&Schwarz customizes baseband streams

- Rohde&Schwarz offers the generation of customer-specific transport streams or analog CCVS signals as a service

R&S®SFU Broadcast Test System



Multistandard test transmitter for R&D

RF signals for a variety of broadcasting transmission standards can be transmitted by the integrated test transmitter over a wide, user-variable frequency range. All the different standards – for terrestrial, satellite or cable transmission – can be easily loaded into the multistandard test transmitter via software, and an extremely pure spectrum can be generated.

- Multistandard platform
- Realtime digital TV, analog TV and audio broadcasting signal generation
- Digital and analog transmission standards
- Wide output frequency range 100 kHz to 3 GHz
- Internal digital and analog interferer simulation
- Realtime transmission simulations
- Bit error ratio (BER) measurement
- TS generator, TRP and ETI player, recorder
- 256 Msample I/Q arbitrary waveform generator
- Fully digital baseband signal processing

Outstanding signal quality

- I/Q modulator with 180 MHz RF bandwidth
- Very low SSB phase noise of typ. –135 dBc at 1 GHz (20 kHz carrier offset, 1 Hz measurement bandwidth)
- High-stability reference oscillator as standard

I/Q signal generator

Customer I/Q waveforms or Rohde&Schwarz waveform libraries for different transmission standards can be replayed with the arbitrary waveform generator.

Channel simulator

Integrated transmission simulators for AWGN, phase noise, impulsive noise and fading, as well as adjacent channel simulations are available for simulating real and, above all, reproducible environmental conditions in the lab.

Specifications in brief

Frequency	
Frequency range	100 kHz to 3 GHz
Frequency sweep	digital sweep in discrete steps
Operating modes	automatic, single shot, manual or external trigger, linear or logarithmic
Sweep range, step width (lin)	full range
Step width (log)	0.01% to 100%
Level	
Maximum level	+13 dBm (PEP), –120 dBm to +20 dBm
With R&S®SFU-B90 option	+19 dBm (PEP), –120 dBm to +30 dBm
Level accuracy	< 0.5 dB
VSWR (f ≤ 3 GHz, ALC ON)	typ. < 1.4
Spectral purity	
Harmonics	< –30 dBc
Nonharmonics (CW, offset > 10 kHz, 200 MHz < f ≤ 1.5 GHz)	< –80 dBc
Subharmonics (f > 1.5 GHz to 3.0 GHz)	< –74 dBc
Wideband noise (offset > 5 MHz, 1 Hz CW, 200 MHz < f ≤ 1.5 GHz	< –150 dBc
I/Q modulator	external wideband I/Q, internal baseband I/Q
Transmission standards	
Digital TV	DVB-T, DVB-C, DVB-S, DVB-S2, DVB-SH, ATSC/8VSB, J.83/B, DIRECTV, ISDB-T, GB 20600-2006
Analog TV	B/G, D/K, M/N, L, I, with PAL, SECAM, NTSC
Mobile TV	DVB-H, ISDB-T, MediaFLO™, DMB-TH, T-DMB, ATSC M/H
Audio broadcasting	DAB, DAB+, HD Radio™, DRM (waveform), ISDB-T_{SB}
Modulation frequency range	100 MHz (I/Q wideband ON)
Transmission simulations	
AWGN	R&S®SFU-K40 option
Phase noise	R&S®SFU-K41 option
Impulsive noise	R&S®SFU-K42 option
Fading simulator	R&S®SFU-B30 option
Number of paths	20 (with R&S®SFU-K31 option: 40)
BER measurements	R&S®SFU-K60 option
Baseband generator	
ARB waveform generator	R&S®SFU-K35 option
TS generator	R&S®SFU-K20 option
TS player	R&S®SFU-K22 option
TS recorder	R&S®SFU-K21 option
Video signal generator	included in R&S®SFU-K190 to R&S®SFU-K194 options
Video signals (ATV video basic)	COLORBARS_75 (PAL, NTSC, SECAM), FUBK (PAL)
ATV video	libraries with analog video test signals

R&S®SFE Broadcast Tester

Compact signal generator for digital and analog TV and audio broadcasting standards

The R&S®SFE is a multistandard signal generator that supports all common TV standards and a number of audio broadcasting standards. Whether analog or digital terrestrial TV, cable, satellite or mobile TV, or sound broadcasting – the R&S®SFE modulates all these signals in realtime. For this purpose, it combines a high-quality RF modulator, a universal realtime coder and diverse baseband signal sources in a single unit.

- Versatile multistandard signal generator with real-time coding: DVB-T, DVB-T2, ATSC/8VSB, ISDB-T, ISDB-T_B, DTMB, DVB-S, DVB-S2, DIRECTV, DVB-C, J.83/B, ISDB-C, DVB-H, T-DMB, ISDB-T 1 Seg, CMMB, MediaFLO™, ATSC-M/H, B/G, D/K, M/N, I, L
- High-precision signal generation over wide frequency and level range
- Integrated transport stream generator and audio/video generator
- Flexible signal generation with ARB waveform generator
- Simulation of multipath propagation and single-frequency networks
- Simulation of multipath propagation and SFNs
- Receiver tests with noise source and BER tester
- Compact design and convenient graphical user interface

Specifications in brief		
Frequency range		100 kHz to 2.7 GHz
Level		–110 dBm to +15 dBm
Transport stream generator	file format	Rohde&Schwarz proprietary
Transport stream player	file format	TRP, T10, ETI, FLO, MFS, PMS, BIN
ARB waveform generator	memory	256 Msample
Fading simulator	number of paths	12
	profiles	static, constant phase, pure Doppler, Rayleigh, Rice
	path delay	0 ms to 5.242 ms
AWGN generator	signal-to-noise ratio	–30 dB to +60 dB
BER measurement		serial PRBS or MPEG-2 TS

R&S®SFE100 Test Transmitter

Powerful broadcast signal generator for production test systems

The R&S®SFE100 is a multistandard test transmitter providing realtime coding for broadcast signals. It supports all common digital and analog TV standards and a number of audio broadcasting standards. Its flexible customization options make the R&S®SFE100 suitable for a wide variety of applications – from production and quality assurance to simple development applications.

Versatile multistandard test transmitter with realtime coding

- Digital and analog TV standards for cable, satellite and terrestrial transmission
- Digital and analog audio broadcasting standards
- Realtime signal generation with selectable modulation and coding parameters
- Standards available as software options

High-precision signal generation over wide frequency and level range

- Frequency range 100 kHz to 2.7 GHz
- Level range –110 dBm to +15 dBm
- Output power up to 27 dBm with integrated power amplifier
- Extremely short switching times
- Low phase noise and high MER
- High-precision modulator (MER typ. +43 dB)
- Integrated noise generator

Integrated baseband signal sources

- Transport stream generator, transport stream player and comprehensive test signal libraries
- Audio/video generator with test pattern library for analog TV
- ARB waveform generator with waveform libraries
- Digital I/Q input

User-friendly control elements and convenient remote operation

- Control keys and LC display on front panel
- Local control via USB mouse, USB keyboard and monitor
- Remote control and remote operation via LAN

Economical instrument models without local controls

- For all digital or analog standards
- Full remote control capability

Optimized for use in production test systems

- Integrated power amplifier for high output levels
- Optional RF output on rear
- Compatible with system control software from Rohde&Schwarz
- Low power consumption

Specifications in brief

RF signal	
Frequency range	
Without power amplifier	100 kHz to 2.7 GHz
With power amplifier	47 MHz to 862 MHz
Frequency resolution	1 Hz
Level	
Without power amplifier	–110 dBm to +15 dBm
With power amplifier	+27 dBm, adjustable from 0 dB to 30 dB
Spectral purity	
SSB phase noise (at 300 MHz and 20 kHz carrier offset)	< –115 dBc (1 Hz)
Broadband noise (> 10 MHz)	< –135 dBc (1 Hz)
Digital realtime modulation systems	
Terrestrial TV	DVB-T2 [1], DVB-T, DTMB, ISDB-T, ISDB-T_B, ATSC/8VSB
Cable TV	DVB-C, J.83/B, ISDB-C
Satellite TV	DVB-S, DVB-S2, DIRECTV
Mobile TV	DVB-H, T-DMB, ISDB-T 1-Segment, MediaFLO™, CMMB, ATSC-M/H
Digital audio broadcasting	DAB, DAB+, ISDB-T_{SB}

Analog realtime modulation systems	
Analog TV	B/G, D/K, I, M/N, L
Analog audio broadcasting	AM, FM mono, FM stereo with RDS
ARB-based modulation systems	
Digital audio broadcasting	HD Radio™, DRM, DRM+ [1]
Digital TV	DVB-T2, CMMB, MediaFLO™
Baseband signal sources	
Transport stream generator	
File format	Rohde&Schwarz proprietary
Data rate (including null packets)	100 kbit/s to 214 Mbit/s
Transport stream player	
File format	TRP, T10, ETI, FLO, MFS, PMS, BIN
Data rate	100 kbit/s to 90 Mbit/s
ARB waveform generator	
Memory	256 Msample
Sample rate	up to 100 Msample/s
Noise generator [1]	
AWGN, signal-to-noise ratio (SNR)	–30 dB to +60 dB

[1] Currently in preparation.

R&S®ETH Handheld TV Analyzer

Portable DVB-T/DVB-H signal analysis up to 3.6 GHz/8 GHz

The R&S®ETH handheld TV analyzer was specially developed for coverage measurements as well as for service and maintenance work on DVB-T and DVB-H gap-filler and low-power transmitters. The R&S®ETH handheld TV analyzer is the compact combination of a TV analyzer, spectrum analyzer and network analyzer.

- Measurement of DVB-T and DVB-H signal parameters
- Display of constellation diagram, channel impulse response, OFDM spectrum with shoulder distance and MER(k)
- Wide input level range due to integrated preselection and preamplifier
- Full-featured spectrum analyzer
- Network analysis and distance-to-fault measurement by means of integrated tracking generator (option)
- Fast and precise measurement due to realtime demodulation
- BER measurement and ASI transport stream output
- Optimized for field use: compact, lightweight instrument with rugged housing
- Easy-to-replace lithium-ion battery for long battery operating time
- Frequency correction and positioning via GPS
- Reproducible measurements using user-specific measurement profiles, transducers and cable models
- Convenient data exchange with PC: R&S®ETHView PC software for configuring channel tables, limit tables and measurement profiles and transferring measured data to PC via LAN or USB interface

Specifications in brief

DVB-T/H receiver		
Quasi-error-free input level range	RF = 500 MHz, RF preselection ON	typ. –76 dBm to +10 dBm
Inherent modulation error ratio (MER)	RF = 500 MHz RF preselection OFF, level = –30 dBm RF preselection OFF, level = –45 dBm	 > 43 dB, typ. 46 dB > 41 dB, typ. 44 dB
Spectrum analysis		
Displayed average noise level (DANL)	10 MHz < RF < 2 GHz, RF attenuator 0 dB RF preselection OFF RF preselection ON	 typ. –156 dBm (1 Hz) typ. –165 dBm (1 Hz)
Resolution bandwidths (RBW)		100 Hz to 3 MHz in 1, 3 sequence
Video bandwidths		10 Hz to 3 MHz in 1, 3 sequence
Network analysis		
Tracking generator output level		–40 dBm to 0 dBm
Data points		631
Dynamic range for transmission measurements	300 kHz to 3.6 GHz	> 70 dB, typ. 90 dB

R&S®FSH3-TV Handheld TV Analyzer

Universal combined TV and spectrum analyzer from 100 kHz to 3 GHz

- Measurement functions for analog and digital TV signals
- Full-featured spectrum analyzer
- Combined video/ASI output
- Compact and robust housing
- Four hours operating time on battery power
- Wide selection of accessories for diverse measurement tasks
- Preselector option with 75 Ω RF input

Specifications in brief

Spectrum analyzer	
Frequency range	100 kHz to 3 GHz
Resolution bandwidths	100 Hz to 1 MHz
Video bandwidths	10 Hz to 1 MHz
Displayed average noise level (DANL)	typ. –135 dBm (100 Hz)
TOI	typ. 13 dBm
SSB phase noise	< –100 dBc (1 Hz) at 100 kHz from carrier
Sweep at span = 0 Hz	100 µs to 100 s
Detectors	sample, max./min. peak, auto peak, RMS
Level measurement uncertainty	< 1.5 dB, typ. 0.5 dB
Reference level	–80 dBm to +20 dBm
Digital TV receiver (R&S®FSHTV-K21 for QAM, R&S®FSHTV-K22 for 8VSB)	
Modulation methods	4-, 16-, 32-, 64-, 128- and 256QAM, 8VSB
Bandwidths, depending on standard	6 MHz, 7 MHz and 8 MHz
Symbol rate	2 MHz to 6.999 MHz/10.762238 MHz
Inherent MER (equalizer ON)	> 35 dB
Analog TV receiver	
Standards	B, G, H, D, K, I, L, M, N
Sound standards	IRT-A2, NICAM, BTSC, EIA-J
Video bandwidths	depending on standard
Inherent S/N video, weighted in line with ITU-R Rec. 567	> 50 dB

R&S®ETL TV Analyzer

Universal multistandard platform for the analysis of TV, mobile TV, DAB and FM radio signals

The R&S®ETL TV analyzer platform has been mainly designed for the commissioning, installation, and servicing of TV and FM radio transmitters, for carrying out coverage measurements on terrestrial networks, and for performing measurements on cable headends. Using only a single unit, broadcast transmitters or CATV systems can be installed easily and with high precision, and maintained cost-effectively. Due to its compact and robust design, the R&S®ETL is suitable for mobile and portable (battery-operated) applications, which greatly simplifies network coverage measurements.

- TV, video, FM radio, MPEG-2 transport stream and spectrum analyzer in a single instrument
- Wide input level range due to integrated preselection and preamplifier
- Wide range of in-depth signal analysis functions

Specifications in brief

Frequency range	500 kHz to 3 GHz
FM radio	75 MHz to 110 MHz
Displayed average noise level (DANL)	
50 MHz to 3 GHz, preamplifier OFF	≤ –140 dBm (1 Hz)
500 MHz, preamplifier/preselector ON	typ. –166 dBm (1 Hz)
3 GHz, preamplifier/preselector ON	typ. –161 dBm (1 Hz)
Level	
Quasi-error-free for digital standards, depending on transmission modes	–84 dBm to +10 dBm
T-DMB/DAB, with R&S®ETL-B203 preselector, preamplifier ON	–92 dBm
Inherent modulation error ratio (MER)	
Signal level = ≥ –30 dBm, f ≤ 1.3 GHz	≥ 40 dB, typ. 46 dB
DTMB	≥ 34 dB
Video S/N (analog TV mode)	≥ 60 dB
Dimensions (W × H × D, with handle)	409 mm × 158 mm × 465 mm (16.1 in × 6.2 in × 18.3 in)
Weight (without options)	< 9 kg (< 19.8 lb)

- Software- and hardware-based realtime demodulators for: analog TV, DVB-T/DVB-H, DVB-T2, ATSC/8VSB, ATSC Mobile DTV (RF layer), ISDB-T_B, J.83/A/C (DVB-C), J.83/B, DTMB, T-DMB/DAB and FM (radio)
- Baseband outputs
- Generators for video, audio and MPX signals and MPEG-2 transport streams
- MPEG-2 transport stream recorder
- MPEG-2, MPEG-4 (H.264), HE-AAC decoder with TV picture display
- Tracking generator
- Support of power sensors
- LAN and USB interfaces

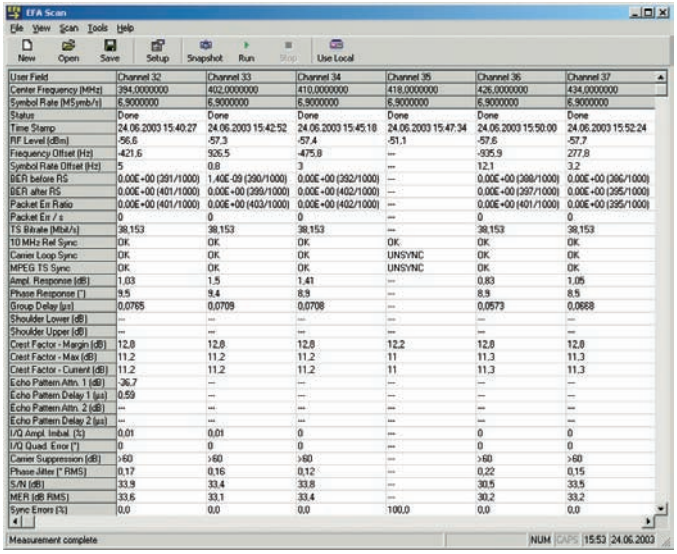
R&S®EFA TV Test Receiver Family

Comprehensive analysis/demodulation/monitoring of digital and analog TV signals

- High-end test receiver
- High-end demodulator
- Models for DVB-T/DVB-H, DVB-C, ATSC, J.83/B and analog TV
- Comprehensive measurement and monitoring functions
- Simple, user-friendly operation
- Modular design – easy retrofitting of options
- IEC/IEEE bus and RS-232-C interface

Specifications in brief		
Frequency range	standard test receiver high-end test receiver high-end demodulator	48 MHz to 860 MHz 5 MHz to 1000 MHz 45 MHz to 1000 MHz
Level	quasi-error-free for digital standards depending on transmission modes and TV standards	–88 dBm to +20 dBm
Inherent modulation error ratio (MER)	signal level ≥ –40 dBm standard test receiver high-end test receiver high-end demodulator	 ≥ 40 dB ≥ 41 dB ≥ 42 dB
Video S/N_W	analog TV mode standard test receiver high-end test receiver high-end demodulator	 ≥ 60 dB (typ. 64 dB) ≥ 64 dB (typ. 66 dB) ≥ 67 dB (typ. 70 dB)
Dimensions	W × H × D	435 mm × 147 mm × 460 mm (17.1 in × 5.8 in × 18.1 in)
Weight	depending on options	approx. 12 kg (26.5 lb)

R&S®EFA-K1 EFA-SCAN Measurement Software



Fast recording and documentation of measurement values for the R&S®EFA digital test receivers

- Repeated measurements in any number of loops
- Use for R&S®EFA .2x/4x/5x/6x/7x models
- PC connection via RS-232-C, IEC/IEEE bus, TCP/IP
- Runs on any PC under Windows

Easy operation

- A sequence of registers in the entry dialog specifies the steps that need to be carried out one after the other
- Clearly arranged dialog window helps users defining the measurement task at hand
- User-defined measurement parameter handling:
  - Only to be displayed
  - Only stored to a file
  - Displayed and stored

Two measurement modes

- Measurements are started at a keystroke
- Snapshot mode
  - Snapshot mode processes previously defined frequency list just once
- Run mode
  - Run mode is cyclically performed until the measurements are explicitly stopped
  - Measurement values obtained in this way are displayed in tables for each frequency

Convenient data storage

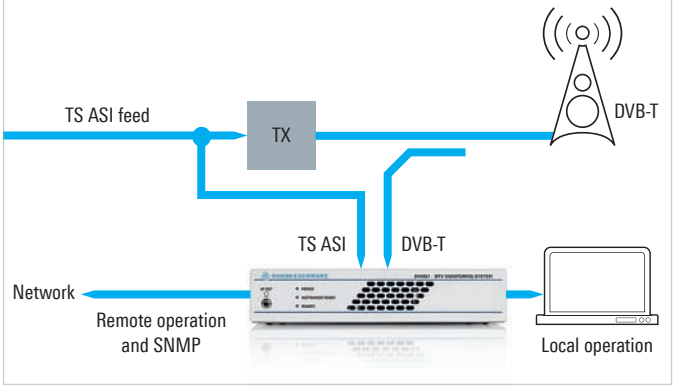
- Easy storage of measurement values in CSV format
- Comma-separated values
- Commonly used CSV file format enables data to be ported to Excel or a database, for example

R&S®DVMS1 Digital TV Monitoring System

DVB-T/DVB-H and transport stream monitoring and analysis

The R&S®DVMS1 is an attractively priced, complete and compact solution for monitoring DVB-T/DVB-H networks as well as MPEG transport streams (TS).

Signal monitoring at the transmitter site

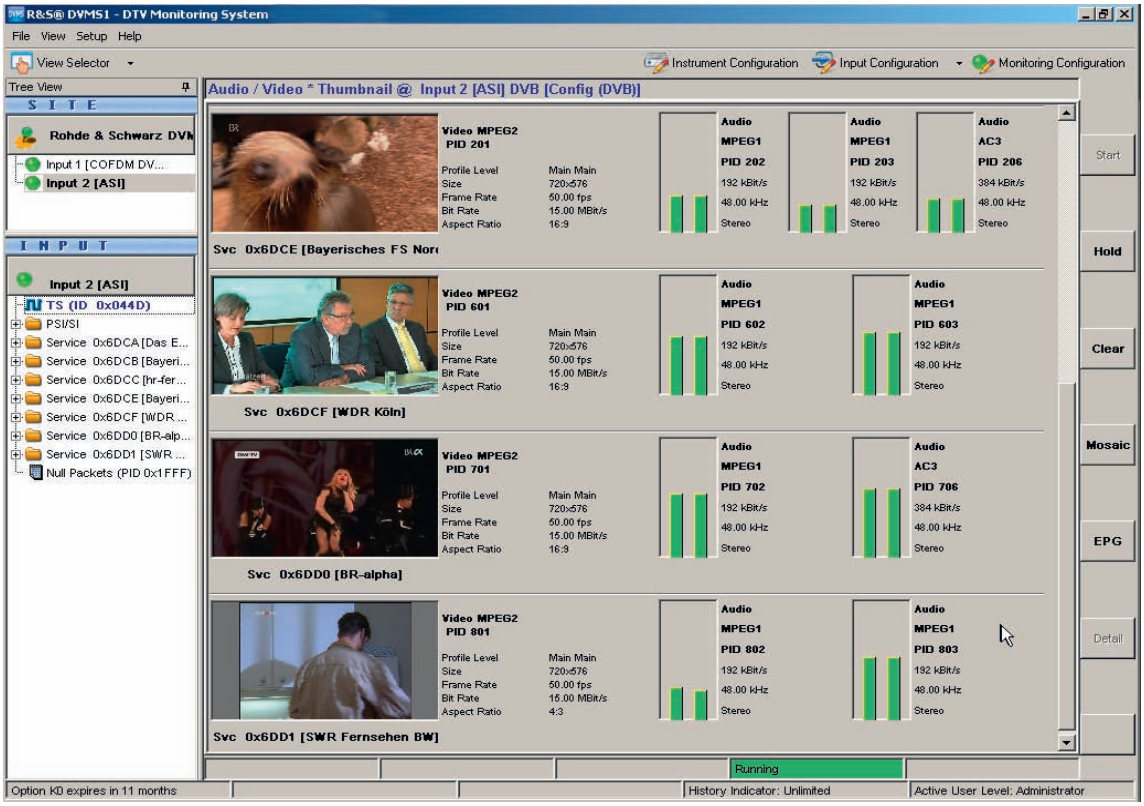


All relevant errors at the RF and TS level are recognized and reported immediately. High-quality analysis functions and easy-to-understand displays complement the system's extensive array of monitoring functions.

- Simultaneous monitoring of up to two signals (DVB-T/DVB-H and TS)
- Detection of all relevant errors at the RF and TS level
- Simple operation and configuration
- Extremely compact design (1 HU, ½ 19" width)
- Optional functions for detailed analysis

Monitoring of a DVB-T network

Monitoring a DVB-T network requires monitoring of the signal quality of the transmitters involved. The R&S®DVMS1 is ideal for performing this task: The signal for the transmitter's monitoring output is fed directly into the R&S®DVMS1. All essential RF characteristics are monitored. As an option, both the transport stream contained in the DVB-T signal and the transport stream fed into the transmitter can also be monitored. This makes it possible to pinpoint problems directly and describe them in detail so that countermeasures can be implemented immediately. Further analyses can be performed remotely via the network or directly on the instrument. Although the R&S®DVMS1 offers simultaneous monitoring of two signals along with in-depth analysis function, it requires only a minimum of space. This is clearly beneficial for installation at a transmitter site.



GUI showing thumbnails and audio level.

DTV monitoring and analysis

R&S®DVM Family

The R&S®DVM family of instruments combines the tools needed for all monitoring and analysis applications in the area of digital television signal generation and distribution. An extensive range of analysis tools is available to support the development and testing of digital television equipment such as multiplexers, encoders, modulators and associated components.

- Minimal installation effort due to low space requirements and combination of various functions in one instrument
- Minimal training required due to intuitive operating concept
- Cost-effective and future-ready modular design
- Portable and simple operation due to small, lightweight design and integrated display (R&S®DVM400)

The R&S®DVM family consists of four base units and one expansion unit, all of which have extremely compact designs. All four base units can be configured in accordance with customer requirements and expanded whenever necessary.

Multiple RF, IP and transport stream signals can be monitored and analyzed simultaneously. For example, up to four RF signals can be monitored in a single height unit at the same time.

Extensive testing can be carried out on a variety of data services such as videotext, subtitles, system software updates (SSU) and DVB-H signals including electronic service guide (ESG). Video and audio elementary streams (MPEG-2, MPEG-4/AVC/H.264, AAC and AC-3) are analyzed using special software tools.

A hardware decoder processes SD and HD signals coded with either MPEG-2 or MPEG-4/AVC/H.264 to enable the fast and simple analysis of various video formats. Using the qPSNR analysis, the encoding quality of these video signals is also tested and visualized in realtime.

R&S®DVM400 Digital Video Measurement System

Universal and portable

- Broadest scope of functions – ideal for development and maintenance
- Monitoring/analysis of transport streams and contents
- Monitoring, analysis and demodulation of RF signals of various standards
- Monitoring, analysis and transcoding of IPTV signals (Gigabit Ethernet)
- Powerful generator and recorder options with extensive TS libraries and TS multiplexer software
- Simultaneous operation of multiple functions
- Small and lightweight, therefore ideal for portable applications

R&S®DVM100L MPEG-2 Monitoring System

The space saver

- Ideal for network operators and program providers
- Monitoring/analysis of transport streams and contents
- Monitoring, analysis and demodulation of RF signals of various standards
- Monitoring of up to 20 signals in one system when expanded with the R&S®DVM120

R&S®DVM50 MPEG-2 Monitoring System

The starter package

- Particularly cost-effective solution for all monitoring and analysis tasks, including in the lab, for service applications or unattended in the field
- Monitoring/analysis of transport streams and contents
- Monitoring, analysis and demodulation of RF signals of various standards
- Operation via external PC

R&S®DVM120 MPEG-2 Monitoring System

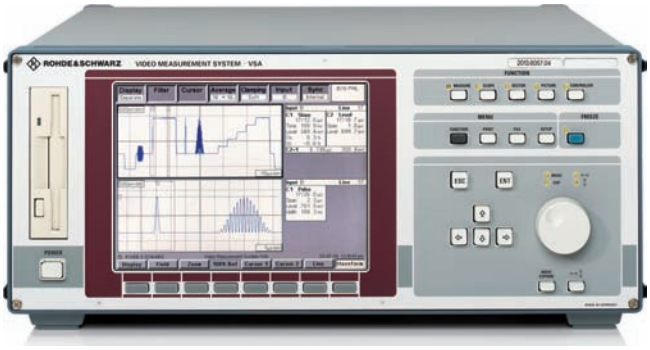
The expansion unit

- Add-on to the R&S®DVM100, R&S®DVM100L and R&S®DVM400 for simultaneous monitoring of more than four signals in one system
- Integration into the base unit user interface

Base units				Expansion unit
	R&S®DVM50 [1] 	R&S®DVM100L 	R&S®DVM400 	R&S®DVM120 
Height	1 HU	1 HU	4 HU	1 HU
Number of transport streams that can be monitored in parallel	1 to 4	1 to 4	1 to 4	1 to 4 (with RF inputs) 1 to 8 (without RF inputs)
Number of RF signals that can be demodulated and monitored in parallel	1 to 4	1 to 2	1 to 4	1 to 4
Expansion by the R&S®DVM120 for a total of:	–	20 TS and 18 RF inputs	20 TS and 20 RF inputs	–
Local operation	PC required	via external monitor, external keyboard and mouse	integrated color display, keys and rotary knob; if necessary, external mouse and keyboard	via base units
Remote operation via web server	•	•	•	via base units
SNMP (incl. traps)	•	•	•	via base units
Alarm relays	–	•	•	via base units
TS monitoring and analysis including TS capture	•	•	•	•
ES and data service analysis	•	•	•	•
Streaming function	via PC interface	•	•	via base units
Software decoder	•	•	•	•
Hardware decoder with various interfaces	•	•	•	•
Recorder and generator options	–	–	•	–
Gigabit Ethernet/IP interface, monitoring functions and transcoding	–	–	•	–
Reference clock input	–	–	•	–
SPI input and output	–	–	•	–

[1] The operation of the R&S®DVM50 requires a PC. Some of the functions specified are only available via the PC.

R&S®VSA Video Measurement System



Video and FFT analyzer, vectorscope and oscilloscope in one unit

The R&S®VSA video measurement system provides several functions in a minimum of space:

- Video and FFT analyzer
- Three-channel oscilloscope
- Vectorscope
- Monitor
- System controller

Owing to its versatility, the R&S®VSA is suitable for a wide variety of applications:

- In labs and service centers
- In automatic measuring and monitoring systems
- In production and quality assurance of video equipment

Further features of the R&S®VSA include:

- Four loop-through video signal inputs with analog 9 MHz bandwidth
- High-contrast color LCD
- Convenient menu-driven user interface
- IEC/IEEE bus controller
- Two serial interfaces (RS-232-C)
- SCPI remote control via IEC/IEEE bus or serial interface
- Hard disk for storing results and application programs

Specifications in brief

Frequency range	0 Hz to 9 MHz
Standard	B/G, I, D/K, PAL, SECAM[1], NTSC (R&S®VSA-B1 option)
Signal inputs	
Video inputs	75 Ω loop-through filters
Level	1 V ± 6 dB
Return loss up to 6 MHz	> 40 dB
Return loss up to 10 MHz	> 36 dB
Decoupling of inputs up to 10 MHz	> 85 dB
DC input	1 MΩ
Level	±5 V
Signal outputs	
Zero-reference control pulse, 75 Ω	
Level	1.4 V
Line position and duration	adjustable
Interfaces	
Remote control	IEC 625-2/IEEE 488-2, 2 × RS-232-C (9-contact)
Printer	parallel interface (Centronics)
External monitor	640 × 480 pixel, VGA color monitor
External keyboard	PC AT keyboard
Display	640 × 480 pixels, color TFT

Available functions for different signal types

	Video and FFT analyzer	3-channel oscilloscope	Vectorscope	Control monitor
CCVS	•	•	•	•
R/G/B[2]	•[2]	•[3]		
Y/Cb/Cr	•[2]	•[3]		•[4]
Y/U/V	•[2]	•[3]		•[4]
S-VHS[2]	same as CCVS (signals added) or RGB (signals separated)			

[1] SECAM without color subcarrier measurements.
[2] Only one component at a time.
[3] Requires sync pulse in the signal or via an additional sync signal.
[4] Only for Y component.

Chapter 11
System Components

For demanding computational tasks, Rohde&Schwarz offers system controllers, switch units and test chambers that are versatile and flexible in everyday use. Excellent EMC shielding, reliable test results and modular solutions are core benefits of these instruments.

Type	Designation	Description	Page
R&S®PSL1	Industrial Controller	EMC-shielded system controller for highest requirements	127
R&S®PSL3	Industrial Controller	The powerful industrial controller	127
R&S®OSP	Open Switch and Control Platform	Open platform for fast and easy implementation of RF switch and control tasks	128

R&S®PSL1 Industrial Controller

EMC shielded system controller for highest requirements

Due to its excellent EMC characteristics, the R&S®PSL1 industrial controller is ideal for use in radiocommunications, radio measurement or radiomonitoring systems. The R&S®PSL1's housing largely suppresses its inherent radiated emission and, moreover, allows it to be used close to strong electromagnetic fields. Its components meet the high quality standards that Rohde&Schwarz stands for. This ensures high failsafety of the entire controller.

- Maximum reliability due to optimized design and comprehensive tests during production
- Long-term availability of spare parts
- Immunity to electromagnetic interference
- Minimum emission due to excellent EMC values
- Energy-saving design throughout for low temperature stress on the components
- Customized and flexible expansion capability
- Compact design, installable in 19" standard racks (1 HU)

Specifications in brief	
Drives	
Hard disk (model .14)	40 Gbyte or better
Hard disk (model .24, .34)	100 Gbyte
CD/DVD writer	combination drive
Internal interfaces	
PCI	1 slot, max. 32 bit
External interfaces	
Display	
DVI, max. resolution	1280 × 1024 pixel
DVI-D connector	front
VGA, max. resolution	1600 × 1200 pixel
15-pin D-Sub connector	rear
USB	1 × USB 1.1, 2 × USB 2.0, 1 × front/2 × rear
Ethernet	1 × 10/100/1000 Mbit/s, RJ-45 (rear), 1 × 10/100 Mbit/s, RJ-45 (front)
IEC/IEEE (model .14 only)	IEC 60625-2 (IEEE 488.2), NI TNT-compatible, 24-pin Amphenol connector (rear)
Serial (model .14)	1 × RS-232-C (COM), 9-pin D-Sub connector (front)
Serial (model .24 and .34)	1 × RS-232-C (COM), 9-pin D-Sub connector (front), 5 × RS-232-C (COM), 50-pin D-Sub HD connector (rear)
Audio (model .24 and .34)	Line-In, Line-Out (stereo), Mic-In (mono), 3 × 3.5 mm connectors (rear)
Operating system (optional)	Windows XP Embedded (English)

R&S®PSL3 Industrial Controller

The powerful industrial controller

In conjunction with suitable software packages and hardware expansions, the R&S®PSL3 industrial controller reliably performs its tasks in a wide spectrum of possible application scenarios. Its features exceed those of a conventional industrial controller and meet the tough requirements common to areas such as radio measurements, radiolocation and radiocommunications.

- Maximum reliability due to optimized design and comprehensive tests during production
- Long-term availability of spare parts
- Energy-saving design throughout for low temperature stress on the components
- Immunity to electromagnetic interference
- Minimum emission due to excellent EMC values
- Customized and flexible expansion capability
- Extremely rugged construction: vibration- and shock-resistant
- Compact design, installable in 19" standard racks

Specifications in brief	
Drives	
Hard disk	250 Gbyte or better
Second hard disk	R&S®PSL-B7 option
CD/DVD writer	combination drive
Internal interfaces	
PCI	4 slots, max. 32 bit
PCI express	1 × PCIe x1, 1 × PCIe x4
External interfaces	
Display	max. 1920 × 1200 pixel
DVI-D connector	rear
15-pin D-Sub connector	rear
USB	5 × USB 2.0
Ethernet	1 × 10/100/1000 Mbit/s, RJ-45 (rear), 1 × 10/100 Mbit/s, RJ-45 (front)
IEC/IEEE	IEC 60625-2 (IEEE 488.2), NI TNT-compatible, 24-pin Amphenol connector (rear)
Operating system (optional)	Windows XP Embedded (English)

R&S®OSP
Open Switch and Control Platform

Open platform for fast and easy implementation of RF switch and control tasks

The R&S®OSP open switch and control platform is designed to handle RF switch and control tasks. A number of optional modules make the R&S®OSP ideally suited for a wide range of applications from simple RF switch functions to automatic path switchover in complex RF test systems such as EMC systems.

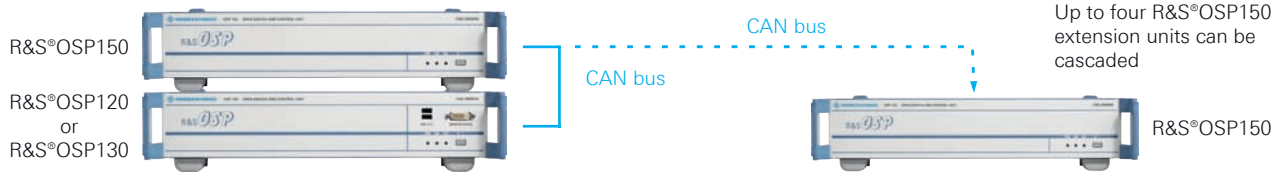
The modularity provided by the R&S®OSP family helps ensure the fast setup of test and measurement configurations for applications in production, test labs and development departments. The ability to implement complex wiring by means of a single switch and control platform is an essential prerequisite for reliable and reproducible measurements that can be automated to enable cost-efficient test sequences.

All base units of the platform can be controlled via the Ethernet interface. This interface makes it possible to connect the platform directly to a PC, integrate it into test systems or remotely operate it via a corporate network.

Compared to the R&S®OSP120, the R&S®OSP130 also has a control panel with a keyboard for direct manual operation of the R&S®OSP130 and any extension units that are connected. Manual operation of the R&S®OSP120 is possible by connecting an external keyboard and a monitor. The operating software supplied or a web GUI can be used to control the switch and control modules easily and directly without special software knowledge. Of course, it is also possible to control the platform from application programs such as LabVIEW, LabWindows/CVI, Agilent VEE, C++, C#, Visual Basic, Visual Basic .NET.

- Compact size requiring little space
- Optimal configuration by selecting the appropriate switch and control modules
- Plug & play makes complex installation superfluous
- Path control allows easy, reliable and independent switching of different switching paths using only one command
- Easy generation of switching configurations owing to intuitive operating menu
- Flexible system integration via Ethernet interface
- Operation on the instrument ensures fast and direct access
- The R&S®OSP150 extension unit allows the range of functions to be expanded as necessary

Combinations of the R&S®OSP120 or R&S®OSP130 with the R&S®OSP150



Chapter 12
Radar Test Solution

R&S®TS6600 Test System for Phase-Coherent Multichannel Signal Simulation

Tester for phase-coherent measurements on radar frontends in development, production and service

To test and calibrate multichannel radar frontends in development, calibration and service, phase-coherent test signals are required. These may be modulated or unmodulated pulse sequences or even complex, real-world scenarios.

Vital requirements for such signals are high level and phase accuracy over a wide dynamic range as well as high measurement speed and automated test sequences. The high level and phase stability required for EUT testing and calibration must be ensured over an extended period of time and a wide temperature range. The R&S®TS6600 test system provides an efficient solution for analyzing radar frontends by means of multichannel, phase-coherent signals.

High level and phase accuracy are ensured through short recalibration of the test system, which is performed automatically each time the system is started and after each temperature change. In conjunction with the use of all-inclusive test routines, this simplifies tests in production and service. The system is controlled via a GUI or from the customer's main measurement software.

Flexible signal generation is a key requirement in the creation and simulation of radar scenarios. The test system from Rohde&Schwarz allows the use of predefined, manually created signal sequences or previously recorded sequences.

The R&S®TS6600 test system can be precisely configured to match the specific application and the required parameters. With its high degree of scalability, the system can be tailored to offer the required functionality for any desired application from development to servicing.

- Generation of up to ten phase-coherent, synchronous RF signals
- High-speed level and phase variation over 50 dB dynamic range by means of waveforms loaded into the tester (I/Q mode)
- CW and pulse mode
- Generation of I/Q data or use of existing I/Q data of customer-specific waveforms with up to 120 MHz bandwidth, as well as playback of realistic reception scenarios
- Analysis of transmit pulses including power measurement
- EUT multiplexing
- Rapid, integrated temperature compensation of test system > 10 s by means of integrated power meter
- Full system calibration (level and phase) in less than 40 min by means of power meter and combiner
- Software libraries for easy integration into main test software

Specifications in brief	
Frequency range	1 GHz to 6 GHz
Signal generation	
Max. number of RF channels	10
Level range	–135 dBm to –17 dBm
Phase	±360°
Fast leveling mode	< 1 µs/step over 50 dB dynamic range with 0.15 dB relative level accuracy (I/Q mode)
Signal types	continuous, pulse (≥ 100 ns, 10 ns resolution), stored waveform (up to 120 MHz bandwidth, larger bandwidth on request)

Appendix
Service and Support

We are here to assist you – live with real experts.
At Rohde&Schwarz you talk to people.

Rohde & Schwarz worldwide

Headquarters

At company headquarters in Munich, around 2000 employees work in research and development, central sales and service, marketing and administration.

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Contact

Sales
For the addresses of the local sales companies in more than 70 countries see: www.sales.rohde-schwarz.com

Customer support – worldwide live support
Whatever problem you have, our support center is there to help you. Your question will be dealt with fast and in detail. There are three support centers in three different time zones: Munich, Washington and Singapore. Support is available 24 hours a day, Monday through Friday excluding public holidays. The staff of our support center is optimally trained to assist you in solving your problems. Our regional support centers will be glad to answer any questions regarding our products and service:

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Service you can rely on

Dear Customer,

At first glance, tradition and high-tech don't really seem to fit together. Rohde&Schwarz, however, has shown that these two concepts can make a perfect match: For more than 75 years, it has been the company's tradition to explore the limits of what is physically feasible in generating and measuring electronic signals. As a manufacturer, we have always proved that our products comply with the relevant specifications. We provide this proof with the calibration certificate issued by our service centers. As a matter of course, we apply the same high technological and quality standards that we demand of our products. We know that low calibration costs are the crucial factor when it comes to total cost of ownership. And we are also aware of the high demands placed on our equipment and the necessary scope of measurements. Moreover, we will not accept compromises on quality for the sake of costs. This is why we offer efficient, favorably priced calibration solutions to our customers. These solutions are implemented in the test procedures running on our automatic test systems worldwide. Our driving force is your satisfaction over the complete life cycle of our products. This is yet another tradition at Rohde&Schwarz.

Dr. Klaas Hoekstein
Director of International Service

Contractually assured services

Rohde&Schwarz offers full-range service at your command. You can mix and match our services according to your technical and budgetary requirements.

Service contracts

As the original equipment manufacturer (OEM), we provide the most qualified, responsive and thorough service available. Customer care is especially important to us. We support you with services tailored to your needs:

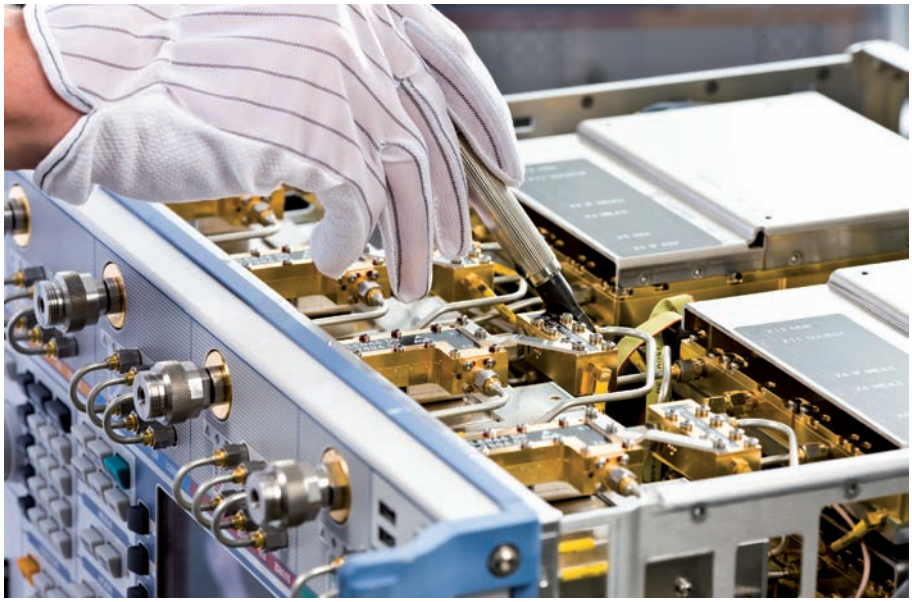
- Short and reliable turnaround times
- Efficient logistics for pickup and return of your equipment
- High spare-part availability
- Flexible adjustment of terms during the contract period
- Services tailored to your needs

Service options

Service options are powerful service contracts that are offered exclusively when you purchase a new product. Taking advantage of a service option ensures optimum performance and availability of your Rohde&Schwarz product at low, predictable operating costs.

Asset management

The Rohde&Schwarz Service Gateway lets you view all your test and measurement instruments at a glance. You can register for your secure account at https://gloris.rohde-schwarz.com and request access to the service gateway. As soon as permission is granted, you can view and administer your instrument data.



Calibration | Repair			
Factory standard calibration ❙ Full calibration, returning the instrument to the same state as when it originally left the factory ❙ Traceability to national/ international standards ❙ Adjustment included ❙ Calibration report and test data included ❙ Software update and hardware modifications included	**Accredited calibration** ❙ Same features as factory standard calibration ❙ Directly traceable calibration in line with ISO 17025 ❙ Controlled by national accreditation authority (NIST, DKD, etc.)	**Performance calibration** (only available under service contract) ❙ Competitive price ❙ Complete measurement of all specifications as with factory standard calibration ❙ Test report and certificate ❙ Only quality-related software updates and hardware modifications ❙ No instrument adjustments	**Adjustment** ❙ Includes adjustment and incoming equipment test report ❙ Can only be ordered in connection with performance calibration
Standard price repair ❙ Predefined repair price which covers the costs of materials and work performed ❙ Calibration in line with ISO 9001 including documentation of test results ❙ Twelve-month service warranty on the entire equipment (does not apply in case of improper handling or alteration of the equipment) ❙ Latest hardware and software update	❙ Pickup and return of the equipment (only for shipping by a Rohde&Schwarz logistics partner in the country of the Rohde&Schwarz service organization) ❙ If it turns out that only little work and material are needed to eliminate the fault, you pay merely a small lump sum instead of the standard price	**Time and material repair** ❙ Repair based on the amount of material and work required to repair the equipment	

Rohde&Schwarz service offers you further advantages

On-site calibration

You can opt for on-site calibration of your Rohde&Schwarz equipment and products from other manufacturers. On-site calibration is convenient and reduces downtime to the absolute minimum. Various calibrations and minor repairs can be performed at your company; minimum quantities apply.

Pickup service

On request we pick up your equipment at your company. We can also arrange for the packaging.

Loan equipment

Your local service center can offer a loaner to bridge the repair time – subject to availability.

Service for TPM products

Rohde&Schwarz also offers the services mentioned here for TPM products.

Calibration-document service

Via the service gateway, you can download your calibration documents from the Internet.

Service order tracking

The www.servicestatus.rohde-schwarz.com portal allows you to verify the repair or calibration status of your instrument. Service order tracking provides effective transparency. You only need the service reference number and the serial number of your equipment to track its status.

Training and application support

The product portfolio of Rohde&Schwarz is accompanied by a comprehensive choice of training seminars and detailed application notes. By offering comprehensive application notes and practice-oriented training, we want to show you how to use our products most effectively. This ranges from first-time users who can choose from detailed introductory courses and practical T&M examples up to seasoned users who can gain deep insight into the numerous – as well as very special – ways to use the high-performance solutions from Rohde&Schwarz.

Training

The extensive choice of seminars includes everything from standard training classes on numerous topics in radio engineering and test and measurement to practice-oriented product training for Rohde&Schwarz solutions.

If needed, customer-specific training programs designed specially for your wishes and requirements are held in order to achieve optimum benefit for the participants. Skilled trainers convey concise, practice-oriented knowledge at our state-of-the-art and fully equipped training center in Munich. Alternatively, training can also be held on the customer's premises or at any other location of choice.

Comprehensive choice of training seminars

Standard seminars
Detailed seminars are offered on numerous topics in radio engineering and T&M such as RF and EMC testing, as well as classes covering the fields of wireless communications, television and antennas from the basics up to workshop level.

Customized seminars
Optimum benefit for customers and their participants is the focal point of customer-specific seminars. The training content is tailored specifically to the customer's wishes and requirements.

Hands-on experience
Practical exercises are an essential part of all seminars to help ensure that the material just learned can be tried out immediately using state-of-the-art test setups. This is crucial for understanding and clarifying the training content in detail.

Small groups
The number of participants is intentionally kept small so that everyone has sufficient time for questions as well as the opportunity to try out the class content in a hands-on environment.

Trainers/training staff
For the trainers, it goes without saying that they must continuously keep their technical knowledge up to date. They possess not only technical knowledge but also the ability to convey it in an understandable and lasting manner.

Location
Classes may be held at the state-of-the-art training center at company headquarters in Munich. Optionally, seminars can take place on the customer's premises or at any other suitable location.

Timetable
Standard training classes are scheduled twice a year. The dates can be viewed on the Rohde&Schwarz homepage. The schedule for customized seminars is drawn up together with the individual customer.

Languages
The seminars are conducted either in German or English. If needed, special training classes can be held in other languages.

Registration and organization
All detailed information regarding the seminars – including class descriptions, registration, cost, procedure and content – is provided on the Rohde&Schwarz homepage under Service&Support/Training.

A limited number of participants helps to ensure better communications between participant and trainer. Knowledge is conveyed more intensely, and extra time is available for questions so that the participants can put their newly gained knowledge and skills into practice immediately after the seminar.

Skill and up-to-date knowledge are top priority in all our seminars. The company's intensive participation in relevant bodies – such as in the standardization of state-of-the-art wireless communications – is reflected in training classes, which are always cutting-edge both in theory and in T&M expertise. Our customers also benefit from this.

Application support

Rohde&Schwarz offers you support for your measurement task no matter which application and which category of industry it involves. We look forward to sharing the knowledge and the experience of our worldwide network of experts with you:

- Local application engineers help you to successfully implement your specific application on site by using Rohde&Schwarz T&M solutions, and provide guidance services for all T&M matters
- A large number of application notes, often combined with helpful application programs or T&M examples, can be downloaded from www.rohde-schwarz.com/appnote

Abstracts of some popular application notes

Download application notes from: www.rohde-schwarz.com/appnote

Development hints and best practices for using instrument drivers (1MA153)
To make the programming of your own T&M applications efficient, the Rohde & Schwarz website offers the required device drivers as free-of-charge downloads. Application note 1MA153 provides important hints on how to use these drivers in various development environments and also answers frequently asked questions on how to control the T&M equipment. Therefore, it offers valuable support for application engineers and software developers alike.

RSCommander – versatile software tool for Rohde&Schwarz instruments (1MA74)
RSCommander is a popular software tool that makes your daily business easier when operating Rohde&Schwarz T&M instruments, and especially when using them via remote control. In addition to many further useful functions, screenshots from T&M instruments can be generated or trace data can be output in order to process it on your computer. The tool also provides convenient access to the T&M equipment's file management system.

RSCommander is available for a large number of Rohde&Schwarz T&M instruments, including signal generators, signal and spectrum analyzers, as well as network analyzers.

LTE base station tests in accordance with TS 36.141 (1MA154 and 1MA162)
Wireless communications networks worldwide are currently being equipped with long term evolution (LTE) technology, which is the follow-up development to the existing UMTS networks and promises even higher data rates for the end customer. These two application notes support developers of LTE base stations with a free-of-charge example program that facilitates the settings of the T&M equipment for all tests required by the standard.

Transmitter and receiver tests in line with the 3GPP TS36.141 specification are addressed in application note 1MA154, and performance tests in 1MA162.

VoIP measurements for WiMAX™ (1MA149)
Voice quality is a key performance indicator for wireless communications systems and therefore also for the testing of terminal equipment. In the packet-oriented, next-generation wireless communications technologies such as WiMAX™ and LTE, voice over IP is used to transfer speech.

A combination of the R&S®UPV audio analyzer and the R&S®CMW270 WiMAX™ communication tester allows the voice and audio quality of a WiMAX™ mobile station to be determined. Application note 1MA149 describes the steps required for performing the measurement and for configuring the T&M equipment.

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. Rohde&Schwarz has many years of experience implementing turnkey EMC test centers, type-approval test systems for mobile phones, 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 (e.g. of temperature) at defined test intervals

Project handling by Rohde&Schwarz

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 are essential 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 from both Rohde&Schwarz and other manufacturers. 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 the initial planning through to the operational system.

Rohde&Schwarz 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 often subject to delays. Today, to reduce test time, 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.

The unique Rohde&Schwarz modular hardware and software concept supports a large variety of test combinations for 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 also in the RF range via test prods; with conveyor belts; networking within user-specific computer networks; logistics; consulting and advice regarding 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 benefit from this high innovation potential. Specialists at Rohde&Schwarz implemented the latest requirements for type-approval measurements in the appropriate test systems and were able to use ultramodern measuring equipment from our production.

This synergy of available equipment and new system applications yields optimum results. At a result it is possible for instance, to achieve maximum test depth while ensuring the highest degree of ergonomics and operational reliability. And another great advantage is self-calibration. Customers can utilize all these benefits to make their products fit for both the present-day and future markets.

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 optimal operation.

EMC test systems and test centers

Rohde&Schwarz offers complete EMC test systems that can handle all the complex aspects in this field. No matter whether it is about precompliance tests at the manufacturer, acceptance tests in accredited test houses or market monitoring by government authorities, Rohde&Schwarz always provides an appropriate solution from the compact system based on a test cell to the complete test center.

Applications

- Commercial
- Wireless
- Automotive components
- Automotive vehicles
- MIL
- Medical

Rohde&Schwarz also offers test systems for over-the-air (OTA) performance measurements for characterizing DUTs with built-in antenna as well as systems for measuring ambient electromagnetic fields (EMF).

Future-oriented design

Measurement and test systems from Rohde&Schwarz feature extremely flexible hardware and software concepts that allow adaptation to modified requirements to 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-hour spare parts service and a telephone support line.

References

Measurement and test systems from Rohde&Schwarz are successfully used 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 know-how and experience gained over many decades. In line with the Rohde&Schwarz system philosophy, the high level of expertise does not stop with system development but is maintained during the operational life of the systems by means of the services offered.

Telephone support, continuous updating of system software, fast replacement and repair of equipment and modules in case of a fault are essential prerequisites for the 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 an entire series of services for hardware and software.

Services available during warranty period

- Enhanced warranty service
  - Problem report service
  - Telephone support line service
  - Access to a pool of spare modules
- Calibration service

Services available after warranty period

- After-warranty service
  - Problem report service
  - Telephone support line service
  - Access to a pool of spare modules
- Software service
- Calibration service

Enhanced warranty service

The enhanced warranty service supplements the standard warranty services of Rohde&Schwarz to satisfy – even 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
- Telephone support line service
- Access to a pool of spare modules
- On-site repair, if necessary
- Escalation procedure

After-warranty service

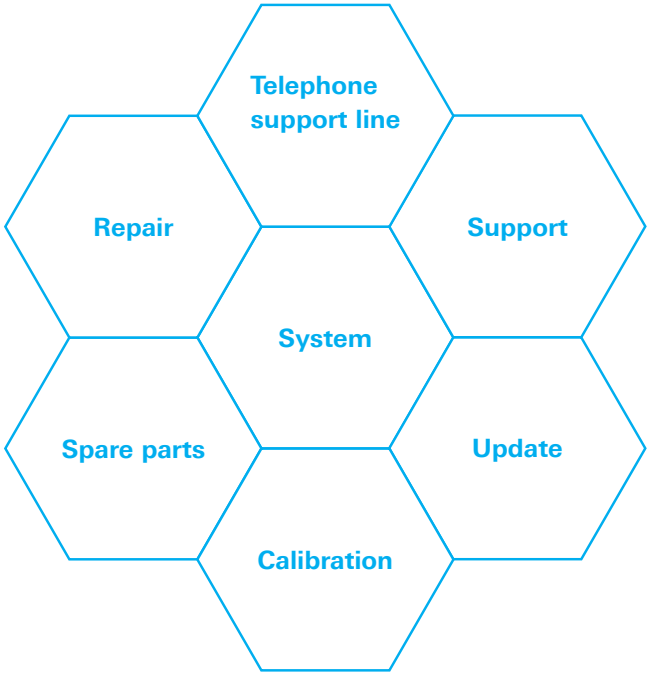
The after-warranty service contains all the unit blocks of the enhanced warranty service plus the following:

- Repair of faults
- Supply of software updates

Calibration service

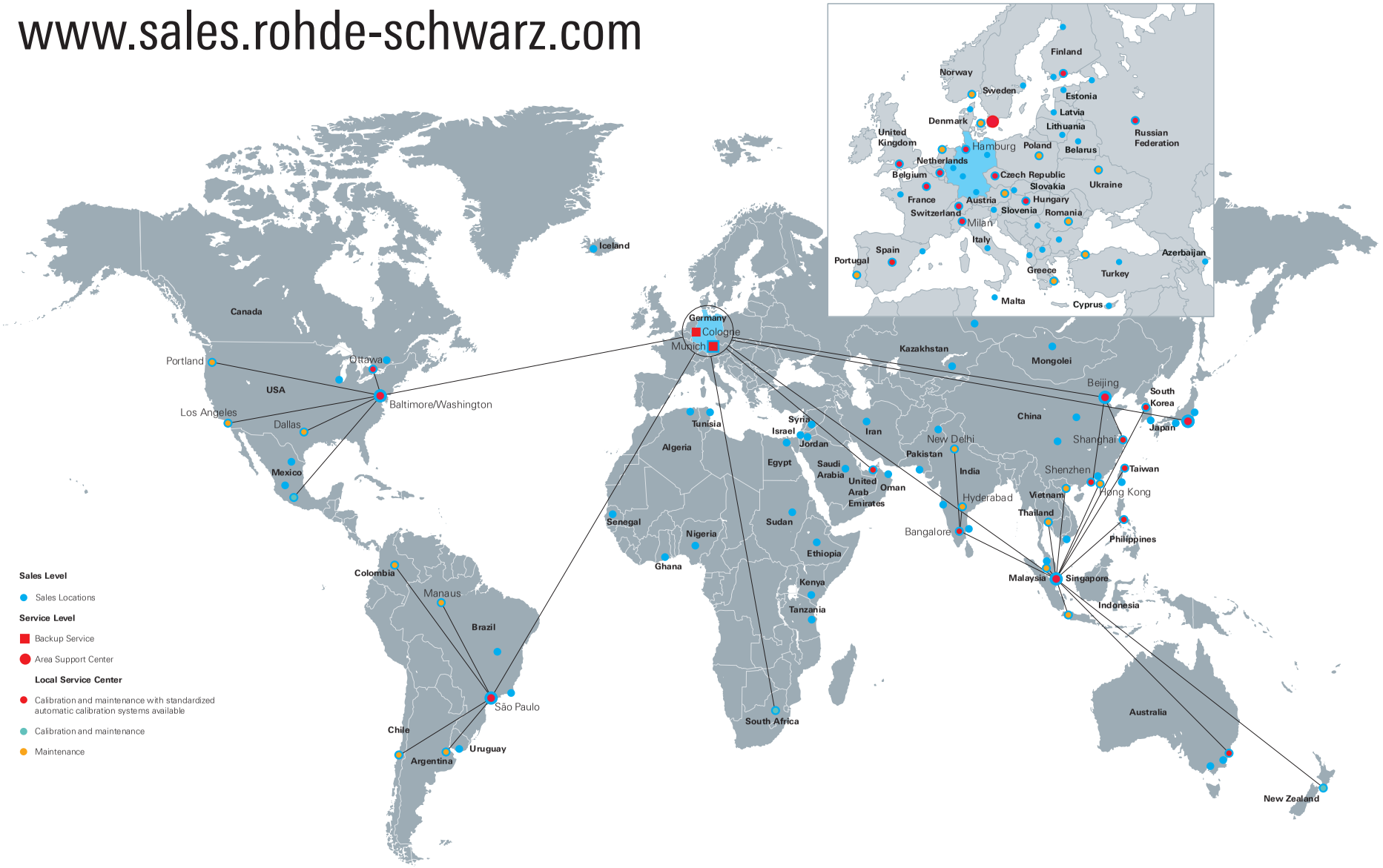
The calibration service assures you that the parameters of your system will be checked at regular intervals and corrected if necessary.

- 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



Global sales and service locations

www.sales.rohde-schwarz.com



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